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5.3.7 Wetlands

5.3.7.1 Introduction

Wetlands are defined as “land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment” (National Wetlands Working Group, 1988). Wetlands range from permanently wet areas to seasonally dry areas during drier months in the summer.

Wetlands provide a range of ecological services called wetland functions. Wetland functions are commonly classified into ecological, hydrological, biochemical, and habitat functions (Hanson et al., 2008; Mitsch and Gosselink, 2007). Wetland functions include, but are not limited to: providing flood protection, erosion control, groundwater recharge, and climate regulation (hydrological functions); and providing water quality treatment, nutrient and organic export, and carbon sequestration and storage (biochemical functions); and providing wildlife habitat during all or a portion of certain species life cycles (habitat functions). Wetland ecological function is a measure of wetland extent on the landscape. Wetlands are valued by society as supporting a source of food (e.g., berries), providing passive recreation by naturalists, and potentially supporting unique flora and fauna.

Wetlands were selected as a Project Valued Component (VC) because wetlands are valued by local communities; Aboriginal groups; and local, provincial, and federal governments for the values and functions wetlands provide for society and the environment (**Section 4.2**, Identification and Selection of Valued Components). Wetlands are present within the proposed Blackwater Gold Project (the Project) area and will be affected by the six Project components: mine site, mine access road, freshwater supply pipeline, transmission line, airstrip and access road, and the Kluskus Forest Service Road (FSR) improvements. Adverse impacts on wetlands are anticipated as a result of implementing the Project. Indicators for determining effects on the Wetlands VC include wetland ecological functions, hydrological functions, biochemical functions, and habitat functions.

The rationale for spatial and temporal boundaries for the aquatics subject area is presented in **Section 4.3.1** (Assessment Boundaries). The Local and Regional Study Areas (LSA and RSA, respectively) specific to the wetlands effects assessment are consistent with the aquatics discipline spatial boundaries. The temporal boundaries include the 2-year construction phase, 17-year operation phase, 18-year closure phase, and the 30-year post-closure phase. Traditional, ecological, and community knowledge regarding wetlands and their use in the LSA and RSA are also included.

This section presents the results of the wetland baseline mapping and functions assessment, and assesses potential Project effects on these existing wetland functions and values by Project component over time. Mitigation measures are presented that minimize Project effects on wetlands. The significance of residual Project effects is then characterized. The last section of analysis addresses Project cumulative effects with other VCs and other projects within the region, followed by monitoring recommendations, conclusions, and limitations.

5.3.7.1.1 Federal and Provincial Legislation and Policies Related to Wetlands

Wetland protection and conservation in British Columbia (BC) and Canada are guided by governmental review during the environmental permitting process. Regulatory tools within federal and provincial legislation that support wetland protection, in conjunction with other statutory objectives, enforce wetland policies (Rubec and Lynch-Stewart, 1998). **Table 5.3.7-1** lists key federal and provincial policies and legislation related to wetland resources in Canada that are applicable to the Project. AMEC has completed this wetland effects assessment, including proposed mitigation measures, in consideration of these wetland policies that support wetland protection.

Table 5.3.7-1: Federal and Provincial Legislation and Policies Related to Wetlands

Regulations and Policies	Purpose
Canadian Environmental Assessment Act, 2012 (CEA Act) (Government of Canada, 2012)	Responds to Canada's economic and environmental resources by implementing responsible and timely resource development for the benefit of all Canadians. The environmental assessment focuses on potential adverse environmental effects that are within federal jurisdiction. Cumulative effects, mitigation measures, and comments received from the public are factors considered during the assessment. Project development requiring a *CEA Act* review may result in impacts to wetlands.
Species at Risk Act (SARA) (Government of Canada, 2002)	Developed with three main goals: 1. prevent endangered or threatened species from becoming extinct or extirpated; 2. help in the recovery of endangered, threatened, or extirpated species; and 3. manage species of concern to help prevent them from becoming endangered or threatened. SARA plants and animals may occur in wetlands.
Migratory Birds Convention Act (Government of Canada, 1994)	Protects migratory birds and their nests. Migratory birds may forage, breed, and/or seek cover in wetlands.
Canada Wildlife Act (Government of Canada, 1985)	Protects wildlife and wildlife habitat for conservation, research, and interpretation. Wetlands may impact wildlife protected under the *Canada Wildlife Act*.
Fisheries Act (as amended in June 2012) (Government of Canada, 2013)	Protects habitats directly or indirectly supporting existing or potential fisheries. Wetlands may support fish that are protected under the *Fisheries Act*.

Regulations and Policies	Purpose
Federal Policy on Wetland Conservation (Government of Canada, 1991)	Approved by Cabinet in 1992, directs all departments to implement the seven strategies of the Policy. Two key commitments include no-net-loss of wetland functions on all federal lands and waters, and enhancement and rehabilitation of wetlands in areas where the continuing loss or degradation of wetlands or their functions have reached critical levels. Not only does the Policy apply to the management of federal lands but all federal programs, services, and expenditures.
Federal Policy on Wetland Conservation: Implementation Guide, for Federal Land Managers (Government of Canada: Lynch–Stewart et al., 1996)	Developed to ensure compliance with the Policy, the Implementation Guide outlines the sequence of mitigation alternatives, compensation, and monitoring to meet the policy goal of no-net-loss of wetland functions.
BC *Water Act* (Government of BC, 2004)	Wetland protection is applied when an application is made to withdraw water from a wetland, or carry on activities in and around streams that may be part of a wetland system that support fish and fish habitat.
BC *Mines Act* (Government of BC, 1996)	Promotes watershed protection during mining exploration, construction, operations, closure, and reclamation phases, including limitations and restrictions on operations near streams, lakes, and wetlands.

5.3.7.1.2 Assessment Methods, Information Sources, and Indicators of Effects

Potential Project effects on wetlands and the functions wetlands provide were quantitatively and qualitatively assessed. Wetlands in the LSA were mapped using provincial Terrestrial Ecosystem Mapping (TEM) protocols (Resource Inventory Committee (RIC), 1998), classified in the Canadian wetland classification system (Warner and Rubec, 1997) and by vegetation association (Mackenzie and Moran, 2004) and their extent quantified. Wetlands in the RSA were mapped using Terrain Resources Information Management (TRIM) data (BC MELP, 1991). Mapped wetland polygons were verified in the field. Baseline data was collected on landscape position, hydrology, plant species composition, water quality, and wildlife habitat and use.

Baseline wetland functions for mapped wetlands were qualitatively assessed per wetland class in the LSA. Project effects on wetlands and wetland functions were determined by overlaying the Project footprint (mine footprint and linear corridor components) on the mapped wetlands and then calculating direct loss of wetland extent using Geographical Information System (GIS) analysis. The loss of wetland functions was qualitatively assessed by documenting wetland functions per federal wetland class, calculating lost area of each wetland class, and evaluating degraded wetland functions and hydrologically altered wetlands. Wetlands were classified by hydrogeomorphic (HGM) unit to characterize and assess effects on hydrologic functions (Hanson et al., 2008). Field data documented in the Wetland Baseline Report (AMEC, 2013) were used to support the wetland effects assessment.

The four indicators used to assess potential Project effects on wetlands included wetland ecological functions, hydrological functions, biochemical functions, and habitat functions.

5.3.7.1.3 Spatial and Temporal Boundaries for Wetlands Effects Assessment

The Project effects assessment includes six Project components: mine site, mine access road, freshwater supply pipeline, airstrip and access road, transmission line, and improvements to the Kluskus FSR. Detailed descriptions of the Project components are provided in the Project Description in **Section 2** (Project Overview). The mine site LSA and RSA for the wetlands VC are based on watershed drainage basins where the Project components are likely to affect hydrological resources (**Figure 5.3.7-1**). The spatial boundaries for the LSA and RSA for the wetlands VC are a combination of the spatial boundaries for the aquatics disciplines (Fish, Fish Habitat, Surface Water Flow, and Surface Water and Sediment Quality), the Ecosystem Composition VC, and the Plant Species and Ecosystems at Risk VC, as presented in **Section 4** (Assessment Methodology) (**Table 5.3.7-2**).

Table 5.3.7-2: Description of Wetland Local and Regional Study Areas from Section 4 (Assessment Methodology)

Study Area	Description
Local Study Area (LSA)	Mine Site: Entire watersheds of Davidson Creek, Creek 661, Turtle Creek, and Creek 705. tributaries flowing in to the south side of Tatelkuz Lake; Chedakuz Creek from confluence with Creek 661 to Tatelkuz Lake. Chedakuz Creek from Tatelkuz Lake to confluence with Turtle Creek. Linear Components: transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR upgrade – 100 m beyond the linear component boundary.
Regional Study Area (RSA)	Mine Site: Entire watershed of Chedakuz Creek not included in the LSA. Includes entire watershed of Laidman Lake not included in the LSA. Linear Components: transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR upgrade – 500 m beyond the proposed linear component boundary.

The LSA for the wetlands VC is based on watershed boundaries so that Project effects on surface and groundwater resources will be fully incorporated into the wetlands effects assessment. Wetlands within the entire LSA have been mapped. The linear components are included in this LSA, so the 100 m area associated with the linear components as specified in **Section 4** (Assessment Methodology) has been incorporated into the effects assessment. In addition, the transmission line extends north beyond these watershed boundaries. As a result, the LSA also includes 100 m on both sides of the corridor for this linear component, and is identified as the Transmission Line LSA in the baseline summary (**Section 5.3.7.2**). Descriptions and sizes of the linear component boundaries are provided in **Table 5.3.7-3**. Additional details pertaining to the transmission line and associated access roads are presented in **Section 2.2.4.4**.

Table 5.3.7-3: Description of Linear Component Boundaries used for the Wetlands VC

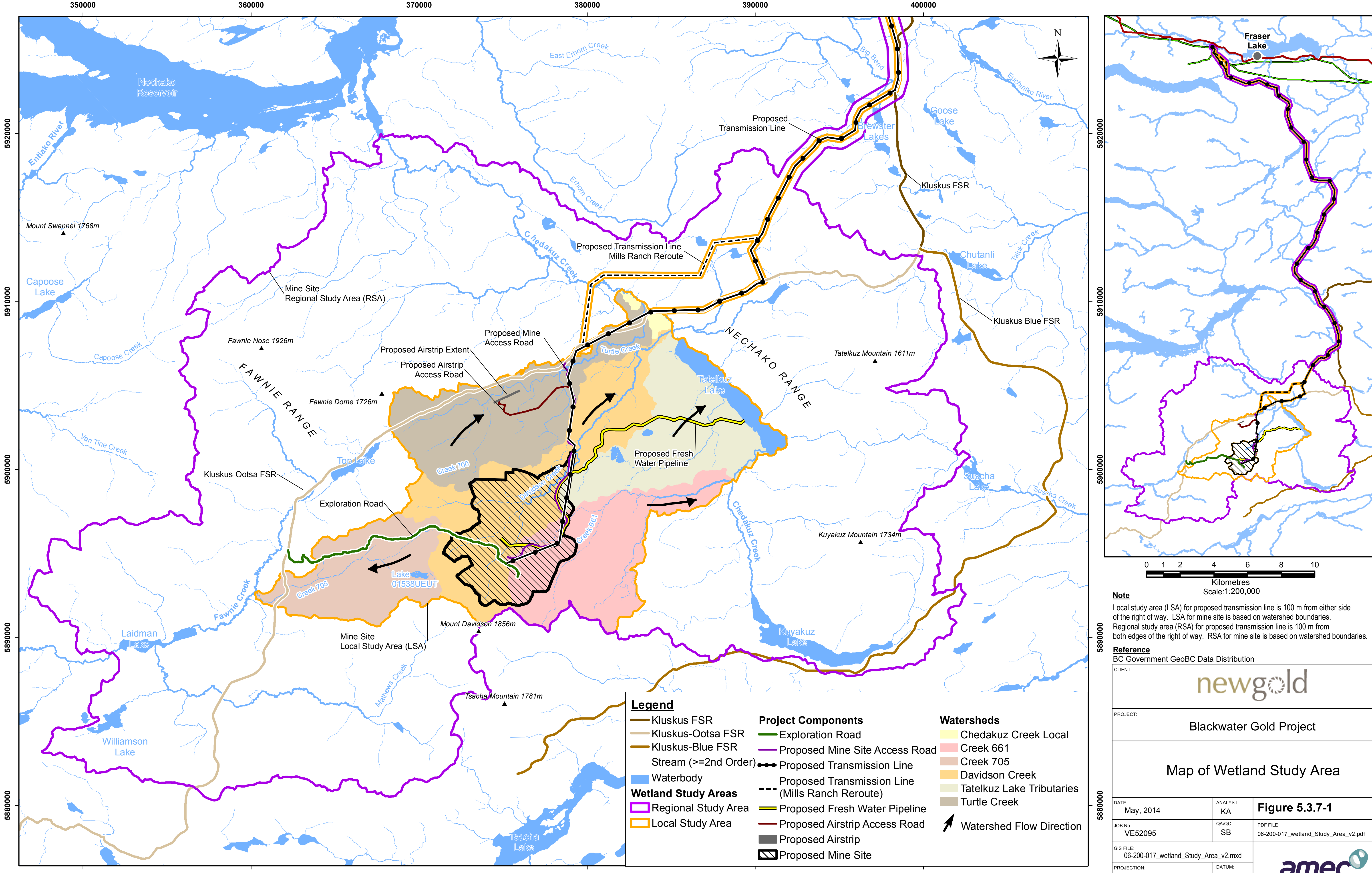
Linear Component	Description
Transmission Line	Transmission Line Corridor (140 km long, 140 m wide), including Tatelkuz Lake Ranch (15 km long) and Stellako (8 km long) re-routes
Mine Access Road	Mine Access Road Corridor (15 km long, 120 m wide)
Airstrip and Access Road	Airstrip (2 km long, 200 m wide) including associated access road (10 m wide)
Freshwater Supply Pipeline	Water Pipeline Corridor (20 km long, 110 m wide)

Note: The Kluskus FSR upgrade area is located within the RSA, and does not have a corridor because it is an existing road. Wetlands in the vicinity of the upgrade have been mapped in accordance with the rest of the RSA.

The RSA surrounds the LSA, and wetlands have been mapped within the RSA as well. The RSA is based on the entire watershed of Chedakuz Creek and Laidman Lake that is not included in the LSA. The RSA includes 500 m from the boundary of the transmission line corridor after it extends north beyond these watershed boundaries as shown in the inset photo on **Figure 5.3.7-1**. The RSA represents the boundaries for the Project Cumulative Effects Assessment (CEA).

The temporal boundaries remain unchanged, and include the 2-year construction phase, 17-year operations phase, 18-year closure phase, and the post-closure phase (estimated for a minimum of 30 years following closure). For each of the four phases, a wetland impacts analysis was conducted for the wetlands effects assessment using a single footprint that captured the site disturbances across time. The mine site footprint reflects the extent of disturbance over these four phases.

Separate administrative boundaries or technical boundaries were not established for the analysis.



Note

Local study area (LSA) for proposed transmission line is 100 m from either side of the right of way. LSA for mine site is based on watershed boundaries. Regional study area (RSA) for proposed transmission line is 100 m from both edges of the right of way. RSA for mine site is based on watershed boundaries.

Reference

BC Government GeoBC Data Distribution

CLIENT:	newgold
PROJECT:	Blackwater Gold Project
	Map of Wetland Study Area
DATE: May, 2014	ANALYST: KA
Figure 5.3.7-1	
JOB No: VE52095	QA/QC: SB
PDF FILE: 06-200-017_wetland_Study_Area_v2.pdf	
GIS FILE: 06-200-017_wetland_Study_Area_v2.mxd	
PROJECTION: UTM Zone 10	DATUM: NAD83

amec

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5.3.7.2 Valued Component Baseline

Wetlands within the mine site and linear corridors provide a variety of hydrological, biochemical, habitat, and ecological functions. Wetland functions are defined as natural processes (e.g., chemical, physical, and biological) that occur in wetlands and render services that are of value to society (British Columbia Ministry of Environment (BC MOE), 2009). The Wetlands Baseline Report (AMEC, 2013) documents the methods and results of physical, chemical, and biological baseline wetland studies completed from 2011 to 2013. The wetland baseline program was designed to document and describe the distribution, size, composition, and primary functions of wetlands within the mine site, and the five associated linear components (i.e., freshwater supply pipeline, mine access road, airstrip, transmission line, and Kluskus FSR upgrade). Field surveys in the mine site and LSA confirmed wetland classes and the extent of mapped wetlands. Information sources, including the Federal Policy on Wetland Conservation (Government of Canada, 1991), the Wetland Ecological Functions Assessment: An Overview of Approaches (Hanson et al., 2008); and other sources were reviewed and methods were adapted, where appropriate, to complete the baseline study. More details are presented in the Wetland Baseline Report in **Appendix 5.1.2.5A**). Other guidance documents such as the Federal Policy on Wetland Conservation: Implementation Guide, for Federal Land Managers (Government of Canada: Lynch–Stewart et al., 1996) were considered as presented in **Section 5.3.7.1.1**.

5.3.7.2.1 Setting

The Project site is on BC's Nechako Plateau, part of the Interior Plateau, east of the Coast Mountains (Coast Range), in an area of moderate relief characterized by gently undulating, northwest-trending hills cut by small- to medium-sized drainages. The Project property ranges from just over 1,000 metres above sea level (masl)—in low-lying areas northeast of the proposed mine site—to 1,800 masl at the summit of Mt. Davidson, on the southwest side of the property. Mt. Davidson is the highest peak in the Fawnie Range, and the Blackwater deposit is on the mountain's northern flank. Most of the proposed mine site lies within the Davidson Creek watershed; a small portion lies within the watershed of Creek 661.

The mine site covers approximately 4,413 hectares (ha) across three biogeoclimatic (BGC) zones. The majority (99%) of the mine site lies within two BGC units: 1) Engelmann Spruce-Subalpine Fir Moist Very Cold Nechako variant (ESSFmv1) (71%), and 2) Sub-Boreal Spruce Moist Cold Kluskus variant (SBSmc3) (28%). The third unit, Engelmann Spruce-Subalpine Fir Moist Very Cold Parkland subzone (ESSFmvp) comprises approximately 66 ha (1%) of the mine site at the highest elevations.

5.3.7.2.2 Past, Present or Future Projects/Activities

Section 4.3.6.2, Table 4.3-11 shows the Summary Project Inclusion List developed for CEA (**Appendix 4C** contains the comprehensive Project Inclusion List).

Past forestry activities, mining exploration, and infrastructure development may have contributed to a loss of wetland extent and function within the LSA prior to implementation of the *Mines Act*

(Government of BC, 1996) that afforded wetland protections. Exploratory mining activities were initiated in 1971 via ground and air surveys and soil sampling. Drilling began in 1985 (64 holes from 1985 to 1987), with limited activity in the 1990s (10 holes). Exploration activities increased in intensity in support of the Preliminary Economic Assessment in 2012, and drilling has continued into 2013.

Wetland functions may be degraded currently or in the past through agricultural activities. Active range tenures are located in the LSA and RSA. Grazing in wetlands has the potential to cause nutrient loading from animal waste, and inhibit growth of native vegetation if wetland areas are grazed on a routine basis. Historical wetlands may potentially have been drained by installing drainage ditches, which can artificially lower the water table and make land more suitable for haying or grazing.

5.3.7.2.3 Methods

The following section provides an overview of the methods used to characterize baseline conditions for the four wetland VC indicators (wetland ecological functions, hydrological functions, biochemical functions, and habitat functions).

5.3.7.2.3.1 Wetland Ecosystem Classification

In accordance with the provincial wetland guide, *Wetlands of British Columbia: A Guide to Identification* (MacKenzie and Moran, 2004), AMEC classified mine site wetlands to the ecosystem site-unit level. This provincial classification system is based on the *Biogeoclimatic Ecosystem Classification System* (BEC) (Pojar et al., 1987) and the *Canadian Wetland Classification System* (CWCS) (Warner and Rubec, 1997). The CWCS comprises five wetland classes: bog, fen, marsh, swamp, and shallow water. Typical water quality, hydrologic source, soil characteristics, vegetation cover, and habitat structure for these five wetland classes are provided in **Table 5.3.7-4**.

Table 5.3.7-4: Summary Characteristics of Wetland Classes in British Columbia

Site Class	Environmental Feature	Cover Type	Species Group
Bogs	+/- ombrotrophic; pH < 5.5; > 40 cm fibric/mesic peat	Conifer trees or low shrub	Sphagnum mosses, ericaceous shrubs, conifers
Fens	Groundwater-fed; pH > 5; > 40 cm fibric/mesic peat	Graminoid or low shrub	Deciduous shrubs, sedges, brown mosses
Marshes	Mineral soils or well-humified peat; protracted shallow flooding (0.5 m to 2.0 m)	Graminoid or forb	Large emergent sedge, grass, forb, horsetail species
Swamps	Mineral soils or well-humified peat; temporally shallow flooding (0.1 m to 1.0 m); significant water flow	Tall shrub or forested	Conifers, willows, alders, forbs, grasses, leafy mosses
Shallow Waters	Permanent deep flooding (0.5 m to 2.0 m)	Aquatic	Aquatic species, emergent vegetation, < 10% cover

Source: Adapted from MacKenzie and Moran, 2004

5.3.7.2.3.2 Wetland Functional Assessments

AMEC collected baseline data to support wetland functional assessments within the LSA in conjunction with ecosystem classification field sampling. Data were collected using both desktop review and field techniques that provided baseline data for three primary wetland functions (hydrological, biochemical, ecological/habitat functions). The functional components selected and associated protocols for data collections were developed using two EC wetland assessment documents: Wetland Ecological Functions Assessment: An Overview of Approaches *(*Hanson et al., 2008), and *Wetland Environmental Assessment Guideline* (Milko, 1998). Wetland data used to support wetland functional assessments are provided in **Table 5.3.7-5**. These three primary wetland functions were further evaluated using Hanson et al. (2008) for each wetland class identified within the mine site.

Table 5.3.7-5: Wetland Functions and Assessment Components

Category	Functions	Assessment Component
Hydrological	Groundwater recharge; flow moderation (flood protection); shoreline and erosion protection; climate regulation	HGM units; CWCS classification
Biochemical	Water quality treatment; nutrient and organic export; carbon sequestration and storage	Water quality; Nutrients; Organics; CWCS classification
Ecological / Habitat	Biological productivity and biodiversity	Extent; supporting hydrology; Species richness and diversity; Ecosystems and species at risk; Wildlife habitat potential and functional values, incl. migratory birds; CWCS classification

Note: HGM = Hydrogeomorphic; CWCS = Canadian Wetland Classification System

At-risk wetland ecosystems are identified by the BC Conservation Data Centre (BC CDC), and ranked as either Red-listed (Threatened or Endangered) or Blue-listed (Special Concern) ecosystems (BC MOE, 2013). Factors used in assessing the conservation status of ecological communities include rarity in the landscape, development pressure and potential threats, and unique vegetation associations (BC MOE, 2013).

5.3.7.2.4 Results

The first section provides results of the wetlands baseline study—information on wetland extent, hydrological functions, biochemical functions, and ecological/habitat functions. Wetland cultural values and historical activities that may have affected wetland functions are also presented.

5.3.7.2.4.1 Wetland Extent

Within the proposed mine site, approximately 575 hectares (ha) (13% by area) are classified as wetlands (**Figure 5.3.7-2**). Swamp wetlands are the most common wetland class mapped (9.5%, 421 ha, **Table 5.3.7-6**). Blue-listed wetland ecosystems occupy approximately 39 ha (0.9%) of the mine site. Mapped wetland resources comprise approximately 3,122 ha (12%) of the LSA and 5,846 ha (5%) of the RSA (**Figure 5.3.7-3**).

Table 5.3.7-6: Wetland Classes and Distribution per Mine Site, LSA, RSA

Wetland Class	Mine Site		LSA		RSA	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Bog	101.40	2.29	947.79	3.64	-	-
Fen	39.34	0.89	612.66	2.35	-	-
Marsh	2.77	0.06	50.52	0.19	-	-
Swamp	421.25	9.54	1,452.54	5.58	-	-
Shallow-water	8.19	0.18	58.17	0.22	-	-
Pond	2.16	0.05	-	-	-	-
TRIM/TEM	-	-	-	-	5,846.42	4.98
Total Wetland Area	**575.15**	**13.03**	**3,121.68**	**11.98**	**5,846.42**	**4.98**
Total Area	**4,412.66**		**26,047.57**		**117,349.82**	

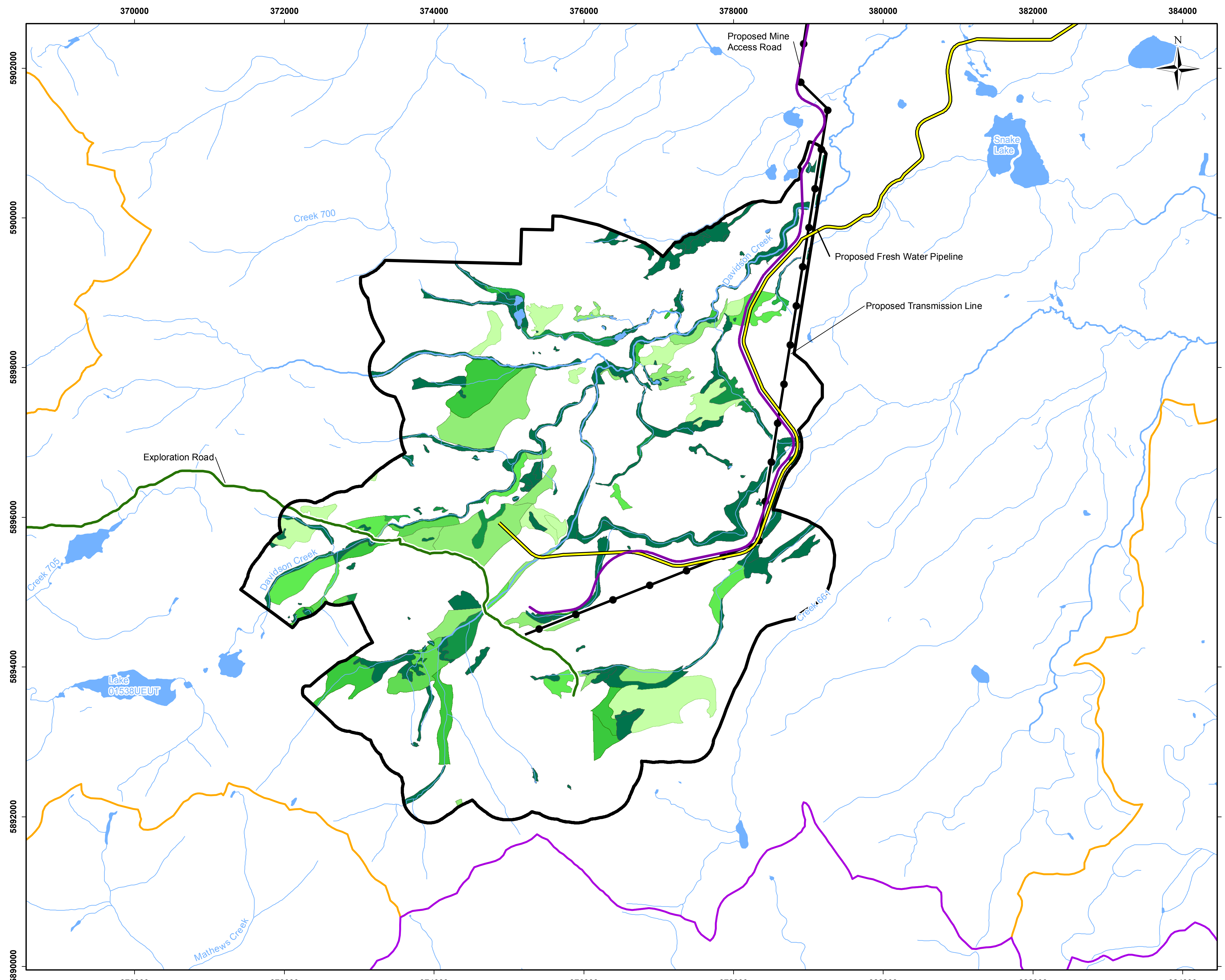
Note: ha = hectare; LSA = Local Study Area; RSA = Regional Study Area
Mine Site, LSA, and RSA are mutually exclusive; percents are % of total area.

The combined area of all linear corridors is approximately 2,367 ha, of which 163 ha are mapped wetlands (**Table 5.3.7-7**). Wetlands comprise approximately 7% of the transmission line corridor, 6% of the mine access road corridor, 8% of the freshwater supply pipeline route, and 4% of the airstrip and airstrip access road corridor.

Table 5.3.7-7: Area of Wetland Classes in the Baseline Study Areas for the Linear Project Component Corridors

Wetland Class	Transmission Line				Mine Access Road		Freshwater Supply Pipeline Route		Airstrip and Airstrip Rd	
	Corridor (140 m wide)		LSA		Corridor (120 m wide)		Corridor (110 m wide)		Airstrip Footprint and Corridor (10 m wide)	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Bog	27.08	1.30	31.92	1.13	1.66	1.60	1.64	1.20	1.07	2.10
Fen	15.91	0.80	17.68	0.62	0.51	0.50	1.08	0.80	-	-
Marsh	2.97	0.10	6.68	0.24	0.11	0.10	0.05	<0.01	-	-
Swamp	97.15	4.70	151.00	5.34	4.00	3.90	8.14	5.90	0.88	1.70
Shallow-water	0.60	<0.01	3.21	0.11	-	-	-		-	-
Total Wetland Area	**143.70**	**6.90**	**210.49**	**7.44**	**6.28**	**6.10**	**11.03**	**8.00**	**1.95**	**3.86**
Total Area of Linear Component	**2,074.41**	**-**	**2,828.76**	**-**	**103.15**	**-**	**138.59**	**-**	**50.51**	**-**

Note: ha = hectare; LSA = Local Study Area; m = metre; Rd = Road; RSA = Regional Study Area
(1) Areas Calculated in UTM projection, Zone 10, NAD 83. Percents are % of total area for the total linear component outside of the mine site. Corridors widths represent the extent of the wetland study area for each linear component. The transmission line corridor includes the Tatelkuz Lake Ranch and the Stellako re-routes.



Legend

- Stream
- Waterbody

Project Components

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

Wetland Study Areas

- Regional Study Area
- Local Study Area

Percent Wetland in TEM Mapped Polygon

- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

0 0.5 1 2
Kilometres
Scale:1:50,000

Note
Wetlands shown may contain multipl ecosystems.
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Distribution of Wetland Resources near the Mine Site

DATE: May, 2014	ANALYST: AA	Figure 5.3.7-2
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-016_wetland_ecosystem_footprint_v4.pdf
GIS FILE: 06-200-016_wetland_ecosystem_footprint_v4.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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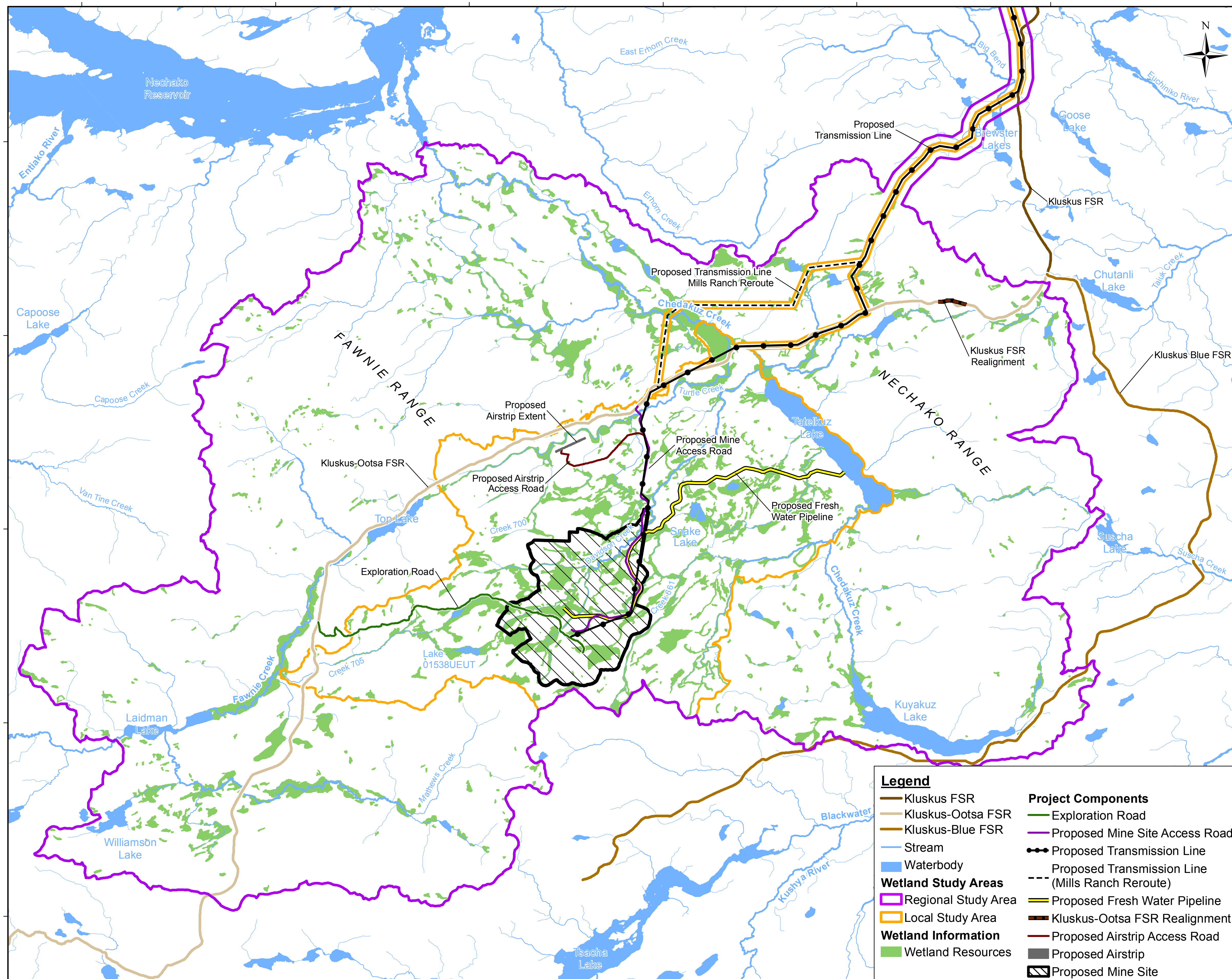

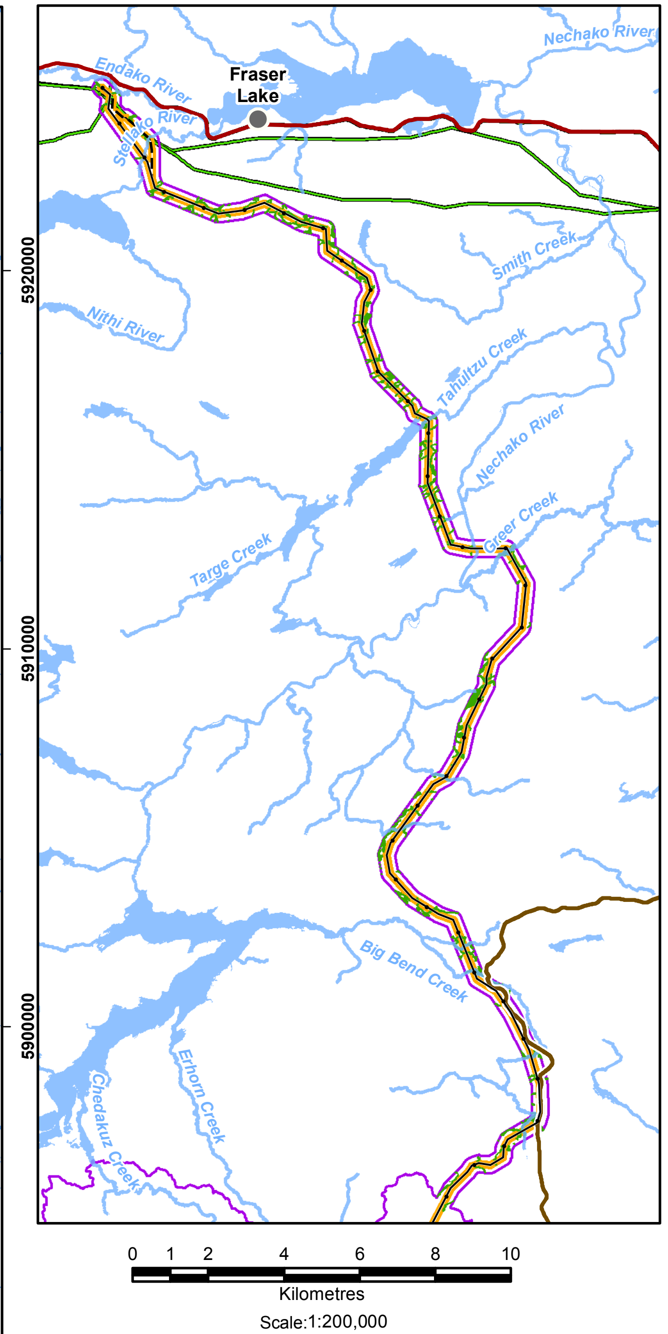

Note
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Distribution of Wetland Resources within Regional Study Area

DATE: September, 2014	ANALYST: KA	**Figure 5.3.7-3**
JOB No: VE52420	QA/QC: SB	PDF FILE: 06-200-009_wetland_ecosystem_RSA_v5.pdf
GIS FILE: 06-200-009_wetland_ecosystem_RSA_v5.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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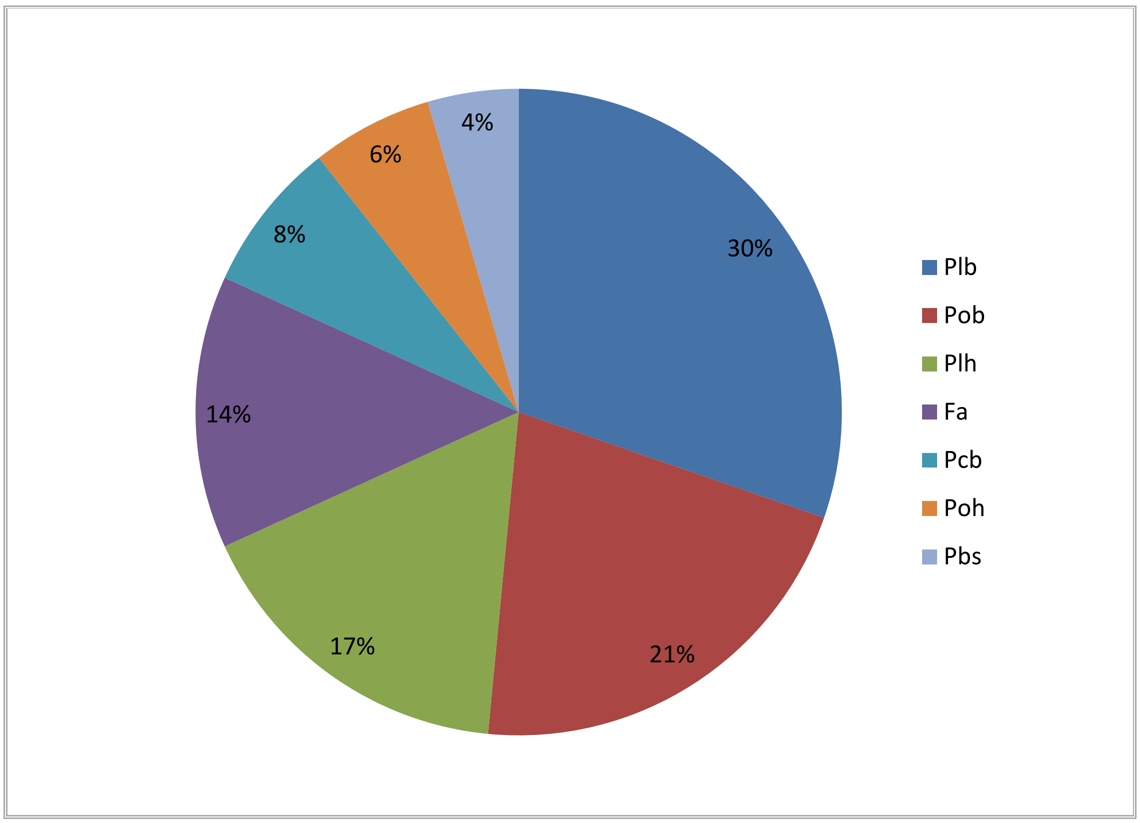
5.3.7.2.4.2 Wetland Hydrological Functions

Wetland hydrological functions include water flow moderation (flood protection), groundwater recharge, shoreline and erosion protection, and climate regulation (Hanson et al., 2008). Wetland HGM units can also be classified by topographic position and hydrologic source to indicate the opportunity wetlands have to provide hydrological functions. For example, linked-hollows receive overbank flooding from streams and provide flood storage during storm events and freshet. Conversely, blanket slope wetlands are typically located above floodplains, receive hydrological inputs from groundwater seeps, and generally provide few hydrological functions.

Sixty-one percent (61%) of surveyed wetlands in the mine site were classified by HGM unit as linked basins, linked hollows, or fluvial wetlands (**Figure 5.3.7-4**), and 50% in the LSA. Linked hollows and fluvial HGM class swamps are both associated with riparian areas, and are common in the mine site. These wetlands include the largest sites; the wetlands often occupy flat areas that are part of historical, small lake or flood plain bottoms, and likely have little ground-water input. This indicates that mine site wetlands provide an important role in surface water storage, flow moderation, and erosion protection.



Note: P = Palustrine, F = Fluvial, lb = linked basin, ob = overflow basin, lh = linked hollow, a = alluvial, cb = closed basin, oh = overflow hollow, bs = blanket slope.

Figure 5.3.7-4: Distribution of Hydrogeomorphic Classes for 66 Select Wetlands in the Mine Site

The performance of wetland hydrological functions by different wetland classes is variable (Hanson et al., 2008). Wetland hydrological functions provided by the different wetland classes in the mine site can be evaluated by assessing the extent of wetland classes that are known provide a high level of hydrological functions. As such, 73% of mapped wetlands within the mine site are classified as swamp wetlands, and the second most common wetland class are bogs (18%). Together, 91% of mapped wetlands occur as either swamps or bogs in the mine site, which perform hydrological functions at a high level.

Riparian swamps generally function well for water flow control and erosion protection. Linked basins/hollows and fluvial HGM class swamps are common in the mine site area and function to slow runoff and store water for extended periods. These wetlands perform these functions because these wetlands receive overbank flooding during high flow events, and generally have inflowing or outflowing hydrological connections.

Bog hydrological function is typically low to variable because bogs are isolated from surface water inputs, as indicated by the high proportion of closed basin bogs in the mine site. However, bogs are often in wetland complexes with fens and therefore likely contribute to the control of flow during extreme flooding events.

Additionally, half of the sampled wetlands associated with the mine site are overflow or linked headwater wetlands. Headwater wetlands are associated with intermittent and perennial streams at the higher reaches of the watershed, and intercept and modify runoff and shallow groundwater entering streams and rivers. Headwater wetlands are important for water flow supply to lower reaches of the watershed (Mitsch and Gosselink, 2007).

Wetland hydrological functions in the linear corridors are similar to functions in the mine site because the majority of wetlands in each of the linear corridors are also classified as swamps and bogs (**Table 5.3.7-7**). Approximately 68% of all wetlands in the transmission line corridor are classified as swamps, and 19% as bogs. In the mine access road corridor, 64% of wetlands are classified as swamps and 27% as bogs. In the freshwater supply pipeline corridor, 74% of all wetlands are classified as swamps, and 15% as bogs. Lastly, bogs and swamps account for 100% (55% and 45%, respectively) of the wetlands in the airstrip and airstrip road corridor.

5.3.7.2.4.3 Wetland Biochemistry and Biochemical Functions

Overall, baseline water quality results suggest typical conditions for sampled wetlands for the following parameters: temperature, conductivity, dissolved oxygen (% and mg/L), pH, total dissolved and suspended solids, dissolved anions, organic carbon (dissolved and total), and nutrients (phosphorous and nitrogen). Indicators such as low pH, high nutrients (i.e., nitrogen and phosphorus), and moderate levels of organic carbon are within the natural range of variation for wetland ecosystems in BC (BC MOE, 2006). For example, average pH in sampled wetlands was lowest in bog wetlands, which typically have a lower pH relative to swamps and marshes due to the release of organic acids from peat (Mitsch and Gosselink, 2007; MacKenzie and Moran, 2004).

Freshwater aquatic guideline exceedances were detected for total and dissolved metals in all years (2011 to 2013) for some analytes tested, particularly total cadmium, total iron, total zinc, and dissolved aluminum. Elevated metal concentrations occurred in sampled wetlands in the mine site and LSA, and in reference wetlands in the RSA. Zinc and aluminum (and to a lesser extent, cadmium) are typically found in surface waters as a result of weathering processes on local rocks and soils. Iron concentrations in surface waters are often related to contributions from groundwater sources. These elements were also found in surface waters included in the baseline water quality study, particularly dissolved aluminum, which was found to exceed the BC freshwater guidelines (BC MOE, 2006) in several of the samples collected in watersheds adjacent to the mine site (Surface Water Quality Baseline Report, AMEC, 2013) (**Appendix 5.1.2.2A**).

A high level of biochemical functions are performed by wetlands in the mine site due to the high proportion of swamp wetlands and bogs. Both swamps and bogs export nutrients and organic carbon to streams, which supports the aquatic food chain. Swamps and bogs also function to sequester and store carbon. Bogs generally perform this function better than swamps as bogs accumulate peat and woody biomass over time, whereas swamps' seasonally fluctuating water tables allow for biomass and soil decomposition. Consequently, disturbances and alterations to bog wetlands potentially can cause a release of carbon from the moderately decomposed sphagnum peat and buried wood (Hanson et al., 2008).

The potential for wetlands to provide biochemical functions is related to a wetland's position on the landscape. A wetland's opportunity to provide these functions is dependent on the resources in the aquatic system. The majority of wetlands within the mine site are hydrologically linked to surface waters and streams, as 61% of all wetlands are classified as linked basins/hollows or fluvial wetlands in the HGM system. The tributaries in the mine site support downstream populations of rainbow trout and kokanee in Davidson Creek and Creek 661. Wetlands within the mine site provide a high level of biochemical functions regarding nutrient export because of this hydrological connection to surface waters that support fish and other aquatic resources.

Wetlands within the mine site also function to provide water quality treatment as 73% of all wetlands are swamps, and 61% are linked basins/hollows or fluvial wetlands. Seasonally fluctuating water tables in swamps enable frequent interactions between water and root-bacteria assemblages that provide the opportunity for biogeochemical cycling. Linked-basins/hollows and fluvial wetlands have surface water interactions that increase the exchange of minerals and nutrients with their surroundings through flooding (Mitsch and Gosselink, 2007). Conversely, bogs generally provide low water quality treatment function because bogs are typically isolated from surface water inputs such as streams (Hanson et al., 2008).

Wetland biochemical functions in the linear corridors are similar to those in the mine site, because the majority of wetlands in each of the linear corridors are also classified as swamps and bogs (**Table 5.3.7-7**).

5.3.7.2.4.4 Wetland Ecological and Habitat Functions

Wetland ecological and habitat function involves the role of wetlands in relation to their surroundings and their ability to support a variety of plant and animal species and communities (Mitsch and Gosselink, 2007). Twenty-one distinct wetland ecosystems were classified within the wetlands RSA. Ten of these wetlands are provincially Red-listed (Threatened) or Blue-listed

(Special Concern) ecosystems. A minimum of 132 wildlife species potentially occurring in northern BC depend on wetlands for a portion of their lifecycle, 16 of which are of conservation concern (i.e., either provincially or federally listed).

5.3.7.2.4.5 Wetland Ecological Site Associations

The majority of the 575 ha of mine site wetlands occur in the SBSmc3 and ESSFmv1 BGC zone variants. The area covered by each wetland site association in the mine site varies greatly, with Ws08 (Swamp Wetland–Bl–Horsetail–Glow moss) and Ws07 (Swamp Wetland–Spruce–Horsetail) comprising the greatest area (274 ha and 122 ha, respectively). The next most common wetland site associations in the mine site are Wb08 (Blackspruce–Soft-leaved sedge–Peat-moss bogs, 47 ha), Wb05 (Blackspruce–Water sedge–Peat-moss bogs, 37 ha), and Ws04 (Drummond's willow–Beaked sedge, 25 ha), which comprise a combined area of 109 ha. **Table 5.3.7-8** presents the areas of wetland site associations within the mine site by BGC zone variant.

Approximately 3,122 ha of wetland ecosystems were mapped within the LSA, and 5,846 ha within the RSA. Approximately 59% of wetlands in the LSA occur in the SBSmc3 variant, 22% in the ESSFmv1 variant, and 15% in the Sub-Boreal Spruce Dry Cool (SBSdk) subzone. Most wetlands in the RSA occur in the SBSmc3 variant (52%), and 26% in the SBSdk subzone.

Table 5.3.7-8: Wetland Site Associations by Area within Mine Site

BGC Zone Variant	Wetland Type	Site Association	BC CDC List	Area (ha)	Percent of Mine Site
ESSFmv1	Shallow-water	Ww	NL	1.721	0.04
	Bog	Wb05	Yellow	15.372	0.35
	Bog	Wb08	Yellow	27.907	0.63
	Bog	Wb10	Blue	13.943	0.32
	Fen	Wf01	NL	2.116	0.05
	Fen	Wf02	Blue	11.085	0.25
	Fen	Wf03	Yellow	6.386	0.14
	Fen	Wf04	Yellow	1.657	0.04
	Fen	Wf07	Yellow	2.171	0.05
	Fen	Wf11	Blue	4.187	0.09
	Marsh	Wm01	Yellow	1.805	0.04
	Swamp	Ws04	NL	12.21	0.28
	Swamp	Ws08	NL	273.914	6.21
ESSFmv1 Wetland Total				**374.474**	**8.49**
ESSFxvp	Shallow-water	Ww	NL	0.233	0.01
ESSFxvp Wetland Total				**0.233**	**0.01**
SBSmc3	Shallow-water	Ww	NL	6.236	0.14
	Bog	Wb05	Yellow	21.662	0.49
	Bog	Wb08	Yellow	18.793	0.43
	Bog	Wb09	Blue	0.729	0.02
	Bog	Wb10	Blue	3.028	0.07
	Fen	Wf01	Yellow	2.757	0.06
	Fen	Wf02	Blue	3.491	0.08

BGC Zone Variant	Wetland Type	Site Association	BC CDC List	Area (ha)	Percent of Mine Site
	Fen	Wf03	Yellow	2.827	0.06
	Fen	Wf08	Blue	2.232	0.05
	Fen	Wf11	Blue	0.436	0.01
	Marsh	Wm01	Yellow	0.965	0.02
	Swamp	Ws04	NL	13.302	0.30
	Swamp	Ws07	NL	121.826	2.76
SBSmc3 Total				**200.44**	**4.54**
Blue-Listed Total				**39.131**	**0.89**
Wetland Grand Total				**575.147**	**13.03**

Note: BGC = Biogeoclimatic, BC CDC = British Columbia Conservation Data Centre, ESSFmv1 = Engelmann Spruce-Subalpine Fir Nechako Moist Very Cold variant, ESSFxvp = Engelmann Spruce-Subalpine Fir Very Dry Very Cold Parkland variant, ha = hectares, NL = Not Listed, SBSmc3 = Sub-Boreal Spruce Kluskus Moist Cold variant; Ww = Shallow-water, Wb05–Sb = Water sedge–Peat-moss, Wb08 = Sb–Soft-leaved sedge–Peat-moss, Wb09 = Black spruce–Common horsetail–Peat-moss, Wb10 = Pl–Few-flowered sedge = Peat-moss, Wf01–Water sedge = Beaked Sedge, Wf02 = Scrub birch–Water sedge, Wf03 = Water sedge–Peat-moss, Wf04 = Barclay's willow–Water sedge–Glow moss, Wf07 = Scrub birch–Buckbean–Shore sedge, Wf08 = Shore sedge–Buckbean = Hook-moss, Wf11 = Tufted clubrush–Star-moss, Wm01 = Beaked Sedge–Water Sedge, Ws04 = Drummond's willow–Beaked sedge, Ws07 = Spruce–Horsetail, Ws08 = Bl–Horsetail–Glow moss, Wb = Bog Wetland, Wf = Fen Wetland, Wm = Marsh Wetland, Ws = Swamp Wetland.

5.3.7.2.4.6 Ecosystems at Risk

A total of 21 distinct wetland ecosystems were classified and confirmed in the field during the 2011 to 2013 baseline studies. Ten of these wetland ecosystems are Red- or Blue-listed in BC, and confirmed in the wetland LSA and RSA. Four Blue-listed wetland ecosystem types occupy 39 ha (0.9%) of the mine site. The areas of the Red- and Blue-listed wetlands are shown in **Table 5.3.7-9**, and their locations are mapped on **Figure 5.3.7-5**. No Red-listed ecosystems were identified in the mine site; however, the Red-listed Hudson Bay clubrush–red hook-moss wetland site association (Wf10) was observed in the LSA. Red-listed wetlands comprise approximately 6.19 ha at three separate sites east of the mine site. Approximately 0.9 ha of Blue-listed wetlands are located in the transmission line linear corridor, and 0.3 ha in the proposed Tatelkuz Lake Ranch re-route.

Table 5.3.7-9: Confirmed At-Risk Wetland Ecosystems in the Baseline Study Areas

Site Association Label	Scientific Name	Common Name	BC CDC List	Baseline Study Area
Wb01	*Picea mariana–Gaultheria hispidula–* Sphagnum	Black spruce–Creeping-snowberry–Peat-moss	Blue	LSA; RSA
Wb10	*Pinus contorta/Carex pauciflora*/Sphagnum spp.	Lodgepole pine–Few-flowered sedge–Peat-moss	Blue	Mine Site; LSA
Wb11	*Picea mariana–Menyanthes trifoliata*–Sphagnum	Black spruce–Buckbean–Peat-moss	Blue	LSA
Wb13	*Carex limosa–Menyanthes trifoliata–* Sphagnum spp.	Shore sedge–Buckbean–Peat-moss	Blue	LSA
Wf02	*Betula nana–Carex aquatilis*	Scrub birch–Water sedge	Blue	Mine Site; LSA

Site Association Label	Scientific Name	Common Name	BC CDC List	Baseline Study Area
Wf05	*Carex lasiocarpa–Drepanocladus aduncus*	Slender sedge–Common hook-moss	Blue	LSA
Wf08	*Carex limosa–Menyanthes trifoliata–Drepanocladus*	Shore sedge–Buckbean–Hook-moss	Blue	Mine Site
Wf10	*Trichophorum alpinum–Scorpidium revolvens*	Hudson Bay clubrush–Red hook-moss	Red	LSA
Wf11	*Trichophorum cespitosum–Campylium stellatum*	Tufted clubrush–Star moss	Blue	Mine Site; LSA
Wf13	*Eriophorum angustifolium–Carex limosa*	Narrow-leaved cotton-grass–Shore sedge	Blue	LSA

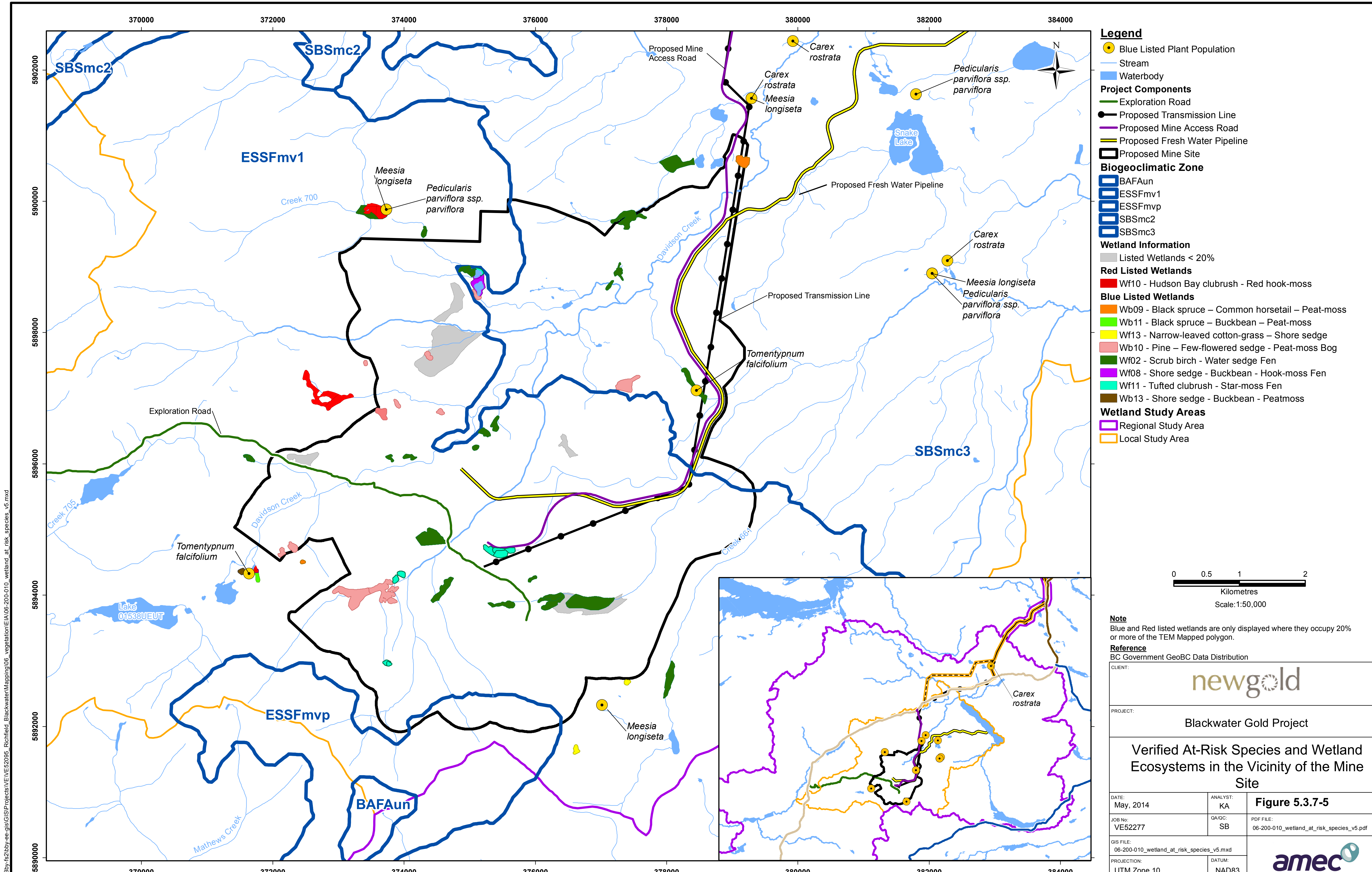
Note: BC CDC = British Columbia Conservation Data Centre; LSA = Local Study Area; RSA = Regional Study Area; WB = Bog Wetland Class, Wf = Fen Wetland Class;
RSA was not fully classified to Site Association level.

5.3.7.2.4.7 Plant Biodiversity and Species at Risk

Swamp wetlands (Ws) are the most common wetlands in the mine site, and Spruce–Horsetail swamps (Ws07) have the highest plant species richness (99 species). A total of 318 plant species were identified during the wetland field surveys.

A list of 69 at-risk wetland plant species potentially occurring in the mine site, LSA, and RSA is provided in the Wetlands Baseline Report (AMEC, 2013) (**Appendix 5.1.2.5A**). The list includes known plant populations of listed plants within 50 km of the wetland study area, or that are known to occur in a BGC subzone that is contiguous with or intersects the study area. Plant growth habits include woody plants (trees and shrubs), forbs, graminoids, and nonvascular plants. The following aquatic plants are potentially occurring: *Sparganium fluctuans*, *Stuckenia vaginata*, and *Utricularia ochroleuca* (**Section 5.4.6** Plant Species and Ecosystems at Risk).

Four plant species are Blue-listed in BC: swollen beaked sedge *(Carex rostrata*), small-flowered lousewort *(Pedicularis parviflora ssp. parviflora*), meesia moss *(Meesia longiseta*), and sickleleaf tomentypnum moss (*Tomentypnum falcifolium*) (**Table 5.3.7-10**). Sickleleaf tomentypnum is not on the list of potentially occurring at-risk wetland plant species. Locations of these at-risk species are shown on **Figure 5.3.7-5**.



CLIENT: newgold

PROJECT: Blackwater Gold Project

Verified At-Risk Species and Wetland Ecosystems in the Vicinity of the Mine Site

DATE: May, 2014	ANALYST: KA	Figure 5.3.7-5
JOB No: VE52277	QA/QC: SB	PDF FILE: 06-200-010_wetland_at_risk_species_v5.pdf
GIS FILE: 06-200-010_wetland_at_risk_species_v5.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

Table 5.3.7-10: Confirmed Plant Species at Risk in the Baseline Study Areas

Common Name	Scientific Name	BC CDC	*SARA*	Provincial Rank	Global Rank	Project Component
Meesia moss	*Meesia longiseta*	Blue	Not listed	S3	G4	LSA; RSA
Sickleleaf tomentypnum moss	*Tomentypnum falcifolium*	Blue	Not listed	S3	G3G5	Mine Site; LSA
Small-flowered lousewort	*Pedicularis parviflora subsp. Parviflora*	Blue	Not listed	S3	G4T4	LSA; RSA
Swollen beaked sedge	*Carex rostrata*	Blue	Not listed	S2S3	G5	LSA; RSA

Note: BC CDC = British Columbia Conservation Data Centre; LSA = Local Study Area; RSA = Regional Study Area; *SARA* = *Species at Risk Act*

One population of sickleleaf tomentypnum moss was observed within the mine site boundaries, and a second population was observed approximately 450 m west of the mine site in the headwaters of Davidson Creek. The other three Blue-listed species were found in the LSA outside of the mine site. A population of meesia moss was identified approximately 750 m southeast of the mine site in the Creek 661 drainage.

In regards to the linear corridors, a single population of swollen-beaked sedge was identified in the transmission line corridor, as shown on **Figure 5.3.7-5**. However, the swollen-beaked sedge population is not within the proposed Tatelkuz Lake Ranch Reroute corridor.

5.3.7.2.4.8 Wildlife Habitat Functions

Wetland habitat function relates to the ability of a wetland ecosystem to support wildlife. The sampled wetlands have the potential to support at least 132 wildlife species for a portion of the wildlife species' lifecycle, including 4 amphibians, 64 birds, 10 mammals, 54 odontates, and 7 lepidopterans. Of the 132 wildlife species identified as potentially occurring in the wetland study areas, 69 species were detected during field surveys. A comprehensive list of wildlife species potentially occurring versus detected in the RSA is provided in the Wetlands Baseline Report (AMEC, 2013).

Wildlife habitat functionality values and ranks were developed for a representative sample of wetlands in the mine site. All mine site wetlands were ranked moderate, with scores ranging from 2.33 to 2.80. Values less than 2 are considered to have high wildlife functions. Seven wetlands are ranked as high (1 to 2) for wetland habitat function, but the majority (48) of surveyed wetlands are ranked as moderate (2 to 3).

Approximately 69% (396 ha) of the wetlands mapped in the mine site are classified as Ws08 and Ws07 (274 ha and 122 ha, respectively) wetland site associations. Swamp wetlands provide highly variable levels of habitat functions, which is consistent with the moderate wetland habitat functionality values of the sampled wetlands listed above. Surveyed bogs, which potentially provide a high level of habitat functions (Hanson et al., 2008), also only had moderate functionality values due to the lack of species detections during the surveys. Bogs, fens, and marshes potentially function to provide valuable wildlife habitat, and occur as approximately 25% (101 ha, 39, ha, and 2.8 ha, respectively) of all mapped wetlands.

5.3.7.2.4.9 Migratory Birds

There were 41 migratory bird species observed in the LSA and RSA that are expected to use wetlands for part of their lifecycle (breeding, moulting, feeding, etc.) and are covered under the *Migratory Birds Convention Act* (Government of Canada, 1994). Twenty-three (23) water bird species were detected including one species of conservation concern, the Blue-listed great blue heron (*Ardea herodias*). The four most frequently detected species include Wilson's snipe (*Gallinago gallinago*), greater yellowlegs (*Tringa melanoleuca*), bufflehead (*Bucephala albeola*), and common loon (*Gavia immer*). Many of the wetlands across the study area were found to have greater yellowlegs or Wilson's snipe; bufflehead or common loon were present on most waterbodies. Wilson's snipe and greater yellowlegs were identified within the mine site.

The Project site is also located in the Northern Rockies Bird Conservation Region (NRBCR), an ecologically defined conservation unit managed by the Canadian Wildlife Service for bird conservation (EC, 2013). Seven of the detected water bird species are priority species for the NRBCR, including great blue heron, hooded merganser (*Lophodytes cucullatus*), mallard (*Anas platyrhynchos*), northern harrier (*Circus cyaneus*), ring-necked duck (*Aythya collaris*), rusty blackbird (*Euphagus carolinus*), and short-eared owl (*Asio flammeus*). These seven priority species potentially use marsh wetlands in the wetland study area; the rusty blackbird uses marsh, bog, fen, and swamp wetland classes. Additional information regarding migratory and water bird species and habitat in the study area is provided in the Wildlife and Wildlife Habitat Baseline Report (AMEC, 2013) for the Project (**Appendix 5.1.3.4A**). The Canadian Wildlife Service will be providing additional bird count data during application review.

5.3.7.2.4.10 Wildlife Species of Conservation Concern

Of the 132 wetland wildlife species with the potential to occur in the LSA and RSA, 16 species are listed as provincial wildlife species at risk. Seven of these species are also *SARA*-listed species, including the western toad (*Anaxyrus boreas*), yellow rail (*Coturnicops noveboracensis*), long-billed curlew (*Numenius americanus*), short-eared owl, olive-sided flycatcher (*Contopus cooperi*), rusty blackbird, and caribou (*Rangifer tarandus).*

Detections of *SARA*-listed species within or adjacent to wetlands in the LSA include western toad, olive-sided flycatcher, rusty blackbird, and caribou. Additional provincially-listed mammal species detections include grizzly bear (*Ursus arctos*), eastern red bat (*Lasiurus borealis*), little brown myotis (*Myotis lucifugus*), and northern myotis (*Myotis septentrionalis*). Additional provincially-listed invertebrate species detections include Jutta Artic (*Oeneis jutta chermocki*) and Hagen's bluet (*Enallagma hageni*). A comprehensive list of wildlife species potentially occurring versus detected in the RSA is provided in the Wetlands Baseline Report (AMEC, 2013)

(**Appendix 5.1.2.5A**). Individual species accounts are provided in the Wildlife and Wildlife Habitat Baseline Report (AMEC, 2013) for the Project (**Appendix 5.1.3.4A).**

5.3.7.2.4.11 Traditional Ecological and Community Knowledge

Wetlands are valued by societies for their ecological and cultural services. Ecological services include the wetland functions described previously, including hydrological, biochemical, and ecological/habitat functions. Wetland cultural functions include the spiritual, inspirational, recreational, aesthetic, and educational opportunities provided by the wetlands. Wetlands are also valued by society as a source of food because they support berry-producing shrubs that can be harvested seasonally (Wardrop, 2011).

Local residents and Aboriginal groups and their members have expressed interest in the Project's potential effects on wetlands. These groups' comments during the engagement and consultation process have provided insights into traditional, ecological, or community knowledge, which is defined as a body of knowledge built up by a group of people through generations of living in close contact with nature. This includes unique knowledge about the local environment, how it functions, and its characteristic ecological relationships.

Traplines for fishing, hunting, and gathering are often located in or near wetlands due to the high functioning wildlife habitat provided by wetlands. For example, muskrats are valued furbearers, typically found in suitable marshes along lake or pond margins shallow enough to support wetland vegetation, and deep enough not to freeze to the bottom in winter (BC MFLNRO, 2003). Other examples of furbearing animals that use wetlands for some or all of their life cycle include marten *(Martes Americana*), mink (*Mustela vison*), beaver (*Castor canadensis*), and fox (*Vulpes vulpes*). Shallow open water ponds and wetlands along streams and rivers also provide off-channel habitat for rearing rainbow trout (*Oncorhynchus mykiss*), which has been documented within the mine site, LSA, and RSA.

Known berry-producing plants were documented within the mine site and the LSA during the wetland baseline studies. These plant species potentially offer foraging opportunities for First Nations in accordance with their traditional livelihoods and customs. The five identified plants include bog cranberry (*Oxycoccus oxycoccos*), nagoonberry (*Rubus arcticus* and *Rubus articus spp. acaulis*), cloudberry (*Rubus chamaemorus*), and bog blueberry (*Vaccinum uliginosum*). These plants typically occur in wet meadow habitats in the fen and marsh wetland classes, except for nagoonberry, which occasionally occurs in a forested understory. Wetland marsh and fen habitats comprise 1% of the mine site and 2% of the LSA (**Table 5.3.7-6**).

According to community knowledge provided by a local trapper, wetland plants, such as Labrador tea (*Rhododendron groenlandicum*), are used for food, and in this case, a drink (interview with Saik'uz First Nation member, 2013). A Lhoosk'uz Dene Nation member noted that wetlands are often associated with increased archaeological potential as well-drained adjacent areas could be village or camp sites (Lhoosk'uz Dene Nation Site Visit, 2013).

Wetland cultural functions also provide recreational opportunities for naturalists for potentially unique flora and fauna and wildlife viewing. One Blue-listed plant species was documented within the mine site (sickleleaf tomentypnum moss). Blue-listed plant species documented only within the LSA include swollen-beaked sedge, small-flowered lousewort, and meesia moss. In regards to unique fauna, both provincially-listed and *SARA*-listed species detections occurred within or adjacent to wetlands in the LSA.

5.3.7.3 Potential Effects of the Proposed Project and Proposed Mitigation

Mapped wetland resources comprise approximately 3,697 ha (12%) of the LSA (inclusive of the mine site), and 5,846 ha (5%) of RSA (**Figure 5.3.7-3**). The Project's six components will interact with wetland resources, potentially causing loss of wetland extent and function. Potential adverse effects from other known past, present, certain and foreseeable future projects or activities in the Project area are discussed in **Section 5.3.7.5.2** (Potential Cumulative Effects with Other Past, Present, and Future Projects and Activities), and include potential effects from forestry, agriculture, and mining exploration activities. The following section provides the potential effects on wetland extent, wetland hydrological functions, wetland biochemical functions, and wetland habitat functions from Project development.

5.3.7.3.1 Potential and Key Project Effects on Wetland Extent and Functions

The key effects on the Wetlands VC are loss of wetland extent and wetland functions associated with the mine site. The loss of wetland extent from Project construction, operations, and closure and decommissioning is used herein as a proxy to measure the loss of wetland functions. The loss of wetland extent and functions will result from fill and grading; site clearing, excavation, infrastructure, and facility construction; watershed alterations resulting in groundwater drawdown; and the diversion, collection, and treatment of surface and seepage water. Potential Project effects that will degrade wetland functions without loss of wetland extent include dust deposition, noise pollution, light pollution, shading, and habitat fragmentation. The Project Component and Activity Interaction Matrix provided in **Section 4** (Assessment Methodology) lists the potential drivers of effects on existing wetlands and wetland functions, which is summarized in **Table 5.3.7-11**. No new potential effects on wetlands are expected during post-closure, as wetland creation will continue during reclamation in the closure phase after progressive reclamation of the D cell starts in Year 4.

Table 5.3.7-11: Project Activities with Potential to Affect Wetland Functions

Project Phase	Project Component	Project Activity
Construction	Mine site	Site clearing, grading, soil salvage, borrow pit development, construction of main and ancillary facilities, water diversion/collection/treatment systems, storage and management of construction materials and waste, construction of work camp.
	Mine access road	Site clearing, grading and road construction, stream crossings.
	Freshwater supply system	Site clearing, grading and road construction, stream crossings, construction of intake, installation of freshwater supply pipeline and freshwater reservoir.
	Airstrip	Site clearing and grading, construction of runway and ancillary facilities.
	Transmission line	Site clearing and grading, construction of access roads, stream crossings, construction of towers.
	Kluskus FSR	Road upgrades, clearing, grading.
Operations	Mine site	Drilling, blasting, ore and waste rock loading, hauling and dumping, ore crushing, ore processing, tailings deposition, maintenance of equipment, management of materials, maintenance of work camp, treatment of waste and sewage.
Closure	Mine site	Decommissioning and demolition of facilities, recontouring and revegetation, reclamation of TSF.
	Airstrip	Decommissioning and demolition of facilities, recontouring and revegetation.
	Transmission line	Decommissioning and demolition of facilities, recontouring and revegetation.
	Freshwater supply system	Decommissioning and demolition of freshwater supply pipeline and freshwater reservoir, recontouring and revegetation.

Note: FSR = Forest Service Road; TSF = Tailings Storage Facility

Potential Project effects on wetlands will occur primarily during the construction phase for all six Project components, and then only within the mine site during the operations phase, as the Tailings Storage Facility (TSF), open pit, waste rock dumps, and borrow pits are expanded. The potential for effects on wetlands will be relatively minor during the closure phase, as the airstrip and transmission line are decommissioned, and the mine site recontoured and revegetated during reclamation. The mine access road and Kluskus FSR upgrade (<2 km and adjacent to existing disturbance) are proposed permanent features, and potential Project effects associated with these two Project components are not anticipated after the initial construction phase.

Key interactions that have greater potential to result in significant adverse residual effects on wetlands and wetland functions are related to habitat losses during the construction and operations phase (**Table 5.3.7-12**). The linear components will have moderate interactions with wetlands during the operations and closure phases due to transportation and maintenance activities.

The linear components have smaller footprints with effects that are less concentrated, and the application of Best Management Practices (BMPs) such as erosion control along the roads will minimize potential effects on wetlands.

The indicators used to evaluate potential key effects on the Wetlands VC include wetland ecological functions (extent), hydrological functions, biochemical functions, and habitat functions.

Table 5.3.7-12: Project Component Interactions with Wetlands VC

Project Component	Project Phase			
	Construction	Operations	Closure (Decommissioning and Reclamation)	Post-Closure
Mine site	K	K	K	-
Mine access road	K	M	M	
Freshwater supply system	K	M	M	-
Airstrip	K	M	M	-
Transmission line	K	M	M	-
Kluskus FSR	K	M	M	-

Note: FSR = Forest Service Road; K = Key interaction; M = moderate interaction; "-" = negligible or no interaction

5.3.7.3.2 Impact Types

Wetland impacts have been classified into three mutually exclusive impact types: 1) mine- related, 2) temporarily-degraded, and 3) hydrologically-affected. Wetland impacts within the mine footprint will vary temporally among these impact types. Irreversible wetland loss occurring from permanent features and changes to the landscape are identified as mine-related impacts. Temporarily-impacted wetlands within the mine footprint, with functions that can be potentially restored following closure, are identified as temporarily degraded impacts. Changes in groundwater hydrology and surface area drainage beyond the mine footprint are identified as hydrologically-affected wetlands. The quantitative loss of wetland extent correlates directly to the loss of wetland function; however, the different functions provided by different wetland classes are evaluated qualitatively (Hanson et al., 2008).

Mine-related wetland impacts will result from the open pit, TSF, waste rock dumps, low-grade stockpile, topsoil stockpile, plant site, truck stop, construction laydown area, operations and construction camps, and borrow areas. These mine-related features will result in permanent changes to the landscape, including loss of wetland extent.

Temporarily-degraded wetland impacts include areas beyond the mine infrastructure where wetland functions will likely be degraded or reduced from dust deposition, winter road maintenance, noise and light pollution, shading, and habitat fragmentation. AMEC calculated these effects by adding a 50-m buffer to the mine infrastructure to account for reduced wetland functions in wetlands that will be partially impacted. This 50-m buffer is based on current literature that suggests upland buffer size to maintain wetland functions (Hruby, 2013; Environmental Law Institute, 2008). Buffers are typically larger to protect habitat functions (46 m to 92 m), but smaller for biochemistry and hydrologic functions (10 m to 33 m). The 50-m width is therefore considered the average distance of reduced wetland functions overall. Temporarily-degraded impacts with reduced wetland functions include wetlands within the mine footprint not accounted for in the 50-m buffer or the mine infrastructure. Temporarily degraded wetland functions will primarily occur during Project construction, operations, and closure.

Hydrologically-affected wetlands will potentially occur beyond the mine footprint, and occur from watershed alterations that will draw down groundwater, and result in surface area drainage changes. Wetlands outside of the mine footprint may be affected by a reduction or increase in surface water and groundwater inputs that support wetland ecosystems (USEPA, 2003). For example, changes to wetland hydroperiods can result in changes in vegetation structure (habitat functions), flow moderation in streams (hydrologic functions), and organic exports (biochemistry functions). Groundwater drawdown can dewater a wetland resulting in carbon release (Mitsch and Gosselink, 2007). On the contrary, changes in local groundwater recharge from changes to surface water drainage patterns may result in the expansion of existing wetlands or the incidental creation of wetlands. Hydrologically-affected wetlands outside of the mine footprint are predicted to be limited to sub-catchment 616152 in the Davidson Creek watershed, and sub-catchments 505659 and 146920 in the Creek 661 watershed (**Figure 5.3.7-1** and **Figure 5.3.7-7**).

Predicting the direction of hydrological effects for individual wetlands over time is difficult and speculative. This uncertainty is due to the complex interaction of abiotic factors that combine to support each wetland ecosystem, including for example, landscape position, regional and local groundwater levels, soil texture and composition, and watershed size. Hydrologically-affected wetlands were identified in conjunction with effect determinations to fisheries resources (streams) for each sub-catchment using the Project's watershed model that incorporates changes in groundwater and surface water flows. Approximately 61% of surveyed wetlands were classified by HGM unit as linked basins/hollows or fluvial wetlands, which are riparian-associated and function to support instream resources such as fish. If instream fish habitat loss is predicted due to reduced instream flows downstream of the mine as a result of changes in surface water and groundwater flow patterns, then wetlands in the same sub-catchments are assumed to experience reduced surface and groundwater inputs as well depending on landscape position. Hydrological effects were assessed for all four phases of the Project in combination with the footprint analysis.

5.3.7.3.3 Indicator: Ecological Functions

5.3.7.3.3.1 Loss of Wetland Extent and Degraded Functions

5.3.7.3.3.1.1 Mine Site

Within the mine footprint, 309.3 ha of wetlands will be lost due to irreversible, mine-related impacts during Project construction, operations, and closure. An additional 132.6 ha of wetland functions will be degraded during the construction, operations, and closure phases. **Figure 5.3.7-6** shows both the mine-related impacts to wetlands and the wetlands expected to have degraded functions. Estimated reduction of wetland cover in the LSA is 8.4%

(**Table 5.3.7-13**). Of affected wetlands, swamps will comprise 77.6%, bogs 13%, and fens 7.2%, approximately 97.8% of the mine-related impacts to wetlands (**Table 5.3.7-14**).

Table 5.3.7-13: Wetland Impacts Related to Mine Footprint by Class

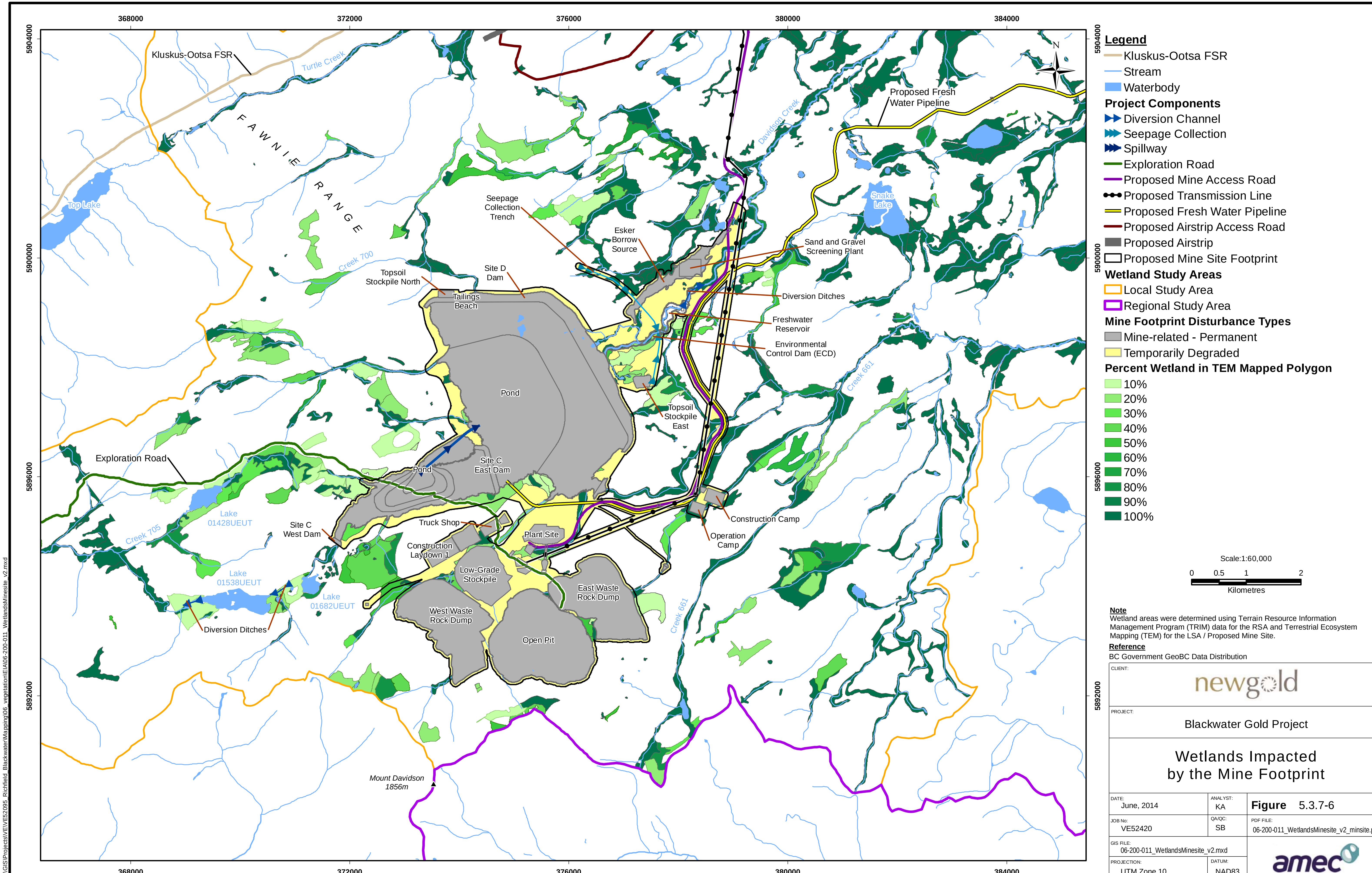
Wetland Class	Mine Site and LSA (ha)	Mine Footprint Impacted Wetlands (ha)	
	Existing Wetlands (% of Total Wetland Cover)	Mine-Related (% Change)	Temporarily Degraded
Bog	1,049.19 (28.38%)	40.075 (-3.8%)	25.465
Fen	652.00 (17.64%)	22.422 (-3.4%)	8.606
Marsh	53.29 (1.44%)	1.912 (-3.6%)	0.710
Swamp	1,873.79 (50.69%)	239.893 (-12.8%)	93.643
Shallow-water/pond	68.52 (1.85%)	4.989 (-7.3%)	4.176
Total	**3,696.83 (100%)**	**309.291 (-8.37%)**	**132.600**

Note: ha = hectare; LSA = Local Study Area

Table 5.3.7-14: Percentage of Wetland Impacts Related to Mine Footprint by Class

Wetland Class	Mine-Related Impacted Wetlands (ha)	
	Extent (ha)	% of all Mine-Related Impacts
Bog	40.075	13.0%
Fen	22.422	7.2%
Marsh	1.912	0.6%
Swamp	239.893	77.6%
Shallow-water	4.021	1.3%
Pond	0.968	0.3%
Total	**309.291**	**100.0%**

Note: ha = hectare



368000
372000
376000
380000
384000
5904000
5900000
5896000
5892000
Kluskus-Ootsa FSR
Turtle Creek
FAWNIE RANGE
Top Lake
Creek 700
Davidson Creek
Proposed Fresh Water Pipeline
Snake Lake
Seepage Collection Trench
Esker Borrow Source
Sand and Gravel Screening Plant
Topsoil Stockpile North
Site D Dam
Tailings Beach
Diversion Ditches
Freshwater Reservoir
Environmental Control Dam (ECD)
Creek 661
Pond
Topsoil Stockpile East
Exploration Road
Pond
Site C East Dam
Lake 01428UEUT
Creek 705
Site C West Dam
Truck Shop
Construction Laydown 1
Plant Site
Construction Camp
Operation Camp
Lake 01538UEUT
Lake 01682UEUT
Low-Grade Stockpile
East Waste Rock Dump
West Waste Rock Dump
Open Pit
Diversion Ditches
Creek 661
Mount Davidson 1856m
N
Legend
Kluskus-Ootsa FSR
Stream
Waterbody
Project Components
Diversion Channel
Seepage Collection
Spillway
Exploration Road
Proposed Mine Access Road
Proposed Transmission Line
Proposed Fresh Water Pipeline
Proposed Airstrip Access Road
Proposed Airstrip
Proposed Mine Site Footprint
Wetland Study Areas
Local Study Area
Regional Study Area
Mine Footprint Disturbance Types
Mine-related - Permanent
Temporarily Degraded
Percent Wetland in TEM Mapped Polygon
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Scale:1:60,000
0 0.5 1 2
Kilometres
Note
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.
Reference
BC Government GeoBC Data Distribution
CLIENT:
newgold
PROJECT:
Blackwater Gold Project
Wetlands Impacted by the Mine Footprint
DATE: June, 2014
ANALYST: KA
Figure 5.3.7-6
JOB No: VE52420
QA/QC: SB
PDF FILE: 06-200-011_WetlandsMinesite_v2_minsite.pdf
GIS FILE: 06-200-011_WetlandsMinesite_v2.mxd
PROJECTION: UTM Zone 10
DATUM: NAD83
amec
Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\06_vegetation\EIA\06-200-011_WetlandsMinesite_v2.mxd

5.3.7.3.3.1.2 Linear Project Components

The linear Project components have the potential to cause wetland losses and degraded wetland functions during Project construction, operations, and closure. The airstrip and access road, Kluskus FSR upgrade, mine access road, and freshwater supply pipeline are anticipated to result in the loss of 6.1 ha of wetland extent during the construction, operations, closure, and post-closure phases. The Kluskus FSR upgrade is not anticipated to result in the loss of wetland extent. The transmission line is not anticipated to result in a loss of wetland extent due to avoidance and mitigation measures; however, potentially 49.1 ha of wetland habitat change will result from installation and maintenance of the overhead power lines, as forested wetlands will be converted to shrub or emergent wetland habitat (**Table 5.3.7-15**). Estimated widths of disturbance for each linear component used for the impacts analysis are provided in **Table 5.3.7-15**.

Table 5.3.7-15: Linear Component Impacts to Wetlands by Wetland Class

	Airstrip Access Road	**Airstrip Footprint**	**Kluskus FSR Upgrade**	**Mine Access Road**	**TL Tatelkuz Lake Ranch Reroute**	**TL Stellako R. Reroute**	**Transmission Line**	**Freshwater Supply pipeline**
Disturbance Width (m)	10	200	10	20	40	40	40	20
Disturbance Length (km)	5.5	2	1.7	15	15.2	8	140	20
Wetland Class								
Bog	-	1.1	-	-	3.8	-	7.2	0.5
Fen	-	-	-	-	2.5	-	2.8	0.2
Marsh	-	-	-	-	0.1	-	0.7	-
Swamp	0.3	0.8	-	1.4	1.4	1.7	28.6	1.8
Shallow-water	-	-	-	-	-	-	0.1	-
Pond	-	-	-	-	-	-	0.3	-
Total Wetland Impacts (ha)	**0.3**	**1.9**	**0**	**1.4**	**7.8**	**1.7**	**39.7**	**2.5**

Note: FSR = Forest Service Road; ha = hectare; km = kilometre; m = metre; TL = Transmission Line

5.3.7.3.3.2 Potential Hydrological Effects on Wetlands Outside of Mine Footprint per Watershed Catchment

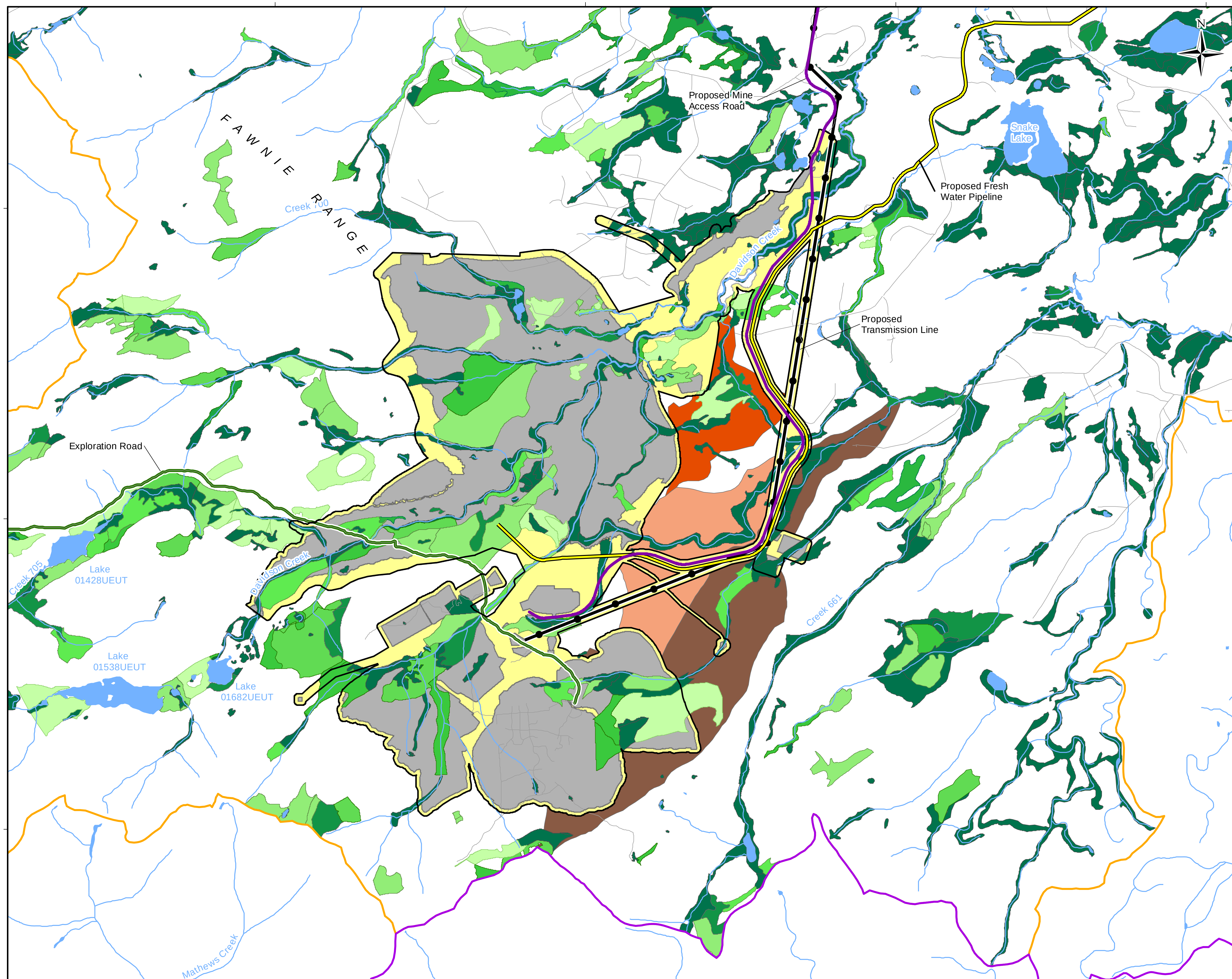
5.3.7.3.3.2.1 Mine Site

Existing hydrological conditions in the LSA will be altered as a result of mine development. According to the watershed model and the surface water flow analysis (**Section 5.3.2**, Surface Water Flow), changes to groundwater flow patterns and surface area drainages are expected to affect stream flows in Davidson Creek, Creek 661, Creek 705, and Chedakuz Creek to varying degrees during the Project phases. No hydrological effects are predicted in Turtle Creek. Surface and groundwater hydrology inputs are essential components of wetland ecosystems. Understanding wetland classes and predicted changes to groundwater flows and surface drainage areas in these watersheds during the Project's four phases is important in assessing potential effects on wetlands beyond the mine footprint. These hydrological effects to wetlands are based on the assumptions inherent in the surface water flow analysis that were made to create the watershed model to predict surface flows at various stages of the Project.

The majority of wetlands in the LSA include swamps (51%), bogs (28%), and fens (18%) (**Table 5.3.7-13**). Swamp and bog wetlands typically receive hydrological inputs primarily from surrounding uplands via surface runoff (melt and precipitation), overbank flooding from adjacent streams, and direct stream inflows. Bog wetlands generally rely solely on precipitation and surface runoff. Fens, on the other hand, are primarily groundwater fed (MacKenzie and Moran, 2004). Changes to surface drainage areas and groundwater levels resulting from the Project, therefore, have potential to alter wetland hydrology and overall wetland functions beyond the Project footprint.

Existing hydrology in the Davidson Creek watershed will be substantially impacted by mine development. Most of the mine facilities will be located in the Davidson Creek watershed, including the TSF, west and east waste rock dumps, open pit, low-grade stockpile, plant site, topsoil stockpile, borrow sources, construction laydown, and truck stop. The Site C and Site D Dams will be constructed across Davidson Creek to create the TSF ponds. Several surface water management features, such as sediment control ponds and ditches to divert runoff to the TSF, will alter surface and groundwater flow patterns during all four phases of the Project. The TSF and open pit lake will be permanent features on the landscape at post-closure, and the other areas will be reclaimed and revegetated with native species following decommissioning.

The surface water flow analysis (**Section 5.3.2**, Surface Water Flow) indicates that during operations and at closure, average annual downstream flows in Davidson Creek will be reduced by approximately 75% from baseline conditions; stream augmentation will restore natural flows. This decrease does not include inputs from the freshwater supply mitigation system that will provide water to Davidson Creek below the environmental control dam (ECD) during operations and closure phases. During post-closure, estimated average annual stream flows in Davidson Creek will be reduced by 10%. Loss of wetland functions is anticipated downstream of the mine site in Davidson Creek due to the loss of wetland extent from mine construction and the TSF. The majority of these potential hydrological effects are captured already in the mine footprint that extends approximately 2 km downstream from the ECD. However, an additional 27.5 ha of wetlands will be hydrologically-affected in the Davidson Creek sub-catchment 616152 below the Site D Dam that abuts the mine footprint (**Figure 5.3.7-7**).



Legend

- Existing Road
- Stream
- Waterbody

Project Components

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

Hydrologically Affected Subcatchments Beyond Mine Footprint

- 505659
- 146920
- 616152

Mine Footprint Disturbance Types

- Mine-related - Permanent
- Temporarily Degraded

Wetland Study Areas

- Regional Study Area
- Local Study Area

Percent Wetland in TEM Mapped Polygon

- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

0 0.5 1 2
Kilometres
Scale:1:50,000

Note
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Potentially Hydrologically Affected Wetlands Beyond the Mine Footprint

DATE: June, 2014	ANALYST: KA	**Figure** 5-3-7-7
JOB No: VE52420	QA/QC: MY	PDF FILE: 06-200-012_PotHydroWetlands_v3.pdf
GIS FILE: 06-200-012_PotHydroWetlands_v3.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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The mine footprint also overlaps with Creek 661 sub-catchments 505659 and 146920. These sub-catchments were modelled together in the overall watershed model for the Project, identified as sub-catchment 505659. The watershed model predicted reduced stream flows at the downstream confluence of these two sub-catchments before reaching Creek 661. Annual stream flows are predicted to be reduced by 28% to 48% during operations and closure, and 47% at post-closure.

Reduced stream flows in sub-catchments 505659 and 146920 are predicted due to construction of the open pit, the diversion channel below the east waste rock dump, the TSF, and the tailings spillway channel. The open pit will serve as a temporary groundwater sink, resulting in decreased streamflows in Creek 661 during operations and closure. The diversion channel, TSF, and open pit will reduce surface drainage area in sub-catchments 505659 and 146920 during operations and closure because surface waters will be re-directed to Davidson Creek after being re-routed to the TSF for water quality control. However, should this diversion water meet water quality guidelines it will be allowed to flow down existing natural channels. Stream flows in sub-catchment 505659 will be reduced at post-closure due to the loss of contributing area associated with the tailings spillway channel that will re-direct surface flows to Davidson Creek and groundwater drawdown.

This reduction in surface drainage area and lower groundwater levels will potentially reduce wetland extent and functions in 62.4 ha of wetlands in sub-catchments 505659 and 146920 (26.7 ha and 35.7 ha, respectively) (**Table 5.3.7-16**). These effects correlate with a 47% reduction in stream flows from baseline conditions at post-closure (**Section 5.3.2**, Surface Water Flow). Instream fish habitat is also anticipated to be reduced in these sub-catchments (**Section 5.3.9**, Fish Habitat). Changes to Creek 661 stream flows downstream of this confluence are expected to be minor during operations and closure (8 to 13% reduction from baseline), and post-closure (13% reduction from baseline), and loss of fish habitat, wetland functions, or wetland extent is not expected.

Table 5.3.7-16: Potential Hydrological Impacts to Existing Wetlands beyond the Mine Footprint by Sub-Catchment

Wetland Class	Creek 661 Sub-Catchments		Davidson Creek Sub-Catchment	Total (ha)
	146920	**505659**	**616152**	
Bog	11.1	4.1	7.0	22.2
Fen	1.9	1.2	0.9	4.0
Marsh	-	-	0.0	0.0
Swamp	22.5	20.9	19.5	62.9
Shallow water	0.2	0.5	0.1	0.8
Total (ha)	**35.7**	**26.7**	**27.5**	**89.9**

Note: ha = hectare

Creek 705 is expected to have increased stream flows as a result of mine development. This increase is attributed to additional surface water and groundwater flows from the Davidson Creek watershed resulting from the construction of the coffer dam (Dam C). The coffer dam will effectively reverse surface flow from the headwaters of Davidson Creek to Creek 705 after Lake 01682LNRS is expanded to its full capacity during construction. The increased surface drainage area is expected to increase the volume of the freshet during spring melt, which could result in increased erosion and scour along Creek 705 downstream of Lake 01682LNRS. However, a water-control structure downstream may be built if necessary to control outflow during the freshet and reduce the potential for scour, erosion, and sedimentation in Creek 705 downstream. The 705 Creek watershed is not included in **Table 5.3.7-16** because wetland extent is expected to increase.

Stream flows in Turtle Creek are predicted to remain unchanged during Project construction, operations, closure, and post-closure, and no hydrological effects on wetlands are anticipated in this watershed.

The freshwater supply system is expected to minimally reduce seasonal water levels in Tatelkuz Lake and average annual streamflows in Chedakuz Creek downstream of Tatelkuz Lake. Annual average monthly water levels are estimated to be reduced by 4 cm to 5 cm during operations and closure, and 0.1 cm at post-closure (**Section 5.3.2**, Surface Water Flow). Tatelkuz Lake is a long (~9 km), narrow (<1 km), steep-sided lake typical of valley lakes found in the BC interior plateau. The littoral zone (<4 m deep) represents approximately 9% (82 ha) of the total Tatelkuz Lake surface area (approximately 910 ha). The long eastern and western shorelines comprise large substrates (i.e., cobbles and boulders) with no vegetation, whereas the northwest and southeast shorelines have sand/silt/gravel beaches with intermittent areas of emergent and/or submergent vegetation. Areas with emergent or submergent vegetation, qualifying as wetland habitat, occupy 10% (8.2 ha) of the total littoral area. Common emergent vegetation include pondweed (*Potomogeton* sp.) and floating burr-weed (*Sparganium* sp.), and submergent vegetation include water-weed (*Elodea* sp.) (**Section 5.1.2.6**, Fish and Fish Habitat Baseline Summary). A loss of wetland extent or functions in Tatelkuz Lake is not anticipated from the 4 cm to 5 cm change in annual average monthly water levels, as these changes are within the natural range of variation. The fen wetland located at the mouth of Tatelkuz Lake is not anticipated to have permanent effects, as flows in lower Chedakuz Creek are estimated to be reduced by only 1% from baseline conditions at post-closure after the freshwater supply system is decommissioned (**Section 5.3.2**, Surface Water Flow).

5.3.7.3.3.2.2 Linear Components

Potential Project effects on wetlands from altered surface water and groundwater flow patterns are expected to be associated with the mine site in the LSA. Potential wetland effects from altered surface water and groundwater flow patterns in the linear corridors are not expected due to implementation of construction BMPs intended to maintain existing wetland hydrological conditions and flow patterns.

5.3.7.3.4 Indicator: Hydrological Functions

5.3.7.3.4.1 Mine Site

Wetland hydrological functions will be reduced during Project construction, operations, and closure. Approximately 77.6% (239.9 ha) of all mine-related wetland impacts will occur on swamps, which provide a high level of hydrological functions in the LSA. Riparian swamps generally function well for water flow control and erosion protection. Linked basins / hollows and fluvial HGM class swamps are common in the mine footprint and function to slow runoff and store water for extended periods because the swamps receive overbank flooding during high flow events, and generally have inflowing or outflowing hydrological connections. Similar hydrological functions will be provided by the TSF and the controlled outflow in the Davidson Creek watershed following operations and closure.

Additionally, the extent of overflow or linked headwater wetlands will be reduced in the headwaters of Davidson Creek and Creek 661. Headwater wetlands are associated with intermittent and perennial streams at the higher reaches of the watershed, and act to intercept and modify runoff and shallow groundwater entering streams and rivers. Headwater wetlands are important for water flow supply to lower reaches of the watershed.

Approximately 20.2% (62.5 ha) of mine-related wetland impacts are to bogs and fens. Bogs are isolated from streams, and provide minimal hydrological functions since bogs frequently occur in closed basins and are supported mainly by precipitation. However, impacted bogs are frequently in wetland complexes with fens and likely moderate surface flows during freshet and storm events.

5.3.7.3.4.2 Linear Components

Construction in the linear corridors will result in the loss of 6.1 ha of predominantly swamp and bog wetlands as shown in **Table 5.3.7-15**, and the wetland hydrological functions provided by these two wetland classes.

5.3.7.3.5 Indicator: Biochemical Functions

5.3.7.3.5.1 Mine Site

Wetland biochemical functions will be reduced during construction, operations, and closure phases of the Project. Wetlands impacted by the mine infrastructure provide a high level of biochemical functions in regards to nutrient export, water quality treatment, and carbon sequestration and storage. Swamp wetlands (77.6%, 239.9 ha) located in riparian corridors are often hydrologically connected to surface waters that support rainbow trout and kokanee habitat lower in the Davidson Creek and Creek 661 watersheds. Seasonally fluctuating water tables in swamps enable frequent interactions between water and root-bacteria assemblages that provides the opportunity for biogeochemical cycling and water quality maintenance.

Mine-related impacts to bogs (13%, 40.1 ha) will also result in reduced carbon sequestration and storage due to the loss of wetland cover. Bogs accumulate peat and woody biomass over time, and disturbances and dewatering can potentially cause a release of carbon from the moderately decomposed sphagnum peat and buried wood (Hanson et al., 2008).

5.3.7.3.5.2 Linear Project Components

Construction in the linear corridors will result in the loss of 6.1 ha of predominantly swamp and bog wetlands as shown in **Table 5.3.7-15**, and the wetland biochemical functions provided by these two wetland classes.

5.3.7.3.6 Indicator: Habitat Functions

The loss of wetland extent during Project construction, operations, and closure will result in the loss of wetland habitat for 132 potentially occurring wildlife species in the LSA and RSA that depend on wetlands for a portion of their life cycle. High-functioning, Blue-listed wetlands will be impacted by mine infrastructure, and migratory water bird habitat will be reduced. Approximately 90.6% (280 ha) of mine-related wetland impacts are on swamps and bogs (77.6% and 13%, respectively), which are predominantly classified as black spruce-dominated forested wetlands. Bogs, fens, and marshes potentially provide a high level of habitat functions, and account for 20.8% (64.4 ha) of all mine-related impacts. Bogs, fens, and marshes account for 1.8 ha of the 6 ha of wetland impacts in the linear corridors. Wetland habitat functions will also be degraded in an additional 132.6 ha of wetlands during Project construction, operations, and closure.

5.3.7.3.6.1 Ecosystems at Risk

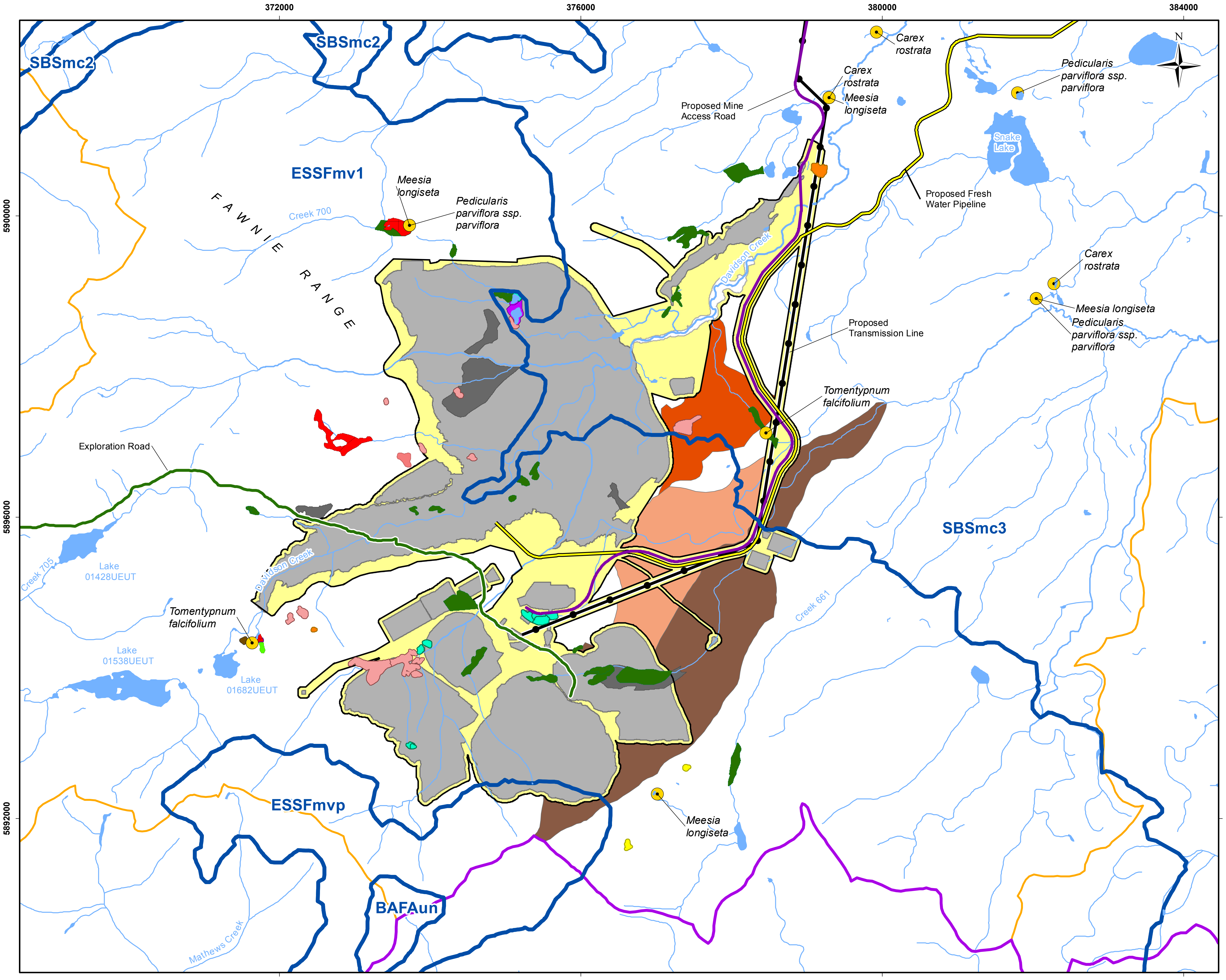
5.3.7.3.6.1.1 Mine Site

Of the total 309.3 ha of mine-related impacts, 24.2 ha are Blue-listed wetland ecosystems at risk (**Figure 5.3.7-8**). Wetland habitat functions in an additional 5.9 ha of Blue-listed wetlands will be degraded from habitat fragmentation, noise and light pollution, dust deposition, and shading, during Project construction, operations, and closure (**Table 5.3.7-17**). Blue-listed wetlands occur as black spruce bogs, and shrub or emergent fens.

Table 5.3.7-17: Mine-Related and Natural Impacts to Blue-Listed Wetlands

Wetland Class	Mine Related Impacts (ha)	Natural (degraded) Impacts (ha)
Bog	9.5	1.7
Fen	14.7	4.2
Total	24.2	5.9

Note: ha = hectare



Legend

- Blue Listed Plant Population
- Stream
- Waterbody

Project Components

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

Biogeoclimatic Zones

- BAFAun
- ESSFmv1
- ESSFmvp
- SBSmc2
- SBSmc3

Hydrologically Affected Subcatchments Beyond Mine Footprint

- 505659
- 146920
- 616152

Mine Footprint Disturbance Types

- Mine-related - Permanent
- Temporarily Degraded

Wetland Information

- Blue Listed Wetlands < 20%

Red Listed Wetlands

- Wf10 - Hudson Bay clubrush - Red hook-moss

Blue Listed Wetlands

- Wb09 - Black spruce – Common horsetail – Peat-moss
- Wb11 - Black spruce – Buckbean – Peat-moss
- Wf13 - Narrow-leaved cotton-grass – Shore sedge
- Wb10 - Pine – Few-flowered sedge - Peat-moss Bog
- Wf02 - Scrub birch - Water sedge Fen
- Wf08 - Shore sedge - Buckbean - Hook-moss Fen
- Wf11 - Tufted clubrush - Star-moss Fen
- Wb13 - Shore sedge - Buckbean - Peatmoss

Wetland Study Areas

- Regional Study Area
- Local Study Area

0 0.5 1 2
Kilometres
Scale:1:50,000

Note
Blue and Red listed wetlands are only displayed where they occupy 20% or more of the TEM Mapped polygon.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold			
PROJECT: Blackwater Gold Project			
Potential Impacts to Verified Ecosystems at Risk			
DATE: June, 2014	ANALYST: KA	Figure 5-3-7-8	
JOB No: VE52420	QA/QC: MY	PDF FILE: 06-200-013_PotImpVerifEAR_v4.pdf	
GIS FILE: 06-200-013_PotImpVerifEAR_v4.mxd			
PROJECTION: UTM Zone 10	DATUM: NAD83	amec	

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Hydrological effects on 0.5 ha of Blue-listed wetlands beyond the mine footprint in the LSA could potentially occur during Project construction, operations, closure, and post-closure. Blue-listed fen wetlands (Wf02) occur in sub-catchment 146920 of Creek 661 (0.2 ha) and sub-catchment 616152 of Davidson Creek (0.3 ha) (**Table 5.3.7-18**). These wetlands occur at the base of the Site D Dam (0.3 ha), and the base of the east waste rock dump (0.2 ha) (**Figure 5.3.7-8**).

Table 5.3.7-18: Potential Hydrological Impacts to Verified Ecosystems at Risk

Wetland Class	Creek 661		Davidson Creek	
Sub-catchment	146920	505659	616152	**Total**
Blue-Listed fen Wf02	0.2	-	0.3	**0.5**

5.3.7.3.6.1.2 Linear Project Components

An additional 1.2 ha of Blue-listed wetlands intersect with the transmission line (**Table 5.3.7-19**). Direct Project effects on these wetlands can potentially be minimized through mitigation measures (pre-construction planning), such as avoiding wetlands altogether and locating support poles in uplands. No loss of wetland extent is expected, but vegetation clearing would be necessary for 0.9 ha of black spruce bog wetlands, which would likely convert these wetlands to shrub habitat. The remaining 0.3 ha of Blue-listed wetland habitat, which is existing shrub and emergent habitat, is not expected to be adversely affected.

Table 5.3.7-19: Impacts on Blue-Listed Wetlands Linear Project Components

Wetland Class	Airstrip Access Road	Airstrip Footprint	Kluskus FSR Upgrade	Mine Access Road	TL Tatelkuz Lake Ranch Reroute	TL Stellako R. Reroute	Transmission Line	Water pipeline
Blue-Listed Wetlands (ha)	–	–	–	–	0.3	–	0.9	–

Note: FSR = Forest Service Road; ha = hectare; TL = transmission line
Blue-listed wetlands occur as shrub and emergent fens (0.3 ha–Wf02, Wf08), and spruce bogs (0.9 ha–Wb01)

5.3.7.3.6.2 Wildlife and Plant Species at Risk

During the Project construction, operations, closure, and post-closure, neither the mine site nor the linear components are expected to affect the four confirmed Blue-listed plant populations in the LSA. Hydroperiods and water quality are expected to be maintained in the wetlands where the Blue-listed plant populations occur. The four plant species are located in wetlands that are at higher elevations than nearby proposed infrastructure; local groundwater recharge, precipitation, and snowmelt are expected to maintain these wetland habitats for these species. Plant Species and Ecosystems at Risk (**Section 5.4.6**) assess habitat suitability for potentially occurring at-risk plant species.

In regards to Project effects on wetland habitat for wildlife species at risk, the loss of 309.3 ha of wetland habitat will reduce the amount of potential habitat for the *SARA*-listed western toad, olive-sided flycatcher, rusty blackbird, and caribou, and Blue-listed Jutta arctic butterfly and Hagen's bluet damselfly. However, the quality of impacted wetland habitat for the western toad and Jutta Arctic butterfly species is generally low because the Project's high elevation is considered unsuitable breeding habitat for these species. Foraging opportunities for the provincially-listed grizzly bear, eastern red bat, little brown mytois, and northern mytois would also be reduced due to the loss of wetland habitat.

5.3.7.3.6.3 Migratory Birds and Water Birds

5.3.7.3.6.3.1 Mine Site

The loss of approximately 1.9 ha of marsh habitat, 4 ha of shallow water habitat, and 1 ha of pond habitat is expected from mine-related impacts during Project construction, operations, and closure. The 21 water birds detected in the LSA potentially use these wetland habitats.

The Project is located in the Northern Rockies Bird Conservation Region 10, and seven priority species in the Bird Conservation Strategy for Bird Conservation Region 10 (EC, 2013) could potentially use marsh wetland habitat in the LSA. Approximately 39.4 ha of marsh wetlands were identified in the LSA, and 1.9 ha will be affected by mine-related impacts. An additional 0.7 ha of wetland marsh habitat will be degraded due to dust deposition, light pollution, and noise pollution. Marsh habitat down-gradient of the mine infrastructure is not expected to be hydrologically altered (**Table 5.3.7-16**).

5.3.7.3.6.3.2 Linear Project Components

The airstrip and access road, Kluskus FSR, mine access road, and freshwater supply pipeline are not expected to directly impact wetland marsh, shallow water, or pond habitats. The transmission line, including re-routes, is expected to cross 1.2 ha of these habitats (**Table 5.3.7-15**). However, no loss or change of these habitats are expected, since these are not forested habitats that would otherwise require vegetation clearing and maintenance during construction. Footings for the power pole structures will be placed outside of these wetland habitats to the maximum extent practicable.

5.3.7.3.7 Mitigation Measures for Potential Adverse Residual Effects on Wetland Extent and Function

Potential adverse residual effects on wetlands include loss extent and wetland functions, and degraded wetland ecological, hydrological, biochemical, and habitat functions. The loss of wetland extent and function was determined where the Project footprint overlays baseline wetland mapping in the mine site and linear corridors. Within the mine footprint, mine-related infrastructure will result in irreversible effects on wetland hydrological, biochemical, and habitat functions resulting from wetland loss. Wetland functions will be temporarily degraded in the remaining wetlands within the mine footprint due to habitat fragmentation, noise and light pollution, shading, dust deposition, and winter road maintenance. Other wetlands outside of the mine footprint will be hydrologically affected, which could also result in loss of wetland functions and extent.

The *CEA Act* (Government of Canada, 2012) defines mitigation as the "practical means of preventing or reducing to an acceptable level any potential adverse effects of the Project." Mitigation measures for the Project comprise actions that eliminate, reduce, or control the adverse environmental effects of a project, and include actions taken to replace, restore, or compensate for any adverse effects. This process is typically summarized as the mitigation hierarchy, which entails four steps with the intention of identifying opportunities to avoid, minimize, restore on-site, and compensate for or offset potential adverse environmental impacts (BC MOE, 2012).

The most direct method to mitigate loss of wetland functions is avoiding and minimizing the loss of wetland extent within the mine site and linear components, and restoring or creating wetlands on site. Other mitigation measures applicable to wetland extent and functions are embedded within the Project design, such as seepage collection trenches and the freshwater supply system for Davidson Creek. Additional mitigation measures are proposed to reduce potential residual effects on wetland functions during Project construction, operations, and closure, such as BMPs described in the Wetlands Management Plan (WMP) (**Section 12.2.1.18.4.3**). Non-embedded mitigation measures have been identified using *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia* (Cox and Cullington, 2009), and *Forested Wetlands–Functions, Benefits, and the Use of Best Management Practices* (Welsch et al., 1995).

The proposed mitigation measures to the Wetlands VC are in support of compliance with the *Federal Policy on Wetland Conservation* (Government of Canada, 1991), the *Canada Wildlife Act* (Government of Canada, 1985), the *Migratory Birds Convention Act* (Government of Canada, 1994), the British Columbia *Policy for Mitigating Impacts on Environmental Values: Final Working Draft* (BC MOE, 2012), and the *Water Act* (Government of BC, 1996).

5.3.7.3.7.1 Avoidance

Avoidance measures occur in site design and planning. Wetland effects have been avoided by massing and clustering the Project facilities and infrastructure, which also reduces habitat fragmentation in the landscape. Multiple site layouts have been considered, and alternative site designs are described in detail in **Section 2.5** (Alternative Means of Undertaking the Proposed Project).

Additional opportunities to avoid impacts to individual wetlands within the mine footprint are limited to relocating other facilities not as constrained by mine engineering and operations. These facilities include the construction and operation camps, construction laydown area, truck stop, and possibly the plant site. If possible, these facilities could be re-located or re-designed to avoid wetlands and the loss of wetland functions during the permitting process.

With regards to the linear Project components, wetlands will be avoided to the maximum extent possible during the planning process by siting the individual components outside of wetlands within the surveyed corridors. For example, the 20-m wide ROW for the mine access road can avoid wetlands within the 120-m wide surveyed corridor. Footings for the transmission line support poles and associated access roads will be located outside of wetlands except where the wetland is already crossed by an existing feature, such as when the transmission line alignment follows an existing road that already crosses a wetland. Pre-construction planning will identify opportunities to avoid wetlands and the loss of wetland functions.

In regards to planning the transmission line route, a single population of swollen-beaked sedge was identified in the initial transmission line corridor. However, the swollen-beaked sedge population is not found within the proposed Tatelkuz Lake Ranch Re-route corridor.

The Kluskus FSR upgrades include road widening and re-alignment for 1.7 km. Portions of the existing road will be removed and straightened to improve safety along this transportation corridor. No Project effects on mapped wetlands are expected. Additional information regarding federal and provincial legislation and proposed road construction BMPs for aquatic resources is provided in the Aquatic Resources Environmental Management Plan (ARMP) (**Section 12.2.1.18.4.2**) and the WMP (**Section 12.2.1.18.4.3**).

5.3.7.3.7.2 Minimization

Project effects on wetlands and wetland functions will be minimized through implementation of the WMP, embedded Project design features, and on-site habitat creation.

5.3.7.3.7.2.1 Wetlands Management Plan for Construction, Operations, and Closure

The goal of the WMP (**Section 12.2.1.18.4.3**) is to minimize and prevent potential effects on wetland functions during Project construction, operations, and decommissioning and closure. Approximately 139 ha of wetlands will have temporarily degraded functions during construction, operations, and closure. Soil disturbances, vegetation clearing, grading, and facility installation activities associated with construction can reduce a wetland's ability to provide biochemical functions, habitat functions, and hydrological functions. The WMP provides information on wetland monitoring, establishing wetland buffers, and following standard BMPs that protect wetland functions.

To limit disturbance where possible during construction, a 30-m vegetated buffer will be preserved around mapped wetlands in the mine site that would not be directly impacted by mine site infrastructure. On a case-by-case basis, as necessary, light activities with temporary impacts will be allowed on the wetland buffer zone—such as temporary access routes, invasive plant species management, sediment and erosion controls, and targeted vegetation clearing. Wherever possible, no additional permanent features will be allowed within the 30-m wetland buffer zones, including buildings or main roads that may be identified as necessary during the operations phase.

It is not the WMP's intention, nor would it be compatible with mine operations, to manage wildlife in the mine site wetlands that have been avoided by the mine site footprint. The main purpose for wetland buffers is sediment removal to protect wetland biochemical and hydrological functions. Metals and nutrients attach to sediments entrained in surface flows. The vegetated buffer functions to slow the velocity of surface flows, which minimizes downstream transport by allowing suspended solids to settle on the land surface, to filter through the soil (Environmental Law Institute, 2008). The efficiency of buffers to remove sediment effectively from the surface flows also decreases as slope increases. Buffers with steep slopes may require greater widths to achieve the same level of functioning as buffers with a lower gradient.

Hruby (2013) and the Environmental Law Institute (2008) suggest wetland buffer widths of 9.1 m to 30 m for sediment removal, depending on the slope of the buffer. Because the mine site has relatively steep terrain, 30-m wetland buffers are proposed. This 30-m buffer is also commensurate with the suggested 30-m riparian vegetation protection zones around streams in the mine site.

The WMP also includes a wetland monitoring program to identify potential negative effects on wetlands from site construction and operations, and to systematically address changes in wetland conditions that may trigger the need for mitigating actions to prevent unforeseen negative effects. A separate wetland monitoring program associated with wetland creation during the reclamation and closure phase will be implemented according to the Wetland Compensation Plan (**Appendix 5.3.7A**). The goal of the monitoring program under the WMP will be to measure potential changes in existing wetlands in terms of hydrological, habitat, and biochemical functions over the life of the mine.

To meet provincial and federal regulatory requirements for wildlife, vegetation, and aquatic resources relating to the conservation of species and ecosystems at risk, the WMP will be implemented along with the 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**), Wildlife Management Plan (WLMP) (**Section 12.2.1.18.4.6**), Sediment and Erosion Control Plan (SECP) (**Section 12.2.1.18.4.1**), Reclamation and Closure Plan (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 all of these management plans, including the wetland specific BMPs, will protect and minimize the potential degradation of wetland biochemical, hydrological, and habitat functions in the wetlands not directly affected by the Project.

5.3.7.3.7.2.2 Project Design Features

Potential wetland impacts would be minimized through several Project design features. During operations, these mitigating design features include the freshwater supply system, seepage collection trenches, the TSF, and wetland creation around the TSF (Pond 1). During closure and reclamation, wetlands will be created around the TSF (Pond 2) and in the converted freshwater reservoir (**Section 2.6**, Reclamation and Closure).

The freshwater supply system will minimize impacts to riparian swamp wetlands within Davidson Creek by maintaining surface flows in the stream. Without the freshwater supply system, average annual streamflows are predicted to decrease by 75% downstream of the mine site during construction, operations, and closure (**Section 5.3.2**, Surface Water Flow). With the freshwater supply system, average annual streamflows are expected to decrease by approximately 21% to 26% during operations and closure. At post-closure, average annual stream flows in Davidson

Creek are expected to be reduced by 10%. The freshwater supply system therefore minimizes impacts to wetlands and associated functions in Davidson Creek, and protects the opportunity these riparian swamp wetlands will have to support instream fish resources during mine construction, operations, and closure.

Impacts to wetland biochemical functions will be minimized through surface water management and seepage collection that will minimize potential effects on groundwater and surface water quality entering wetlands. The seepage collection trenches and the ECD will collect seepage water from the TSF dam, which will prevent seepage from potentially effecting downstream wetland resources. The collected water will then be pumped back to the TSF for treatment. In addition, a 2 ha treatment wetland is proposed as contingency downstream of the ECD to treat any seepage that will potentially bypass the ECD.

5.3.7.3.7.2.3 Wetland Creation on Site

Wetland habitat creation during operations and closure phases will minimize the potential residual Project effects of lost (309 ha) wetland extent and functions. The following wetland habitat creation actions are proposed for the progressive reclamation plan:

- 63 ha of swamp and marsh wetland habitat will be created around Pond 1 of the TSF at Year 4 of the operations phase;
- 231 ha of swamp and marsh wetland habitat will be created around Pond 2 of the TSF at post-closure (Year 35);
- 11 ha of riparian swamp wetland habitat will be restored by converting the freshwater reservoir to wetlands at post-closure (Year 35); and
- 2 ha of riparian swamp wetland will be created as contingency for water quality treatment if necessary.

The proposed 305 ha of swamp and marsh wetland creation by post-closure (Year 32) will minimize the loss of wetland extent that will result from construction of the mine infrastructure and facilities (**Table 5.3.7-20**). The creation of 63 ha of wetlands around Pond 1 at Year 4 will reduce the overall temporal loss of wetland functions within the mine site. The permanent mine-related impacts will be mitigated by creating swamp and marsh wetlands. The functions provided by the created wetlands are intended to provide similar functions as the wetlands that will be removed. Additional information regarding wetland creation on site is provided in the Reclamation and Closure Plan (**Section 2.6**) and the Wetlands Compensation Plan (**Appendix 5.3.7A**).

The 305 ha of swamp and marsh wetlands to be created during operations and closure will provide ecological, biochemical, hydrological, and habitat functions. The water quality of the TSF discharge is expected to meet the BC protection of freshwater aquatic life guidelines, or site specific water quality objectives where backgrounds naturally exceed guidelines, and the wetlands that will be created around the open water in the TSF are not expected to pose a health risk to wildlife during post-closure.

Table 5.3.7-20: Total Wetland Extent Following Wetland Creation on Site

Year	Lost Wetland Extent (ha)	Proposed Wetland Creation on Site (ha)	Wetland Class	Plan	Total Wetland Extent Per Year On Site (ha)
1	-309		Swamp, bog, fen, marsh	Mine Site	-309
4		+63	Swamp, marsh	R & C Plan–Pond 1	-246
35		+231	Swamp, marsh	R & C Plan–Pond 2	-15
35		+11	Riparian swamp	R & C Plan– Freshwater Reservoir Conversion	-4
35		(+2)	Riparian swamp	R & C Plan (contingency)	(-2)
35	**-309**	**+305 (307)**			**-4 (-2)**

Note: R&C Plan = Reclamation and Closure Plan; ha = hectare; () = if necessary as contingency for water quality treatment

The open water and marsh habitat that will be created will minimize impacts to the approximately 1.9 ha of marsh habitat, 4 ha of shallow water habitat, and 1 ha of pond habitat expected to be lost from mine-related impacts during construction, operations, and closure phases. The created wetland habitats can be used by the water birds detected in the LSA, including seven priority species identified in the Northern Bird Conservation Region 10 (EC, 2013), which supports compliance with the *Migratory Birds Convention Act* (Government of Canada, 1994).

5.3.7.3.7.2.3.1 Pond 1 and Pond 2 Wetland Creation

Pond 1 Goal: Create 32 ha of marsh/swamp mosaic and 31 ha of shallow water wetlands by Year 4 at Pond 1 (TSF Cell C)

Pond 2 Goal: Create 59 ha of marsh/swamp complex and 172 ha of shallow water wetlands by Year 35 at Pond 2 (TSF Cell D)

Total wetland creation around Pond 1 and Pond 2 of the TSF is expected to equal approximately 294 ha. Wetlands around Pond 1 will be created by Year 4, and wetlands around Pond 2 will begin to be created by Year 17 and completed by Year 35 (Reclamation and Closure Plan, **Section 2.6**).

The marsh/swamp mosaic wetland communities will have a permanent/semi-permanent hydrology regime that includes both inundated and saturated soil conditions. Stockpiled soils will be placed over tailings to support shallow-rooting hydrophytic shrubs and herbaceous plants. Sedge species are anticipated to provide habitat in permanently saturated areas, and tall shrubs and trees will provide habitat cover in the semi-permanently saturated areas. Vegetation for the marsh and swamp areas will be introduced through live planting, seeding, or redistribution of the seedbed in the stockpiled wetland topsoil. Once established, this mosaic of plant communities is expected to provide water purification, breeding, foraging, and moulting sites for birds, and cover/refuge habitat for wildlife.

The shallow water wetland will be located between the wetland marsh and the permanent pool. Emergent plant species, such as Rocky Mountain pond-lily and bur-reed, are suggested for this wetland area. A <10% cover of emergent vegetation will be considered appropriate for the shallow water area between 75 cm and 2 m in depth (MacKenzie and Moran, 2004). Shallower marsh areas are anticipated to have more dense vegetation cover.

Salvaged soils for reclamation will be stockpiled in two locations. Wetland stockpile sites will be prepared prior to excavating any wetlands, and will remain undisturbed until wetland creation sites are installed. Wetland topsoils will be separate from upland soil. Wetland topsoil material will be excavated from areas designated as wetlands to a minimum depth of 50 cm, or as otherwise designated by the environmental monitor or wetland ecologist.

5.3.7.3.7.2.3.2 Freshwater Reservoir Wetland Creation

Goal: Create 11 ha of riparian swamp by converting the freshwater reservoir by Year 35

Eleven hectares (11 ha) of riparian swamp wetlands will be created by converting the freshwater reservoir at Year 35. The freshwater reservoir area will be regraded and revegetated with native species suitable for swamp wetlands in ESSFmv1.

5.3.7.3.7.2.3.3 Contingency Treatment Wetland Creation on Site

Goal: Create 2 ha of forested swamp/marsh wetlands for water quality treatment by Year 35

The 2 ha seepage treatment wetland above the ECD is to be restored and revegetated post-closure, as needed. The final spatial extent of this area will depend on engineering and water quality control requirements. The created treatment wetlands are anticipated to be riparian swamp wetland habitat, which would provide the water quality treatment and biochemical functions needed.

5.3.7.3.7.3 Compensation

The Wetland Compensation Plan proposed for the Project is included in **Appendix 5.3.7A**, which is based on the currently proposed Project and is subject to review during the Project review process. The goal of no net loss of wetland functions per the *Federal Policy on Wetland Conservation* (Government of Canada, 1991) has guided the mitigation process for the Project. The creation of 305 ha of wetlands on site by post-closure (Year 35) will create a temporal loss of wetland functions between when the impacts occur and when the created wetlands provide similar functions. To reduce this temporal loss of wetland functions regionally, off-site wetland compensation sites are proposed to be installed before or concurrent with Project impacts.

The goals of the minimization and compensation actions are to: 1) maintain the quality and quantity of wetland resources in watersheds through operational Project design features and the strategic selection of mitigation sites; and 2) create wetland ecosystems that provide similar functions to those wetlands affected by the Project. For example, wetland ecosystems at risk have increased habitat value, therefore creating similar habitat types (forested, shrub, emergent mosaics) should be targeted. In addition, 78% of direct wetland impacts occurred on swamps, therefore swamps should be a target wetland class to replace similar functions provided by the impacted wetlands.

Wetlands compensation is proposed for the permanent direct loss of 24.2 ha of Blue-listed wetland ecosystems due to mine-related impacts. The at-risk wetlands occur as black spruce bogs, and shrub or emergent fens. Compensation is proposed to mitigate the potential residual Project effect of eliminating the wetland habitat functions provided by these at-risk wetland ecosystems. It is not practical to assume that wetland bogs and fens can be created in a short time (5 to 10 years) as it has taken hundreds, if not thousands of years, to form peat substrates. However, wetland hydrological and habitat functions can potentially be replaced by off-site compensation sites by selecting sites with similar opportunities to provide these functions. For example, floodplain wetlands that have been drained and used for pasture in the past can be restored to provide wetland hydrological functions (flood attenuation) and black spruce wetland habitat. The Wetlands Compensation Plan has also been developed in conjunction with the Fisheries Mitigation and Offsetting Plan (FMOP) (**Appendix 5.1.2.6C**), since riparian swamp wetlands also have potential to support streams and fish.

5.3.7.3.7.3.1 Off-Site Wetland Compensation Areas

A total of 52.3 ha of off-site wetland compensation is proposed to offset the impacts on 24.2 ha of Blue-listed wetlands. Off-site wetland compensation consists of enhancing 2.2 ha of wetland functions by increasing habitat diversity in existing wetlands through the creation of fishponds in the Davidson Creek and Creek 661 watersheds (FMOP, **Appendix 5.1.2.6C**). An additional 11.4 ha of wetland habitat will be created in the Creek 705 watershed by enlarging Lake 01682LNRS (Lake 16), which will provide wetland habitat in side channels and the margins of open water areas. The open water and marsh habitat complexes will provide habitat for migratory waterfowl and foraging habitat for amphibian species, such as the western toad.

Compensatory mitigation will also be provided through the restoration and enhancement of approximately 38.7 ha of drained and degraded agricultural wetlands that exist southwest of the Project in the Mathews Creek watershed. These wetlands are currently harvested for hay and utilized for pasture, some of which have been drained to support these agricultural uses. These wetlands will be restored to a mosaic of black spruce (*Picea mariana*), or as determined appropriate based on similar adjacent wetlands, shrub, and emergent wetland habitats to support wildlife use by mammals, including caribou, moose, grizzly bears, furbearers, and bats. The Mathews Creek Ranch site also includes channel creation and restoration, and riparian enhancement to benefit fish habitat. Proposed compensation wetland areas, habitats, and vegetation structures are summarized in **Table 5.3.7-21**.

Table 5.3.7-21: Proposed Wetland Habitats at Compensation Sites

Compensation Site	Total Compensation Area (ha)	Proposed Wetland Habitats	Proposed Vegetation Structures
Off-channel Fish Ponds	2.2	Marsh, shallow open water, pond	Riparian shrub, emergent, submergent vegetation
Lake 016 Diversion and Enlargement	11.4	Marsh, shallow open water, pond	Emergent, submergent vegetation
Mathews Creek	38.7	Riparian swamp	Forested, shrub, emergent mosaic
Total	**52.3**		

Note: ha = hectare

The 52.3 ha of compensation are proposed to be constructed before or concurrently with Project impacts on wetlands. Installing the compensation sites prior to the Project impacts on wetlands will offset the 24.2 ha of direct wetland impacts on Blue-listed wetlands. The increased compensation area accounts for the risk involved in successfully installing the compensation sites, and the time required for the off-site compensation and on-site mitigation sites to become established and provide the intended wetland functions.

5.3.7.3.7.4 Mitigation and Compensation Summary

Mitigation measures to address wetland impacts include avoidance, minimization, and compensation actions. A total of 305 ha of wetlands will be created on site, and the restoration or enhancement of 52.3 ha of wetlands off-site will compensate for impacts on 24.2 ha of Blue-listed wetlands (**Table 5.3.7-22**).

Table 5.3.7-22: Wetland Impacts and Compensation

Wetland Class	Lost Wetland Extent (ha)		Proposed Wetland Creation On-Site (ha)	Proposed Wetland Compensation Off-Site (ha)
	Mine Site	Linear Features		
Bog	-40.1	-1.6	-	
Fen	-22.4	-0.2	-	
Swamp	-239.9	-4.3	305[1]	38.7[2]
Marsh	-1.9	-		13.6[3]
Shallow water/pond	-5.0	-	-	
Total	**-309.3**	**-6.1**	**+305**	**+52.3**

Note: ha = hectare;
[1]Combination of marsh and swamp habitats.
[2]Includes 32.0 ha of wetland restoration, and 6.7 ha of wetland enhancement.
[3]Combination of wetland marsh, shallow water, and pond habitats associated with the Fish Habitat Mitigation and Offset Plan.

5.3.7.3.7.5 Effectiveness of Mitigation

Table 5.3.7-23 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on wetlands during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.3.7-23: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Wetlands during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Loss of wetland extent and wetland functions, and degraded wetland ecological, hydrological, biochemical, and habitat functions	Construction, Operations, Closure, Post-closure	Avoid and minimize the loss of wetland extent within the mine site and linear components and restore or create wetlands on site	Moderate
		Seepage collection trenches and freshwater supply system for Davidson creek	High
		Project effects on wetlands and wetland functions will be minimized through embedded Project design features, and on-site habitat creation	Moderate
		Implementation of the WMP (**Section 12.2.1.18.4.3**)	High
		Non-embedded mitigation measures have been identified using *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia* (Cox and Cullington, 2009), and *Forested Wetlands-Functions, Benefits, and the Use of Best Management Practices* (Welsch et al., 1995)	High
		To meet provincial and federal regulatory requirements for wildlife, vegetation, and aquatic resources relating to the conservation of species and ecosystems at risk, the WMP will be implemented along with the LSVMRP (**Section 12.2.1.18.4.4**), ISMP (**Section 12.2.1.18.4.5**), WLMP (**Section 12.2.1.18.4.6**), SECP (**Section 12.2.1.18.4.1**), RCP (**Section 2.6**), and the ARMP (**Section 12.2.1.18.4.2**)	High
	Construction	Avoidance by massing and clustering the Project facilities and infrastructure, which also reduces habitat fragmentation in the landscape	High
		Additional opportunities to avoid impacts to individual wetlands within the mine footprint are limited to relocating other facilities not as constrained by mine engineering and operations	High
		If possible, re-locate or re-design facilities to avoid wetlands and the loss of wetland functions during the permitting process	High

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
		With regards to the linear Project components, wetlands will be avoided to the maximum extent possible during the planning process by siting the individual components outside of wetlands within the surveyed corridors	High
		Footings for the transmission line support poles and associated access roads will be located outside of wetlands except where the wetland is already crossed by an existing feature, such as when the transmission line alignment follows an existing road that already crosses a wetland	High
		Pre-construction planning will identify opportunities to avoid wetlands and the loss of wetland functions	High
		To limit disturbance where possible during construction, a 30-m vegetated buffer will be preserved around mapped wetlands in the mine site that would not be directly impacted by mine site infrastructure	High
		On a case-by-case basis, as necessary, light activities with temporary impacts will be allowed on the wetland buffer zone—such as temporary access routes, invasive plant species management, sediment and erosion controls, and targeted vegetation clearing	High
		Wherever possible, no additional permanent features will be allowed within the 30-m wetland buffer zones, including buildings or main roads that may be identified as necessary during the operations phase	High
	Construction, Operations	The WMP also includes a wetland monitoring program to identify potential negative effects on wetlands from site construction and operations, and to systematically address changes in wetland conditions that may trigger the need for mitigating actions to prevent unforeseen negative effects	High
		Inclusion of the freshwater supply system, seepage collection trenches, the TSF, and wetland creation around the TSF (Pond 1)	Moderate
		63 ha of Swamp and marsh wetland habitat will be created around Pond 1 of the TSF at Year 4 of the operations phase	Moderate
		2 ha of riparian swamp wetland will be created as contingency for water quality treatment if necessary	Moderate

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
	Closure	A separate wetland monitoring program associated with wetland creation during the reclamation and closure phase will be implemented according to the Wetland Compensation Plan (**Appendix 5.3.7A**)	High
		Wetlands will be created around the TSF (Pond 2) and in the converted freshwater reservoir (**Section 2.6**, Reclamation and Closure)	Moderate
		Impacts to wetland biochemical functions will be minimized through surface water management and seepage collection that will minimize potential effects on groundwater and surface water quality entering wetlands	High
	Post-closure	231 ha of swamp and marsh wetland habitat will be created around Pond 2 of the TSF at post-closure (Year 35)	Moderate
		11 ha of riparian swamp wetland habitat will be restored by converting the freshwater reservoir into wetlands at post-closure (Year 35)	Moderate

Note: ARMP = Aquatic Resources Management Plan; ha = hectare; ISMP = Invasive Species Management Plan; LSVMRP = Landscape, Soils and Vegetation Management and Restoration Plan; m = metre; RCP = Reclamation and Closure Plan; SECP = Sediment and Erosion Control Plan; TSF = Tailings Storage Facility; WMP = Wetlands Management Plan; WLMP = Wildlife Management Plan

In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The effectiveness of mitigation measures is rated moderate to high because they are standard practices in mitigating impacts to wetland and wetland functions. For example, the effectiveness of avoidance measures (e.g., locating a facility in uplands rather than wetlands) is high because the initial impact is avoided or minimized. The effectiveness of the implementation of the WMP to mitigate impacts to wetlands is high because soil erosion and sediment control structures will be in place to limit potential negative effects to water quality. However, the effectiveness of the embedded project design features (e.g., freshwater supply system, seepage collection trenches) will require monitoring to prove effectiveness and will require contingency measures if they are not effective over time. The effectiveness of the monitoring for wetland creation around Ponds 1 and 2 of the TSF is high since the monitoring goals are to ensure that the targeted habitats and wetland acreage are achieved.

5.3.7.4 Residual Effects and their Significance

Residual effects are those remaining after implementing all mitigation measures, and the expected consequences of the Project on the Wetlands VC (BC EAO, 2013). The residual physical change in the environment within the mine site includes the temporal loss of wetland functions provided by the existing wetlands present before mine development, and those created during operations, and reclamation and closure.

5.3.7.4.1 Residual Effects after Mitigation

After mitigation, residual effects on the Wetlands VC are from the temporal loss of wetland functions and values due to the loss of wetland extent. The wetland compensation sites will help mitigate the temporal loss of wetland functions, because these sites will be constructed concurrently in advance of the mine construction and operations. **Table 5.3.7-24** summarizes the potential effects of the Project on the Wetlands VC that will be carried forward in the assessment.

Table 5.3.7-24: Summary of Potential Effects to be Carried Forward into the Assessment of Wetlands

Key Project Effects	VC Indicator	*Project Phase*				Potential for Residual Effects	Carried Forward
		Construction	Operations	Closure	Post-closure		
Loss of wetland functions	Ecological functions	√	√	√	-	Yes	Yes
	Hydrological functions	√	√	√	-	Yes	Yes
	Biochemical functions	√	√	√	-	Yes	Yes
	Habitat functions	√	√	√	-	Yes	Yes

Note: VC = Valued Component ; √ = Potential adverse effect likely; - = Potential adverse effect unlikely;

5.3.7.4.2 Significance of Residual Project Effects

In determining the significance of residual Project effects for the Wetlands VC, effects on wetland functions considered the additional areas of degraded wetland functions and hydrologically altered wetlands that extend beyond the direct wetland impacts within the mine footprint. Direct impacts will reduce wetland extent and functions, and the degraded and hydrologically altered wetlands will diminish wetland functions. A significance determination for wetland functions was evaluated for the end of closure and for post-closure, since the post-closure analysis incorporates the environmental conditions to follow reclamation and closure.

5.3.7.4.2.1 Wetland Functions

During Project construction, operations, and closure, the ecological context is medium since Blue-listed wetlands will be impacted. The magnitude is medium (10% to 20% reduction) and the geographical extent is local because there will be a 14.6% reduction in wetland extent and functions from baseline conditions, limited to the LSA. The 16.1% reduction is determined by combining the loss of wetland extent (315.4 ha, including the mine site and linear components) in the LSA, the area of degraded wetland functions (132.6 ha), and the area of hydrologically altered wetlands (89.9 ha). The duration will be long-term and the effect reversible because of the temporal loss of wetland extent and functions until all wetlands are created on site. Wetland functions will be partially replaced by off-site compensation sites prior to construction, and replaced in full at post-closure upon successful creation of on-site wetlands. The effect will occur intermittently, and the likelihood and confidence are high because loss of wetland extent due to mine development is certain. The significance determination is rated Not Significant (moderate) because the magnitude is medium, geographic extent is local, frequency is intermittent, and the duration long-term. The level of confidence is high because the extent of direct wetland loss is well understood.

At post-closure, the magnitude and levels of confidence in likelihood and significance change (**Table 5.3.7-25**). The magnitude of the effect becomes low at post-closure since there will be a less than 1% reduction in wetland cover in the mine site from baseline conditions. The significance determination is rated Not Significant (minor) because the magnitude is low, geographic extent is local, frequency is intermittent, and the duration long-term. The likelihood and significance rating changes to moderate confidence levels because the success of wetland creation during reclamation has been proven elsewhere (Hamaguchi et al., 2008). The moderate confidence levels and associated risk can be addressed through monitoring during all four phases of the Project to ensure the success of created wetlands.

Table 5.3.7-25: Residual Effects Assessment for Loss of Wetland Functions

Effect Attribute	Construction, Operations, and Closure	Post-Closure
Context	Medium	Medium
Magnitude	Medium	Low
Geographic extent	Local	Local
Duration	Long Term	Long Term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	High	High
Level of confidence for Likelihood	High	Moderate
Significance Determination	Not Significant (moderate)	Not Significant (minor)
Level of confidence for Significance	High	Moderate

5.3.7.5 Cumulative Effects

5.3.7.5.1 Rationale for Assessing Cumulative Effects

A CEA for the Wetlands VC is necessary because the Project is expected to have a Not Significant (moderate) residual adverse effect on wetland extent and functions. Residual effects on wetland extent and functions 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 the wetlands VC 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.

5.3.7.5.2 Potential Cumulative Effects with other Past, Present, and Future Projects and Activities

For the Wetlands VC CEA, the most relevant land uses in the RSA that could potentially interact with wetland ecosystems include forestry, mining, and agriculture. 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 5.3.7-26**.

Table 5.3.7-26: Interactions between Wetlands VC and other Past, Present, and Future Projects/Activities

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

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

Forestry-related activities in the RSA have the potential to temporarily alter and degrade wetland functions through habitat conversion, noise pollution, erosion and sedimentation, and invasive species introduction. Although forestry activities do not typically result in loss of wetland extent, the temporary effects on wetlands from current and future forestry activities could result in the temporary degradation of wetland functions. Habitat conversion results from removing the overstory in multi-strata forested wetland habitats.

Agricultural activities in the RSA also have the potential to degrade wetland functions. Cattle grazing can alter wetland vegetation cover in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in wetlands through fertilizer and pesticide use. Similar to forestry activities, agricultural activities do not typically result in the loss of wetland extent but may result in degraded wetland functions.

Mining activities (e.g., current prospecting, exploration) are occurring southeast and northwest of the mine site, and are likely to continue into the future. Mineral prospecting can result in degraded wetland functions through accidental discharge of drilling fluids, noise pollution, and vegetation removal. Negligible loss of wetland extent is possible due to temporary access road construction.

5.3.7.5.3 Potential Residual Cumulative Effects and Mitigation Measures

A Wetland Compensation Plan (**Appendix 5.3.7A**) has been developed for the Project. Approximately 305 ha of wetlands will be created in the mine site to mitigate the loss of 309.3 ha of wetlands and wetland hydrological, biochemical, and habitat functions. An additional 52.3 ha of wetland compensation will be provided for the loss of Blue-listed wetland ecosystems.

The Proponent is committed to following mitigation measures provided in the guidance document *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia* (Cox and Cullington, 2009) to minimize adverse effects on wetland functions. If forestry, agricultural, and mineral prospecting practitioners in the RSA follow this guidance, then potential degraded wetland functions resulting from these activities can be successfully mitigated through avoidance and minimization.

Suggested mitigation measures for forestry activities include: 1) maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings; 2) avoiding harvesting in wetland and riparian areas; and 3) replanting native vegetation to expedite succession. These mitigation activities are already included in the Environmental Management Plans for the Project (**Section 12.2**).

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 wetlands; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996), include: 1) pre-planning to avoid wetlands and 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.

A residual cumulative effect on the loss of wetland function is expected. However, the residual cumulative effect is not expected to be significant because of the on- and off-site mitigation measures described in the Wetland Compensation Plan (**Appendix 5.3.7A**).

5.3.7.5.4 Significance of Potential Residual Cumulative Effects

The Project will contribute to additional loss of wetland extent and function in combination with the three past, present, and future activities (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. Due to the minimal loss of wetland extent and functions 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 5.3.7-27**) because of the mitigation and compensation measures for the Project. The level of confidence is moderate due to the risk associated with the wetland mitigation measures, which can be addressed through monitoring to ensure the success of the created wetlands on site.

Table 5.3.7-27: Residual Cumulative Effects Assessment for Loss of Wetland Extent and Functions

Effect Attribute	Current / Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect with Project
Context	Medium	Medium
Magnitude	Low	Low
Geographic extent	Regional	Regional
Duration	Long Term	Long Term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	High	High
Level of confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of confidence for Significance	High	Moderate

5.3.7.6 Limitations

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

5.3.7.7 Conclusion

The Project will directly affect 309.3 ha (9.3%) of wetland ecosystems in the mine site during construction, operations, and closure. An additional 132.6 ha of wetland functions may be degraded, and 89.9 ha of wetlands may be hydrologically altered. The primary effect on the Wetlands VC will be the loss of wetland extent and functions, and the degradation of functions provided by remaining wetlands. Mitigation measures to address these impacts include avoidance, minimization, and compensation actions. After considering mitigation measures, the temporal loss of wetland functions remain as residual effects. The loss of wetland functions was rated as a Not Significant (moderate) effect as there will be a less than 1% reduction in wetland cover at post-closure within the mine site. During operations and closure the temporal loss of wetland functions between the time that impacts occur and the time new wetlands are created will be minimized through establishing off-site wetland compensation sites prior to or concurrently with the impacts. The cumulative effects of forestry, agriculture, mineral exploration, and the Project on the Wetlands VC were assessed for the RSA. Potential cumulative effects of the Project on wetland extent and functions are expected to be Not Significant (moderate) within the RSA as a result of mitigation measures.