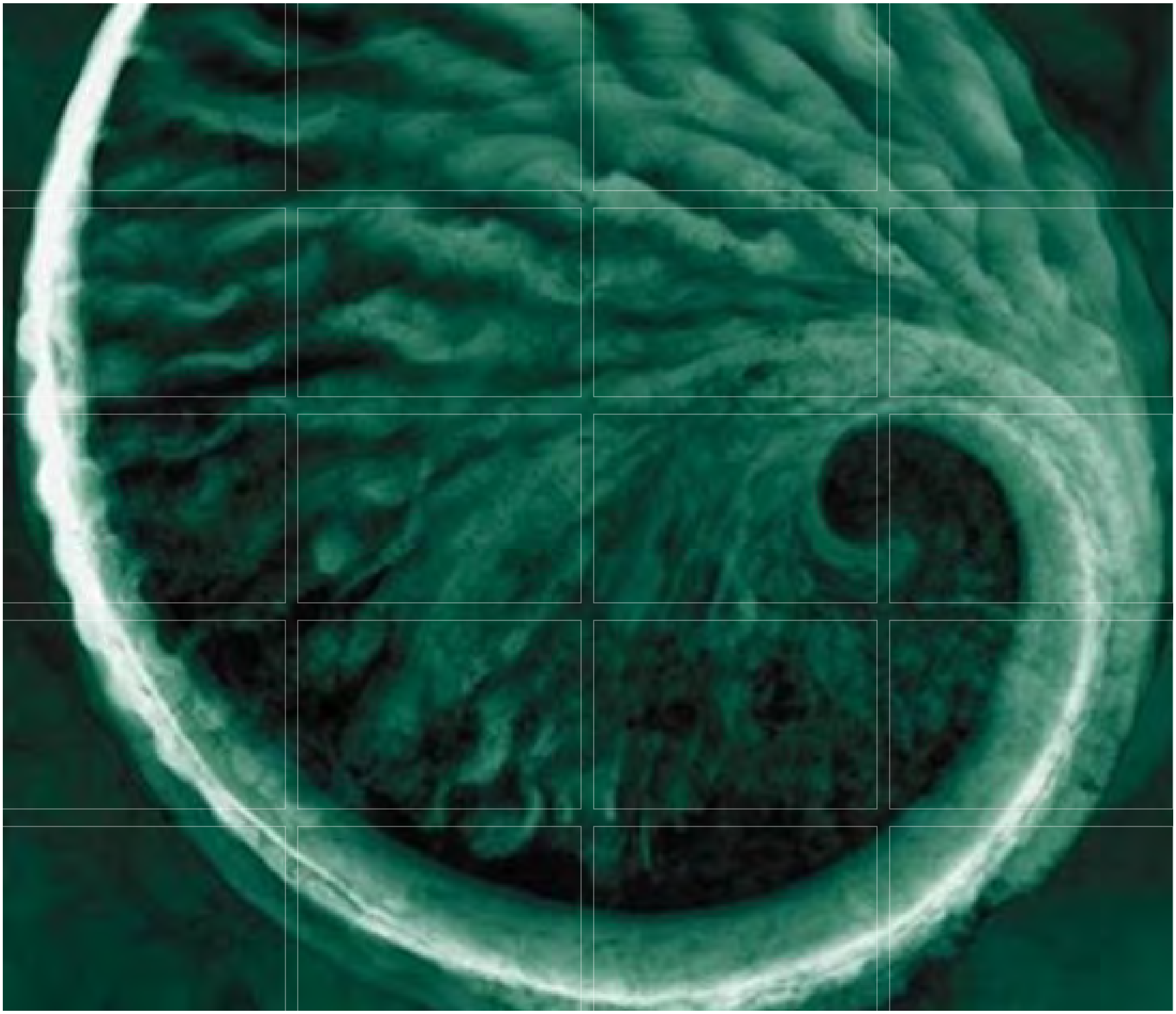
Appendix 10-A

Noise Baseline Report

HARPER CREEK PROJECT

Application for an Environmental Assessment Certificate / Environmental Impact Statement



Prepared for:

HARPER CREEK
MINING CORP.

HARPER CREEK PROJECT

Noise Baseline Report

August 2014

ERM

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Harper Creek Mining Corporation

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Noise Baseline Report

August 2014

Project #0230881-0006

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ERM Rescan
ERM Rescan Building, 15th Floor
1111 West Hastings Street
Vancouver, BC
Canada V6E 2J3
T: (604) 689-9460
F: (604) 687-4277

EXECUTIVE SUMMARY

The Harper Creek Project (the Project) is a proposed open pit copper mine located in south-central British Columbia (BC), approximately 150 km northeast by road from Kamloops. The Project has an estimated 28-year mine life based on a process plant throughput of 70,000 tonnes per day. The Proponent, Harper Creek Mining Corporation, is a wholly owned subsidiary of Yellowhead Mining Inc., which is a public BC junior mineral development company trading on the Toronto Stock Exchange.

This report describes the noise baseline conditions for the purposes of the Application for an Environmental Assessment Certificate under the British Columbia *Environmental Assessment Act* and the Environmental Impact Statement under the *Canadian Environmental Assessment Act* in accordance with the Approved Project Application Information Requirements for the Project issued October 21, 2011.

Three noise monitoring stations (S1, S2 and S3) were set up within the study area and noise levels were recorded over a 24 hour period in September 2012. The locations were selected to characterize the range of baseline conditions in the region.

Natural background noise sources observed included birds, small mammals, wind and rain. Anthropogenic noise sources observed included aircraft (helicopters and fixed wing), road vehicles, trains and general human activity. Recorded noise levels were lowest at station S2 and the highest noise levels were recorded at station S3. From the background data collected at the monitoring station during the monitoring period:

- the daily logarithmic average noise (L_{Aeq}) levels that were measured ranged from 31.7 (S2) to 55.8 (S3) dBA;
- the daily average noise (L_{A90}) levels that were measured ranged from 20.9 (S2) to 42.4 (S3) dBA;
- the daily minimum (L_{Amin}) noise levels ranged from 20.4 (S2) to 40.1 (S3) dBA; and
- the daily maximum (L_{Amax}) noise levels ranged from 48.3 (S2) to 72.8 (S1) dBA.

The L_{eq} values are in the range that would be expected for baseline rural noise levels; approximately 35 dBA during the nighttime and around 45 dBA during the daytime. Higher values, such as at station S3 are due to anthropogenic activity (mostly helicopters) in the study area.

ACKNOWLEDGEMENTS

This report was prepared for Harper Creek Mining Corporation by ERM Consultants Canada Ltd. (ERM Rescan). Field work was completed by Knight Piésold Ltd. Data analysis was performed by Jem Morrison (B.Sc.; ERM Rescan). This report was written by Jem Morrison and reviewed by Derek Shaw (M.A.Sc., P.Eng.; ERM Rescan), Mark Branson (M.Sc. (Hons.) ERM Rescan), and Anne Currie (B.Sc., MPA; ERM Rescan).

HARPER CREEK PROJECT
Noise Baseline Report

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GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AIR	Application Information Requirements
AER	Alberta Energy Regulator
BC	British Columbia
BC EAA	British Columbia *Environmental Assessment Act*
BC EAO	British Columbia Environmental Assessment Office
CEA Agency	Canadian Environmental Assessment Agency
CEAA, 1992	*Canadian Environmental Assessment Act, 1992*
dBA	Sound levels, in decibels, measured with an A-weighted filter
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
EIS	Environmental Impact Statement
HCMC	Harper Creek Mining Corporation
L_{A90}	The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.
L_{Aeq}	Continuous equivalent sound level over a time period
L_{Amax}	Maximum recorded sound level during a time period
L_{Amin}	Minimum recorded sound level during a time period
MSC	Meteorological Service of Canada; a division of Environment Canada
M	Million or Mega
Mt	Million tonnes
Precipitation	Liquid or solid products of the condensation of water vapour falling from the clouds which include rain, sleet, hail, snow, and other forms of water
Project, the	The Harper Creek Project
Proponent, the	Harper Creek Mining Corporation

QA	Quality Assurance
QC	Quality Control
t/d	tonne per day
t/y	tonne per year
TMF	Tailings Management Facility
TSX	Toronto Stock Exchange
YMI	Yellowhead Mining Inc.

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

Harper Creek Mining Corporation (HCMC) proposes to construct and operate the Harper Creek Project (the Project), an open pit copper mine near Vavenby, British Columbia (BC). The Project has an estimated 28-year mine life based on a process plant throughput of 70,000 tonnes per day (25 million tonnes per year). Ore will be processed on site through a conventional crushing, grinding and flotation process to produce a copper concentrate, with gold and silver by-products, which will be trucked from the Project Site along approximately 24 km of existing access roads to a rail load-out facility located at Vavenby. The concentrate will be transported via the existing Canadian National Railway network to the existing Vancouver Wharves storage, handling and loading facilities located at the Port of Vancouver for shipment to overseas smelters.

The Project consists of an open pit mine, on-site processing facility, tailings management facility (TMF) (for tailings solids, subaqueous storage of PAG waste rock, and recycling of water for processing), waste rock stockpiles, low grade and overburden stockpiles, a temporary construction camp, ancillary facilities, mine haul roads, sewage and waste management facilities, a 24 km access road between the Project Site and a rail load-out facility located on private land owned by HCMC in Vavenby, and a 12 km power line connecting the Project Site to the BC Hydro transmission line corridor in Vavenby. The Project location and infrastructure is shown in Figure 1.1-1.

This report describes the noise baseline conditions for the purposes of the Application for an Environmental Assessment (EA) Certificate under the British Columbia *Environmental Assessment Act* (BC EAA) and the Environmental Impact Statement (EIS) under the *Canadian Environmental Assessment Act* (CEAA; 1992) in accordance with the approved Application Information Requirements (AIR) for the Project issued October 21, 2011.

1.2 PROJECT LOCATION

The Project is located in the Thompson-Nicola area of BC, approximately 150 km north-east of Kamloops along Yellowhead Highway #5, approximately 10 km southwest of the unincorporated municipality of Vavenby, British Columbia. The Project is located within National Topographic System (NTS) map sheets 82M/5 and 82M/12, is geographically centred at 51°30′N latitude and 119°48′W longitude, and is situated at approximately 1,800 Metres above sea level (masl). The mineral claims comprising the Project cover an area of 42,636.48 hectares. The Project location is shown in Figure 1.2-1.

1.3 PROJECT ACCESS

Access to the Project is from Kamloops to Vavenby via Yellowhead Highway # 5, across the North Thompson River and then eastward along the Birch Island - Lost Creek Forestry Service Road (FSR) for approximately 6 km to the Jones Creek FSR (Figure 1.1-1).

Figure 1.1-1
Project Location and Infrastructure

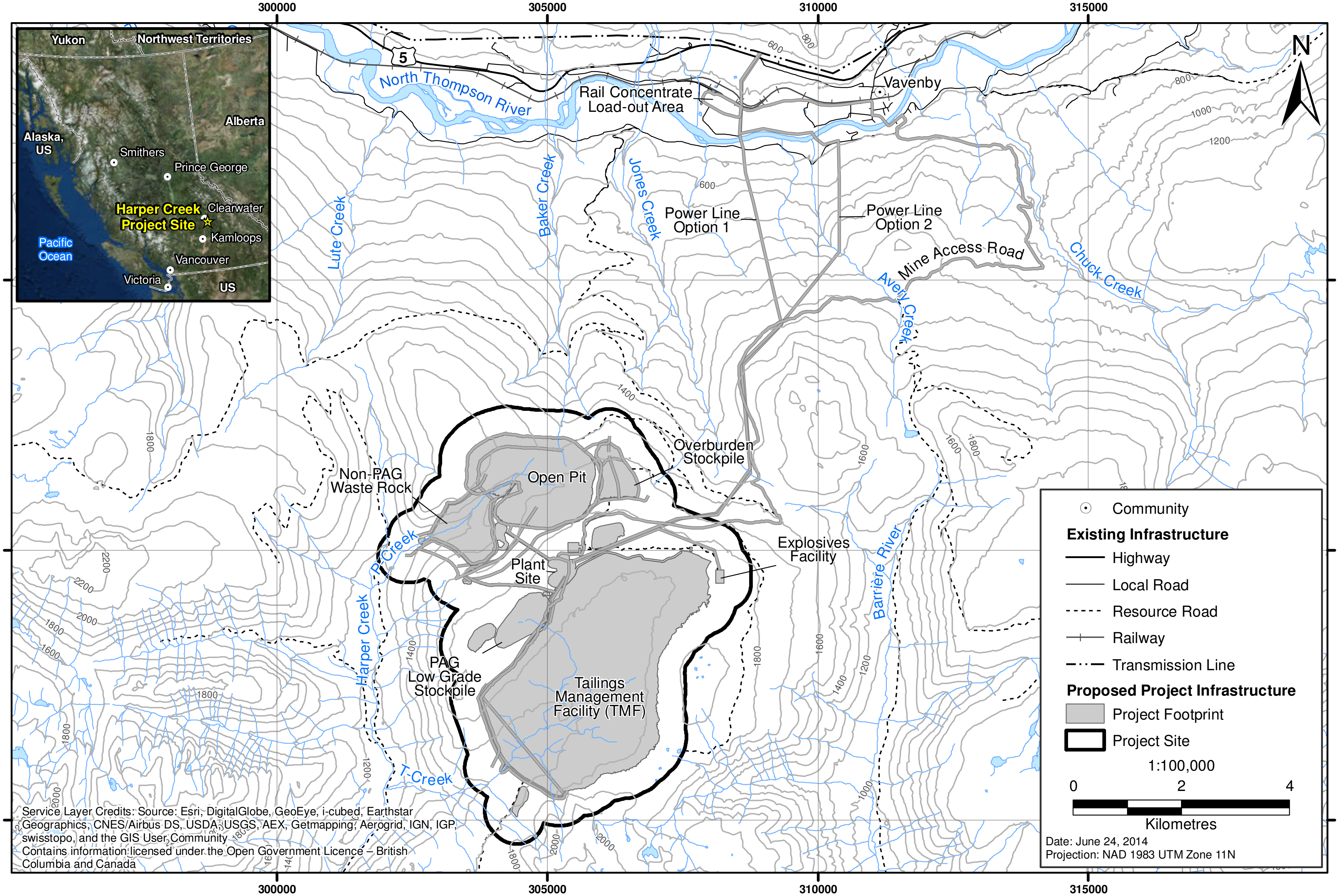
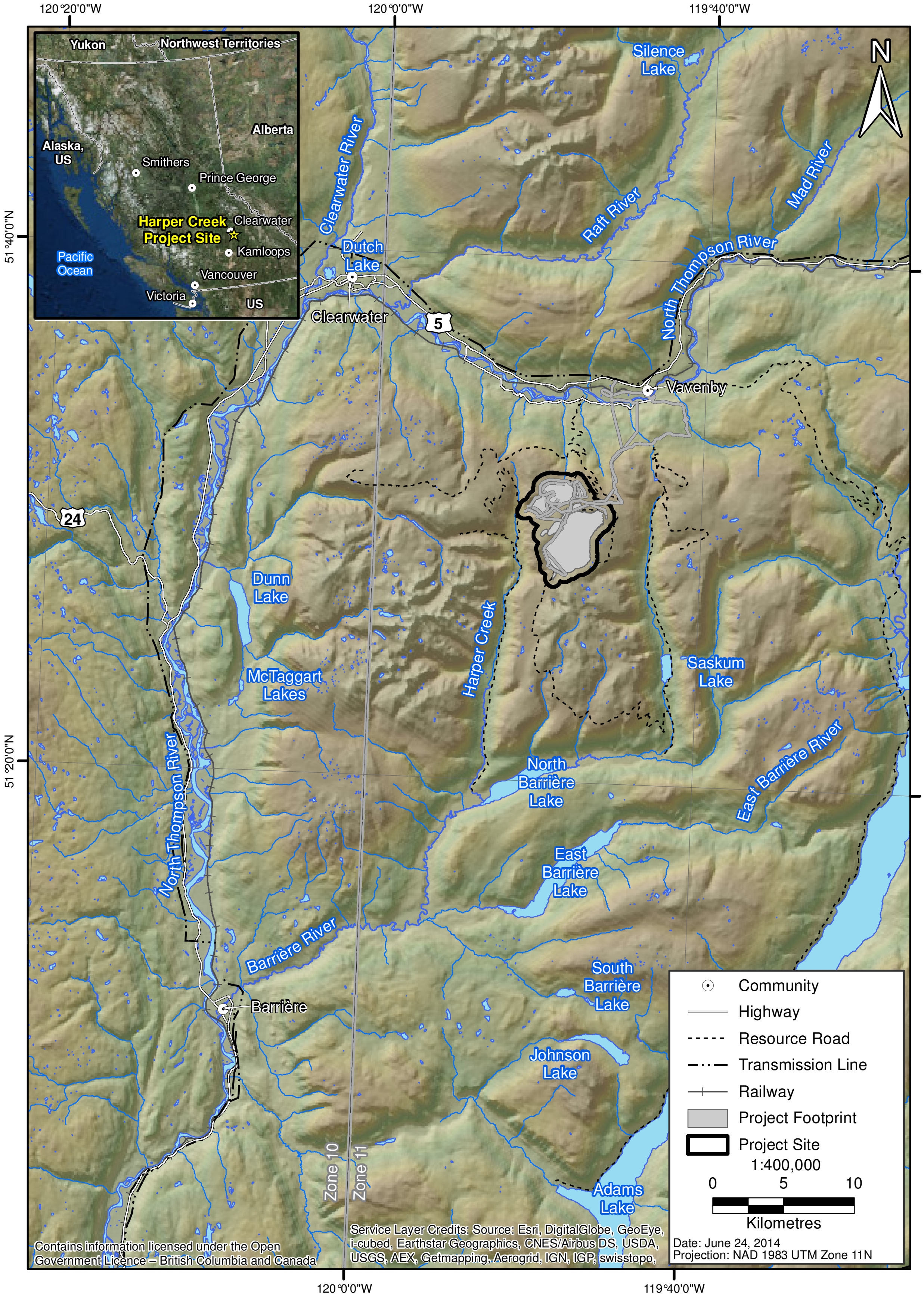


Figure 1.2-1

Project Location



The proposed main access route to the Project Site is from Vavenby via the Vavenby Mountain FSR. This road runs along the western side of Chuck Creek for approximately 6 km before heading west toward Avery Creek and the southeastern part of the Project. This road then meets the Barrière Mountain FSR at approximately 11 km. From there, the Saskum Plateau FSR heads southwest to the eastern and central areas of the Project.

1.4 Project Proponent

The Proponent of the Project is HCMC, a wholly owned subsidiary of Yellowhead Mining Inc. (YMI). YMI was formed in 2005 as a private British Columbia company specifically to acquire, explore and, if feasible, develop the Project. YMI is now a publicly owned BC-based mineral development company trading on the Toronto Stock Exchange (TSX) in Canada. HCMC's strategy is to engineer, permit, finance, construct, and operate the Project.

1.5 Project Setting

Noise is generally defined as unwanted sound. It is characterized in terms of the pressure of the sound wave. Human perception of sound pressure is non-linear: a ten-fold increase in sound pressure is perceived as a doubling of the noise level by the average person. This non-linearity is reflected in the use of the decibel (dB), a logarithmic measure of noise level. The dB is the logarithm of the ratio of the root mean square (rms) sound pressure relative to a standard rms sound pressure, usually 20 µPa, the hearing threshold below which sound is not generally detectable by the human ear.

Noise is typically monitored as sound pressure level, in A-weighted decibels (dBA). The A-weighting is designed to match the average frequency response of the human ear. Some typical noise levels are as follows (in dBA):

- rustling leaves: 20;
- refrigerator humming: 40;
- normal conversation: 60;
- business office: 65;
- average city traffic: 80 to 85;
- jackhammer: 100;
- jet take-off at 100 m distance: 130; and
- motorcycles, firecrackers, small arms fire: up to 140.

In general, a 3 dBA difference is required by the average person to notice any alteration in noise level.

Potential noise sources in the surrounding area include Vavenby, located approximately 10 km to the northwest of the Project, including a sawmill. There is active logging in the area surrounding the Project location, with a network of forest service roads. The Yellowhead Highway #5 runs along the North Thompson River and at its closest point the highway is approximately 7 km to the north of the Project Site. The Yellowhead Highway #5 is a significant source of noise in the area.

1.6 Study Objectives

The main objectives of the noise baseline program were to:

- measure noise levels at a range of representative locations in the vicinity of the Project Site; and
- provide a point of reference to assess potential project effects.

2. BACKGROUND REVIEW

2.1 LEGISLATION, REGULATIONS, AND GUIDELINES

The Project is subject to both provincial and federal EAs under the British Columbia *Environmental Assessment Act* (2002) and *Canadian Environmental Assessment Act* (CEAA; 1992). The EA will undergo a coordinated review in accordance with the 2004 Canada-BC Agreement on Environmental Assessment Cooperation. The requirements for the EA are defined in the AIR for the Project, approved by the BC Environmental Assessment Office (EAO) on October 21, 2011. This baseline report has been prepared to support the submission of the Application/EIS.

There is currently no federal or provincial legislation that stipulates noise levels for mine development projects. For construction, noise levels are compared to the British Standards Institute BS 5228 *Code of Practice for Noise and Vibration Control on Construction and Open Sites* (BSI 2009). For operation, noise levels are compared to the Alberta Energy Regulator's (AER) Directive 038 Noise Control (AER 2007). These two guidelines derive 'permissible sound levels' based on baseline ambient noise levels.

Typical baseline rural sound levels are around 35 dBA (nighttime) and 45 dBA (daytime) as presented in AER Directive 38: Noise Control (AER 2007) and reproduced in the BC Oil and Gas Commission (OGC) *British Columbia Noise Control Best Practice Guideline* (OGC 2009).

From a wildlife perspective, there is limited information in the scientific literature related to the effects of elevated noise levels on various species, especially since many species' auditory range is very different from humans. From literature that is available, the recommended federal management limit for night time mining activity noise levels is 45 dBA as related to wildlife (EC 2012).

3. METHODOLOGY

3.1 SAMPLING METHODS

Baseline noise samples were collected using Brüel & Kjær Model 2250 sound level meters capable of logging data. These instruments have operating ranges from 16.7 to 140 dBA (at 1 kHz pure tone signal) that capture low sound levels, which are typical for undisturbed wilderness areas, as well as high sound levels. Each instrument's microphone was protected by a wind screen/weather shield and bird spikes. Other than the ground, all surfaces or obstacles were at least 3 m away from the stations. A weather resistant case protected the meter and battery pack and provided a stable base for each kit. The average, minimum and maximum peak sound levels were measured using the "A" standardized frequency rating (dBA), designed to match the frequency response of the human ear. Each sound level meter was calibrated before sampling.

Noise measurements were made once every 0.1 seconds, approximately 1 metre above ground. Each monitoring period was at least 24 consecutive hours, however, the noise recorded during the installation and demobilization of the noise monitor is removed during post processing and this can make the reported timeframe of the monitoring period slightly less than 24 hours.

The instruments were set up to record a range of statistics based on user-specified averaging periods, including L_{Aeq}, L_{A90}, L_{Amax}, and absolute L_{Amin}, as described below:

- L_{Aeq} is the continuous equivalent sound level over a time period, typically one hour, using the 0.1 second monitoring data. One minute L_{Aeq} values were also recorded for graphical data presentation and analysis.
- L_{A90} is the ninetieth percentile level (the sound pressure level that is exceeded 90 percent of the time during the measurement period). For example, LA_{90} = 20 dBA means that the sound pressure level exceeded 20 dBA during 90% of the measurement period. LA_{90} is usually regarded as the residual level or the background noise level without discrete events (e.g., helicopters, fixed wing aircraft).
- L_{Amax} is the maximum value recorded during an hourly period, using the 0.1 second monitoring data.
- L_{Amin} is the minimum value recorded during an hourly period, using the 0.1 second monitoring data.
- The absolute L_{Amax} and L_{Amin} are the maximum and minimum 0.1 second values recorded in the monitoring period (typically 24 hours).

L_{Aeq} values include higher noise levels from anthropogenic sources such as helicopters and aircraft movement, and therefore may not accurately reflect the natural noise level conditions in the area. L_{A90} values provide a better indication of the natural noise levels in remote locations since discrete events that occur from anthropogenic sources (such as helicopters) will not typically be part of 90% of the measurement time period. It should be noted, however, locations S1 and S3 were near enough to anthropogenic sources (trains, traffic and the sawmill primarily) that the L_{90} value would include noise from these sources.

Additionally, the sound level meters recorded audible sound files, which were used for the analysis of the baseline data to identify the peak events and the associated noise sources.

The weather parameters recorded at the Project's automated meteorological station during each noise measurement time period, and the ideal weather conditions for noise monitoring, are presented in Table 3.1-1.

Table 3.1-1. Meteorological Conditions for Noise Monitoring

On-site Monitoring	Ideal Condition
Relative humidity (%)	<90%
Wind speed (km/h or m/s)	<20 km/h
Wind direction (degrees from true north)	n/a
Active precipitation (rain or snow)	0 mm
Temperature (°C)	Temperatures that allow the meter body to be maintained within manufacturer's specifications

Note: n/a = not applicable.

The timing of the monitoring periods were selected to reduce the likelihood of unfavorable weather conditions, for example, by avoiding months that typically have high precipitation rates. Where unfavorable weather conditions occurred, these conditions have been noted in this report. To maximize the size of the datasets used in this study no monitoring data have been removed due to unfavorable weather conditions.

In addition to taking pictures of the monitoring site, the following information was recorded in the field during the noise monitoring program:

- time of set up and tear down;
- calibration settings;
- type of surface the meter is placed on;
- observed audible noise sources;
- details of nearby obstacles, where applicable (cannot be closer than 3 m to any surface except the ground);
- global position system (GPS) location;
- serial number of the meter being used; and
- weather conditions at each site at the time of set up, including precipitation and cloud cover.

3.2 SAMPLING LOCATIONS

The monitoring was conducted at three locations from September 10 to 17, 2012. There was no known physical disturbance of the noise monitors by wildlife or humans during the monitoring period.

Table 3.2-1 provides the UTM locations of the three sampling sites. The locations were selected to characterize the range of baseline conditions in the region, based on their proximity to proposed Project and local infrastructure and where future mining activities are expected. Monitoring locations are shown in Figure 3.2-1, and described in the subheadings below.

Table 3.2-1. Locations of Noise Monitoring Stations

Monitoring Station	UTM Zone	UTM Easting (m)	UTM Northing (m)
S1	11U	300887	5719051
S2	11U	306541	5713176
S3	11U	310770	5718169

Note: UTM coordinates refer to NAD 83.

3.2.1 Station S1

Noise monitoring station S1 was located approximately 10 km to the north west of the proposed Project infrastructure (Figure 3.2-1). The monitoring location was in the North Thompson River Valley approximately 0.75 km to the east of the hamlet of Birch Island and 10 km to the west of Vavenby.

The microphone was set up in a flat open area, approximately 150 m to the west of the Birch Island/ Lost Creek Road. The North Thompson River was located approximately 150 m to the north of the station and in between the river and the noise monitor was a rail line. Yellowhead Highway #5 was on the north side of the river located less than 1 km from the monitoring site. The station had road access during the monitoring period (Plate 3.2-1).

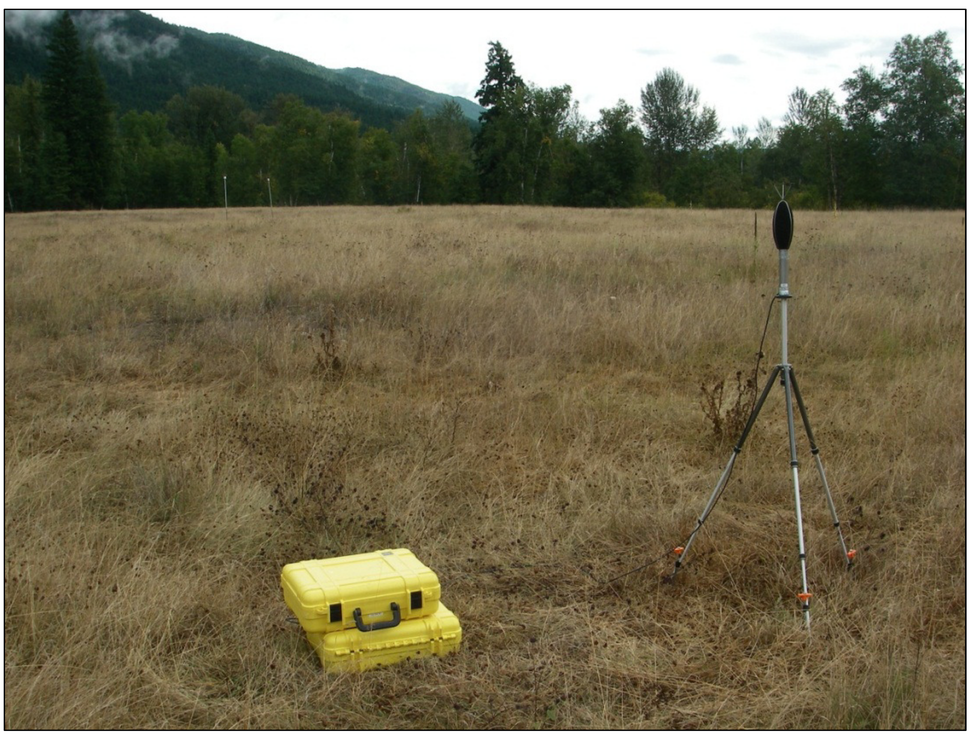
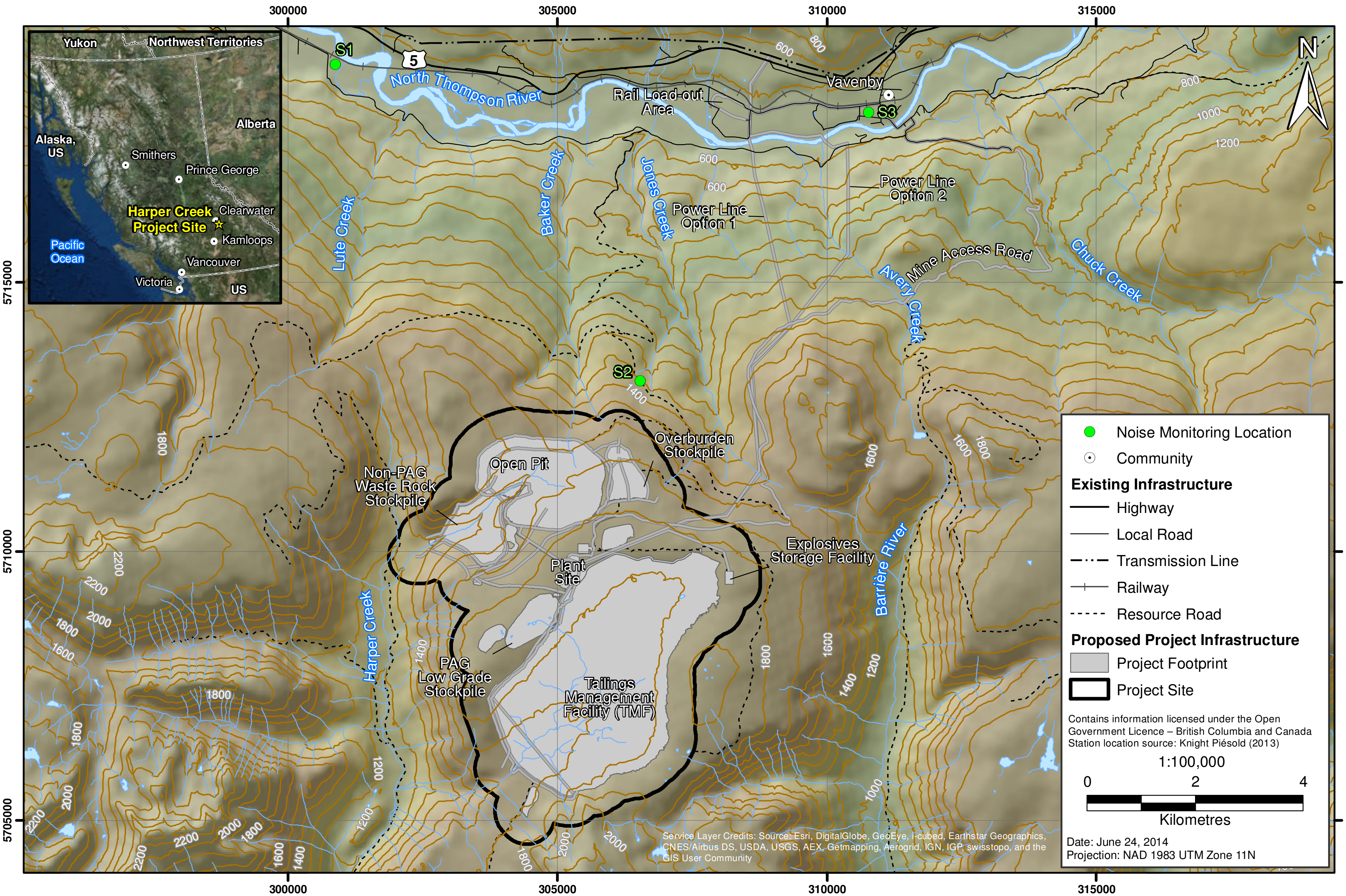


Plate 3.2-1. Noise monitoring location S1, September 10, 2012.

Figure 3.2-1
Noise Monitoring Locations

ERM



Noise monitoring was started at 10:26 am on September 10, 2012. The station was collected the following day, after recording 25 hours of noise data. During the monitoring period, 2.6 mm of precipitation was recorded at the Vavenby climate station operated by MSC, located approximately 7 km to the east of the station S1 (EC 2014). Potential anthropogenic sources of noise at this location included local vehicle traffic, helicopters, trains and highway traffic.

3.2.2 Station S2

Noise monitoring station S2 was located approximately 4 km to the north of the proposed Project Site (Figure 3.2-1). The sampling location was on the middle to upper slope, on a north aspect, of the North Thompson River valley. The noise monitor was set up in an open area adjacent to a gravel road (Plates 3.2-2 and 3.2-3). Trees and shrubs were approximately 5 m away.

Plate 3.2-2. Facing south, noise monitoring station S2, September 14, 2012.

Plate 3.2-3. Facing north, noise monitoring station S2, September 14, 2012.

Noise monitoring was started at 8:45 am on September 14, 2012. The station was collected the following day, after recording 25 hours of noise data. There was no precipitation recorded at the Vavenby climate station operated by MSC, located approximately 4.5 km to the north of station S2 (EC 2014). Elevated noise readings included local vehicular traffic, wildlife and wind.

3.2.3 Station S3

Noise monitoring station S3 was located approximately 10 km to the north east of the Project Site (Figure 3.2-1). The sampling location was located near the HCMC exploration storage warehouse in the town of Vavenby (Plates 3.2-4 and 3.2-5).

Noise monitoring was started at 9:45 am on September 16, 2012. The station was collected the following day, after recording 25 hours of noise data. There was no precipitation recorded at the Vavenby climate station operated by MSC, located approximately 3.0 km to the west of the station S3 (EC 2014). Numerous sources of anthropogenic noise existed at this location, in particular the station was installed within a couple of hundred meters of an operating sawmill.

Plate 3.2-4. Facing east, noise monitoring station S3, September 16, 2012.

Plate 3.2-5. Facing west, noise monitoring station S3, September 16, 2012.

3.3 DATA ANALYSIS

Data analysis was done using BZ5503 – Measurement Partner Suite software. BZ5503 is used in the field to transfer the data files from the SD card in the noise monitor to the field laptop. BZ5503 also allows the technician to see and listen to the noise recording and determine the length of the recording.

Calculations were performed in Excel during post processing. The noise station data analysis provides hourly L_{Amax}, L_{Amin},L_{Aeq} and L_{A90}.

The noise values are adjusted during the post processing, which is performed to remove any sounds from the technicians that can skew the averages at the start and end of the monitoring period. Additional processing will be performed to provide a data parameter called the $L_{A90.}$

Because of the non-linearity nature of the dB scale, the L_{Aeq} sound levels cannot simply be added. Instead the logarithm has to be inverted before adding and then applied to the sum (AER 2007).

$$L_{total} = 10\log_{10}(10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}})$$

For example, the addition of people talking (50 dBA) in a very calm room (background noise of 35 dBA) does not bring up the noise level in the room to 85 dBA. Adding the noise levels in this example according to the formula above will raise total noise levels to 50.1 dBA. In fact, the background noise will no longer be audible once people start talking. For the noise source to be audible it has to be at least as loud as the background (i.e., a background noise level of 35 dBA and a 35 dBA noise source have a total noise level of 38 dBA). On the other hand, if the total noise level is 41.2 dBA "switching off" the background noise and leaving only a noise source of 40 dBA (a 1.2 dBA change) will not be audible.

3.4 LIMITATIONS AND ASSUMPTIONS

The noise monitoring stations were operated by Knight Piésold Ltd. No noise monitoring was carried out during the winter months, therefore seasonal variation cannot be assessed. Only one background noise monitoring location was installed, near the Project Site, the results from this site have been assumed to be representative of background conditions throughout the study area.

4. RESULTS AND DISCUSSION

This section presents the results from the baseline noise measurements completed in September 2012. Results from each station are provided individually, and a summary of all results is provided in Chapter 5.

4.1 STATION S1

One-minute noise levels recorded on September 10 and 11, 2012 are shown in Figure 4.1-1. Hourly, maximum, minimum, and logarithmic average L_{Aeq}, L_{A90}, L_{Amax} and L_{Amin} results of the 24-hour sampling period are shown in Table 4.1-1. The majority of noises observed at this location were trains, vehicular traffic and birds.

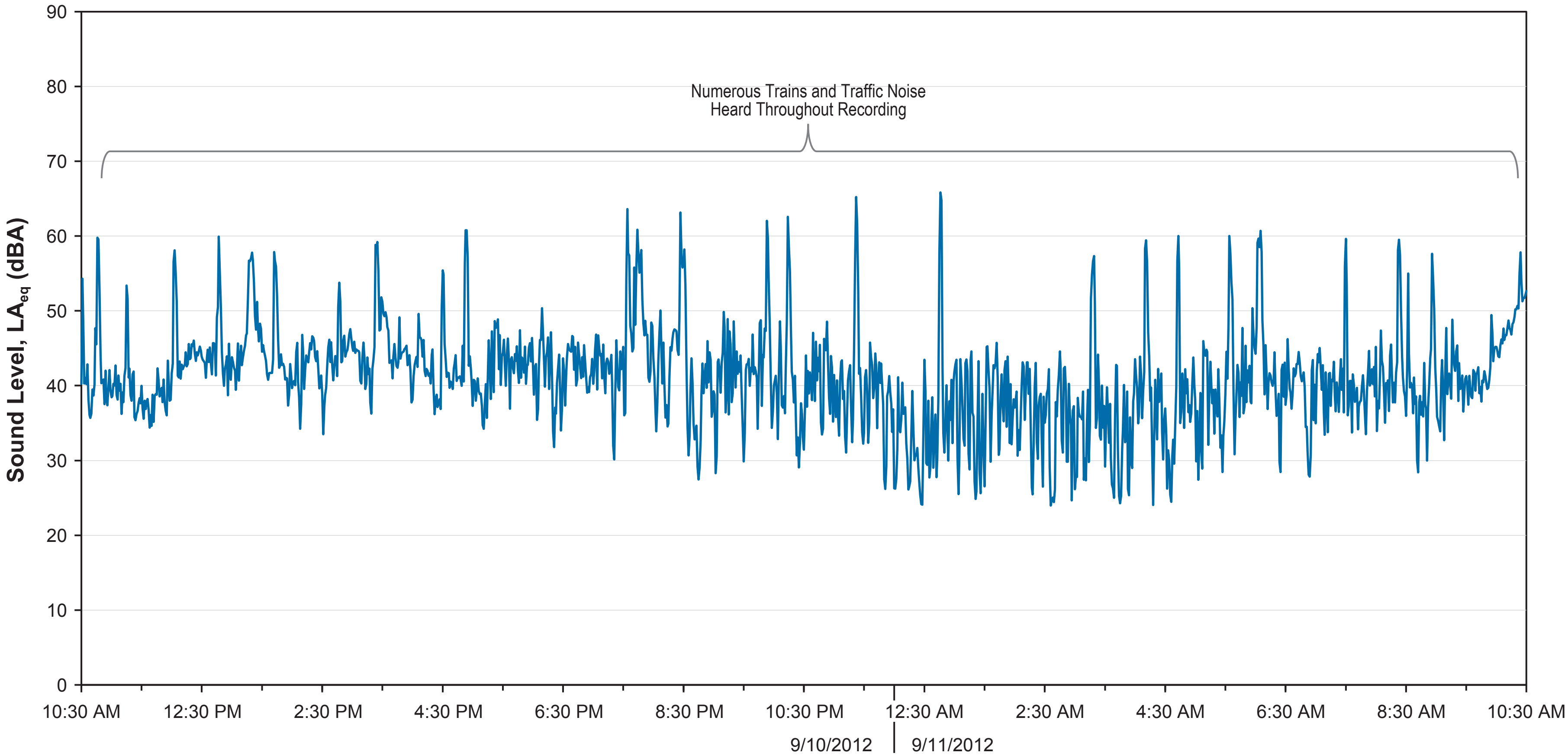
Table 4.1-1. Hourly Sound Levels, Station S1, September 2012

Date	Start Time	End Time	Wind Speed (m/s)	Wind Direction (degrees from true north)	Sound Level (dBA)			
					L_{Aeq}	L_{Amax}	L_{Amin}	L_{A90}
9/10/2012	10:30:00 AM	11:30:00 AM	3.0	293.7	47.4	56.4	42.2	44.3
9/10/2012	11:30:00 AM	12:30:00 PM	2.7	289.3	46.1	51.6	42.0	43.1
9/10/2012	12:30:00 PM	1:30:00 PM	3.0	267.6	50.0	57.5	46.1	47.4
9/10/2012	1:30:00 PM	2:30:00 PM	3.0	275.1	46.6	52.1	42.6	43.9
9/10/2012	2:30:00 PM	3:30:00 PM	2.4	241.7	48.9	54.7	44.8	46.4
9/10/2012	3:30:00 PM	4:30:00 PM	2.6	225.5	45.5	52.3	41.6	43.0
9/10/2012	4:30:00 PM	5:30:00 PM	2.4	254.0	48.9	53.5	44.9	46.3
9/10/2012	5:30:00 PM	6:30:00 PM	2.5	275.3	43.5	50.2	37.7	39.7
9/10/2012	6:30:00 PM	7:30:00 PM	1.7	251.8	43.2	50.8	37.6	39.7
9/10/2012	7:30:00 PM	8:30:00 PM	2.0	274.9	53.3	64.1	47.8	49.2
9/10/2012	8:30:00 PM	9:30:00 PM	2.6	260.3	44.9	51.6	39.1	41.0
9/10/2012	9:30:00 PM	10:30:00 PM	2.7	264.7	50.5	55.3	45.2	46.8
9/10/2012	10:30:00 PM	11:30:00 PM	2.4	293.5	50.1	55.2	45.4	46.6
9/10/2012	11:30:00 PM	12:30:00 AM	1.6	304.9	38.4	44.2	31.7	34.3
9/11/2012	12:30:00 AM	1:30:00 AM	2.7	274.4	51.1	57.0	46.1	47.1
9/11/2012	1:30:00 AM	2:30:00 AM	2.1	279.4	39.8	46.6	32.7	35.0
9/11/2012	2:30:00 AM	3:30:00 AM	2.5	274.6	45.0	49.1	41.6	42.7
9/11/2012	3:30:00 AM	4:30:00 AM	2.6	287.2	46.0	50.3	41.5	42.6
9/11/2012	4:30:00 AM	5:30:00 AM	2.1	289.6	45.8	51.0	39.4	40.7
9/11/2012	5:30:00 AM	6:30:00 AM	1.9	288.9	50.8	55.8	46.3	47.6
9/11/2012	6:30:00 AM	7:30:00 AM	1.7	285.7	45.3	49.8	40.9	42.2
9/11/2012	7:30:00 AM	8:30:00 AM	1.8	284.2	47.1	52.0	42.0	43.5
9/11/2012	8:30:00 AM	9:30:00 AM	2.1	264.8	45.3	53.1	38.6	40.3
9/11/2012	9:30:00 AM	10:30:00 AM	2.5	267.1	48.0	53.1	45.6	46.6
Maximum			*3.0*		*53.3*	*64.1*	*47.8*	*49.2*
Minimum			*1.6*		*38.4*	*44.2*	*31.7*	*34.3*
Logarithmic average[1,2,3,4]			*2.4*		*47.9*	56.8	37.6	39.7

[1] *Wind speed and wind direction are arithmetic averages.*
[2] *L_{Amax} is an overall average using the 90 percentile.*
[3] *L_{Ain} is an overall average using the 10 percentile.*
[2] *L_{A90} is an overall average using the 10 percentile.*

Figure 4.1-1

Harper Creek Noise Monitoring Station S1, September 10 and 11, 2012



During the monitoring period the average L_{Aeq} sound level was 47.9 dBA, primarily due to train noise from the nearby rail line activity. The L_{A90} was lower at 39.7 dBA. The difference between the L_{Aeq} to the L_{A90} shows that there were discrete events to remove from the data. The hourly L_{Aeq} and L_{A90} saw the lowest values between 11:30 pm and 12:30 am (38.4 and 34.3 dBA respectively), due to significantly less frequent train noise. The minimum one minute sound level (L_{Amin}) was 22.2 dBA recorded at 3:00 am on September 11, and the maximum one minute sound level (L_{Amax}) was 78.7 dBA recorded at 7:34 pm. Noise levels are reflective of rural locations.

4.2 STATION S2

One-minute noise levels recorded on September 14 and 15, 2012 are shown in Figure 4.2-1. Hourly, maximum, minimum, and logarithmic average L_{Aeq}, L_{A90}, L_{Amax} and L_{Amin} results of the 24-hour sampling period are shown in Table 4.2-1. General sources of noise observed at this location were birds, small mammals, local vehicular traffic, and trains.

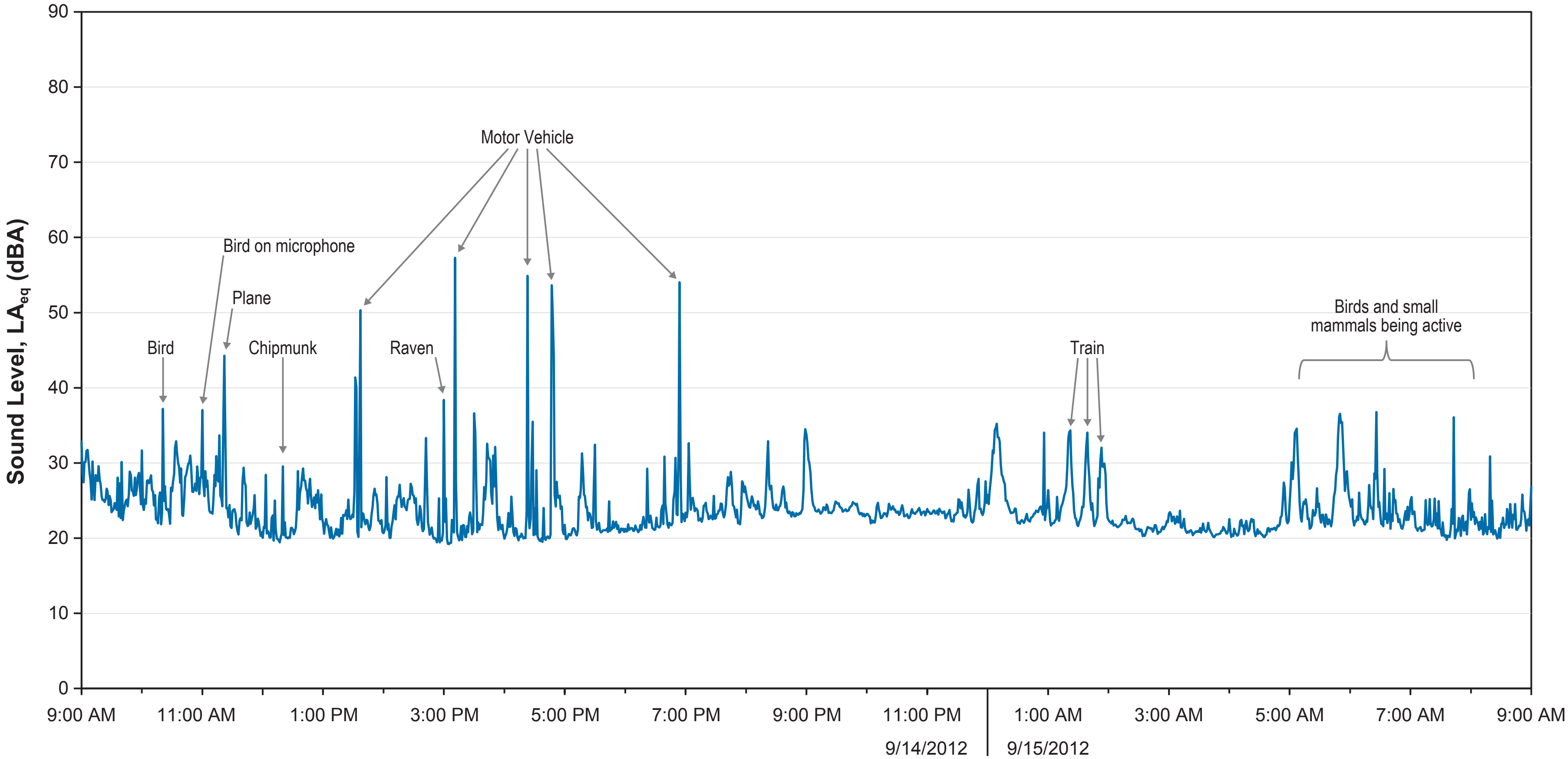
Table 4.2-1. Hourly Sound Levels, Station S2, September 2012

Date	Start Time	End Time	Wind Speed (m/s)	Wind Direction (degrees from true north)	Sound Level (dBA)			
					L_{Aeq}	L_{Amax}	L_{Amin}	L_{A90}
9/14/2012	9:00:00 AM	10:00:00 AM	2.0	183.7	27.3	41.2	23.2	24.5
9/14/2012	10:00:00 AM	11:00:00 AM	1.1	298.4	28.5	42.0	23.9	25.4
9/14/2012	11:00:00 AM	12:00:00 PM	1.5	315.0	29.4	41.5	21.9	23.6
9/14/2012	12:00:00 PM	1:00:00 PM	1.2	340.7	24.3	34.5	21.3	22.3
9/14/2012	1:00:00 PM	2:00:00 PM	2.0	332.8	33.8	46.8	20.9	22.0
9/14/2012	2:00:00 PM	3:00:00 PM	1.7	344.9	25.8	41.2	21.5	22.5
9/14/2012	3:00:00 PM	4:00:00 PM	1.4	353.0	39.7	49.4	21.5	22.8
9/14/2012	4:00:00 PM	5:00:00 PM	1.6	10.3	40.6	53.9	21.3	23.9
9/14/2012	5:00:00 PM	6:00:00 PM	0.9	350.9	23.6	30.7	20.8	21.6
9/14/2012	6:00:00 PM	7:00:00 PM	0.9	333.0	36.5	48.9	21.1	21.6
9/14/2012	7:00:00 PM	8:00:00 PM	0.5	324.1	25.0	31.8	22.9	23.7
9/14/2012	8:00:00 PM	9:00:00 PM	0.3	37.6	26.3	30.2	24.2	25.2
9/14/2012	9:00:00 PM	10:00:00 PM	0.8	42.1	24.9	27.3	23.6	24.3
9/14/2012	10:00:00 PM	11:00:00 PM	1.0	46.4	23.4	25.8	22.3	22.9
9/14/2012	11:00:00 PM	12:00:00 AM	0.7	105.1	23.9	26.8	22.4	23.1
9/15/2012	12:00:00 AM	1:00:00 AM	0.8	141.3	27.7	42.6	24.9	26.1
9/15/2012	1:00:00 AM	2:00:00 AM	1.1	145.0	27.4	32.2	24.8	26.1
9/15/2012	2:00:00 AM	3:00:00 AM	1.6	146.5	21.6	24.1	20.7	21.2
9/15/2012	3:00:00 AM	4:00:00 AM	1.5	153.8	21.4	23.3	20.3	20.8
9/15/2012	4:00:00 AM	5:00:00 AM	0.9	222.5	21.9	24.1	20.7	21.2
9/15/2012	5:00:00 AM	6:00:00 AM	0.4	245.4	28.9	35.4	25.4	26.9
9/15/2012	6:00:00 AM	7:00:00 AM	0.5	3.6	25.2	38.2	21.0	21.7
9/15/2012	7:00:00 AM	8:00:00 AM	1.0	330.2	23.7	36.5	20.0	20.6
9/15/2012	8:00:00 AM	9:00:00 AM	0.8	351.6	22.9	34.9	19.9	20.6
Maximum			*2.0*		*40.6*	*53.9*	*25.4*	*26.9*
Minimum			*0.3*		*21.4*	*23.3*	*19.9*	*20.6*
Logarithmic average[1]			*1.1*		*31.7*	48.3	20.4	20.9

[1] *Wind speed and wind direction are arithmetic averages.*
[2] *L_{Amax} is an overall average using the 90 percentile.*
[3] *L_{Ain} is an overall average using the 10 percentile.*
[2] *L_{A90} is an overall average using the 10 percentile.*

Figure 4.2-1

Harper Creek Noise Monitoring Station S2, September 14 and 15, 2012



As might be expected noise monitoring location S2 had the lowest logarithmic averages, as this station was the furthest from potential anthropogenic sources. During the monitoring period the average L_{Aeq} sound level was 31.7 dBA. The L_{A90} was lower at 20.9 dBA and is representative of low background noise levels. The hourly L_{Aeq} saw the lowest value between 3:00 am and 4:00 am (21.4 dBA) and the lowest L_{A90} of 20.6 dBA was recorded between 7:00 am and 9:00 am. The minimum one minute sound level (L_{Amin}) was 18.6 dBA recorded at 3:18 pm on September 14, and the maximum one minute sound level (L_{Amax}) was 67.9 dBA recorded at 4:23 pm. Noise levels are reflective of a remote area with minimal anthropogenic activity.

4.3 STATION S3

One-minute noise levels recorded on September 16 and 17, 2012 are shown in Figure 4.3-1. Hourly, maximum, minimum, and logarithmic average L_{Aeq}, L_{A90}, L_{Amax} and L_{Amin} results of the 24-hour sampling period are shown in Table 4.3-1. Numerous anthropogenic noise sources were recorded during the monitoring period, and included helicopters, heavy equipment, trains and noises from the nearby sawmill.

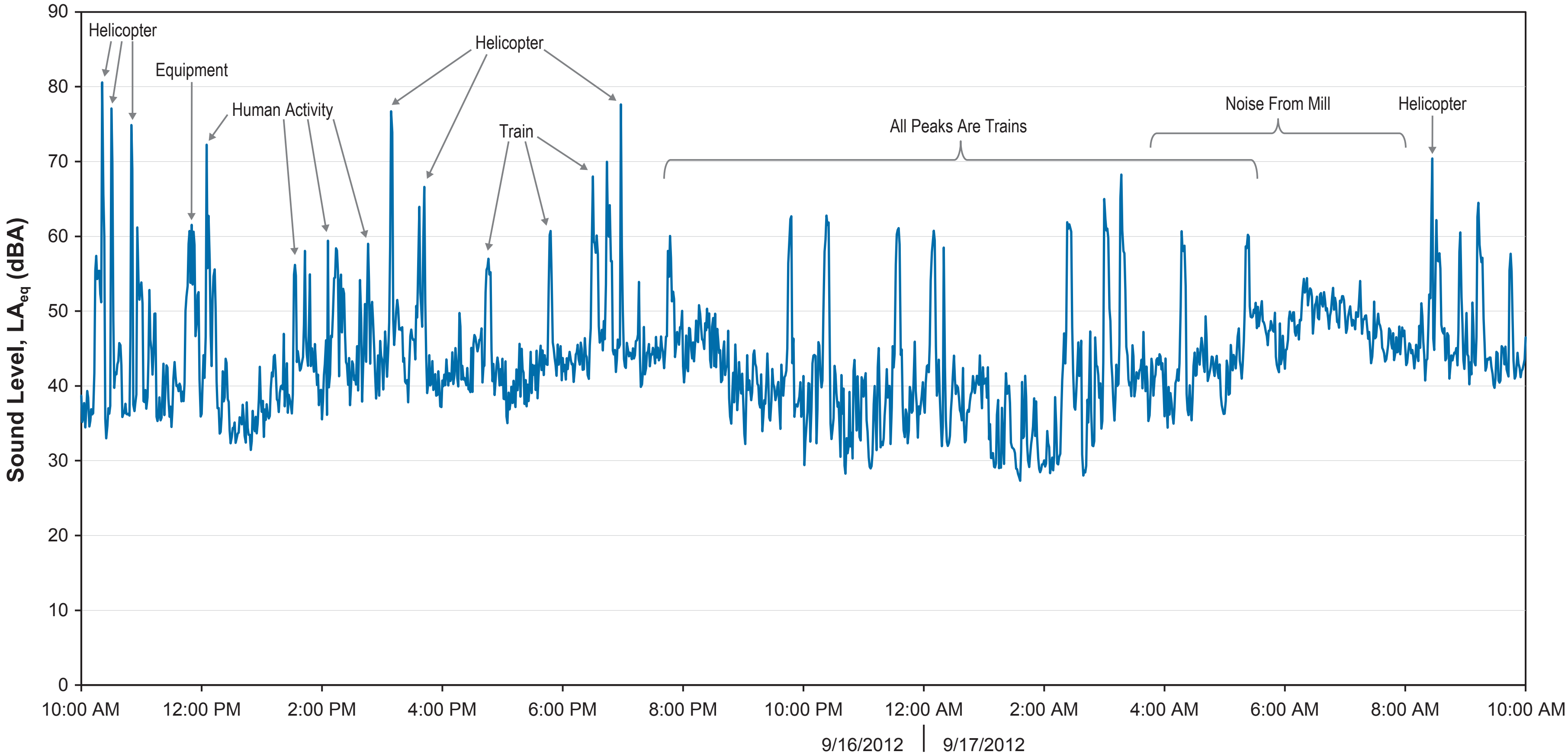
Table 4.3-1. Hourly Sound Levels, Station S3, September 2012

Date	Start Time	End Time	Wind Speed (m/s)	Wind Direction (degrees from true north)	Sound Level (dBA)			
					L_{Aeq}	L_{Amax}	L_{Amin}	L_{A90}
9/16/2012	10:00:00 AM	11:00:00 AM	2.5	324.2	65.7	77.8	45.6	47.4
9/16/2012	11:00:00 AM	12:00:00 PM	2.8	330.1	51.1	62.8	44.3	45.6
9/16/2012	12:00:00 PM	1:00:00 PM	2.0	334.2	55.4	73.6	39.9	43.2
9/16/2012	1:00:00 PM	2:00:00 PM	1.6	334.6	46.8	60.1	37.5	39.3
9/16/2012	2:00:00 PM	3:00:00 PM	1.9	338.1	50.6	63.2	41.5	44.2
9/16/2012	3:00:00 PM	4:00:00 PM	1.9	334.6	61.4	73.3	43.4	46.0
9/16/2012	4:00:00 PM	5:00:00 PM	2.6	321.2	47.3	52.7	42.9	44.4
9/16/2012	5:00:00 PM	6:00:00 PM	2.3	297.0	47.9	54.2	42.9	44.4
9/16/2012	6:00:00 PM	7:00:00 PM	2.0	295.7	61.6	71.6	49.8	51.8
9/16/2012	7:00:00 PM	8:00:00 PM	1.6	295.4	49.0	56.8	43.5	44.8
9/16/2012	8:00:00 PM	9:00:00 PM	1.7	301.7	45.5	53.5	40.4	42.0
9/16/2012	9:00:00 PM	10:00:00 PM	2.5	305.6	49.7	55.1	44.0	46.4
9/16/2012	10:00:00 PM	11:00:00 PM	2.4	316.1	50.7	55.7	46.3	47.8
9/16/2012	11:00:00 PM	12:00:00 AM	2.3	319.7	49.4	54.7	45.0	46.4
9/17/2012	12:00:00 AM	1:00:00 AM	2.2	320.6	49.2	56.2	44.0	45.6
9/17/2012	1:00:00 AM	2:00:00 AM	1.4	326.2	35.6	44.2	30.4	31.6
9/17/2012	2:00:00 AM	3:00:00 AM	1.4	323.8	52.4	58.1	46.0	47.9
9/17/2012	3:00:00 AM	4:00:00 AM	1.7	311.7	54.9	61.0	49.1	50.7
9/17/2012	4:00:00 AM	5:00:00 AM	2.2	290.7	48.6	53.5	45.4	46.5
9/17/2012	5:00:00 AM	6:00:00 AM	2.2	302.8	50.2	54.9	46.9	48.1
9/17/2012	6:00:00 AM	7:00:00 AM	2.1	292.4	50.7	59.4	47.0	48.6
9/17/2012	7:00:00 AM	8:00:00 AM	2.0	291.3	47.9	54.9	43.8	45.5
9/17/2012	8:00:00 AM	9:00:00 AM	2.4	292.7	55.3	62.9	46.3	48.1
9/17/2012	9:00:00 AM	10:00:00 AM	2.3	311.4	52.0	60.9	46.6	48.1
Maximum			*2.8*		*65.7*	*77.8*	*49.8*	*51.8*
Minimum			*1.4*		*35.6*	*44.2*	*30.4*	*31.6*
Logarithmic average[1]			*2.1*		*55.8*	72.8	40.1	42.4

[1] *Wind speed and wind direction are arithmetic averages.*
[2] *L_{Amax} is an overall average using the 90 percentile.*
[3] *L_{Ain} is an overall average using the 10 percentile.*
[2] *L_{A90} is an overall average using the 10 percentile.*

Figure 4.3-1

Harper Creek Noise Monitoring Station S3, September 16 and 17, 2012



Monitoring location S3 had the highest logarithmic averages due to its location (Vavenby). During the monitoring period the average L_{Aeq} sound level was 55.8 dBA. The L_{A90} was lower at 42.4 dBA and is representative of the background noise found in areas with numerous sources of anthropogenic noise. The hourly L_{Aeq} saw the lowest value between 1:00 am and 2:00 am (35.6 dBA) and the lowest L_{A90} of 31.6 dBA was also recorded between 1:00 am and 2:00 am. The minimum one minute sound level (L_{Amin}) was 26.1 dBA recorded at 1:18 am on September 17, and the maximum one minute sound level (L_{Amax}) of 93.2 dBA recorded at 10:21 am was due to a helicopter flying overhead. Noise levels are reflective of a moderately developed area.

5. CONCLUSIONS

Three noise monitoring stations (S1, S2 and S3) were set up within the study area and noise levels were recorded over a 24 hour period in September 2012. The locations were selected to characterize the range of baseline conditions in the region.

Natural background noise sources observed included birds, small mammals, wind and rain. Anthropogenic noise sources observed included aircraft (helicopters and fixed wing), road vehicles, trains and general human activity. Recorded noise levels were lowest at station S2 and the highest noise levels were recorded at station S3 within Vavenby. From the background data collected at monitoring stations during the monitoring period:

- the daily logarithmic average noise (L_{Aeq}) levels that were measured ranged from 31.7 (S2) to 55.8 (S3) dBA;
- the daily average noise (L_{A90}) levels that were measured ranged from 20.9 (S2) to 42.4 (S3) dBA;
- the daily minimum (L_{Amin}) noise levels ranged from 20.4 (S2) to 40.1 (S3) dBA; and
- the daily maximum (L_{Amax}) noise levels ranged from 48.3 (S2) to 72.8 (S1) dBA.

The L_{Aeq} values are in the range that would be expected for baseline rural noise levels; approximately 35 dBA during the nighttime and around 45 dBA during the daytime. Higher values (over 70dBA), such as at station S3 are due to anthropogenic activity (mostly helicopter activity) in the study area.

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