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5.1.1 Atmospheric and Acoustic Environment

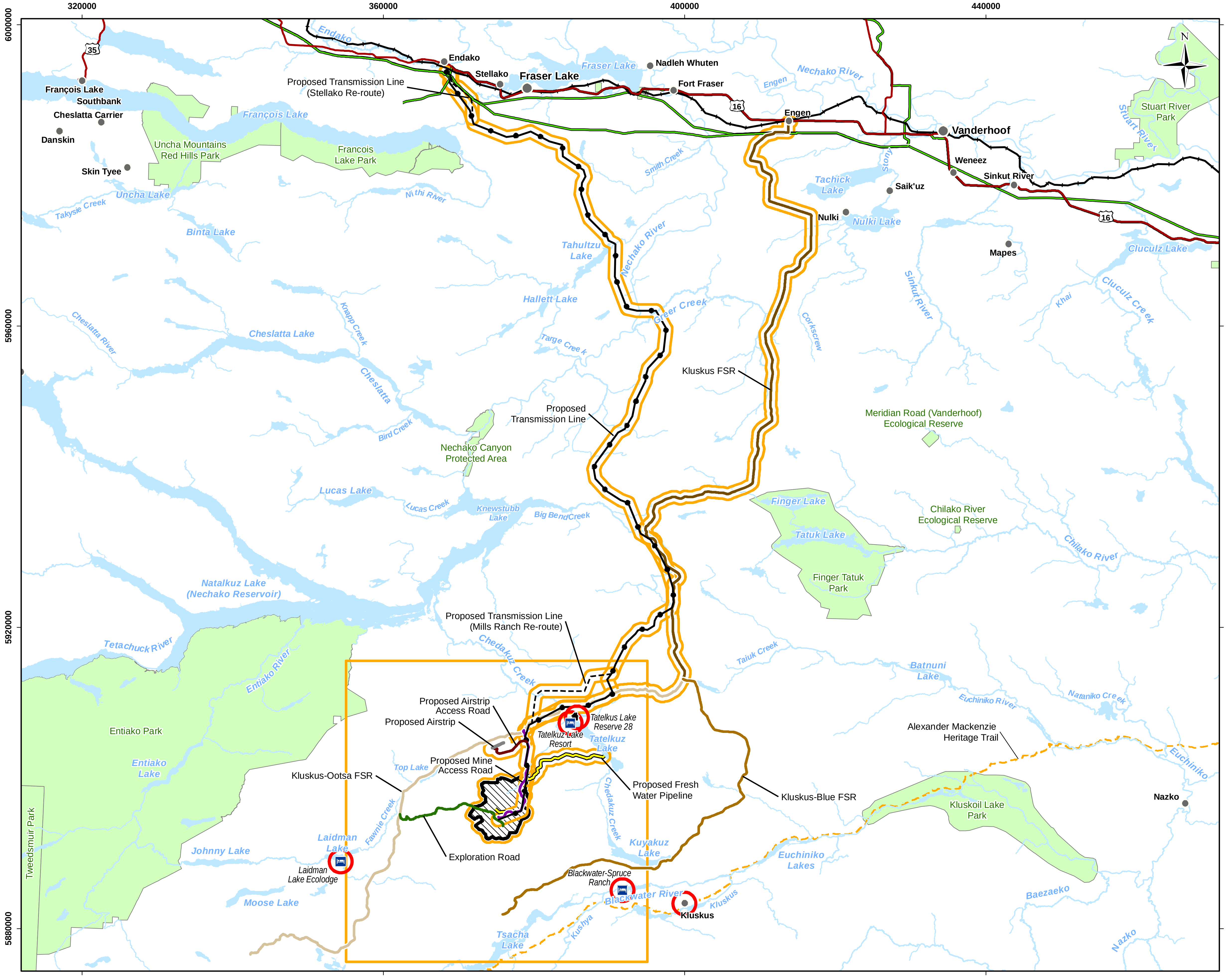
This section provides a description of the baseline condition of the proposed Blackwater Gold Project (the Project) for the Atmospheric and Acoustic Environment, which includes:

- Climate (**Section 5.1.1.1**);
- Air Quality (**Section 5.1.1.2**); and
- Noise and Vibration (**Section 5.1.1.3**).

5.1.1.1 Climate

The Project is located on the Nechako Plateau, approximately 110 km southwest of Vanderhoof, in central British Columbia (BC). A climate monitoring program was initiated for the Project with the installation of a climate station in July of 2011. A second climate station was installed in July of 2012. The climate study area is shown on **Figure 5.1.1.1-1**. The climate change VC was assessed at a Provincial and National level given the global nature of this VC. The Regional Study Area (RSA) is the same as the Local Study Area (LSA) climate, as described in **Section 4, subsection 4.3.1.1**. The climate study area incorporates the area where all greenhouse gas (GHG) emissions associated with the Project are emitted. GHG emission have no local effect, they contribute to overall global atmospheric levels of GHGs that affect climate behaviour. As climate change effects occur at a global level, no local assessment of climate change effects is provided and the climate study area is not used for effects assessment.

This section summarizes the climate baseline and GHG emission release information for the Project. Unless otherwise noted, all climate baseline information and data were obtained and provided by Knight Piésold Consulting Ltd. (Knight Piésold). Available climate data collected at these stations from their installation till December of 2012 (at least 16 months of data) along with detailed climate baseline information from Knight Piésold is provided in **Appendix 5.1.1.1A**.



Legend

- Populated Place
- Recreation Lodge
- Homestead
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Railway
- Existing Transmission Line
- Stream
- Waterbody
- Parks & Protected Areas

Project Components

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

Air Quality and Climate

- Local Study Area (LSA)
- Receptor Location

Note: Regional Study Area (RSA) is the same as the LSA

Scale: 1:500,000

0 5 10 20

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Air Quality and Climate Study Areas

DATE: October, 2014	ANALYST: WR	**Figure** 5.1.1.1-1
JOB No: VE52420	QA/QC: GH	PDF FILE: 04-100-001_v5_Air_SA_Receptor.pdf
GIS FILE: 04-100-001_v5_Air_SA_Receptor.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\04_air-quality\Baseline\04-100-001_v5_Air_SA_Receptor.mxd

5.1.1.1.1 Information Sources and Methods for Data Analysis

This section summarizes the information sources and methods for data analysis used to prepare the climate baseline data for the Project. Climate data were collected at two weather stations on the Project site (**Figure 5.1.1.1-2**) during 2011 and 2012. The climate monitoring program was initiated for the Project in July 2011 with the installation of the Blackwater Low climate station at an elevation of 1,050 masl. The Blackwater High climate station was installed in July 2012 at an elevation of 1,470 masl. Site visits to download the recorded data have been completed since the installation of the climate stations. Avison Management Services Ltd. (Avison) completed field data collection. Knight Piésold has provided field training, data management, and data reduction services for the collected information. The Project climate stations monitor the following parameters:

- Air Temperature (°C);
- Relative Humidity (%);
- Atmospheric pressure (kPa);
- Precipitation (mm);
- Snow depth (m);
- Solar radiation (W/m^2);
- Wind speed (m/s); and
- Wind direction (degrees from true north, and standard deviation wind direction).

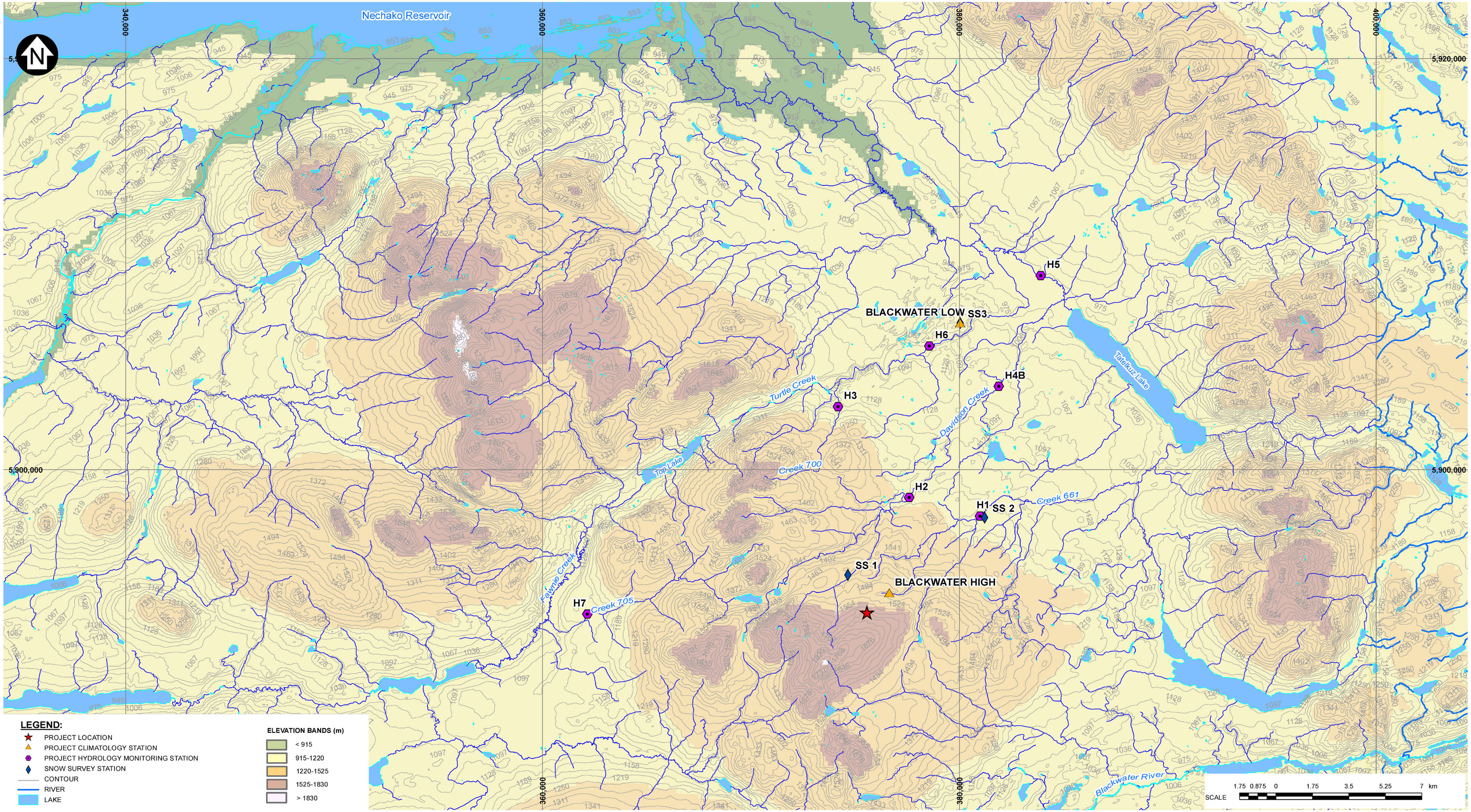
Regional climate data are available for weather stations operated in the area of the Project by Environment Canada (EC) or BC Forest Service (**Figure 5.1.1.1-3**). **Table 5.1.1.1-1** includes a summary of regional weather stations.

Table 5.1.1.1-1: Regional Weather Stations

Station Name	ID Number	Elevation (m)	Distance from Project (km)	Period of Record (number of complete years of data in brackets)
Fraser Lake North Shore	109C0LF	674	100	1969-2007 (37)
Vanderhoof	1098D90	638	112	1980-2012 (25)
Tatelkuz Lake	1088007	914	17	1970-1977 (4)
Endako Mine	1092676	984	97	1973-1982 (8)
Fort Fraser 13S	1092905	701	106	1970-1993 (23)
Ootsa	1085835	861	100	1956-2012 (44)
Kluskus	n/a	1,137	34	1991-2012 (0)

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)

Note: All stations are operated by Environment Canada except for Kluskus, which is operated by the BC Forest Service.



Notes:

Figure from Knight Piésold 2013 Engineering Hydrometeorology Report (VA101-457/6-12, Revision 0) dated 04 November 2013 (Appendix 5.1.2.1B).

CLIENT:	newgold
AMEC Environment & Infrastructure 4445 Lougheed, Suite 600, Burnaby, B.C., V5C 0E4 Tel. 604-294-3811 Fax 604-294-4664	amec
DWN BY:	MY
CHK'D BY:	JK
DATUM:	N/A
PROJECTION:	N/A
SCALE:	N/A
PROJECT	Blackwater Gold Project
TITLE	Project Monitoring Stations
DATE:	January 2014
PROJECT NO:	VE52277
REV. NO.:	A
FIGURE No.	5.1.1.1-2

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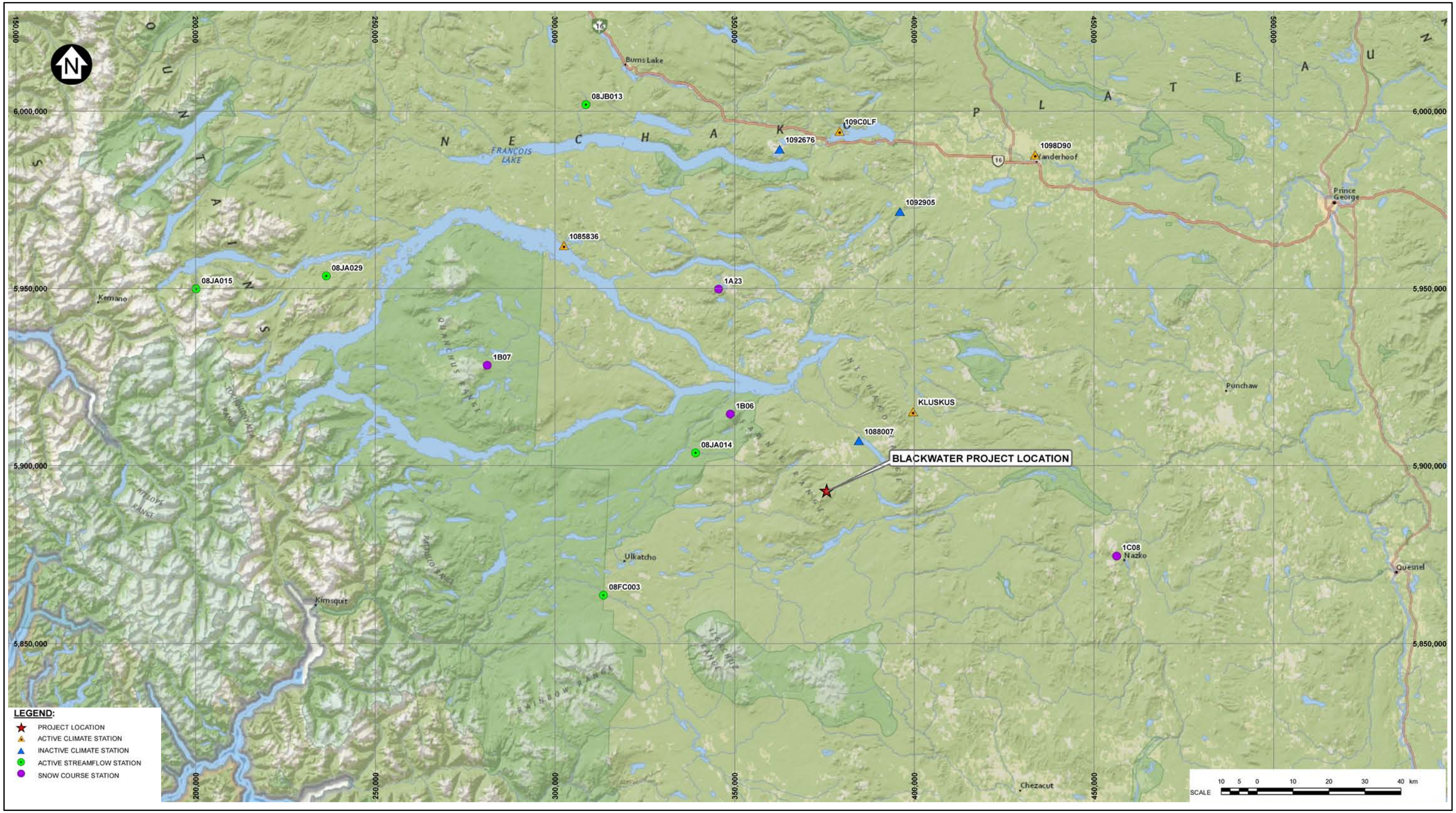

Notes:

Figure from Knight Piésold 2013 Engineering Hydrometeorology Report (VA101-457/6-12, Revision 0) dated 04 November 2013 (Appendix 5.1.2.1B).

CLIENT: newgold	DWN BY: MY	PROJECT: Blackwater Gold Project	DATE: January 2014
	CHK'D BY: JK		PROJECT NO: VE52277
AMEC Environment & Infrastructure 4445 Lougheed, Suite 600, Burnaby, B.C., V5C 0E4 Tel. 604-294-3811 Fax 604-294-4664	DATUM: N/A	TITLE: Regional Streamflow and Climate Stations	REV. NO.: A
amec	PROJECTION: N/A		FIGURE No. 5.1.1.1-3
	SCALE: N/A		

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Table 5.1.1.1-2 summarizes the Project and regional weather station precipitation distributions with period of records longer than 10 years.

Three snow course surveys were operated in 2012 near the Project at SS1, SS2, and SS3 (**Figure 5.1.1.1-2**). These stations were commissioned in February 2012 and visited three times during that same winter. Regional snow course survey data are also available near the Project at 1B06 and 1A23 (**Figure 5.1.1.1-3**). Snow course survey data were used to estimate snow accumulation, density, and melt patterns. **Table 5.1.1.1-3** summarizes the Project and regional snow course data.

Using site and regional precipitation data, annual precipitation for the Project was estimated. Extreme 24-hour precipitation values for the Project were estimated using the Rainfall Frequency Atlas frequency factor approach. In addition, wet and dry year precipitation values were estimated based on a normally distributed probability of occurrence. No evaporation data were collected at the Project or at regional weather stations operated by Environment Canada (EC) near the Project. Therefore, annual potential and actual evapotranspiration values for the Project were estimated using common engineering/hydro-meteorological practices. Due to limited snow course survey information for the Project, the snowmelt pattern for the Project was estimated using regional snow course survey data. Sublimation was estimated for the Project using values consistent with those reported in literature. Mean monthly temperature values were estimated based on a long-term synthetic monthly data series developed for the Project. No regional wind speed data were available near the Project; therefore, mean values were estimated from values measured at the Project. Likewise, no regional relative humidity and solar radiation data were available near the Project. Therefore, mean values were estimated from values measured at the Project climate stations (**Appendix 5.1.1.1A**).

Table 5.1.1.1-2: Project and Regional Weather Station Precipitation Distributions

Station Name	Period of Record	Mean Total Precipitation													
		Unit	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Blackwater High	2012	mm	-	-	-	-	-	-	60.9	44.1	14.7	55.3	19.8	8.5	-
		% annual	-	-	-	-	-	-	-	-	-	-	-	-	-
Blackwater Low	2011	mm	-	-	-	-	-	-	-	15.4	42.2	6.2	19.9	36.5	-
		% annual	-	-	-	-	-	-	-	-	-	-	-	-	-
	2012	mm	-	19.0	21.6	51.1	32.2	66.1	50.1	66.9	7.2	60.9	22.5	8.2	
		% annual	-	-	-	-	-	-	-	-	-	-	-	-	-
Kluskus	1991-2012	mm	-	-	-	19.3	40.9	65.4	53.1	47.0	49.6	41.1	-	-	-
		% annual	-	-	-	-	-	-	-	-	-	-	-	-	-
Fraser Lake North Shore	1969-2007	mm	49.6	30.1	27.7	20.3	37.9	54.1	55.9	45.2	48.1	49.3	48.8	50.2	**517**
		% annual	10%	6%	5%	4%	7%	10%	11%	9%	9%	10%	9%	10%	100%
Ootsa	1956-2012	mm	42.6	25.0	22.4	18.3	27.5	44.5	44.2	39.9	36.1	41.4	42.8	46.3	**431**
Vanderhoof	1970 – 2012	mm	43.7	28.1	22.7	25.2	35.4	55.1	51.4	46.7	42.6	50.9	45.5	41.1	**488**
		% annual	9%	6%	5%	5%	7%	11%	11%	10%	9%	10%	9%	8%	100%
Tatelkuz Lake	1970 – 1977	mm	51	25	25	17	20	70	64	42	37	38	40	55	**483**
		% annual	10%	5%	5%	3%	4%	15%	13%	9%	8%	8%	8%	11%	100%

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)

Note: All stations are operated by Environment Canada except for Kluskus, which is operated by the BC Forest Service.

Table 5.1.1.1-3: Regional and Project Snow Course Data

Station Name	Elevation (m)	Year	Snow Water Equivalent (mm)		
			January	February	March
1B06	1,596	Mean Annual	211	254	290
		2012	199	254	273
1A23	1,196	Mean Annual	108	133	143
		2012	104	156	132
SS1	1,412	2012	70	93	-
SS2	1,168	2012	28	57	-
SS3	1,051	2012	15	42	-

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)
Note: m = metre; mm = millimetre

5.1.1.1.2 Results/Discussion

This section summarizes the climate baseline data for the Project. Mean annual precipitation of 636 mm was estimated for the Project. Based on regional precipitation distribution patterns, it is expected that the Project area would experience precipitation throughout the year with April being the driest month and November, December, and January being the wettest months. (**Appendix 5.1.1.1A**). **Table 5.1.1.1-4** summarizes the average precipitation, rainfall, and snow water equivalent estimated for the Project.

Table 5.1.1.1-4: Estimated Average Precipitation, Rainfall, and Snow Water Equivalent for the Project

Parameter	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation	mm	73	45	39	20	50	66	52	51	47	47	74	72	636
Precipitation Distribution	%	12	7	6	3	8	10	8	8	7	7	12	11	100
Rainfall	mm	0	0	0	13	50	66	52	51	47	31	0	0	310
Rainfall Distribution	%	0	0	0	65	100	100	100	100	100	65	0	0	49
Snow Water Equivalent	mm	73	45	39	7	0	0	0	0	0	16	74	72	326
Snow Water Equivalent Distribution	%	100	100	100	35	0	0	0	0	0	35	100	100	51

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)
Note: mm = millimetre; % = percent

Table 5.1.1.1-5 summarizes the 24-hour extreme precipitation estimated for the Project.

Table 5.1.1.1-5: Estimated 24-Hour Extreme Precipitation for the Project

Return Period (Years)	24-hour Extreme Event (mm)
2	37
5	44
10	50
15	53
20	55
25	56
50	61
100	66
200	71
500	78
1000	82
PMP	195

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)
Note: mm = millimetre; PMP = Probable Maximum Precipitation

Table 5.1.1.1-6 summarizes the wet and dry annual precipitation estimated for the Project.

Table 5.1.1.1-6: Estimated Wet and Dry Annual Precipitation for the Project

Return Period (Years)	Precipitation (mm)
1:200 year wet	794
1:100 year wet	779
1:50 year wet	762
1:20 year wet	737
1:10 year wet	715
Mean Annual	636
1:10 year dry	557
1:20 year dry	535
1:50 year dry	510
1:100 year dry	493
1:200 year dry	478

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)
Note: mm = millimetre

Annual potential evapotranspiration of 445 mm was estimated for the Project. The annual actual evapotranspiration that was estimated for the Project ranges between 267 mm and 356 mm based on vegetation native to the area (**Appendix 5.1.1.1A**). **Table 5.1.1.1-7** summarizes the estimated potential evapotranspiration for the Project. The potential evapotranspiration is defined as the amount of evapotranspiration that would occur given an infinite supply of water from a crop surface, and these values are believed to be reasonably representative of lake evaporation conditions.

Table 5.1.1.1-7: Estimated Potential Evapotranspiration for the Project

Parameter	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Potential Evapotranspiration	mm	0	0	0	20	66	93	104	91	54	13	0	0	445
Potential Evapotranspiration Distribution	%	0	0	0	4	15	21	23	20	12	3	0	0	100

Source: Knight Piésold, 2013 (**Appendix 5.1.1.1A**)
Note: mm = millimetre; % = percent

Sublimation was estimated for the Project to be 100 mm for the winter season. The snowmelt for the Project was estimated to be 21% in April, 53% in May, and 26% in June (**Appendix 5.1.1.1A**).

Annual mean temperature was estimated to be 2.0°C for the Project. The minimum monthly mean temperature was estimated to be -7.7°C and is expected in January. The maximum monthly mean temperature was estimated to be 12.5°C and is expected in July (**Appendix 5.1.1.1A**).

Annual mean wind speed for the Project was estimated to be 2.4 m/s using data from the Blackwater Low climate station, with the wind predominantly from the southwest (**Appendix 5.1.1.1A**).

Annual mean relative humidity was estimated to be 61% for the Project using data from the Blackwater Low climate station. The minimum monthly relative humidity was estimated to be 49% in May. The maximum monthly relative humidity was estimated to be 71% in November and December (**Appendix 5.1.1.1A**).

Readings from the Project climate stations indicated that solar radiation tends to be zero following sunset and prior to sunrise and at its maximum during the middle of the day. Maximum solar radiation for the Project was estimated to be 1,033 W/m^2 and is expected in the summer months (**Appendix 5.1.1.1A**).

The Project climate stations estimate that atmospheric pressure is the highest in September at 103 kPa and lowest in January at 101kPa. Atmospheric pressure is approximately 101 kPa at sea level (**Appendix 5.1.1.1A**).

5.1.1.1.3 Climate Change

Climate change effects are global in nature, and emissions at any one location do not necessarily have effects at that location. Therefore, a Project-specific climate change baseline was not assessed.

BC has six operating metal (i.e., not including coal) mines that reported GHG emissions in 2013 (BC Ministry of Environment (BC MOE), 2013). None of these mines are easily comparable to the Project as one is an underground mine, three of the mines have no gold or silver production and the remaining two have copper as the primary metal production (by weight). Typically a sector-specific profile would require at least three similar facilities to produce a baseline to compare the Project against. There is insufficient data to produce a sector-specific GHG emission profile to compare to the Project. Therefore Project emissions were only compared to Provincial and national emission inventories.

The Project will produce GHG emissions from the combustion of fossil fuels that produce carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). GHG emissions are expressed in carbon dioxide equivalents (CO_2E). Factors for global warming potential used in generating GHG estimates are 1 for CO_2, 21 for CH_4, and 310 for N_2O emissions (World Meteorological Organization (WMO), 2007). Climate change will be assessed by estimating GHG for the Project and comparing these to provincial (BC) and national (Canada) emission inventories. **Table 5.1.1.1-8** summarizes the GHG emissions for BC and Canada.

Table 5.1.1.1-8: British Columbia and Canada GHG Emissions

Project GHG Emissions Comparison	Total GHG Emissions (kt CO_2E/y)
British Columbia GHG Emissions (2010)	62,000
Canada GHG Emissions (2011)	702,000

Source: BC MOE, 2012; EC, 2013
Note: CO_2E = carbon dioxide equivalent units, which convert non-CO_2 species (CH_4 and N_2O) using global warming potentials; GHG = greenhouse gas; kt/y = thousand tonnes per year

5.1.1.1.4 Conclusions

The climate parameters estimated in the climate baseline will be used to support the air quality, noise, climate change, and hydrology effects assessments for the Project.

5.1.1.2 Air Quality

The baseline refers to the collective level of air contaminants contained in the larger airshed, rather than just local measurements. These contaminants may arise from natural or anthropogenic (manufactured) sources. Understanding the appropriate background concentration of air pollutants is critical in assessing overall air quality, which incorporates background values and adds the predicted incremental increase from the Project emission sources. The detailed Air Quality Baseline Report is included in **Appendix 5.1.1.2A**. The study areas for air quality are presented in **Figure 5.1.1.1-1**. The air quality LSA includes the mine site, 40 x 40 km^2, where most of the activities that generate particle and combustion gases emissions will be located within a polygon that defines spatial boundaries for air quality modelling. The transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus Forest Service Road (FSR) are defined by a 3-km wide corridor along the linear components. The RSA is the same as the LSA for air quality.

Several databases were identified and analyzed by AMEC Environment & Infrastructure (AMEC) using such references as the number of monitored criteria air contaminants (CACs), instrumentation, location, the monitoring period, and the relevance to the Project with respect to level of development.

Availability of reliable, public domain air quality data covering remote areas of central and northern BC that allows the determination of the most likely baseline concentrations of relevant air contaminants near the Project is limited. Data were used from a remote monitoring station in Alberta as suggested by the BC EAO regional Meteorologist. BC monitoring station data sets were used to compliment and support these data, although some of those datasets were limited (**Appendix 5.1.1.2A**).

The final selection was narrowed to the following four data sources:

- The National Air Pollution Surveillance Program (NAPS)
  The NAPS program is a federal monitoring program that has been operating since 1972. Data is collected from 286 sites in 203 communities in every province and territory, providing a wide-range of options for obtaining locally representative data. Monitored species include the full range of substances evaluated for the Blackwater project;
- BC MOE Monitoring Network
  The BC MOE operates a network of nearly 2000 monitoring sensors throughout the Province of BC. The closest monitoring stations to the proposed Blackwater project are in Vanderhoof, Quesnel, Prince George, and Burns Lake;
- West Central Airshed Society (WCAS) Monitoring Stations
  The West Central Airshed Society is the oldest airshed in Alberta and has been operating a monitoring network since 1995. The Hightower station is often used as a background source in assessments as it is located in an undeveloped are of boreal forest remote form any settlements or industrial development. It was selected for this project on recommendation from the BC MOE Regional meteorologist, and it has a similar latitude and elevation to the proposed Blackwater mine site; and
- On-site Blackwater particulate monitoring
  As requested by BC MOE, a particulate sampling system was operated at the proposed mine site from August 2012 to December 2013. The system sampled every 3 days and collected 24-hour samples of $PM_{2.5}$ and PM_{10}.

The methodology of how each data source was used to determine the baselines values is provided in greater detail in the Air Quality Baseline Report found in **Appendix 5.1.1.2A**. Based on relevant data available at the above sources, values of the background concentrations proposed for the Project site for relevant contaminants are as follows:

- Particulate matter 2.5 microns (µm) diameter ($PM_{2.5}$) .... 4 µg/m^3
- Particulate matter 10 µm diameter (PM_{10}) .... 9 µg/m^3
- Nitrogen dioxide (NO_2) .... 8 µg/m^3
- Sulphur dioxide (SO_2).. 2 µg/m^3
- Ozone (O_3) .... 48 µg/m^3
- Carbon monoxide (CO) .... 120 µg/m^3

There is no ambient monitoring dust deposition data representative of the Blackwater site for dust deposition, Total Suspended Particulate (TSP) matter or Volatile Organic Compounds (VOC). Baseline dust deposition is assumed to be zero and the baseline concentration of TSP has been assumed to be 2.5x the PM_{10} value based on the rationale provided in Section 3.3.7 of the baseline report. Baseline VOC concentrations are assumed to be zero as there are no anthropogenic sources of VOCs in the LSA and from comments provided by the BC MOE Regional Meteorologist, that the baseline would be expected to be negligible.

Time-varying baseline values were not provided as it was determined that annual average values could be used for all parameters. This approach was discussed with and agreed to by the Regional Meteorologist of the BC MOE.

The background concentrations are low compared to ambient air quality objectives. This is expected as the Project is located in a remote area with no substantive nearby anthropogenic emission sources.

5.1.1.3 Noise and Vibration

Knowledge of a baseline noise level is a prerequisite to an Environmental Impact Assessment (EIA). Noise levels during mining will be incremental to the existing background noise. The baseline noise strength is important for assessing the perception of sound because a person's subjective reaction is to compare the new noise environment to the undisturbed acoustic environment.

The baseline noise levels were estimated to characterize the acoustical environment at the Project area in preparation for the Application. Specific objectives of the noise baseline programs were to find equivalent sound pressure levels (L_{eq}) and sound statistical descriptors (L_{10}, L_{50}, and L_{90}), which exist at remote locations of the Project prior to commencement of the exploratory, construction, and operation activities. Background noise levels are required to assess potential effects on receptors at or in the vicinity of the proposed Project including people and wildlife. Human receptors have been selected based on the proximity to the mine site which will be the main source of noise for the Project. The closest human receptors (permanent residents) were identified at approximately 15km of the proposed mine site, and include Tatelkuz Lake Ranch Resort and Tatelkuz Indian Reserve 28. Human receptors are presented in **Figure 5.1.1.3-1**. Wildlife is also present and has been characterized in **Section 5.1.3.4**. Selected species of wildlife (grizzly bear, furbearers, moose, caribou water birds, forest and grassland birds) have been chosen as Valued Components and the noise effects on these species are discussed in **Section 5.4**.

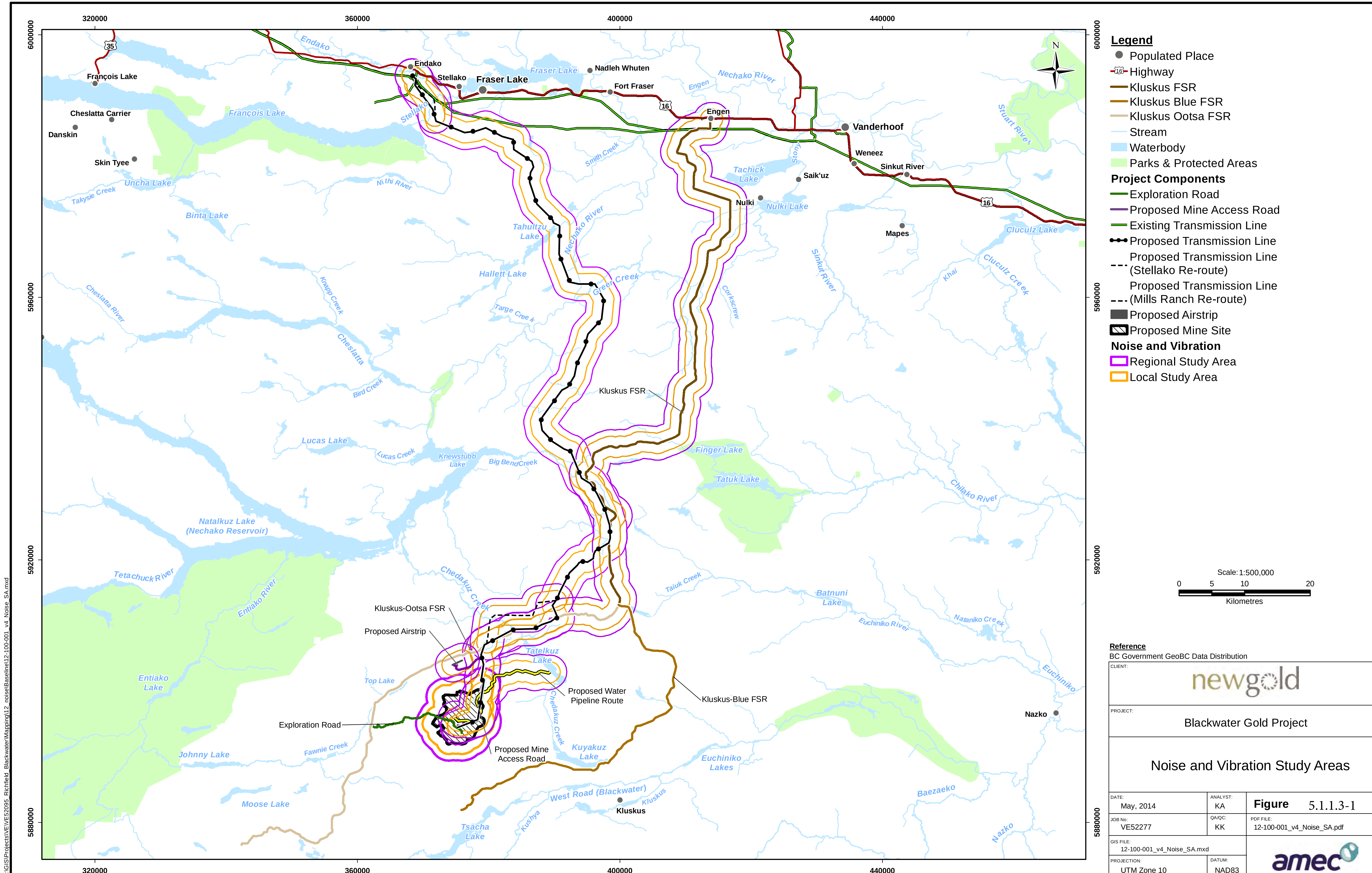
To scrutinize accuracy of the above estimate, it was necessary to conduct a real-time noise survey at anticipated sites of future noise sources in the area of the Project. The survey conducted in July 2013 revealed actual baseline noise levels similar to those included in the desktop study.

A summary of the baseline noise assessment and baseline vibration analysis is presented in the following subsections. The detailed 2013 Noise and Vibration Baseline Report is included in **Appendix 5.1.1.3A**. **Figure 5.1.1.3-1** shows the noise and vibration study areas. Study area boundaries were defined using professional judgement and experience in other mining developments as the area where potential noise effects could be perceived by human receptors. The study areas for noise are also discussed in **Table 4.3-1** in **Section 4** (Assessment Methodolgy) that presents the spatial boundaries description and rationale for each Valued Component.

5.1.1.3.1 Baseline Noise

Baseline sound monitoring surveys have been completed in central BC by AMEC for the Hillsborough Echo Hill Coal, Mt. Milligan Copper-Gold, and Bullmoose North Coal mining projects. The results were gathered and statistically analyzed in a desktop study, and used as the pre-exploration and pre-construction natural sound levels representing the undisturbed acoustic environment of the Project site.

Analysis of the results of the desktop study revealed that the measured sound parameters are comparable, although not identical. The similarity in baseline noise levels can be explained by the absence of anthropogenic noise sources, comparable topography, similar groundcover, and similar wildlife. These factors influence the acoustic environment, likely dominated by noise generated by various sources, such as wind blowing through trees and vegetation, insects, wildlife, birdsongs, animal and amphibian calls, the sound of running water in streams, distant thunder, etc. The Project is located in a remote area with comparable topography, regional climate, and groundcover, and away from regional municipal and industrial centres such as Prince George and Vanderhoof.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Proposed Transmission Line (Mills Ranch Re-route)
Proposed Airstrip
Proposed Mine Site
Noise and Vibration
Regional Study Area
Local Study Area
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Scale: 1:500,000
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Kilometres
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360000
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440000
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Endako
Stellako
Fraser Lake
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Fort Fraser
Engen
Vanderhoof
Weneez
Sinkut River
Saik'uz
Nulki
Mapes
François Lake
Cheslatta Carrier
Danskin
Skin Tyee
Nazko
Kluskus
Uncha Lake
Binta Lake
Takysie Creek
Nithi River
Tahultzu Lake
Nechako River
Hallett Lake
Green Creek
Targe Creek
Knapp Creek
Cheslatta River
Cheslatta
Bird Creek
Lucas Lake
Lucas Creek
Knewstubb Lake
Big Bend Creek
Finger Lake
Tatuk Lake
Natalkuz Lake (Nechako Reservoir)
Tetachuck River
Entiako River
Entiako Lake
Chedakuz Creek
Tatelkuz Lake
Top Lake
Johnny Lake
Fawnie Creek
Moose Lake
Kuyakuz Lake
Euchiniko Lakes
Euchiniko River
Euchiniko
West Road (Blackwater)
Tsacha Lake
Kushya
Baezaeko
Nazko
Batnuni Lake
Taiuk Creek
Nataniko Creek
Chilako River
Cluculz Lake
Cluculz Creek
Khai
Sinkut River
Corkscrew
Stony
Tachick Lake
Nulki Lake
Smith Creek
Nechako River
Stuart River
Endako
Fraser Lake
Engen
Stellako
Kluskus FSR
Kluskus-Ootsa FSR
Proposed Airstrip
Exploration Road
Proposed Water Pipeline Route
Proposed Mine Access Road
Kluskus-Blue FSR
16
35
Reference
BC Government GeoBC Data Distribution
CLIENT:
newgold
PROJECT:
Blackwater Gold Project
Noise and Vibration Study Areas
DATE: May, 2014
ANALYST: KA
Figure 5.1.1.3-1
JOB No: VE52277
QA/QC: KK
PDF FILE: 12-100-001_v4_Noise_SA.pdf
GIS FILE: 12-100-001_v4_Noise_SA.mxd
PROJECTION: UTM Zone 10
DATUM: NAD83
amec
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The results of the aforementioned background noise surveys are published in EIA reports or are available at AMEC as public domain reports. Background noise parameters include:

- L_{eq} in decibel A-scale (dBA);
- L_{10}, L_{50}, and L_{90}; and
- Baseline sound pressure levels for daytime ($L_{eq\ D}$), night time ($L_{eq\ N}$), and 24-hour ($L_{eq\ 24h}$).

The A-weighted sound level expressed in the dBA unit. The A-scale gives greater weight to the frequencies of sound to which the human ear is most sensitive, and describes the intensity or the sound pressure level in a particular location.

Sound statistical descriptors relate to the time-varying character of environmental noise. L_{10} is the A-weighted sound level equalled or exceeded during only 10% of the measurement time. L_{10} provides a good measure of the maximum sound levels caused by intermittent or intrusive noise. L_{50} is the A-weighted sound level that is equalled or exceeded by 50% of the measurement time period; it represents the median sound level. L_{90} is the A-weighted sound level equalled or exceeded by 90% of the time. Since this represents "most" of the time, L_{90} generally has been adopted as a good measure of the ambient baseline noise of the measurement site.

Because sound levels can vary markedly over a short period of time, a method for describing the average character of the sound must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy equivalent sound/noise descriptor is denoted by L_{eq}. The most common averaging period is hourly; however, L_{eq} can describe any series of noise events for any selected duration such as daytime (7 a.m. to 10 p.m.), night time (10 p.m. to 7 a.m.), or 24-hour duration. In determining the daily measure of environmental noise, it is important to account for the different response of people to daytime and night time noise. During the night time, exterior background noise levels are generally lower than in the daytime, and most people trying to sleep are more sensitive to noise. To account for human sensitivity to night time noise levels, a special descriptor was developed, referred to as the Day/Night Average Sound Level ($L_{eq\ D}$/$L_{eq\ N}$).

Baseline noise levels at a specific site can change significantly with time of day/night, season (quiet in winter), atmospheric conditions (high levels during windy weather and thunderstorms), and incidental anthropogenic sources (airplane or helicopter flyover, logging activities). Therefore, baseline noise levels are usually understood as inexact values within some unpredictable maximum/minimum range.

Baseline noise surveys for all three referenced projects were completed over 24-hour continuous monitoring sessions with each of them fulfilling common requirements:

- Meteorological parameters: wind speed below 4 metres per second (m/s) (14.4 kilometres per hour (km/h)), no precipitation, relative humidity below 95%, temperatures above the freezing point;

- Similar groundcover (trees, shrubs, grasses, etc.);
- Complex terrain (mountainous areas, elevations 900 to 1,100 masl); and
- Instrumentation: sound level meters Type 2 with the current versions of ANSI S1.4-1971 and ANSI S1.11-1966 standards and onsite calibrators.

The results of the surveys were used to approximate baseline noise levels for the Project by calculating the averages (the arithmetic means) of measured sound parameters. A record of referenced projects' results and calculated averages accepted for the Project are shown in **Table 5.1.1.3-1**.

Table 5.1.1.3-1: Baseline Sound Parameters for Blackwater Gold Project (Estimated) and Reference Projects (Monitored)

Project	UTM Location		Elevation (m amsl)	Sound Meter Type	Survey Date	Sound Parameters (dBA)					
	m E	m N				L_{eq}	L_{10}	L_{50}	L_{90}	$L_{90\ D}$	$L_{90\ N}$
Hillsborough Echo Hill Coal	639252	6138094	889	Quest 2900	18-19 Aug 2011	27.8	29.9	24.4	24.3	25.3	27.7
					19-20 Aug 2011	32.2	34.5	29.3	28.6	29.4	26.6
					25-26 Aug 2011	33.6	36.0	27.1	27.3	28.3	25.3
Mt. Milligan Copper-Gold	436322	6107600	1,056	Larson Davis	12-13 Oct 2006	21.7	25.1	19.2	17.1	16.6	17.8
Bullmoose North Coal	600929	6118813	1,092	Quest SE/DL	14-15 Aug 2012	36.1	38.1	34.9	34.5	34.4	34.6
Estimated for Blackwater Gold Based on the Above Projects	**375400**	**5893000**	**1,602**	**N/A**	**N/A**	**30.3***	**32.7***	**27.0***	**26.4***	**26.8***	**26.4***

Note: amsl = above mean sea level; dBA = decibel; m = metre; E = east; N = north; L_{eq} = equivalent sound pressure level; L_{10} = sound level equalled or exceeded 10% of the measurement time; L_{50} = sound level equalled or exceeded 50% of the measurement time; L_{90} = sound level equalled or exceeded 90% of the measurement time; $L_{90\ D}$ = day sound level equalled or exceeded 90% of the measurement time; $L_{90\ N}$ = night sound level equalled or exceeded 90% of the measurement time; N/A = not applicable (no survey); UTM = Universal Transverse Mercator; * = the average accepted as baseline noise for the Project

In summary, the desktop study revealed that the baseline equivalent sound pressure levels at the Project site are expected to be as follows:

- 24-hour equivalent sound level ($L_{eq\ 24h}$) of 32 dBA;
- Daytime (07:00 a.m. to 10:00 p.m.) sound level ($L_{90\ D}$) of 27 dBA; and
- Night time (10:00 p.m. to 07:00 a.m.) sound level (L90 N) of 26 dBA.

With regard to increases in noise level, the following relationships are helpful in understanding the quantitative changes in noise levels with reference to human perception:

- Except in carefully controlled laboratory experiments, a change of only 1 dBA in sound level cannot be perceived;
- A 3 dBA change is considered a just-noticeable difference;
- A change in level of at least 5 dBA is required before any noticeable change in community response would be expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in loudness, and would almost certainly cause an adverse community response.

In order to assess the accuracy of the desktop study, it was necessary to conduct a real-time baseline noise survey at anticipated future noise sources, such as the mine and airstrip, as well as the nearest permanently occupied dwellings within the Project study area. The proposed mine and airstrip sites are where most of the noise from the proposed Project will be generated; the permanent dwelling and potential airstrip sites near Tatelkuz Lake were chosen as representative of permanent receptors that could be affected by project-related aircraft noise. No mine noise will be audible at the dwellings.

The survey was completed in accordance with the following guidelines:

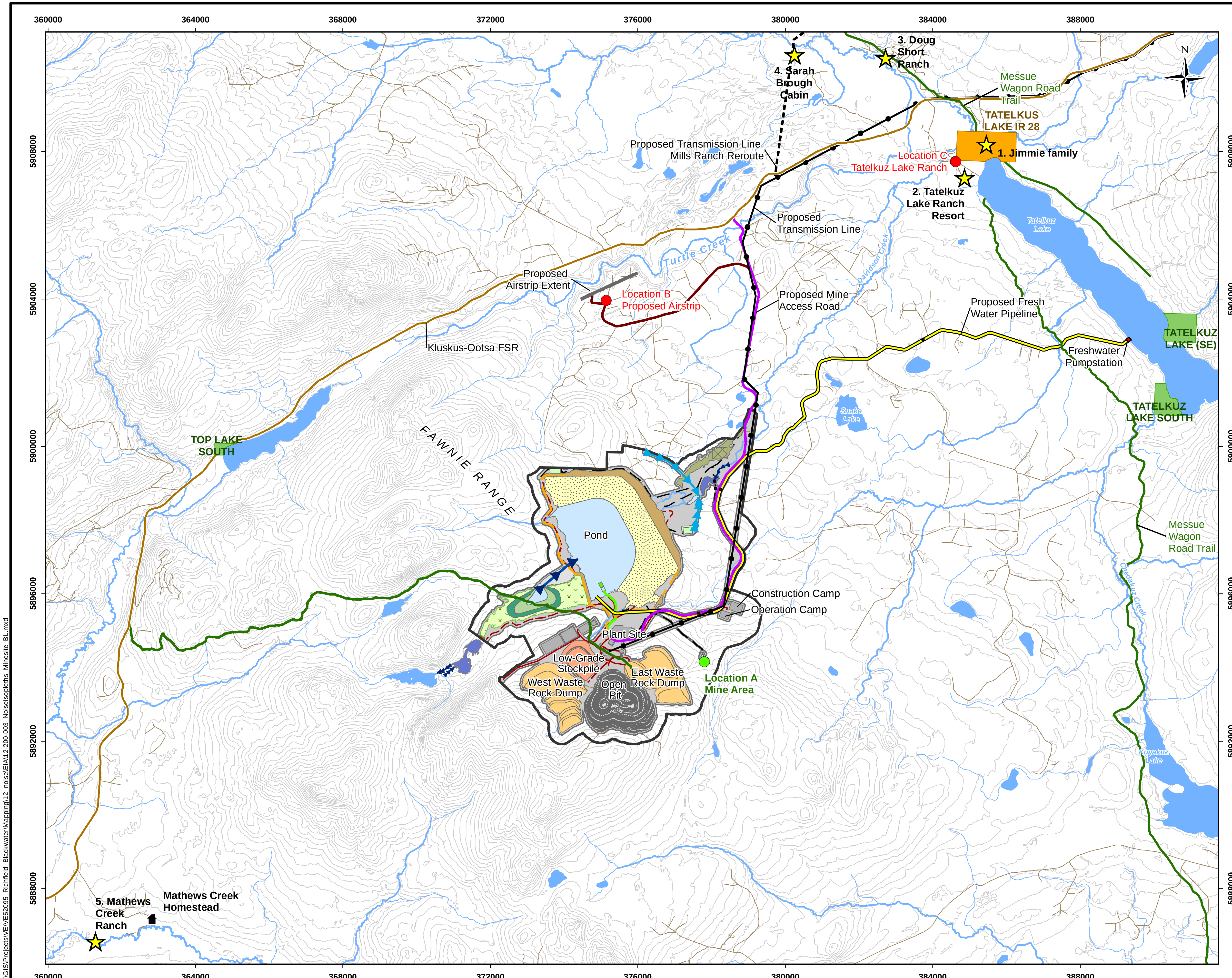
- American National Standard ANSI 1994: Procedures for Outdoor Measurement of Sound Pressure Level (ANSI, 1994);
- International Organization for Standardization ISO 2005: Acoustics – Description, Measurement and Assessment of Environmental Noise. Part 2: Determination of Environmental Noise Levels (ISO, 2005); and
- British Columbia Noise Control Best Practices Guideline (BC OGC, 2009).

An AMEC scientist completed a continuous, long-term (37-hour) survey of baseline noise near the proposed mine site from 29 to 31 July 2013. No anthropogenic sources were audible at the surveyed location. The weather observed during the three-day survey period was deemed suitable for noise monitoring. The principal noise monitor was a System 824 Sound Level Meter/Real Time Analyzer manufactured by Larson Davis, Inc. This instrument is battery-powered and can be operated continuously in several modes including integrated sound level meter (ISM) for recording 48 sound parameters and a sound spectrum analyzer (SSA) with programmable real time 1/1 or 1/3 octave frequency analysis capability. The survey data were recorded at predetermined intervals and stored in the instrument data logger. The logged parameters were downloaded to a computer and analyzed using dedicated Larson Davis software. Sound pressure levels (as L_{eq}) were retrieved and exported to an Excel spreadsheet to determine statistical distribution and elimination of outliers, equivalent sound pressure levels L_{eq} in dBA, statistical descriptors (L_{90}, L_{50}, L_{10}); and sound lowest and highest values of L_{eq} (L_{min} and L_{max}) in dBA.

In addition to the long-term survey, on 31 July 2013 short-term (8 hours and less) baseline noise surveys were completed near the proposed airstrip and at the north end of Tatelkuz Lake.

The proposed mine and airstrip sites are where most of the noise from the proposed Project will be generated. The nearest permanent dwellings to the mine site (i.e., Tatelkuz Lake Ranch Resort and IR Tatelkus Lake 28) and the proposed airstrip were chosen as representative locations that could be affected by project-related aircraft noise. The two permanent dwellings listed above and presented in **Figure 5.1.1.3-2** are considered critical noise receptors where permissible sound levels apply. **Figure 5.1.1.3-2** presents the location of the noise baseline monitoring locations and the critical receptors in the proximity of the mine site.

The summary of the long-term continuous baseline noise survey is provided in **Table 5.1.1.3-2**. The survey resulted in a total of 2,256 records of L_{eq} in dBA logged at 1-minute intervals. The survey hourly sound parameters are shown in Annex 1, Table 1-A of the Noise and Vibration Baseline Report included in **Appendix 5.1.1.3A**. The summary of short-term daytime noise survey results for the proposed airstrip area and near the Tatelkuz Lake Ranch Resort is provided in **Table 5.1.1.3-3**. The relevant survey record for the ranch area, created by Larson Davis software, is provided in Annex 1, Table 1-B of the Noise and Vibration Baseline Report included in **Appendix 5.1.1.3A**.



Legend

- Kluskus-Ootsa FSR
- Exploration Road
- Existing Road
- Contour (20 m)

Project Components
- Proposed Mine Access Road
- Proposed Transmission Line
- Mills Ranch Reroute
- Proposed Fresh Water Pipeline
- Proposed Airstrip Access Road
- Construction Haul Road
- Mine Haul Road
- Flow Direction
- Seepage Collection Trench
- Spillway
- Tailings Pipeline
- Water Reclaim Pipeline
- Messue Wagon Trail
- Proposed Airstrip Extent
- Proposed Mine Footprint
- Proposed Mine Site

Noise Baseline Monitoring Location
- Short Term Monitoring
- Long Term Monitoring

Potential Sensitive Receptors
- Sensitive Receptor Location
- Mathews Creek Homestead
- Indian Reserve
- Recreation Sites

Mine Site Area
- Bog / Wetland Area
- Borrow Source
- Construction Site
- Embankment fill
- Emergent Vegetation Wetland
- Esker Borrow Source
- Fresh Water Reservoir
- Low-Grade Stockpile
- NAG Waste Rock / Overburden
- Open Pit
- Pond
- Reclaim System
- Pumpstation
- Tailings Beach
- Top Soil
- Upland Beach

0 1 2 4
Kilometres
Scale:1:100,000

Reference
BC Government GeoBC Data Distribution
Knight Piésold Consulting Engineers

CLIENT: newgold

PROJECT: Blackwater Gold Project

Noise Baseline Monitoring Stations

DATE: January, 2015	ANALYST: MY	Figure 5.1.1.3-2
JOB No: VE52095	QA/QC: AP	PDF FILE: 12-200-003_NoiseIsopleths_Minesite_BL_minsite.pdf
GIS FILE: 12-200-003_NoiseIsopleths_Minesite_BL.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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Table 5.1.1.3-2: Summary of Long-Term (37 hours) Noise Survey Results at the Proposed Mine Site

Location	UTM Coordinates		Elevation (m amsl)	Sound Meter Type	Time	Sound Parameters (dBA)					
	m E	m N				L_{eq}	L_{10}	L_{50}	L_{90}	L_{max}	L_{min}
Location A – Mine Area	377,804	5,894,159	1,424	Larson Davis	Day	31.0	30.9	29.1	28.0	67.6	26.1
					Night	31.1	32.1	30.8	30.0	43.8	26.5
					Overall	31.1	31.5	29.9	29.0	67.6	26.1

Note: amsl = above mean sea level; dBA = decibel; m = metre; E = east; N = north; L_{eq} = equivalent sound pressure level; L_{10} = sound level equalled or exceeded 10% of the measurement time; L_{50} = sound level equalled or exceeded 50% of the measurement time; L_{90} = sound level equalled or exceeded 90% of the measurement time; L_{max} = maximum sound pressure level; L_{min} = minimum sound pressure level; UTM = Universal Transverse Mercator

Table 5.1.1.3-3: Summary of Short-Term (8 hours) Noise Survey Results at the Proposed Airstrip and Near Tatelkuz Lake Ranch

Location	UTM Coordinates		Elevation (m amsl)	Sound Meter Type	Date 2013	Sound Parameters (dBA)			
	m E	m N				L_{eq}	L_{10}	L_{50}	L_{90}
Location B – Proposed Airstrip	375,141	5,903,953	1,119	Larson Davis 824	29 July	27.7	-	-	-
					31 July	25.0	-	-	-
Location C – Tatelkuz Lake Ranch	384,613	5,907,721	937	Quest SoundPro DL	31 July	24.2	25.4	21.9	20.7

Note: amsl = above mean sea level; dBA = decibel; m = metre; E = east; N = north; Leq = equivalent sound pressure level; L10 = sound level equalled or exceeded 10% of the measurement time; L50 = sound level equalled or exceeded 50% of the measurement time; L_{90} = sound level equalled or exceeded 90% of the measurement time; UTM = Universal Transverse Mercator

The measurement of noise levels at the proposed mine site revealed the daytime (07:00 a.m. to 10:00 p.m.) sound pressure level (SPL) $L_{eq\ D}$ of 31.0 dBA, the night time (10:00 p.m. to 07:00 a.m.) SPL $L_{eq\ N}$ of 31.1 dBA, and the overall average SPL $L_{eq\ D\ N}$ of 31.1 dBA, which is very close to 30 dBA of the desktop study.

The $L_{eq\ D}$ recorded at two locations near the airstrip were 27.7 dBA and 25.0 dBA, and at Tatelkuz Lake area was 24.2 dBA; all levels lower than at the mine site (31.0 dBA). Therefore, the long-term surveys at these locations were not warranted since the critical case defined by the highest baseline noise level was at the mine site. Overall, noise levels at all three locations were similar to those typically observed at the remote areas where the audible anthropogenic sources were not present.

5.1.1.3.2 Baseline Vibration

No baseline vibration occurs at the Project area. Natural sources of ground vibration are usually related to volcanic occurrences and seismic activities caused by movements along the edges of the plates that make up the Earth's crust. No records of seismic or volcanic activity were found for the Project area. Typical anthropogenic sources of background vibration at remote areas include:

- Seismic exploration for mining and oil and gas developments, which use vibrations such as sound waves and shock waves to map the different layers of the ground;
- Movement of heavy trucks and earth-moving equipment; and
- Timber harvesting and hauling by heavy machinery near the proposed mine site and processing facility areas.

None of the above activities are currently taking place within the Project footprint however; these activities are present within the region.