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11 POTENTIAL EFFECTS OF THE ENVIRONMENT ON THE PROJECT

11.1 Introduction

This section assesses the potential environmental factors that may affect the proposed Blackwater Gold Project (the Project) and the predicted effects of those environmental factors as required by the provincial Application Information Requirements (AIR) and federal Environmental Impact Statement (EIS) Guidelines. The range of climate conditions, including geological hazards, extreme weather events, and climate change is considered. The proposed Project has specifically used design strategies to compensate for the increased likelihood of environmental extremes under global climate change scenarios such as total containment of contact water during probable maximum flood events.

Major resource projects are designed in consideration of potential effects of the environment. Project facilities must be built to withstand local environmental conditions to ensure uninterrupted project operations, maintenance of project assets, environmental protection and the safety of personnel and the general public.

The federal EIS Guidelines require that the Proponent provide an examination of the potential effects the environment may cause on the Project, corresponding to the federal scope. Specifically, the Guidelines state:

> *The EIS will take into account how local conditions and natural hazards, such as severe and/or extreme weather conditions and external events (e.g., flooding, ice jams, landslides, avalanches, erosion, subsidence, fire, outflow conditions and seismic events) could adversely affect the project and how this in turn could result in impacts to the environment (e.g., extreme environmental conditions result in malfunctions and accidental events) (CEA Agency, 2013).*

Further, the approved AIR pursuant to the BC *Environmental Assessment Act* (BC *EAA*) indicates that the Application will:

- Identify and describe the environmental factors deemed to have possible adverse effects on the Project such as:
    - Natural hazards, including geological hazards (ice jams, landslides, avalanches, freezing, etc.);
    - Extreme weather conditions (drought, flooding);
    - Natural seismic events (e.g., liquefaction, subsidence, etc.);
    - Volcanic events;
    - Forest fires;
    - Slope stability and mass wasting events (outflow conditions); and
    - Climate change;

- o Identify any changes or effects on the Project that may be caused by the above-mentioned environmental factors, whether the changes or effects occur within or outside of Canada;
- o Identify the likelihood and severity of the changes or effects; and
- o Identify mitigation measures, including design strategies, planned to avoid or minimize the likelihood and severity of the changes or effects.

Natural hazards, including geological hazards, and climate change have been assessed in terms of their likelihood of occurrence of a residual effect, their anticipated effect on the Project's infrastructure and production, and the proponent's potential response should one or all of these environmental hazards occur. As applicable, this section also describes proposed mitigation measures, including design strategies, planned to avoid or minimise the likelihood and severity of the changes or effects.

11.2 Information Sources and Methods

This section was prepared using various publicly available sources:

- AMEC. 2013a. Blackwater Project, Baseline Report – Vegetation. Burnaby, BC;
- AMEC. 2013b. Blackwater Gold, Baseline Report – 2013 Surface Hydrology. Burnaby, BC;
- Knight Piésold Ltd. 2013a. 2013 Hydrometeorology Report. Rev0. New Gold Inc. Blackwater Project. Vancouver, BC, Canada;
- Knight Piésold Ltd. 2013b. Reconnaissance Terrain and Terrain Stability Mapping. Rev0. New Gold Inc. Blackwater Project. Vancouver, BC, Canada (**Appendix 11A**);
- Knight Piésold Ltd. 2013c. Transmission Line Feasibility Study. New Gold Inc. Blackwater Project. Vancouver, BC, Canada;
- New Gold Inc. 2012. Blackwater Project, British Columbia. Preliminary Economic Assessment Report. Vancouver, BC; and
- Knight Piésold Ltd. 2013x. Mine Waste and Water Management Design Report. New Gold Inc. Blackwater Project. Vancouver, BC, Canada.

11.3 Subsidence

Subsidence is not expected to be a concern at the Project. Subsidence occurs when an underlying material is removed by some means, creating an underground void into which the surface slumps. Common causes of subsidence include dissolution of limestone by groundwater flow, underground mining, and oil and natural gas extraction.

The Project is located on the Nechako Plateau, a region of flat to gently rolling terrain on the northern slope of Mt. Davidson. Bedrock outcrops are present and limited to the peak and ridges of Mt. Davidson. The Project site is underlain by inter-calcated volcanic and volcaniclastic felsic to intermediate lapilli and ash tuff, volcanic breccias and andesitic flows. Dissolution is not of concern. Similarly, there are no existing underground workings and none is planned, nor is there local oil and natural gas extraction.

11.4 Landslides/Mass Wasting/Slope Stability

11.4.1 Baseline

As stated above, the Project is located on the Nechako Plateau, a region of flat to gently rolling terrain on the northern slope of Mt. Davidson, with bedrock outcrops limited to the peak and ridges of Mt. Davidson. The area is generally covered with glacial till (Knight Piésold, 2013b; Drawings G0030 to G0032). The majority of the till present is stiff to very stiff or dense and has been interpreted as lodgement or basal till. An area of ablation till has been identified at the proposed east waste rock dump in addition to some small area of organic swamp at the main project site (Knight Piésold, 2013b; Drawing G0030). Glaciofluvial soils were mapped over a large portion of the Davidson Creek and tributary (Knight Piésold, 2013b; Drawing G0031).

As a result of this terrain, relatively few past landslides have been identified proximal to the proposed development areas. Past landslides identified include naturally occurring (Knight Piésold, 2013b): recent debris slides, rock falls, and potentially two relic (pre-aerial photography) rock avalanches. These past mass wasting events are situated southwest of the proposed development area in gullied terrain (Knight Piésold, 2013b; Drawing G0030). All of the identified relic or recent slides have limited areal extent.

In order to assess the potential for future mass wasting events, terrain, and terrain stability maps were prepared for the area surrounding the Project site (Knight Piésold, 2013b; Drawings G0020 to G0022, G0030 to G0032, and G0040 to G0042). Terrain stability refers to the likelihood of a landslide initiating on disturbance (such as by road construction or timber harvesting). Individual terrain polygons were developed based on geomorphology, presence/absence of soil or rock exposures and vegetation. Terrain stability ratings were assigned to each identified terrain polygon by interpretation of aerial photographs, satellite imagery, and LiDAR survey utilizing the criteria outlined in *Mapping and Assessing Terrain Stability Guidebook* (BC MOF, 1999). Approximately 17% of the terrain polygons were field-truthed to confirm the remote assessment.

The majority of the Project development area is relatively flat-lying to gently sloping, with slope angles of generally less than 26% (Knight Piésold, 2013b; Drawings G0020 to G0022). There are some areas of moderately sloping lands (27% to 49%), but they are generally of limited areal extent. These tend to be found in association with the TSF, which has been sited to maximize natural containment and storage availability (amongst other aspects), and as a result, the tailings dams are strategically placed across a valley where more steeply sloped lands are present (Knight Piésold, 2013b; Drawing G0021).

Three stability classes were identified and used to assess potential terrain stability issues and need for mitigation:

- Stable: terrain with a negligible to low likelihood of landslide initiation following road construction and timber harvesting;
- Potentially unstable: terrain expected to contain areas with a moderate likelihood of landslide initiation following road construction and timber harvesting; and
- Unstable: terrain expected to contain areas where there is a high likelihood of landslide initiation.

An assessment was also made of the terrain hazard risk associated with the proposed transmission line route and its alternatives by Knight Piésold (2013c). The region between the Project site and the BC Hydro grid connection point is relatively flat to rolling terrain, although there are isolated areas where the terrain is steeper than 35%. The preferred route has moderate terrain and moderate foundation conditions (principally glacial till, with largely ice contact glaciofluvial deposits in valleys), and is forested.

Terrain mapping was completed as part of the Feasibility Study for the preferred transmission line route following the Provincial guidelines, supplemented by helicopter site reconnaissance and field truthing (Knight Piésold, 2013c, Figures 3.3 to 3.28). Relic (pre-aerial photographic record of 1953) and recent landslides were also mapped. Relatively few landslides (debris slides, debris flows and rockfalls) were identified, and where present, were in natural terrain, rather than associated with infrastructure such as forestry roads.

11.4.2 Potential Effects on the Project and Mitigation

The terrain mapping and investigations completed by Knight Piésold Inc. (Knight Piésold) did not identify any existing widespread areas of sheet or gully erosion at the Project site and environs (Knight Piésold, 2013b). The majority of the proposed development area is considered stable with a negligible to low likelihood of landslide initiation following road construction and timber harvesting, as shown on Drawings G0040 to G0042 (Knight Piésold, 2013b). There are no areas of potentially unstable or unstable land identified at the main site (Drawing G0040).

General sediment and erosion control strategies are also being developed as part of the Project design for all phases and applicable areas of the Project. A detailed plan for the construction phase to proactively manage water, erosion and sedimentation is well progressed (Knight Piésold, 2013d). Strategies could include establishing either temporary or permanent, diversion and runoff collection ditches, constructing sediment control ponds, and stabilizing disturbed land surfaces to minimize erosion. Slope control and sediment control measures for the main Project area are discussed in further in **Section 12.2.1.18.4.1**, Sediment and Erosion Control Plan (SECP).

Unstable and potentially unstable terrain units occupy a very small percentage of the proposed development area. Where present to a limited extent, they are generally found at the TSF as it cuts across valley lands. The TSF design and dam construction measures will include the necessary engineering design or construction measures to ensure that the structure meets all requirements for maintenance of long-term integrity. The identified areas of potentially unstable terrain will be effectively buttressed by the tailings dams and tailings themselves once the mine is operational (Knight Piésold, 2013b). The Project SECP will include measures to ensure that appropriate measures are put in place to control sediment transport after vegetation removal and prior to operations, when the area will be re-stabilized.

There are limited areas of organic soils and silt-rich, glacial lake deposits identified at the location of a number of the proposed site facilities that are expected to be more prone to erosion when vegetation is removed than the pervasive till. These limited areas/material types and proposed erosion control measures are addressed in the Project SECP.

The terrain hazard assessment of the proposed transmission line identified the potential for the following slope stability hazards (Knight Piésold, 2013c):

- Local debris and rock slides on steep slopes adjacent to drainage;
- Local debris flows along tributary drainage channels; and
- Local rockfall from steep slopes.

There is a relatively low proportion of steep terrain (60% gradient or greater) in the vicinity of the proposed transmission line alignment, as shown on Drawings G0070 Rev A to G0094 Rev A (Knight Piésold, 2013c). Knight Piésold (2013c) has identified that areas of glacial lake deposits and areas of gullied terrain along the proposed route that may also be potentially unstable at lower slope angles. Where transmission line towers and/or poles and construction access are proposed to be constructed in these susceptible areas, Terrain Stability Assessments will be conducted as part the detailed design. The Terrain Stability Assessments will support the development of site-specific mitigation measures for both, transmission line pole/tower anchoring, as well as track access for construction and future maintenance in those areas identified with higher landslide risk.

11.4.3 Summary

Based on the desktop studies and field investigations, terrain stability issues are not expected to have an effect on the Project. Terrain Stability Assessments will be conducted as part the detailed design where transmission line towers and/or poles and construction access are proposed to be constructed in terrain susceptible to instability.

The potential for landslide effects on transport and associated potential environmental effects are considered in **Section 10**, Accidents and Malfunctions.

11.5 Avalanches

11.5.1 Baseline

The main Project area and infrastructure are located in Central BC, which receives moderate amounts of snowfall annually. Avalanches take place when a layer of snow collapses and slides downhill. Four factors are involved: presence of steep slopes, snow cover, a weak layer in the snow, and a trigger (Government of Canada, 2013).

Along with the presence of snow is a requirement for significant relief. Snow avalanches generally occur on terrain with slope angles of 27 degrees (°) to 40° or approximately 49% to 70% (Knight Piésold, 2013b). As identified in **Section 11.4.1**, the majority of the Project development area is relatively flat-lying to gently sloping, with slope angles of generally less than 26% (Knight Piésold, 2013b; Drawings G0020 to G0022). Mapping prepared by Knight Piésold in conjunction with the slope stability assessment at the Project area, did not identify any clearly discernible, existing snow avalanche paths in local treed areas.

While there is a somewhat greater proportion of moderately steep terrain (26% to 40%) near the proposed transmission line right-of-way (ROW), the lengths of slopes are relatively short. Mapping associated with the terrain stability assessment of the proposed transmission line route, did not identify any evidence of snow avalanche paths in existing treed areas (Knight Piésold, 2013c).

11.5.2 Potential Effects on the Project and Mitigation

The main Project area is located in an area of rolling terrain where slope angles are generally about 49%, which is the minimum slope angle required generally for avalanches to occur. Moderately steep terrain is present at some locations along the proposed transmission line route. Small avalanches could occur on local areas of steeper terrain within the larger terrain units identified after removal of vegetation. The area where steeper terrain is present is however, limited, and the lengths of such slopes are relative short. For that reason the risk of potential snow avalanches at the main Project area and proposed transmission line route has therefore been assessed as relatively low (Knight Piésold, 2013b; Knight Piésold, 2013c).

Although a relatively low risk is defined and there is no evidence to suggest past occurrences; should a risk be identified in the future, mitigation measures, such as the placement of: retaining barriers, deflecting dikes/walls, splitting wedges, snowsheds, retarding works (breakers or arresters) or snow collection fences; could be readily emplaced as either temporary or permanent measures to protect facilities (Canadian Avalanche Association, 2001).

11.5.3 Summary

No direct effect on the Project is expected from avalanches and no specific mitigation measures are proposed. Mitigation measures are available should a risk be defined in the future. Risks associated with potential avalanche effects on transport and potential environmental effects are considered in **Section 10**, Accidents and Malfunctions.

11.6 Seismic Events and Liquefaction

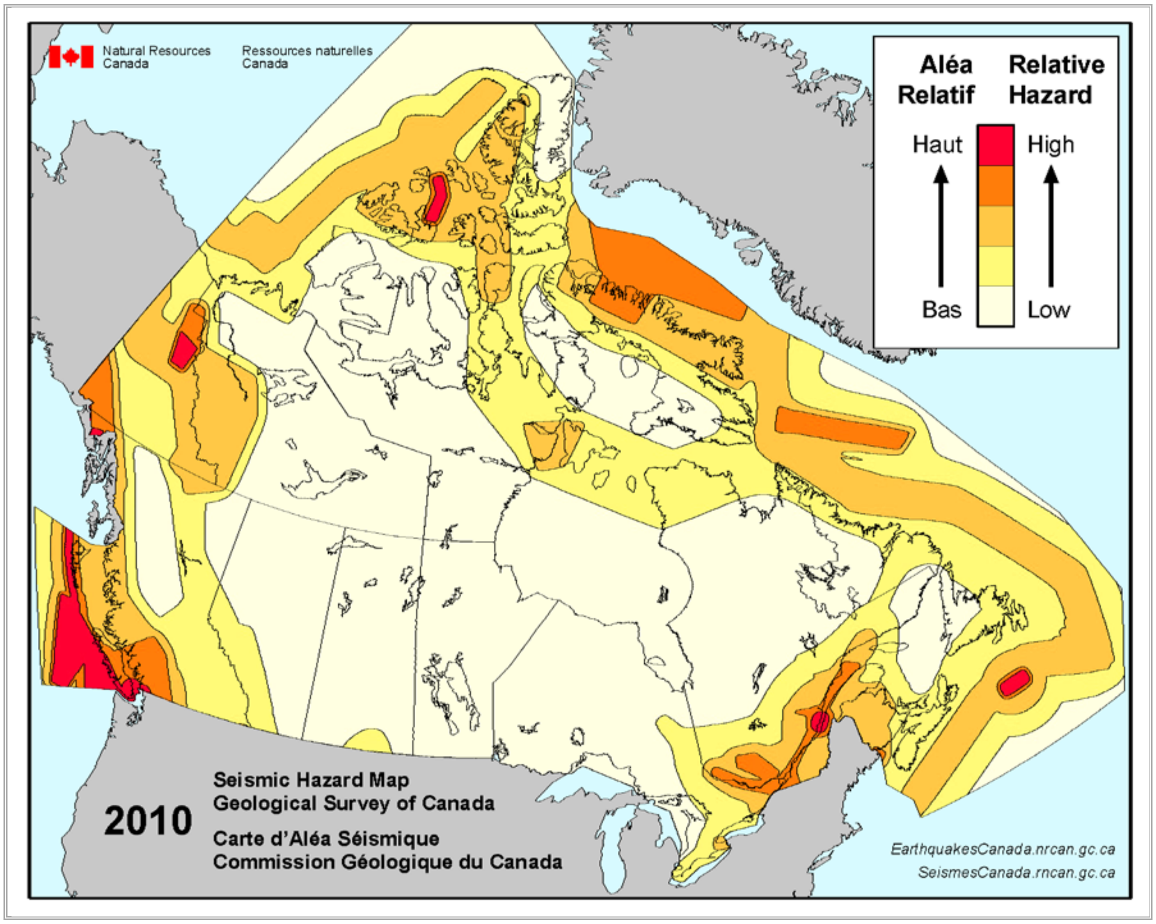
11.6.1 Seismic Events Baseline

The Project study area is situated in an area of historically low seismic activity. There is the potential for smaller events in the interior of BC with most >5 magnitude (Richter scale) earthquakes occurring offshore (Natural Resources, 2014a).

The maximum earthquake magnitude for the potential seismic source regions of nearby northern BC and the Coast Mountains is estimated to be in the range of 7.0 to 7.3 (Adams and Halchuk, 2003). Major seismic activity generally occurs at the boundaries between tectonic plates. The Project area is located on the North American plate, approximately 400 km northeast of the Cascadia Subduction Zone (which separates the Juan de Fuca and North American plates). The last known megathrust earthquake at the Cascadia Subduction Zone in the northwest occurred in 1700. Based on geological evidence, a return period in the order of 400 to 600 years is expected (Pacific Northwest Seismic Network, 2013).

11.6.2 Potential Effects on the Project and Mitigation

The seismic hazard map (**Figure 11.6.2-1**) layer indicates the relative seismic hazard across Canada (NRCan, 2014a). The 2010 Canadian Seismic Hazard Map shows a low probability of a strong shaking (less than 1 percent chance in 50 years) in the Project study area (Natural Resources Canada 2014).



Source: Natural Resources Canada, 2014

Figure 11.6.2-1: 2010 Seismic Hazard Map – Geological Survey of Canada

The 2010 National Building Code of Canada interpolated seismic hazard values determined for 2% in 50-year (0.000404 per annum) probability of exceedance (NRCan, 2010). Probabilities for future seismic events for Prince George indicated a 0.89% likelihood of a magnitude 5 (Richter scale) earthquake occurring during the next 10 years, rising to 8.6% during the next 100 years (Onur and Seeman, 2004). The likelihood of a magnitude 7 (Richter scale) event was 0.012% during the next 10 years and 0.12% during the next 100 years (Onur and Seeman, 2004).

Liquefaction can occur when water-saturated sand or sandy soils are subjected to ground shaking, such as from an earthquake. When the soil liquefies, it loses strength and behaves as a viscous liquid rather than as a solid potentially causing damage to facilities and infrastructure. Liquefaction is not of concern for the Project, as the presence of saturated, sandy soils is required in addition to a significant seismic occurrence. Soils in the Project area do not meet this requirement (**Table 11.6.2-1**).

All buildings and mineral waste management structures (TSF, waste rock dumps, ore stockpiles) at the Project have been designed to meet anticipated seismic requirement and be compliant with the BC Building Code.

Table 11.6.2-1: Summary of Soil Associations in the Project Study Area

Soil Association	Parent Material	General Soil Types
Alix	Glaciofluvial	Rapidly drained, typically Orthic Dystric Brunisol
Barrett	Morainal (Basal Till)	Medium to moderately fine to moderately coarse-textured soil
Berman	Glaciolacustrine	Moderately-fine, silty glaciolacustrine, well-drained soils
Chief	Organics	Very poorly-drained organic soils
Deserters	Morainal (Basal Till)	Moderately fine to coarse-textured with moderate amounts of coarse fragments
Knewstubb	Glaciolacustrine	Well drained, with fine sandy loam to silt loam being the most common texture
Moxley	Organics	Very poorly-drained organic soils
Nechako	Fluvial	Variable textured soils
Nithi	Fluvial	rapidly-drained soils are very coarse-textured, often with a thin cap of finer-textured material and low coarse fragment content
Ormond	Colluvium / Bedrock	Coarse textured, well to rapidly drained, with common textures ranging from sandy loam to loamy sand, with moderate to high levels of coarse fragments
Pinkut	Colluvium/Till	Moderately fine to coarse textured soils, similar in nature to the original till material
Twain	Morainal (Basal Till)	Mostly thin, bedrock-controlled soils, and are often found in complexes with colluviated soils in areas of high relief
Vanderhoof	Glaciolacustrine	Well-drained, fine-textured soils that have developed on glaciolacustrine clay sediments

11.6.2.1 Tailings Dam Hazard Classification

The TSF has been designed to meet all current Canadian Dam Association (CDA) Dam Safety Guidelines. According to these guidelines, each structure is assigned a dam class based on the incremental losses that could result from failure of the dam with respect to loss of life, environmental and cultural values, as well as infrastructure and economic losses. The dam class determines the required Inflow Design Flood and Earthquake Design Ground Motion for the design of the dam structure and water management systems.

The CDA Dam Safety Guidelines (2007) suggested minimum inflow design flood and earthquake design ground motion for the Project tailings dams. Classification of the tailings dams was carried out by considering the potential incremental consequences of a failure. The dam safety class for the Project tailings dam is very high, which provides assurance that the TSF dams are designed for anticipated seismic (and flood) events.

The Proponent has opted for a more conservative approach to its design of the Project's major structures. The Proponent has selected the design parameters for a dam class of extreme, and the TSF has been designed to withstand a 10,000-year return period earthquake event.

The TSF dam construction (initial construction and subsequent dam raises) are required to be, and will be, completed under the supervision of a qualified geotechnical engineer to ensure that calculated factors of safety are maintained through the construction process. The risk of a tailings dam failure resulting from an earthquake was taken into consideration in the dam designs, and in the manner in which the dams will be constructed.

As a result, there are no expected environmental effects resulting from seismic events.

11.6.2.2 Seismic Effects on Pit Wall Stability

No pit wall instability from the low potential seismic effects in the Project area are anticipated, as these effects are orders of magnitude lower than the effects from blasting in the pit.

11.6.3 Summary

No direct effects on the Project are expected from seismic events. Mitigation measures are inherent to the Project design, in order to meet design standards.

11.7 Volcanic Events

11.7.1 Volcanic Events Baseline

There are no volcanoes near the Project. There are however, a number of volcanoes located along a belt stretching north from Washington through BC to Alaska (Smithsonian Institution, 2013). The closest volcano to the Project area is the dormant Nazko Cone, located approximately 90 km east of the Project (**Figure 11.7.3-1**). The Nazko Cone is a small, tree-covered, basaltic volcano comprised of lava flows, a composite cinder cone and air-fall tephra. This cinder cone volcano is believed to have last erupted approximately 5,220 years ago and there have been no recent earthquakes (Volcano Discovery, 2013a). Its last eruption produced two small lava flows that flowed approximately 1 km to the west, along with a blanket of volcanic ash that extends several kilometres to the north and east of the cone (NRCan, 2013). According to NRCan (2013c), the most immediate hazard relating to future eruptions from Nazko cone (if any) would be only of local concern, related to the possibility of forest fires and disruption of local air traffic in the event of an ash cloud.

The Satah Mountain is a dormant cinder cone located in central BC (**Figure 11.7.3-1**). It is approximately 90 km south of the Project. The date of its last eruption is unknown but may be of similar age to the nearby Nazko Cone (Volcano Discovery, 2013b).

While the Nazko Cone and Satah Mountain are considerably closer to the Project area, they are dormant and Mount Baker is considered to have the greatest potential to cause volcanic (dust) damage on the Lower Mainland of BC (and south of the Project area).

Mount Baker is located in Washington, US near the Canada border, approximately 600 km south-southeast of the Project area. The last eruption of Mount Baker was in 1870 (Emergency Management BC, 2013). A study by the U.S. Geological Survey suggests that tephra from the eruption of a US Cascade volcano (such as Mount Baker) will most commonly be carried eastward due to the prevailing wind patterns and would be greatest (<1 cm thick) within 50 km of the volcano, even under less common wind conditions (USGS, 1995).

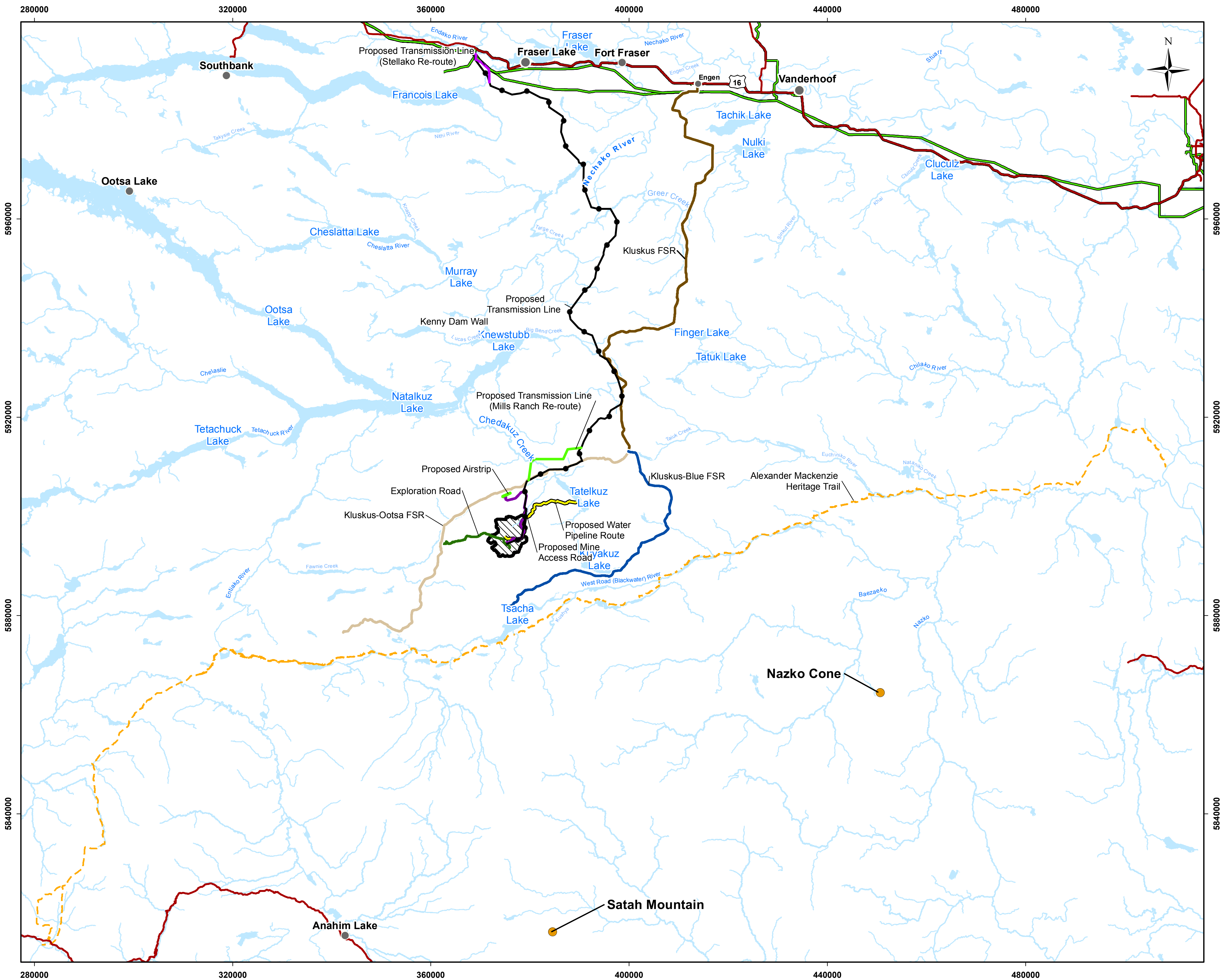
11.7.2 Potential Effects on the Project and Mitigation

There is no expectation that a volcanic eruption would occur that would directly affect the Project area and no mitigation measures are proposed.

In the unexpected circumstance that the Nazco Cone or Satah Mountain became active, the distance of the Project area from these volcanoes, make it unlikely that the Project and personnel would be in danger from the direct effects of a volcanic eruption. In addition, it is likely that there would be some warning before a significant eruption occurred. Should a volcanic event occur from either of these, or more distant active volcanoes (such as Mount Baker), it is possible that the Project site could be affected by ash dust/cloud, depending on wind direction, which could affect the health of the employees (and potentially cause some damage to facilities).

11.7.3 Summary

Based on existing information, it is highly unlikely that the Project will be affected by a volcanic eruption or other volcanic event. Should this extreme event occur, personnel would be directed to congregate at mustering locations for evacuation or similar measures to protect the health and safety of employees.



KEY MAP

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Location of Proposed Mine Site, Mine Access Road, Transmission Line, and Water Supply Pipeline

DATE: July, 2013	ANALYST: MY	Figure 11.7.3-1
JOB No: VE52277	QA/QC: LR	PDF FILE: Other-100-088_satah_nazko.pdf
GIS FILE: Other-100-088_satah_nazko.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

11.8 Natural Fires/Forest Fires

11.8.1 Natural Fires Baseline

The Project area is located in the Vanderhoof Forest District (**Figure 11.8.1-1**). Proposed developments are located within the Fraser Plateau and Fraser Basin ecoregion and more specifically within the Nazko Upland and Nechako Lowland ecosection, and to a lesser, the extent Bulkley Basin (AMEC, 2013a).

The proposed mine site occurs in a landscape that is primarily high elevation forest with limited forestry activity (cutblocks and roads). Lower elevation areas have been extensively logged where evidence of mountain pine beetle is prevalent (AMEC, 2013a). Sparsely vegetated ecosystems such as talus, rocky outcrop, and cliff are uncommon. Project facilities are located in the following biogeoclimatic units:

- SBSdk (Sub-Boreal Spruce Dry Cool subzone): transmission line, water pipeline and access road;
- SBSmc2 (Sub-Boreal Spruce Moist Cold Babine variant): mine site transmission line and access road;
- SBSdw3 (Sub-Boreal Spruce Dry Warm Stuart variant): transmission line and access road;
- SBSmc3 (Sub-Boreal Spruce Moist Cold Kluskus variant): mine site, transmission line, water supply pipeline and access road; and
- ESSFmv1 (Engelmann Spruce-Subalpine Fir Moist Very Cold Nechako variant): mine site, transmission line and access road.

The SBSdk subzone is the driest of the variants described and occurs at lower elevations (700 m to 1,050 m). Young and mature seral forests predominate, due to recurrent disturbances such as fire and insect outbreaks. Forested areas are often dominated by lodgepole pine and trembling aspen. Lodgepole pine forests have been affected by the Mountain Pine Beetle (MPB), and forests of dead standing lodgepole pine are common.

Upper portions of the transmission line and access road traverse the SBSdw3 variant occurs at lower elevations (750 m to 1,100 m). Forests tend to be diverse for the region, and include tree species such as Douglas fir, lodgepole pine, and hybrid white spruce on zonal sites. Currently, all of the lodgepole pine forests have been affected by the MPB. Forests of standing dead lodgepole pine are common. Deciduous forests are dominated most commonly by trembling aspen.

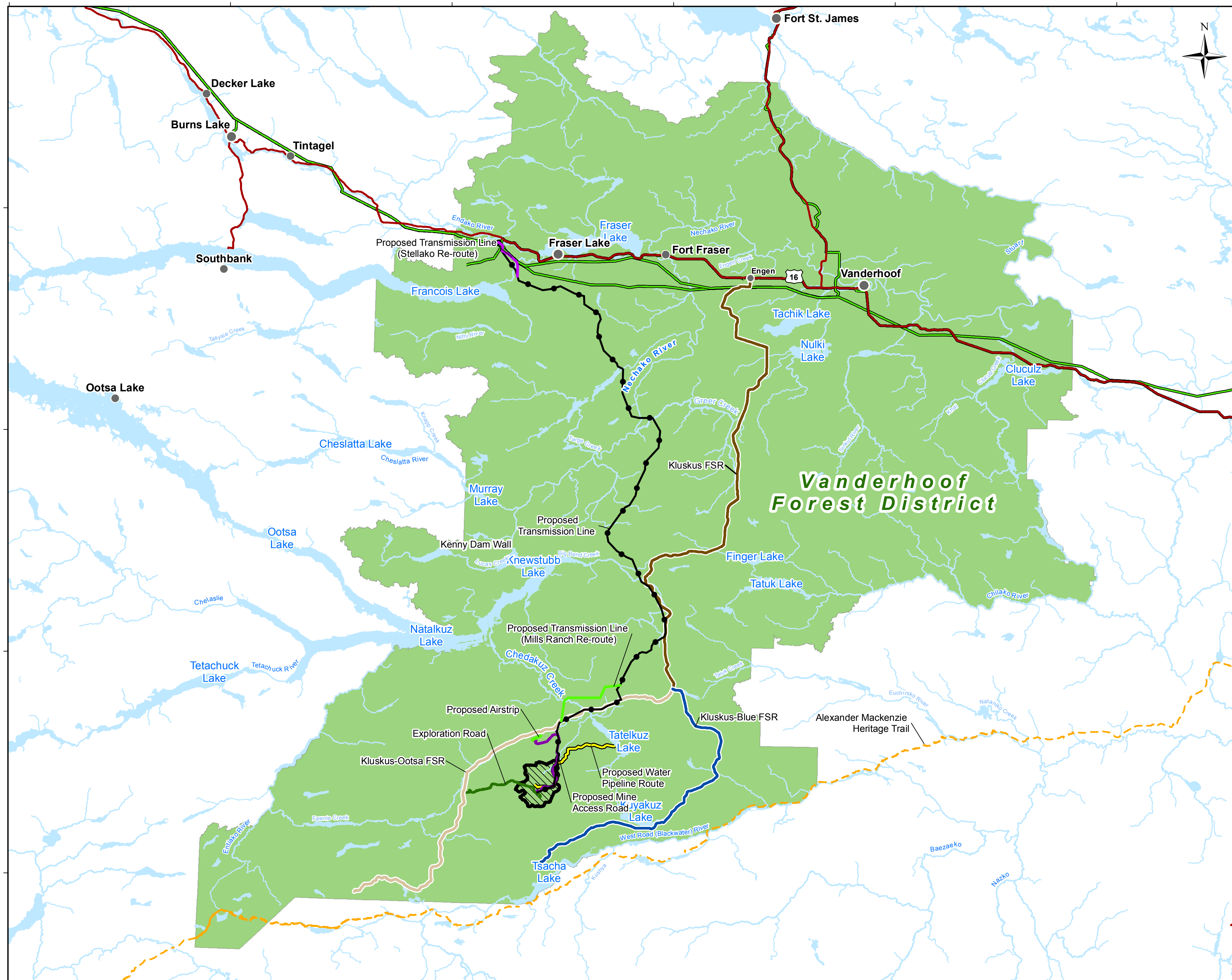
SBSmc2 occurs at elevations from 900 m to 1,250 m and is very limited in total area. On mesic sites, hybrid white spruce, subalpine fir, and lodgepole pine make up the canopy. Lodgepole pine is associated with more xeric site conditions.

SBSmc3 covers a large portion of the study areas and has an elevation range from 975 m to 1,300 m. Lodgepole pine and hybrid white spruce are the dominant canopy species on gentle terrain, and in areas of cool exposure with average moisture availability. Lodgepole pine is prominent in areas of dry, warm exposure. Hybrid white spruce can be dominant on moist to wet seepage sites and flood plains.

ESSFmv1 is the most common variant in the study area occurring from approximately 1,300 m to 1,620 m. Subalpine fir and Engelmann spruce are dominant trees in mesic sites. Lodgepole pine gains prominence on submesic sites, and as a seral species in younger stands and on warm exposures.

According to the Prince George Fire Centre (2013a), only one wildfire of greater than 1,000 ha was documented between 1980 and 2003 in the Vanderhoof Forest District (1987; 1,195 ha). **Figure 11.8.1-2** shows the total amount of hectares (ha) that were burned by wildfires from 1980 to 2012. Four years, 2004, 2005, 2006 and 2010, showed significantly higher burning than the rest of the years, which could be related to the MPB epidemic in the region. A total of 20,504 ha were burned by wildfires in 2010, which according to fire records, represents the largest area burned by wildfires in one year during 1980 to 2012.

Fire records between 1980 and 2012 indicated that, in general, the majority of wildfires in the Vanderhoof Forest District burned only small areas, covering areas of less than 20 ha, except for a few isolated events that covered large areas (greater than 1,000 ha). The forest fire record for the Vanderhoof Forest District is included in **Appendix 11B**.



Legend

- Populated Place
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Alexander Mackenzie Heritage Trail
- Existing Transmission Line
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Re-route)
- Proposed Transmission Line (Stellako Re-route)
- Exploration Road
- Proposed Mine Access Road
- Proposed Water Pipeline Route
- Stream
- Waterbody
- Proposed Mine Site

KEY MAP

Scale: 1:700,000

0 5 10 20

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold		
PROJECT: Blackwater Gold Project		
Vanderhoof Forest District		
DATE: July, 2013	ANALYST: MY	**Figure 11.8.1-1**
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GIS FILE: Other-100-087_vanderhoof_forest_district.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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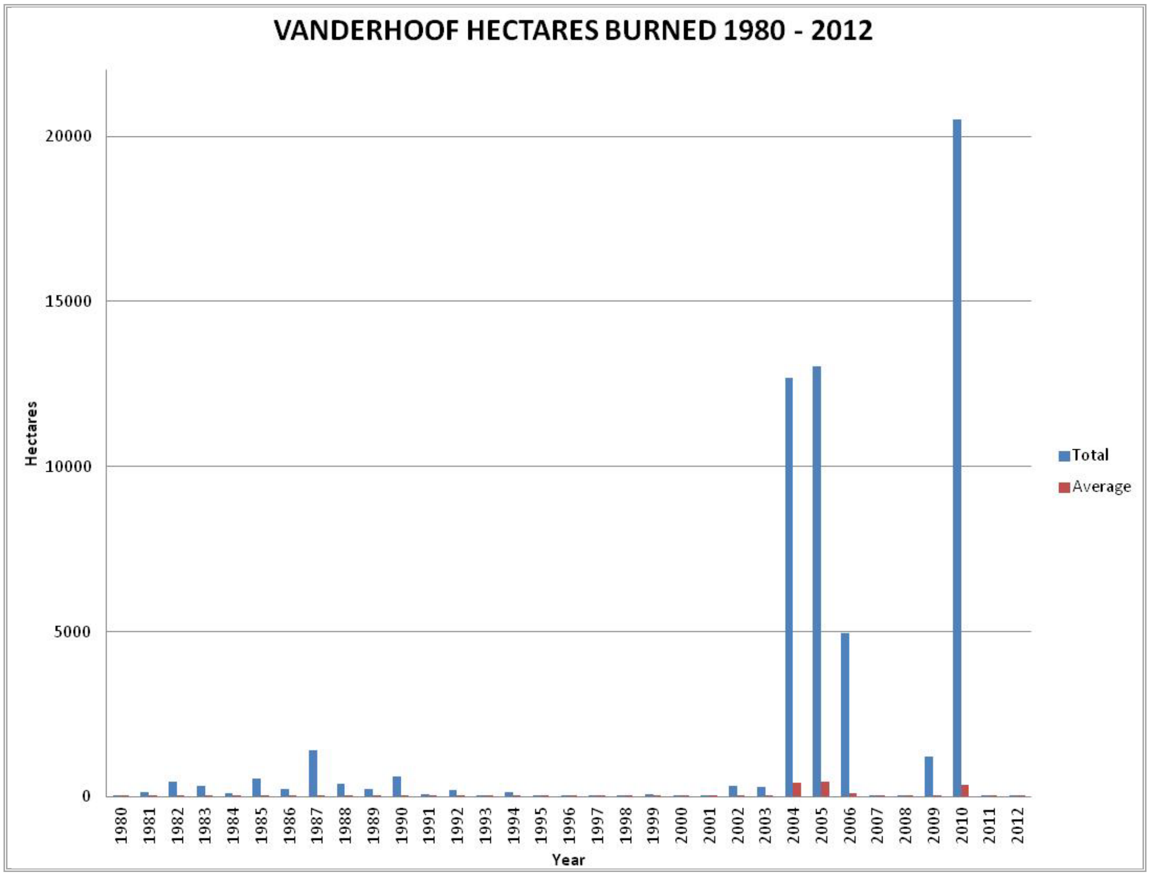

Figure 11.8.1-2: Record of the Total and Average Amount of Hectares Burned by Forest Fires in the Vanderhoof Forest District between 1980 and 2012 (Prince George Fire Centre, 2013a)

The Prince George Fire Centre has prepared a prototype probability map for the Vanderhoof Forest District (Prince George Fire Centre, 2013b). While it is subject to change and has not been ground-truthed to reflect present fuel conditions, it nonetheless reflects the identified potential for a natural fire in the District. In general, the southwestern portion of the District where the Project site is located has been identified as an area with significantly lower probability for a natural fire, than the areas near the Nechako River where the transmission line connection is proposed.

11.8.2 Potential Effects on the Project and Mitigation

Forest fires are a natural part of ecosystem regeneration. Terrestrial habitat losses resulting from fire damage will allow for the natural succession ecological processes that occur throughout the region. All Project components are vulnerable to natural fire, but particularly the process plant and the transmission line.

Fire Danger Class Reports are provided by the BC Wildfire Management Branch (BC WMB) on an ongoing basis for the Province and including for the Project study area. The Danger Class Reports are updated on an hourly basis using weather station data and can vary from low to extreme. Under extreme conditions, extreme caution must be used in any forest activity, and open burning and industrial activities may be restricted (BC WMB, 2013).

The forest fire record for the Vanderhoof Forest District indicated that significantly larger than average historical wildfires occurred between 2004 and 2010. It is understood that MPB infestations of lodgepole pine have increased during the past years. As a result, there is a potential for wildfires to occur in the vicinity of the Project during the mine lifetime.

Fire suppression systems will be established to protect key buildings and help ensure the safety of personnel. Fire water storage will comply or exceed regulatory requirements. The process plant and other buildings will be somewhat protected from natural fires, as a result of their position relative to the fire breaks offered by the Project's dominantly mineral (non-burning) facilities:

- TSF (to the north);
- Stockpiles (to the southwest and southeast);
- Open pit (to the south); and
- Main access road (to the east).

This facility-related fire break will be most effective to the southwest and southeast, as a forested area will be maintained between the mill site and the TSF, and least effective from the east. The dominant wind direction at the Blackwater High climate station (closest to the main site) is from the west (Knight Piésold, 2013a).

The greatest damage would occur if a fire reached the plant site and associated buildings. The mine site and some facilities such as the Low Grade Stockpile, the TSFs and the dams are proposed to be located in areas where they would provide a significant buffer zone in the north, east, and south directions.

A significant fire could cause construction or operations to cease and facilities to be destroyed. Related smoke could reduce visibility and cause a need to restrict unnecessary outdoor activities and/or provide appropriate equipment to protect workers. Given that there is only one main access road to the Project site, particular care will be taken by maintaining contact with the BC Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO) fire control staff particularly when there are active fires in the region, to ensure there is sufficient time to evacuate workers, should it be deemed necessary. A protocol will be established to ensure efficient evacuation occurs, with appropriate drills to confirm adequacy; or alternatively, personnel will remain at site should that prove the safest option. Personnel will also be trained to be attentive during storm events for lighting strikes and will also abide by Forest Protection Fire Hazard ratings and closures, particularly during the construction phase, when there are a greater number of personnel at site, potentially not familiar with the local region and conditions. However, the airstrip will be available for evacuation.

During the operations phase, the Proponent would reduce the risk of fire by:

- Carefully managing the proposed mine site, keeping areas clean and free of clutter and unused equipment, and maintaining cleared fire breaks;
- Complying with fire hazard ratings and carefully managing activities that could potentially increase the risk of fire, especially during high-risk periods; and
- Remaining continuously attentive to minimizing the risk of fire, especially during fire closures.

The Project will have a plan in place to assist in protecting the Project site and surrounding area from fire. Employees will gain knowledge of fire prevention and early detection as part of their site entrance training. The mine rescue team will be trained in effective firefighting techniques. Designated employees will remain in close contact with the BC MFLNRO fire control staff during the fire season to identify any fire threats that may occur at or near the Project site. Additional wildfire mitigation measures are described in **Section 12.2.1.18.4.20**.

The transmission line is anticipated to be the Project facility at greatest risk to natural fire damage as it passes through remote areas of mature forest. Rather than additional clearing to create fire breaks, mitigation will be primarily by managing the risk. Risk will be managed through such means as: maintaining communications with appropriate fire-related agencies; conducting line maintenance during lower fire risk periods if possible; and educating workers on fire prevention.

If portions of the transmission line were to be damaged by fire, those portions of the line would be repaired. Until such time, processing and associated operations would cease due to a lack of power. A small set of contingency transmission line poles may be stored at site to facilitate expeditious line repair in the event of a small area of fire damage. Emergency diesel generators will be available to provide the power needed for critical functions, such as pumps.

While natural fires may have an effect on the Project and could cause disruption of operations, they are not reasonably expected to result in an additional environmental effect, such as causing a malfunction or accident.

11.8.3 Summary

Forest fires are a natural hazard that has the potential to affect the Project, particularly in the more remote, forested areas. The Project has been designed to protect workers safety and health as a priority through the establishment of a fire safety and response plan. The transmission line is at greatest risk and contingency measures will be in place to ensure that critical power needs at the Project site can be maintained until repairs can be made. Nonetheless, should a major fire affect the region, there is the potential for disruption to site access and damage to the Project facilities that could cause a disruption in operations and the potential need for reconstruction. Smoke and visibility from regional fires could also cause some temporary disruption in outdoor activities.

11.9 Flooding and Ice Jams

11.9.1 Flood Baseline

The Project is located dominantly on the northern slope of Mt. Davidson and includes or is adjacent to the following watersheds: Turtle Creek, Davidson Creek, Creek 661, Creek 705 and Chedakuz Creek (Figure 2.1-1 in AMEC, 2013b). All Project mining components are located in the upper reaches of the Davidson Creek and Creek 661 watersheds. The local creeks are characterized by relatively high flows in late spring and early summer, due to rain and snowmelt, and low flows in winter. Flood frequency analysis including the determination of: estimated monthly streamflows for average, through 1:5 and 1:200 wet years (Table 3.1-1 in AMEC, 2013b); along with peak instantaneous flows for the Project hydrometric stations (Table 3.1-2 in AMEC, 2013b) was completed.

The Upper Davidson Creek catchment will be impounded to create the TSF, with the runoff from the catchment being used to supply water for operations, with the exception of an extreme upper portion that is being diverted into Creek 705. Extensive investigations and modelling have been completed to assess the hydrologic conditions at and surrounding the Project, as described by AMEC (2013b) in order that the Project is designed to accommodate both average and extreme hydrologic conditions.

11.9.2 Potential Effects on the Project and Mitigation

Extreme flood events have the potential to cause structural failure of tailings dams and other dam structures, and to flood low-lying facilities. The Project is located on the side of Mt. Davidson and with the exception of the TSF, there are no major facilities in lower-lying areas associated with the Project (with the exception of unavoidable pumping station(s) and transmission line crossings) which will not be in active channel per DFO guidelines.

The TSF has purposefully been designed and placed within the upstream portion of the Davidson Creek valley, in part to minimize upstream catchment area. Nonetheless, to protect the tailings dams against the risk of extreme floods, the tailings dams have been designed to meet all regulatory requirements. Tailings dams were designed to Canadian Dam Association Very High classification. Additional discussion can be found in **Section 2.2.3.4.6**. The dams will contain the Environmental Design Flood and the spillways will be designed to pass extreme floods (the Probable Maximum Flood) without affecting dam stability. The Probable Maximum Flood is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.

Diversion channels and diversion dams that route water around the TSF during the construction phase have been designed to pass a 1:10 year 24-hour storm event, as well as 1:10 year wet October, November, and December water volumes. Other water management structures have generally been designed to this same criterion.

The post closure spillways proposed to transfer overflow from the open pit and from the TSF to local watercourses once environmental discharge criteria are met, have been designed to pass the probably maximum precipitation event. This is defined as 195 mm in 24 hours and 1:100 year snowmelt (459 mm) without consideration of the runoff attenuation provided by storage below the spillway crest (Knight Piésold, 2014).

Any water that enters the pit through direct precipitation or through the limited overland flooding possible would be pumped out over a period of several days. Mining would either continue to occur above the flooded pit level, or the process plant feed would derive from the coarse ore or low-grade ore stockpiles.

Transmission line structures will be placed above the flood zone, or will be suitably protected to ensure damage does not occur, such as with armour stone.

The EIS Guidelines list ice jams as potential natural hazards. As the Project is located in a headwater area, the size of the watercourses associated with the Project are such that there is no potential for concern related to ice jams and associated flooding. The TSF will not be subject to ice jam effects, as it will have insufficient wind fetch to generate an ice jam either during operations or at closure.

11.9.3 Summary

Extreme flood events are not expected to affect the Project, and no resulting environmental effects are expected. Floods such as the 5-year or 10-year floods that represent less extreme events would similarly not have an effect on the Project.

11.10 Drought

11.10.1 Drought Baseline

Extreme drought conditions could have two primary effects on a Project:

- Cause the Project area to be more susceptible to fire; and
- Effect the ability to operate and close the Project in the means proposed due to a decreased water supply.

Potential effects of natural fire is addressed in **Section 11.8**.

As part of the Project design, potential effects from low flows and drought conditions were assessed and fully considered. Minimum 7-day low flows conditions occur in late summer in response to depleted groundwater flows and low precipitation; and late winter, in response to depleted groundwater flows and surface water being contained as ice and snow. These distinct low flow periods are evident in both the Project and regional datasets (Knight Piésold, 2014).

Drought conditions would generally be considered a temporary but prolonged, period of abnormally low precipitation over more than a season, rather than the normal seasonally dry conditions described above. Drought information is maintained by the Government of British Columbia including the posting of drought advisories on a seasonal basis and would be available to help guide site operations and modify operations if needed.

11.10.2 Potential Effects on the Project and Mitigation

The Project design is robust and considers drought (dry year) conditions. A water management plan is in place for all mining phases; to help ensure Project area waterbodies are not negatively affected by the Blackwater Mine, and to ensure acceptable restoration of drainages upon closure of the mine. The primary water needs for the Project are to provide sufficient water to support mill water requirements and maintain PAG materials in the TSF in a subaqueous state.

Three natural waterbodies (in addition to considerable process water recycle and re-use of groundwater captured by the open pit) are integral to the fresh water supply system: Tatelkuz Lake, Davidson Creek and Chedakuz Creek. The flows in all three waterbodies are interrelated and essential to the system design. To guard against a series of extremely dry years, sufficient freshwater storage will be provided as an in-creek water body within Davidson Creek (**Section 5.3.2**). The reservoir will have a storage capacity of about 400,000 m^3 of fresh water.

Knight Piésold completed an assessment (**Section 2.2.3.5.2.5**) to address the risk that PAG rock contained in the TSF could become exposed under extreme dry conditions post closure. Two scenarios were considered which are believed to represent the most extreme conditions for the Project area:

- No precipitation over the entire Site D catchment area; and
- A 1:200 year dry precipitation over the Site D catchment area (0.5% probability of exceedance).

The result of the first scenario is that it would take approximately 8 years for the PAG waste rock to be exposed, which equates to a drawdown of 1.3 m/y. This scenario represents a statistical case for which there is no reasonable return period: where absolutely no precipitation occurs within the entire TSF catchment for all 8 years required for the drawdown to occur.

The result of the second scenario is that the volume of runoff and direct precipitation (inflows) contributing to the TSF under the 1:200 year dry annual precipitation condition (6.5 Mm^3/y), is greater than the losses due to seepage and evaporation (2.65 Mm^3/y). The surplus inflow would contribute to the TSF pond and discharge through the TSF spillway to Davidson Creek even under these dry conditions. Consequently, the PAG waste rock is not predicted to be exposed in this post closure scenario. The PAG sulphide tailings will be stored in the TSF at an elevation lower than the TSF spillway and covered with oxide tailings and overburden. It can be inferred that the sulphide tailings would also not be exposed since the spillway remains active even under these dry conditions.

A drought could however, have a temporary effect on the success of revegetation efforts associated with progressive and final reclamation, that could result in a need for additional reclamation efforts after drought conditions cease.

11.10.3 Summary

As a result, drought events are expected to have only a minor effect on Project.

11.11 Climate Change

11.11.1 Climate Change Baseline

Climate data are currently being collected at two climatology stations at approximately elevations 1,050 masl and 1,350 masl, which were installed in 2011 and 2012, respectively. As there are currently limited data from both site stations, Project development has relied on the historical data from the closest Meteorological Service of Canada station located approximately 18 km northeast at Tatelkuz Lake (elevation 914 masl), adjusted for the mine site elevation (1,470) as follows (Knight Piésold, 2013a):

- Mean annual temperature at the site is estimated to be 3°C, with minimum and maximum mean monthly temperatures of -4.7°C and 12.0°C occurring in January and July, respectively.
- The mean annual precipitation for the site is estimated to be 636 mm, with approximately 50% falling as rain and 50% falling as snow. Precipitation is fairly evenly distributed throughout the year, with mean monthly values ranging from a low of 20 mm in April to a high of 72 mm in December (Knight Piésold, 2013a).

The effects of climate change on BC has been predicted by the Pacific Climate Impacts Consortium (PCIC); as found in Knight Piésold, 2013a) As shown in **Table 11.11.1-1**, climate changes are expected to result in an increase in mean temperatures in BC by approximately 1.8°C by the 2050s. The effect on precipitation varies by season: overall, winter precipitation is predicted to increase by 8%, but snowfall is predicted to decrease by 58%; with summer precipitation expected to decrease nominally by 1% from the 1961 to 1990 baseline.

Long-term climate data are available from the Ootsa climate station operated by Environment Canada, for which 46 years of complete data are available. This dataset was analyzed to assess whether the predicted long-term regional climate trends predicted by PCIC are applicable to the Project area (Knight Piésold, 2013a).

Table 11.11.1-1: Summary of Predicted Climate Change in BC

Climate Variable	Season	Projected Climate Change in the 2050s		
		Median Change	**10th Percentile Change**	**90th Percentile Change**
Mean Temperature	Annual	1.8°C	1.3°C	2.7°C
Precipitation	Annual	6%	2%	13%
	Summer	-1%	-8%	7%
	Winter	8%	-2%	15%
Snowfall	Winter	-10%	-17%	2%
	Spring	-58%	-71%	-11%

Note: Modified from Table 5.1 in Knight Piésold, 2013a.

The assessment concluded that while there are very slight trends toward an overall increase in temperature, none were significant at the 10% level, such that there is confidence that the trend is not due to random chance. Trend plots of annual precipitation showed slight increases in annual precipitation and rainfall and a slight decrease in annual snowfall, but the trends were not significant to the 10% level. These findings lead to the conclusion that there is currently no notable evidence in the regional data of climate change effects on temperature and precipitation patterns (Knight Piésold, 2013a). This conclusion was similarly supported by an examination of flow records for the Dean River and Van Tine Creek where no notable evidence was found to support climate change effects on annual streamflow patterns (Knight Piésold, 2013a).

The review of historic long-term climate and streamflow records does not suggest notable climate change effects near the Project in the past, with the exception of possibly decreasing peak annual peak flows.

11.11.2 Potential Effects on the Project and Mitigation

Climate and runoff regimes in the region are likely to remain close to their current levels over the life of the mine based on the hydrometeorological assessment (Knight Piésold, 2013a). No material changes to the water balance determinations in the Project design over the mine life are predicted. TSF Closure Spillways have been designed to pass the probable maximum flood sized for the 24 hour probably maximum precipitation and 1:100 year snowmelt (459 mm) without consideration of the runoff attenuation provided by storage below the spillway crest, and are considered sufficiently robust to address potential climate change effects.

No mitigation measures are proposed related to climate change. Any implication of climate change on other aspects, such as potential for forest fires due to a reduced snow pack (if any), would be minor because of the short duration of the Project relative to climate change scenarios.

11.11.3 Summary

No effect from climate change on the Project over the mine life is predicted.

Maintenance of a saturated layer of tailings over PAG rock will be required long term. As discussed in **Section 11.10**, above, even under extreme dry conditions the TSF would remain saturated. Should the PCIC prediction of climate changes prove accurate as compared to the historic climate data for the region, the pit could flood at a nominally faster rate than currently predicted due to the overall increase in precipitation. Once flooded, the pit will overflow to the TSF and TSF supernatant water will overflow and be released to the environment. The length of time for the pit to overflow would not be increased sufficiently to cause a change to downstream water quality predictions from overflow supernatant water from the TSF. Nominally faster flooding of the pit would be an overall project benefit as once flooded, the pit presents less of a local safety hazard.

11.12 Conclusion

The federal EIS Guidelines requires that the Proponent provide a thorough examination of the potential environmental effects of the Project including any effect the environment may cause on the environment. Seven potential effects the environment could have on the Project were identified and assessed. Where applicable, Project components have considered the above aspects and used conservative design criteria as part of the overall Project design in order to mitigate potential negative outcomes from fluctuations in environmental conditions.

After mitigation through Project design and implementation of appropriated management practices and plans, no effects on the environment are expected to result from these aspects.