Upper Lillooet Hydro Project

Weekly Environmental Monitoring Report #51

Reporting Period: January 1 – January 31, 2015

Upper Lillooet River Hydroelectric Facility (Water File No. 2002561, Water licence No. C130613), Boulder Creek Hydroelectric Facility (Water File No. 2003049, Water licence No. C129969) & Transmission Line

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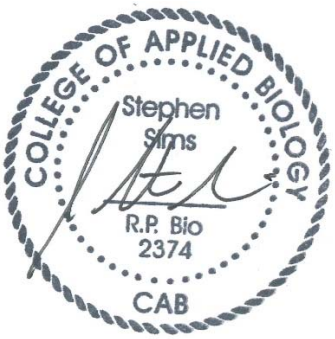
Murray Manson	Fisheries and Oceans Canada	 **J. Alex Sartori, RPBio** *Independent Environmental Monitor (IEM)*  **J. Stephen Sims, RPBio** *Delegated IEM*
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Owner Construction Permits and Approvals

Environmental Assessment Certificate No. E13-01 (Amendment 1, 2, 3, 4 & 5)
Fisheries Act Subsection 35(2)(b) Authorization No. 09-HPAC-PA2-000303 (Amendment 1, 2)
Letter of Advice for the Transmission Line No. 09-HPAC0-PA2-000303
Leave To Commence Construction (ULRHEF) File No. 2002561
Leave To Commence Construction (BDRHEF) File No. 2002453
Leave To Commence Construction (TX Line) File No. 2002561/2002453
Conditional Water Licence (ULRHEF C130613) File No. 2002561
Conditional Water Licence (BDRHEF C129969) File No. 2002453
Conditional Water Licence (BDRHEF C131153) File No. 2003601
Licence of Occupation (ULRHEF #232384) File No. 2409871
Licence of Occupation (BDRHEF #232386) File No. 2409998
Licence of Occupation (TX Line #2423386) File No. 2410654
Occupant Licence to Cut (ULRHEF Amendments 1, 2, 3, 4, 5) No. L49717
Occupant Licence to Cut (BDRHEF – KM 38 laydown) No. L49698
Occupant Licence to Cut (BDRHEF Amendments 1, 2, 3) No. L49816
Occupant Licence to Cut (TX Line Amendment 1, 2, 3, 4, 5, 6) No. L49697
General Wildlife Measure Exemption Approval Letter (TX Line & BDRHEF) File No. 78700-35/06 UWR and 39585-20 WHA
Heritage Conservation Act – Alteration Permit (ULRHEF) File No. 11200-03/2014-0033
Road Use Permit No. 6123-13-02 (Lillooet River FSR); 5673-13-01 (Rutherford Creek FSR); 7977-13-01 (Lillooet South FSR); 8015-13-01 (Ryan River); 8188-13-01 (Pemberton Creek FSR); and 9717-13-01 (Miller Bench FSR)
Junction Permit (ULRHEF & BDRHEF) File No. 11250-32/6123 (Amendment 1)
Aeronautical Obstruction Approval (Tx Line - Lillooet River Crossing) File No. 2013-004
Aeronautical Obstruction Approval (Tx Line - Ryan River) File No. 2013-005
Aeronautical Obstruction Approval (Tx Line - North Miller) File No. 2013-006
Aeronautical Obstruction Approval (Tx Line - South Miller) File No. 2013-007
Aeronautical Obstruction Approval (Tx Line - Pemberton Creek) File No. 2013-008
Aeronautical Obstruction Approval (Tx Line - Lillooet River near Pemberton) File No. 2013-009
Aeronautical Obstruction Approval (Tx Line - Lillooet River near Meager Creek) File No. 2013-010
Navigable Water Protection Act (ULRHEF) File No. 8200-2009-500434-001
Navigable Water Protection Act (BDRHEF) File No. 8200-2012-501-032-001
Navigable Water Protection Act (Tx Line – North Creek) File No. 8200-2013-500103-001
Navigable Water Protection Act (Tx Line – Lillooet River) File No. 8200-2013-500101-001
Navigable Water Protection Act (Tx Line – Lillooet River) File No. 8200-2013-500102-01
Navigable Water Protection Act (Tx Line – Ryan River) File No. 8200-2013-500104-001
Navigable Water Protection Act (Tx Line – South Miller River) File No. 8200-2013-500100-001
Navigable Water Protection Act (Tx Line – Boulder Creek) File No. 8200-2013-500099-001
Navigable Water Protection Act – Extension Approval (ULRHEF, BDRHEF, Tx Line)
Navigable Water Protection Act (Bridge – Ryan River) File No. 8200-2013-500381
Navigable Water Protection Act (Bridge – Upper Lillooet Side Channel; Extension Approval) File No. 8200-2013-500383
Section 57 Authorization (ULRHEF) File No. 16660-20/REC202717
SLRD Temporary Use Permit No. 34 – Boulder Creek HEF
SLRD Temporary Use Permit No. 35 – Upper Lillooet River HEF
Works Permit for Construction within FSR Right-of-Way No. 6123-14-01
Section 52(1)(b) FRPA Authorization for Ryan River Wet Crossing File No. FOR-19400-01/2014
MOTI Permit to Construct, Use and Maintain Works Upon the Right-Of-Way of a Provincial Public Highway No. 2014-06099

Contractor Construction Permits and Approvals

Magazine Licence File No. UL76018
Section 8 Approval – Short Term Use of Water File (Lillooet River and Tributaries) No. A2006123 (Amendment 1)
Waste Discharge under the Code of Practice for the Concrete and Concrete Products Industry under the Environmental Management Act (Authorization No. 107204) Tracking No. 326969
Wildlife Act Permits – Pacific Tailed Frog Salvage Permit # SU14-95304 & SU13-90538, Fish Salvage Permit #SU14-95329
Section 52 of the Fisheries (General) Regulations – Fish Salvage Licence # XR 139 2014
BC Safety Authority – Temporary Construction Electrical Service Permit EL-140698-2014
Municipal Wastewater Regulation - Authorization # 107032
Water Supply System Construction Permits – VCH-14-613 for Main Camp
Water Supply System Permit to Operate Issued July 30th, 2014 for Main Camp
Section 6(3) and Schedule 3 Wildfire Regulations Fire Exemption for Ryan River Bridge File No. 14350-07
SLRD Building Inspection Report dated August 13, 2014 - Construction Camp Building Permit No. 10830
Lillooet River FSR Temporary Road Closures Approval File No. 11250-32/6123 (Amendment 1, 2)
Lillooet South FSR Temporary Road Closures Approval File No. 11250-32/7977

ACRONYMS:

AMBNS	Active Migratory Bird Nesting Survey
ASMP	Archaeological Sites Management Plan
ARD/ML	Acid Rock Drainage and Metal Leaching
BCEAO	British Columbia Environmental Assessment Office
BCWQG	British Columbia Water Quality Guidelines
BDRHEF	Boulder Creek Hydroelectric Facility
BG	Background
BKL	BKL Consultants Ltd.
CE	CRT-ebc Construction Inc.
DFO	Fisheries and Oceans Canada
DS	Downstream
Ecofish	Ecofish Research Ltd.
Ecologic	Ecologic Consulting
EIR	Environmental Incident Report
ESC	Erosion and Sediment Control
FAM	Field Advice Memorandum
FSR	Forest Service Road
GWR	Mountain Goat Winter Range
Hedberg	Hedberg and Associates Ltd.
IE	Independent Engineer (True North Energy)
IEM	Independent Environmental Monitor
INX	Innergex Renewable Energy Inc.
ISW	Instream Works
ITM	Environmental Issue Tracking Matrix
JEM	JEM Energy Ltd. (Delegate Independent Engineer)
LTC	Leave to Construct
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MOE	Ministry of Environment
MOTI	Ministry of Transportation and Infrastructure
NCD	Non Classified Drainage
OLTC	Occupational License to Cut
PAG	Potentially Acid Generating
RoW	Right of Way
RVMA	Riparian Vegetation Management Area
SES	Sartori Environmental Services
Stringer Line	Temporary Backfeed Transmission Line
TX Line	Transmission Line
ULRHEF	Upper Lillooet Hydroelectric Facility
UWR	Ungulate Winter Range
VC	Valued Component
WEL	Westpark Electric Ltd.
WEMR	Weekly Environmental Monitoring Report
WHA	Wildlife Habitat Area
WQ	Water Quality

1.0 Summary of Site Inspections for Reporting Period

The table presented below summarizes the IEM team site presence, weather and monitoring locations by component:

Dates	IEM Team Personnel	Weather Conditions	Key Monitoring Locations & Activities
January 1 – January 10	TH	See ***Weather Notes*** below table	***ULRHEF & BDRHEF Winter Operations*** • Routine equipment maintenance and repairs completed at the 38km laydown shop location • Snow management at camp facilities and within the 38km Laydown (*e.g.*, maintaining electric fence and gates, clearing roof tops, driving surfaces and access paths) • The IEM conducted a site inspection on January 9, 2015 ***TX Line*** • Stringer Line ➢ Setting poles within previously excavated foundations resumed on January 8, 2015 ➢ Blasting within 100m of Salmon Slough was completed on January 10, 2015 ➢ The IEM was onsite to inspect pole setting works within RVMAs and to conduct instream acoustic monitoring during blasting works
January 11 – January 17	KC	See ***Weather Notes*** below table	***ULRHEF & BDRHEF Winter Operations*** • Routine equipment maintenance and repairs completed at the 38km laydown shop location • Snow management at camp facilities and within the 38km Laydown (*e.g.*, maintaining electric fence and gates, clearing roof tops, driving surfaces and access paths) ***TX Line*** • Stringer Line ➢ Setting poles within previously excavated foundations included minor works within RVMAs and CTF stream buffers ➢ Clearing of the previously On Hold section between poles 1 - 5 within the MOTI dedicated road right-of-way ➢ Pole foundation works at structures 1 – 5 were completed following clearing activities
January 18 – January 24	TH	See ***Weather Notes*** below table	***ULRHEF & BDRHEF Winter Operations*** • Routine equipment maintenance and repairs completed at the 38km laydown shop location • Snow management at camp facilities and within the 38km Laydown (*e.g.*, maintaining electric fence and gates, clearing roof tops, driving surfaces and access paths) • The IEM conducted a site inspection on January 23, 2015 ***TX Line*** • Stringer Line ➢ Pole installation was completed on January 19 and conductor stringing commenced on January 20

Dates	IEM Team Personnel	Weather Conditions	Key Monitoring Locations & Activities
January 25 – January 31	AA, KC	See ***Weather Notes*** below table	***ULRHEF & BDRHEF Winter Operations*** • Routine equipment maintenance and repairs completed at the 38km laydown shop location • Snow management at camp facilities and within the 38km Laydown (*e.g.*, maintaining electric fence and gates, clearing roof tops, driving surfaces and access paths) ***TX Line*** • Stringer Line ➢ Conductor stringing continued throughout the week ➢ Minor branch limbing within the Salmon Slough RVMA occurred and was monitoring by the IEM on January 28 • Segment 16 ➢ Clearing of the RoW began on January 26 and continued throughout the week. The IEM was onsite to monitor clearing within 100m of Rutherford Creek (CTF habitat)

IEM Team Personnel: *TH – Tom Hicks; AA – Anthony Andrews; KC – Kirsten Cornwall*

Weather Notes*: Site specific daily avalanche and weather forecasting was provided for WEL and CE sites throughout the reporting period. Heavy snowfalls occurred on January 4 and 5. Rain and warm temperatures were recorded from January 22 – 27. A landslide at 6km of the Lillooet River FSR was reported on January 29.*

2.0 Administrative Summary

Key communications and meetings the IEM team had with the licensees, contractors and/or environmental authorities:

Date	Communication Type	Participants	Issues Discussed	ITM ID No.
January 5, 2015	*Email*	SES, BKL	BKL Consulting Ltd. (acoustical consultants) submitted the Fall 2014 Construction Noise Monitoring Report. The report identifies one blasting event on November 1 that exceeded the noise threshold of 75 dBA. SES has prepared and attached a report to summarize the results of the noise monitoring program that has been completed to date. The report includes a discussion of the effects of construction noise on Mountain Goat Migration through the Truckwash Creek corridor.	-
January 6, 2015	*Email*	WEL, SES, INX, JEM	WEL submitted an email outlining winter safety measures and snow plowing procedures to be implemented for works associated with the Stringer Line. WEL will prepare and submit a formal snow management/winter operating procedure prior to plowing snow in additional work areas.	-
January 8, 2014	*Email*	SES, Hedberg, INX	Hedberg submitted a flight plan for helicopter access into Segment 11, for the purpose of conducting survey works associated with the TX Line. The 1500m horizontal and 400m vertical buffers distances for all Ungulate Winter Ranges were included in the flight plan.	-
January 13, 2015	*Email*	BCEAO, SES, INX, WEL, CE	INX distributed the results of the BCEAO November 26, 2014 site inspection. The report identified no issues of non-compliance (see attached). A follow-	-

Date	Communication Type	Participants	Issues Discussed	ITM ID No.
			up inspection will be conducted in the spring of 2015.	
January 22, 2015	*Onsite communications*	SES, Mumleqs	Prior to clearing works associated with the Stringer Line within the Salmon Slough RVMA, Mumleqs informed the IEM that two trees were unable to be felled without entering the watercourse. Mumleqs in consultation with the IEM developed a plan onsite to lift the trees out of the watercourse using ropes attached to an excavator. As the excavator needed to operate within 30m of the watercourse to conduct the works, additional spill kits, shovels, and sufficient personnel (1 faller, 3 labourers, and 1 site supervisor) were available to respond in case of a spill. Both trees were felled and successfully removed under IEM supervision and no spills or water quality concerns were noted.	-
January 23, 2015	*Pre-work Meeting*	WEL, Hedberg, SES, INX, Mumleqs	The Segment 16 clearing plan and clearing maps were reviewed and discussed prior to beginning clearing activities. Key topics included snow mobile access considerations and the clearing schedule for works in sensitive areas. Specifically within 100m of Rutherford Creek and within RVMA 386A.	-
January 29, 2015	*Email notification*	SES, INX, WEL, CE	INX submitted an email notifying the Project team of a landslide at 6km of the Lillooet River FSR blocking access. Squamish Mills will repair the road as the primary road use permit holder.	

3.0 Current Work Restrictions and Timing Windows

The table presented below outlines work restrictions applicable during the reporting period for each active[1] Project component location:

Component	Location	Wildlife/Archeology Concern	Construction/Timing Restrictions & Mitigations
TX Line	Segment 16 & Stringer Line Alignment	Within 150m of wetlands or 100m of Coastal Tailed-Frog Streams	IEM presence is required when clearing within 150m of wetlands or 100m of Coastal Tailed-Frog Streams, to ensure clearing area is minimized.
		Riparian Vegetation Management Areas (RVMA)	IEM monitoring is required during clearing within RVMAs.

[1] CE did not perform construction activities in the month of January; therefore timing restrictions related to the power generating components of the Project have been omitted from this table.

4.0 Upper Lillooet River Hydroelectric Facility & Boulder Creek Hydroelectric Facility – Monitoring Results

4.1 *Construction Camp & 38 km Laydown*

Winter Operations:

- The transitions between the Lillooet River FSR and the winter works area (at 37.5 km and 38.5 km) were marked and passable by snowmobile during both inspections (January 9 and 23, 2015). The running surface of the Lillooet River FSR was snow covered during the January 9 inspection (Photo 1); however, the rain and warm weather on January 23 resulted in snow melt, exposing patches of the gravel running surface (Photo 2). CE informed the IEM that they were attempting to keep a portion of the running surface of the Lillooet River FSR snow covered to the extent possible despite the warm conditions.
- The electric fence was observed to be buried on January 9. CE was actively in the process of clearing snow and repairing the electric fence (Photo 3). During the follow-up inspection on January 23 the electric fence was fully operational and clear of snow (Photo 4).
- All CE winter operations are restricted to the Construction Camp and 38 km laydown (Photo 5) areas. Works included snow removal (*e.g.*, maintaining electric fence and gates, clearing roof tops, driving surfaces and access paths), and routine maintenance of construction equipment within the mechanic shop at the 38 km laydown.
- Signs have been posted to notify the public of the dangers of entering closed construction sites (Photo 6).

Environmental Summary:

- The IEM performed an inspection of the active ULRHEF and BDRHEF sites on January 9 and January 23, 2015. On January, 9 the IEM observed that the electric fence was under repair and non-operational due to recent heavy snow falls. The gates of each of the four levels of the construction camp were also left open. The IEM asked that the electric fence be repaired and that the gates be closed at all times to prevent wildlife from entering the construction camp area. No wildlife sightings within the construction camp area were reported in January 2015. During the follow-up inspection on January 23 the electric fence was found to be fully operational and clear of snow.
- CE performed daily inspections of the electric fence and fuel storage areas and recorded results in a daily inspection log. Weekly reports were prepared by CE to report activities and conditions onsite. These reports were provided to the IEM, for review. No concerns were noted in the reports.

Photos:

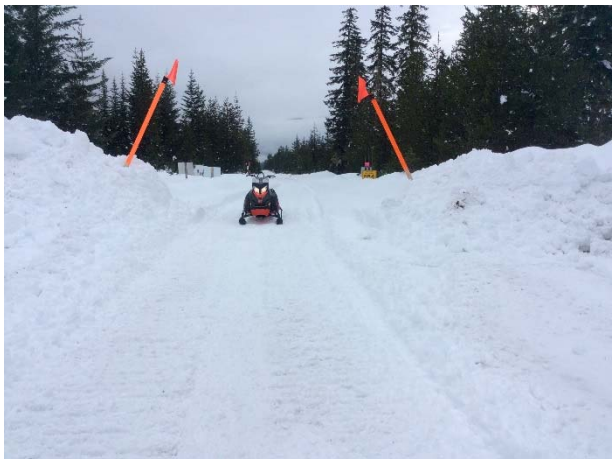

Photo 1 – Transition into winter work area at 37.5km (January 9, 2015).

Photo 2 – Transition into winter work area at 37.5km (January 23, 2015).

Photo 3 – The electric fence was being repaired and cleared of snow during the January 9, 2015 inspection.

Photo 4 – The electric fence was operational and snow free during the January 23, 2015 inspection.

Photo 5 – Conditions at fuel storage area within Pad 1 of the 38km laydown (January 23, 2015).

Photo 6 – Example of sign boards posted to warn public of the dangers of entering closed construction areas (January 23, 2015).

4.2 *Water Quality Results*

The IEM has suspended the weekly WQ monitoring program for the remainder of the winter shutdown period. Weekly water quality monitoring will resume at the start of the 2015 construction season according to the conditions outlined in the Surface Water Quality Protection Plan.

4.3 *Recommendations*

IEM recommendations for the ULRHEF and BDRHEF are as follows:

- The IEM recommends that work sites are closely monitored during the spring melt period to verify the effectiveness of installed winterization and ESC measures, and ensure that regular maintenance is performed as needed.

4.4 *Upcoming Works*

Construction activities will resume in the spring of 2015. A small crew will work to monitor and maintain the construction camp and 38km laydown area during the winter months. The IEM will perform at minimum bi-monthly audits during the winter shutdown period to document compliance with the Winter Operations Plan.

5.0 Transmission Line – Monitoring Results

5.1 *Transmission Line Construction Activities*

Right-of-Way Clearing:

- Stringer Line RoW clearing occurred from pole 1 - 5 on January 14 – 16, 2015 (Photo 7). RVMA clearing of trees overhanging the Salmon Slough occurred on January 22. Minor branch limbing within the Salmon Slough RVMA occurred on January 28. The IEM was onsite to oversee clearing activities within 150m of wetland habitat associated with the Salmon Slough.
- Clearing of the Segment 16 RoW began on January 26 following a pre-work meeting. The IEM monitored hand falling and tree topping within RVMAs and clearing within 100m of CTF streams.

Transmission Line Pole Installation, Line Stringing and Clipping

- Blasting of pole foundations within 30m of the Salmon Slough occurred on January 10 under IEM supervision.
- Stringer Line pole installation was completed on January 19 and conductor stringing commenced on January 20.

Environmental Summary:

- On January 10, 2015 the IEM was onsite to conduct instream acoustic monitoring during blasting works in proximity to the Salmon Slough (Photo 8). The hydrophone trigger

threshold was set at 15kPa and none of the blasting events exceeded the trigger value, therefore all works remained below the 30 kPa instream acoustic pressure limit.

- Prior to clearing works associated with the Stringer Line within the Salmon Slough RVMA, Mumleqs informed the IEM that two trees were unable to be felled without entering the watercourse. Mumleqs in consultation with the IEM developed a plan onsite to lift the trees out of the watercourse using ropes attached to an excavator (Photo 9). As the excavator needed to operate within 30m of the watercourse to conduct the works, additional spill kits, shovels, and sufficient personnel (1 faller, 3 labourers, and 1 site supervisor) were available to respond in case of a spill. Both trees were felled and successfully removed under IEM supervision and no spills or water quality concerns were noted (Photo 10).
- The IEM inspected pole foundations installations within RVMAs and CTF buffers along the Stringer Line alignment on January 10 and concluded that the site conditions were stable and IEM monitoring during pole installations and conductor stringing works within these areas would not be required.

Photos:

Photo 7 – Hand falling near pole 5 of the Stringer Line alignment (January 13, 2015).

Photo 8 – Instream acoutic pressure monitoring during blasting within 30 m of the Salmon Slough (January 10, 2015).

Photo 9 – Removing a tree from the Salmon Slough with ropes attached to an excavator (January 22, 2015).

Photo 10 – Conditions following the operation of an excavator with 30m of the Salmon Slough (January 22, 2015).

5.2 *Water Quality Results*

No water management activities or works affecting water quality were conducted in January 2015. As such the IEM did not conduct water quality sampling during this monitoring period. Clearing activities associated with the Salmon Slough RVMA and Rutherford Creek RVMA were monitored by the IEM and water quality remained visually unaffected throughout the works. Water quality sampling will continued to be collected during TX Line water management activities according to the conditions outlined in the Surface Water Quality Protection Plan. Exceedances of *in-situ* water quality (turbidity) deemed to be caused by project-related activities will be highlighted and discussed accordingly.

Date	Time	Sample Location Description	pH	Turbidity (NTU)	Cond (uS)	Temp (°C)
No water sampling occurred in January 2015. Water quality remained visually unaffected during work activities.						

5.3 *Recommendations*

- Prior to resuming works in the spring of 2015, the IEM recommends access roads be inspected to assess any slope failures or drainage/erosion concerns that have resulted from recent heavy rains and rain on snow events.

5.4 *Upcoming Works*

The following new and/or environmentally sensitive construction activities are scheduled to occur along the TX Line in the upcoming reporting period(s):

- Transmission line pole installation and construction activities have been temporarily suspended and will resume in the spring of 2015. Clearing of the Segment 16 RoW will continue in the coming weeks, and Segment 8 clearing will begin once snow levels allow access back into the area.
- Temporary clear span creek crossings associated with upgrades and repairs to the Lower Miller Bench FSR are scheduled to begin in February once designs are prepared and submitted for approval.
- Completion of the Stringer Line is scheduled for early February 2015. Remaining works included conductor stringing and pole structure anchor setting.

6.0 Wildlife Sightings

As per the CEMP, a wildlife sightings record has been implemented and will be updated regularly by Project Personnel. It is mandatory for all personnel to report wildlife sightings including, but not limited to bears, cougars, mountain goats and deer. Wildlife sighting will be reported and recorded by the contractor(s) and will submitted to the IEM on a weekly basis. Observation or detection of the following species will trigger notification to identified parties according to the following table. No wildlife observations were reported to the IEM in the month of January 2015.

Species Observed or Detected	Notification Period	Agencies to be Notified
Northern Rubber Boa	Immediately	IEM, Owner
Grizzly Bear	24hrs	IEM, Safety Officer, Conservation Officer, Owner
Wolverine Den	24hrs	IEM, MFLNRO, Owner
Spotted Owls	24hrs	IEM, MOE, Owner
Mountain Goats	48hrs	IEM, MFLNRO, Owner

7.0 Mountain Goat Monitoring Program

Mountain Goat monitoring will resume in the spring of 2015, once construction activities resume. BKL Consultants Ltd. submitted the results of the fall 2014 noise monitoring period on January 5, 2015. SES has prepared and attached a report (*Upper Lillooet Hydro Projects – Construction Noise Monitoring Summary and the Effects of Construction Noise on Mountain Goat Migration Through the Truckwash Creek Migration Corridor),* summarizing the construction noise monitoring results collected to date (fall 2013, spring 2014 and fall 2014). The purpose of the report was to assess whether construction related noise has had an impact on Mountain Goat migration through the Truckwash Creek migration corridor.

8.0 Environmental Issues Tracking Matrix (ITM)

8.1 *Hydroelectric Facilities (ULRHEF & BDRHEF)*

ITM Tracking Legend:	*Work Item Open*
	Work Item Complete
	Issue Closed

Issue Tracking		Environmental Issue		Mitigation Measures			
ID No.	Status	Location	Issue Description	Action Taken/Recommended	Date of Identification	Targeted Date for Completion	Date Completed
							next ITM – ULR#23

8.2 *Transmission Line*

ITM Tracking Legend:	*Work Item Open*
	Work Item Complete
	Issue Closed

Issue Tracking		Environmental Issue		Mitigation Measures			
ID No.	Status	Location	Issue Description	Action Taken/Recommended	Date of Identification	Targeted Date for Completion	Date Completed
							next ITM – Tx#3

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MEMORANDUM

To:	Upper Lillooet River Power Limited Partnership
	c/o Julia Mancinelli, Innergex Renewable Energy Inc.
From:	Tom Hicks, Sartori Environmental Services
Date:	March 2, 2015
Reference:	Upper Lillooet Hydro Projects (ULHP) – Construction Noise Monitoring Summary and the Effects of Construction Noise on Mountain Goat Migration Through the Truckwash Creek Migration Corridor

1.0 Introduction

Noise generated during construction of the Upper Lillooet River Hydroelectric Facility (ULRHEF) downstream tunnel portal was monitored to confirm that noise levels were adaptively managed to prevent auditory disturbance to Mountain Goats travelling through the Truckwash Creek Mountain Goat migration corridor between adjacent winter range habitats (u-2-002 UL 11 & u-2-002 UL 19) (Lacroix, et al., 2012). Condition 15 of the Environmental Assessment Certificate issued for the Project (EAO, 2013) prescribes mitigation measures to minimize potential effects to Mountain Goat migration caused by construction related noise. Specifically, construction noise levels must be minimized within 500m of Mountain Goat Ungulate Winter Range (UWR) habitat to the satisfaction of the Independent Environmental Monitor (IEM) and if noise is deemed to exceed the threshold of 75 dBA at the edge of UWR u-2-002 UL 11 or the mitigation corridor during the critical winter (November 1 – April 30) and kidding (May 1 – June 15) periods, additional mitigation measures will be implemented to minimize noise levels according to conditions of the Mountain Goat Management Plan (Lacroix, Newbury, & Leigh-Spencer, 2013). In addition to mitigating construction noise levels during operations, mandatory construction shutdown periods are enacted to permit undisturbed Mountain Goat migration through the Truckwash Creek corridor. These shutdown periods include daily shutdowns timed around sunrises and sunsets in May and November, as well as a two week shutdown period that occurs according to the snow levels measured in the early winter and late spring. This report has been prepared to evaluate adherence to construction noise mitigation requirements and determine whether they have been successful at minimizing impacts to the migration of Mountain Goats through the Truckwash Creek drainage.

2.0 Background

2.1 *Construction Noise Level Monitoring*

To verify the effectiveness of the construction noise mitigation techniques employed during the sensitive Mountain Goat migration and overwintering/kidding periods, a noise monitoring program was developed with technical support from BKL Consultants Ltd. (BKL), a North Vancouver based acoustical consulting firm. As the IEM for the Upper Lillooet Hydro Project (ULHP), Sartori Environmental Services was responsible for

collecting acoustical data during active construction periods in fall 2013 and spring and fall 2014. Data was collected from three noise monitoring stations (see Figure 1). Noise monitoring stations were situated above and below the ULRHEF downstream tunnel portal within the Mountain Goat migration corridor. In the fall of 2014 a third monitoring station was installed between the ULRHEF intake construction site and the northwestern edge of the overwintering and kidding habitat near Keyhole Falls (u-2-002 UL 19). Each of the monitoring stations was installed at a location representing the interface between the nearest construction activity and Mountain Goat habitat. The noise level data collected was analyzed by BKL to determine when construction noise levels exceeded 75 dBA. For each event exceeding the trigger threshold (set as 65 dBA in 2013 and 70 dBA in 2014), audio recordings were captured and later analyzed to determine whether the sound was generated by construction activities or by non-construction related activities[1]. BKL have presented their results in three reports, one per monitoring season. These reports outline data collection and analysis methodologies and provide the duration and maximum levels of all noise level exceedances recorded.

2.2 *Mountain Goat Monitoring*

Concurrently with the noise monitoring program, the IEM or designate was on site to monitor Mountain Goat activity within 500m of construction activities surrounding the ULRHEF downstream tunnel portal and the ULRHEF intake (Figure 1). Mountain Goats were observed from three sites to monitor behavioural signs indicative of disturbance from construction activities and/or noise generated during those activities. Efforts were made to identify age, sex, and repeat observation of individuals, whenever possible. Monitoring sites were chosen to observe the upper (u-2-002 UL 19) and lower (u-2-002 UL11) winter range habitats and the Truckwash Creek migration corridor near the downstream tunnel portal work area. The observation sites were as follows:

- MG-OBS01 (10U 467955 5612773) – Truckwash Creek monitoring site viewing river right within the Migration Corridor, which is approximately 250m from the ULRHEF lower tunnel portal work area;
- MG-OBS02 (10U 466593 5613988) – Keyhole Falls monitoring site viewing the northwest edge of the lower winter range and kidding habitat u-2-002 UL 11, which is approximately 1.5km from the ULRHEF lower tunnel portal and 600 - 850m from the ULRHEF intake work area; and
- MG-OBS03 (10U 467388 5614081) – Garibaldi Pumice mine monitoring site viewing the upper winter range habitat u-2-002 UL 19, which is approximately 1 – 2km from the ULRHEF lower tunnel portal work area.

Daily monitoring effort was split between all three sites between sunrise and sunset, unless safety concerns precluded monitors from doing so. Attempts were made to rotate the order of the sites visited each day. The Mountain Goat Management Plan (Lacroix, Newbury, & Leigh-Spencer, 2013) provides additional details related to the monitoring program.

[1] Please see the attached BKL reports for additional details.

Figure 1. Location of noise monitoring stations and Mountain Goat observation sites. Map courtesy of (Lacroix, Newbury, & Leigh-Spencer, 2013).

3.0 Results

A summary of the noise monitoring effort is presented in Table 1. The data gaps that occurred during the fall 2014 monitoring period at the Upper Truckwash and the Keyhole Falls monitoring sites were the result of equipment malfunctions. Additional details can be found in the attached BKL reports.

Construction related noise levels remained below threshold levels (75 dBA) for the vast majority of the noise monitoring period, with the exception of 56 isolated events that varied between 2 and 17 seconds in duration. Of these events, 14 events were determined to be caused by construction activities as summarized in Table 1 & Table 2. A summary of the observations made during the Mountain Goat monitoring program, corresponding to each construction noise related exceedance have also been include in Table 2 to evaluate the consequences and thus potential adverse effects to Mountain Goats

Table 1. Construction Noise Monitoring Effort and Construction Noise Level Exceedance Events

Monitoring Period	Noise Monitoring Station	Data Collection Periods	Total Noise Monitoring Time (days)	Total Number and Duration of Construction Noise Level Exceedance Events (# of events = seconds)
Fall 2013	Lower Truckwash	October 31 – November 15	16	2 = ~8 seconds*
		December 2 – December 11	9	None
	Upper Truckwash	October 31 – November 15	16	None
		December 2 – December 11	9	None
Spring 2014	Lower Truckwash	April 17 – 22	5	None
		May 18 – June 16	29	8 = 32 seconds
	Upper Truckwash	May 18 – June 16	29	3 = 13 seconds
Fall 2014	Upper Truckwash	October 31 – November 4	5	None
		November 11 – November 12	1	None
	Lower Truckwash	October 31 – November 26	27	1 = 5 seconds
	Keyhole Falls	November 15 – November 19	4	None
		November 22 – November 23	1	None
		November 26	1	None
Totals			152 days (1.31×10^7 seconds)	14 events = 58 seconds

*No duration was reported for these two events. The estimate of ~8 seconds is based on the average duration of other noise level exceedances that were recorded during blasting events that exceeded the 75dbA threshold.

Table 2. Summary of Construction Related Noise Level Exceedances (>75 dBA) and Mountain Goat Observations

Noise Monitoring Site	Date	Time	Duration (seconds)	Max (dBA)	Description of Construction Activity	Mountain Goat (MG) Observations Summary
Lower Truckwash	01-Nov-13	11:12:00	N/A	78	Blasting	No MGs were observed before or during this noise level exceedance event. The first MG sighting of the Fall 2014 monitoring period, which began on October 31, occurred on November 5 from MG-OBS03. No MGs were observed on the lower UWR until November 11.
	08-Nov-13	9:20:00	N/A	77	Blasting	No behavioural responses were observed. 6 MGs were observed feeding, standing, and resting between 8:50 and 9:50 from MG-OBS3. The MGs on the upper UWR were 1 - 2 km from the source of the blast. No MGs were observed on the lower UWR until November 11.
	21-May-14	8:26:38	4	79.7	Blasting	No MGs were observed during these noise level exceedance events; however three MGs were observed from MG-OBS02 at 9:50 shortly after the noise level exceedances occurred. Once the MGs became aware of the monitors presence they moved out of sight behind a ridge line suggesting that the monitors may have caused a disturbance. Grizzly Bear presence at Keyhole Falls was observed on May 18, 20, & 25, which may also have contributed to MG sensitivity to the presence of the monitors. A MG was observed at MG-OBS02 on May 22.
		8:39:36	4	76.8	Blasting	
		9:32:31	4	75.3	Blasting	
	23-May-14	14:51:00	4	77.3	Drilling	No MGs were observed on May 23, 2014 due to low visibility from the monitoring locations. MGs observed on May 24 on the upper UWR and displayed normal behaviour including foraging and travelling. Grizzly Bear presence at Keyhole Falls was observed on May 18, 20, & 25, which may be why no MGs were observed at MG-OBS02 on May 24 and could account for the behaviour of three MGs observed at MG-OBS02 on May 25 who were observed travelling on steep terrain. Evidence of a kidding event was observed on the lower UWR on May 27 (Photo 3).
		16:13:01	5	75.4	Construction vehicles moving	
		16:13:12	6	75.1	Construction vehicles moving	
		16:13:32	3	77.2	Construction vehicles moving	
		17:39:00	2	85.6	Blasting	
	01-Nov-14	6:22:00	5	83.2	Blasting	No MGs were observed before or during this noise level exceedance event. The first MG sighting of the Fall 2014 monitoring period, which began on October 31, occurred on November 4 from MG-OBS01. An adult male was observed on the slopes on the opposite side of the Lillooet River. No behavioural responses were noted.

Noise Monitoring Site	Date	Time	Duration (seconds)	Max (dBA)	Description of Construction Activity	Mountain Goat (MG) Observations Summary
Upper Truckwash	11-Jun-14	14:01:56	5	80.9	Blasting	MGs were observed on June 10 on both the upper and lower UWR; however no MGs were observed on June 11. An adult male MG was observed on June 12 on the UWR travelling and resting below the snow line, displaying no sign of behaviour disturbance. MGs were observed again at MG-OBS02 on June 15, suggesting that the migration to the upper UWR had not yet occurred for some MGs.
	12-Jun-14	10:59:15	4	82	Blasting	No MGs were observed during these noise level exceedance events on June 12; however a MG was observed from MG-OBS03 at 12:30 shortly after the noise level exceedances occurred. An adult male MG was observed travelling and resting below the snow line, displaying no sign of behaviour disturbance. MGs were observed at MG-OBS02 on June 15, suggesting that the migration to the upper UWR had not yet occurred for some MGs.
		11:12:58	4	77.5	Blasting	

In total, 14 construction related noise level exceedances were recorded which varied from 2 – 6 seconds in duration, generating noise level maximums between 75.1 and 85.6 dBA. These 14 events combined to account for approximately one minute of time exceeding the 75 dBA threshold during the152 days of noise monitoring data that has been captured to date. The majority of the exceedances were caused by blasting, which occurred as part of the Lillooet River FSR realignment works at Truckwash Creek (fall 2013; spring 2014) and during blasting associated with the ULRHEF downstream tunnel portal tunneling works (fall 2014). The remaining noise level exceedances, which occurred on May 23, 2014, were caused by the exploratory test pitting and drilling program at the ULRHEF downstream tunnel portal by a travelling excavator and an operating drill rig. It is important to note that there were no construction related noise level exceedances recorded at the Keyhole Falls monitoring site.

The remaining non-construction related events were attributed mostly to IEM staff members changing the batteries of the noise meters and downloading the data. Other non-construction related noise sources included aircraft noise that was not associated with the Project, members of the public hiking and talking around the meters, environmental sounds (*e.g.* debris falling from trees, branches snapping, etc.) and indiscernible noises.

In comparing Mountain Goat monitoring data with construction noise level exceedance events, a single instance was found (November 8, 2013) when Mountain Goats were observed at the same time a construction noise level exceedance occurred. No sign of disturbance was observed as a result of the noise level exceedance.

4.0 Discussion

4.1 *Mountain Goat Monitoring During Periods of Noise Level Exceedance*

Mountain Goat monitors have completed 97 days of monitoring to date and have become accustomed to recognizing routine behaviours of the Mountain Goats in the upper and lower UWRs; however a total of ten instances have been recorded when behavioural responses were observed. Mountain Goats have reacted to the presence of the monitors at the Keyhole Falls monitoring site on seven separate occasions. Four instances have been observed where Mountain Goats were intently watching the observers (vigilance) and three instance where Mountain Goats appeared to move away from the monitoring location due to the presence of the monitors. Moving away from the monitors is defined as a disturbance, however on all three occasions the movements were slow, controlled, and did not seem to cause distress. Two other instances were observed where Mountain Goats appeared restless (hyper-vigilance) in response the presence of a Grizzly Bear sow and cubs. One flight response was also noted on May 27, 2014 which was attributed to non-construction related disturbance; however the source of the disturbance could not be determined.

During the noise exceedance event on November 8, 2013, six Mountain Goats within upper UWR (u-2-002 UL 19) located between 1 – 2 km from the source of the exceedance, displayed no signs of vigilance, hypervigilance, or disturbance at the time construction noise levels exceeded the 75 dBA threshold.

The noise monitoring data collected to date suggests that current construction noise mitigation measures have been successful at maintaining the noise threshold below 75dBA although some exceedances have occurred. To further examine the effects of these exceedances, it is useful to discuss the key observations collected as part of the Mountain Goat monitoring program. The observations confirm the continued uses and migration between the UWRs, and provide evidence of kidding within the Keyhole Falls UWR. This information combined with inferences based on Mountain Goat biology, suggest that construction noise mitigation measures have successfully prevented impacts to Mountain Goats during the monitoring period.

Photographs captured during the Mountain Goat monitoring program (see Photos) provide evidence to support the continued utilization of the Keyhole Falls UWR (u-2-002 UL 11) in each of the monitoring periods (fall 2013, spring 2014 and fall 2014). Furthermore, repeat sightings of an adult female with a broken right horn have been made within the Keyhole Falls UWR (see Photo 1, Photo 2, & Photo 5) suggesting repeated use by a single individual throughout the three monitoring periods. This information leads the assumption that this individual undertook three seasonal migrations between a summer habitat[2] and the Keyhole Falls UWR.

Evidence that Keyhole Falls UWR continues to be used for kidding was observed on May 27, 2014 (Photo 3) and on November 19, 2014 (Photo 5). A newborn Mountain Goat kid was photographed on May 27, 2014 (Photo 3), and the presence of a young-of-year juvenile was photographed on November 19, 2014 (Photo 5). These sightings suggest that a kidding event took place within the Keyhole Falls UWR in the spring of 2014 and that a juvenile was capable of completing a fall migration to the Keyhole Falls UWR in November 2014.

4.2 *Photos*

Photo 1. Adult female observed with broken right horn. MG-OBS02 - November 11, 2013

Photo 2. Adult female observed with broken right horn. MG-OBS02 - December 11, 2013

[2] Mountain Goats typically spend the summer months foraging in alpine and sub-alpine meadows with access to steep angle escape terrain (Shackleton, 2013). The Keyhole Falls UWR can reach upwards of 30ºC in the summer months.

Photo 3. New born kid with mother. MG-OBS02 – May 27, 2014

Photo 4. Adult female observed with broken right horn. MG-OBS02 - November 16, 2014

Photo 5. Adult female observed with young-of-year kid and adult male. MG-OBS02 - November 19, 2014

4.3 *Noise Mitigation Measures and Sounds Levels Recorded During Blasting Activities*

When solid rock is encountered during bulk excavation works, drilling and blasting techniques are used to fracture the rock and allow the excavation to continue to design specifications. Blasting activities were required and approved within the Mountain Goat migration corridor during construction of the Lillooet River FSR realignment at Truckwash Creek, the ULRHEF downstream tunnel portal excavation, and as part of tunnelling works. During these blasts, the contractor employed a number of different noise mitigation techniques including the use of blasting mats; minimum charge weights; increased number of delays per blast; minimizing the number of holes per blast to 10 or less; and, performing blast-hole stemming. Despite these efforts blasting has been the primary cause of noise level exceedances of the 75 dBA threshold. As the vast majority of surface blasting works have now been completed within the migration corridor, fewer noise level exceedances are anticipated during the 2015 noise monitoring periods.

Remaining works within the Truckwash Creek migration corridor include drilling and blasting associated with the ULRHEF tunnel which has proceeded more than 200m underground, as well as bulk excavation and installation of the penstock. Noise monitoring will be performed during these activities to document noise levels and to help guide the adaptive management of noise mitigation measures if the threshold is exceeded. Exceedance of the 75 dBA threshold will require that the Contractor alter their construction methods to reduce the noise levels generated to within acceptable limits in order to minimize impacts to Mountain Goats.

5.0 Recommendations

The first three seasons of construction noise level and Mountain Goat monitoring have produced a wealth of information confirming the repeated usage of the two UWRs and the migration between both UWRs. Mountain Goat monitoring and noise level monitoring will continue in 2015 following similar methodologies employed in 2013 and 2014. The following adjustments are proposed to both monitoring programs in an effort to collect empirical data pertinent to the evaluation of construction noise mitigation success.

- Coordinate Mountain Goat monitoring with blasting activities to the extent possible despite difficulties related to the unpredictable nature of daily Mountain Goat activity, and changes to the blasting schedule and delays inherent with construction activities.
- Document when construction related noise is perceived from the monitoring locations and continue to record Mountain Goat behaviours observed in response to the perceived noise.
- Increase the frequency of the noise monitoring data analyses and reporting at the start of new construction activities. This should help to improve the effectiveness of the adaptive construction noise management plan by recognizing whether changes to the noise mitigation measures are required at the beginning of each new work activity.
- Conduct noise monitoring during the two-week spring and fall shutdown periods to characterize noise levels during these periods.
- Improve the quality of the information recorded by the Mountain Goat monitors. This could be achieved by lowering the number of different monitors performing the task, increasing the number of consecutive days worked by a single monitor, and by employing monitors with a more advanced set of Mountain Goat identification skills. This should help to decrease the variability and improve the quality of the data collected.
- Complete a yearly review of Mountain Goat identification skills and techniques, data recording procedure, and photo documentation skills with the Mountain Goat monitoring team prior to the spring 2015 monitoring season.
- Schedule time to complete a knowledge and information transfer between each rotation of Mountain Goat monitors.
- Attempt to record and photograph unique characteristics of each Mountain Goat observed and document unique behaviours in the monitoring logs whenever possible.

6.0 Summary

Based on the minimal number and duration of construction noise level exceedance events over the noise monitoring period, the evidence of repeated use and migration between the upper and lower UWRs, and the evidence of kidding within the lower UWR/kidding habitat, it is our professional opinion that the construction noise mitigation measures employed to date have achieved the intent of the Mountain Goat Management Plan, and have been performed to the satisfaction of the IEM. With continued use of construction noise mitigation techniques, disruptions to Mountain Goat migrations between UWR habitats u-2-002 UL 11 & u-2-002 UL 19 or abandonment of the Keyhole Falls kidding habitat at u-2-002 UL 19 is unlikely based on observations recorded during the first three Mountain Goat migration seasons. Monitoring of both Mountain Goat activity and construction related noise will continue in 2015 to ensure that appropriate measures remain in practice to protect Mountain Goats within the vicinity of the Upper Lillooet Hydro Project.

Sartori Environmental Services

Prepared by:

Tom Hicks, B.Sc.

Reviewed By:

Stephen Sims, R.P. Bio

7.0 Attachments:

Hunter, T. (2014). *Baseline Noise Monitoring Report (Fall 2013).* Consultant`s report prepared by BKL Consultants Ltd.

Kennedy, D. S. (2014). *Spring 2014 Construction Noise Monitoring Report.* Consultant`s report prepared by BKL Consultants Ltd.

Kennedy, D. S. (2015). *Fall 2014 Construction Noise Monitoring Report.* Consultant`s report prepared by BKL Consultants Ltd.

8.0 References

EAO. (2013, January 8). *Environmental Assessment Certificate #E13-01 for the Upper Lillooet Hydro Project.* Retrieved from Project Information Center: http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_357_35259.html

Lacroix, D., Newbury, A., & Leigh-Spencer, S. (2013). *Upper Lillooet Hydro Project Environmental Protection Plan: Mountain Goat Management Plan.* Prepared by Ecofish Research Inc for: Upper Lillooet River Power Limited Partnership.

Lacroix, D., Regehr, H., Bears, H., Newbury, A., Schultz, M., & Leigh-Spencer, S. (2012). *Upper Lillooet Hydro Project: Cumulative Effects Assessment: Mammal Valued Components, Version 1.* Consultant's report prepared by Ecofish Research Ltd.

Shackleton, D. (2013). *Hoofed Mammals of British Columbia* (Revised ed., Vol. 3: The Mammals of British Columbia). Victoria: Royal BC Museum Publishing.

March 5, 2014

File: 3396-13A

Sartori Environmental Services
106 - 185 Forester Street
North Vancouver, BC
V7H 0A6

Attention: Stephen Sims

Dear Steve:

Re: Baseline Noise Monitoring Report

Noise was monitored in Upper Lillooet, British Columbia, in order to document the noise levels associated with the construction of the Upper Lillooet Hydro Project. This project's construction comprises building new roads, roadways and some tunnelling for the purposes of dam construction. The main noise source of concern is blasting activity.

Mountain goats are a legally protected species present in this area. The sensitivity of goats to noise is a concern of the project, as excessive noise has been associated with behaviour and mortality. Due to the presumption that the high noise levels associated with the construction of this project can potentially affect the mountain goats, activity has been designed to be executed in a manner that will minimize the noise.

The measurements conducted at two locations near goat habitat collected data for, effectively, 24-hours periods from October 31 to November 15 and again from December 2 to December 11, 2013. The noise levels recorded were primarily below 65 dBA. Of the noise events that exceeded 65 dBA, 2% of those project-related noise events also exceeded 75 dBA.

The manner in which the construction activity was executed, along with the distances between the construction activity and the noise monitoring locations, seem to be effective in keeping levels below a threshold that will adversely affect the mountain goats.

Future noise monitoring programs may benefit from using a higher noise threshold; such will filter out more non construction -based noise events and simplify the analysis of the data and audio recorded. A bottom threshold of 70 dBA, up 5dBA from the previously used 65 dBA, is recommended. Fast time averaging (125ms) was found to be an appropriate setting for the equipment utilized, because of the noise environment and because the primary noise interest was blasting.

A review of the noise events recorded in the initial noise monitoring period has shown that there are several noise incidents that exceeded 65 dBA, most of which were not associated with construction, blasts or otherwise noise associated with the project.

A small percentage (11%) of the events that have taken place during the monitoring periods exceeded 75 dBA. While all of these noise events were from human activity, only a fraction of them (1%) were considered being construction or project related.

Further details on noise and the measurements performed are contained in the attached appendices.

Sincerely,

BKL Consultants Ltd.
per:

Tyrone Hunter, B.S.M.E., M.A., INCE

Enclosures: Appendix A: Noise Fundamentals
Appendix B: Noise Setting
Appendix C: Noise Measurement Results

Appendix A: Noise Fundamentals

Noise Primer

Noise is generally defined as an undesired sound that is typically associated with human activity and that interferes with or disrupts an activity or activities. The response to similar noise events is diverse and influenced by the type of noise; the perceived importance of the noise, and its appropriateness in the setting, the time of day and the type of activity during which the noise occurs and the sensitivity of the receiver.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the pitch of the sound and is measured in Hertz (Hz), while intensity describes the sound's loudness and is measured in decibels (dB). Decibels are measured using a logarithmic scale. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above approximately 110 dB begin to be felt inside the human ear as discomfort and eventually pain at 120 dB and higher levels. The minimum change in the sound level of individual events that an average human ear can detect is about 1 to 2 dB. A 3 to 5 dB change is readily perceived. A change in sound level of about 10 dB is usually perceived by the average person as a doubling or a halving of the sound's loudness.

Due to the logarithmic nature of the dB unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically; however, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example: 60 dB + 60 dB = 63 dB, and 80 dB + 80 dB = 83 dB.

Sound level is usually expressed by reference to a known standard. This report refers to sound pressure level. In expressing sound pressure on a logarithmic scale, the sound pressure is compared to a reference value of 20 micropascals. Sound pressure level depends not only on the power of the source, but also on the distance from the source and on the acoustical characteristics of the space surrounding the source.

Hz is a measure of how many times each second the crest of a sound pressure wave passes a fixed point. For example, when a drummer beats a drum, the skin of the drum vibrates a number of times per second. When the drum skin vibrates 100 times per second it generates a sound pressure wave that is oscillating at 100 Hz, and this pressure oscillation is perceived by the ear/brain as a tonal pitch of 100 Hz. Sound frequencies between 20 and 20,000 Hz are within the range of sensitivity of the best human ear.

Mountain Goats are reported to have an audible frequency range from 125 and 40,000 Hz. This monitoring report was prepared is based on the human hearing range. This will provide noise level information relative to what humans are able to discern and practically mitigate in a low tech environment. However, the A-weighting scale is also commonly used when assessing potential noise effects on wildlife.

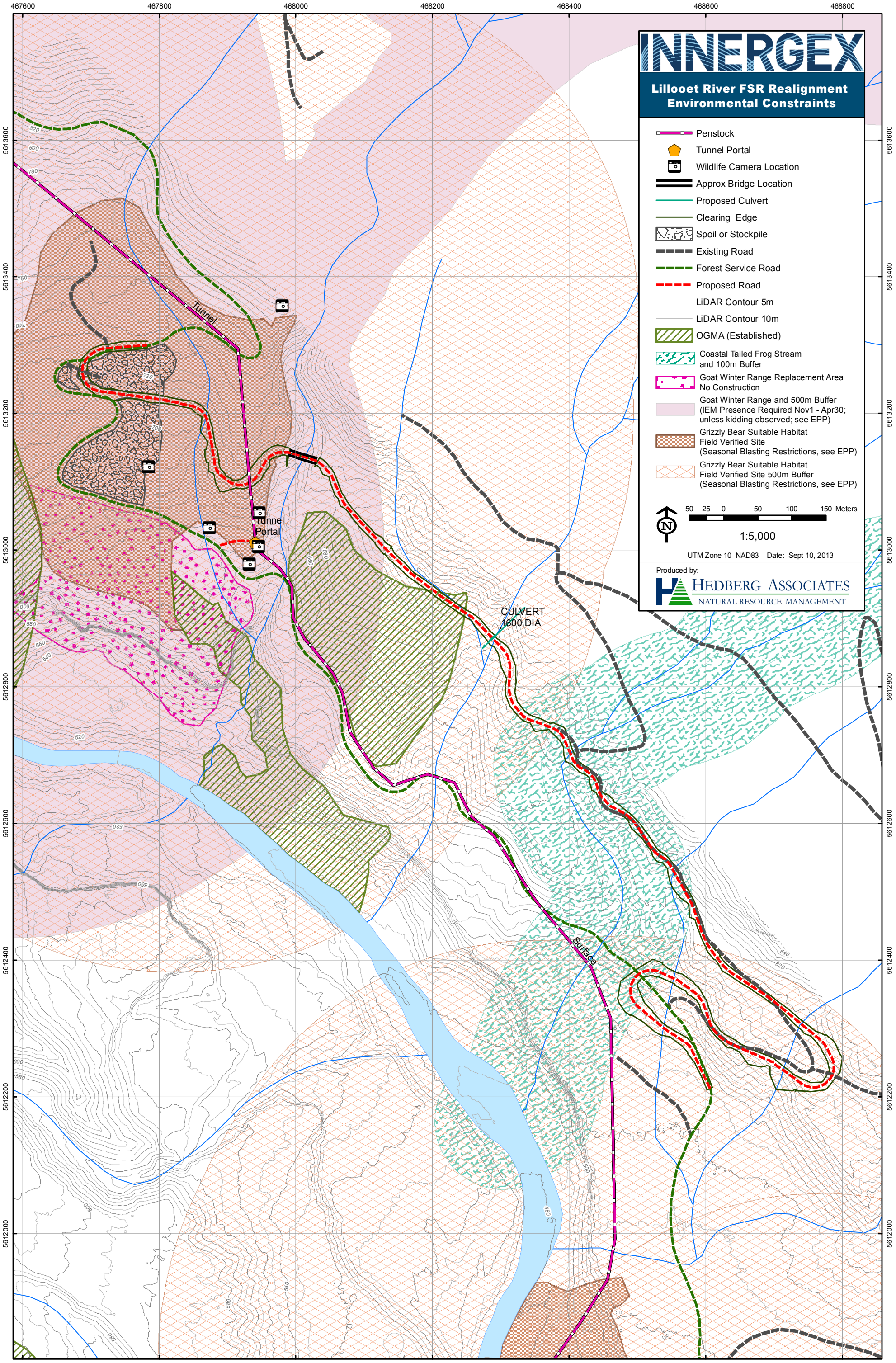
Appendix B: Noise Setting

The Upper Lillooet Hydro Project is located in a generally uninhabited area in Upper Lillooet, British Columbia (BC), 45 Kilometres north of Pemberton, BC. There is very limited human activity within the study area so on most occasions, ambient noise levels will be established by natural sources such as wind, rain, thunder, water flow in creeks, birds, animals and insects.

The measurement locations, referred to as Upper Truckwash and Lower Truckwash measurement sites, were both heavily forested areas, within approximately 40 metres of Upper Lillooet Forest Service Road and within the Mountain Goat winter range and migration corridor buffer. Figure B1, provided by Satori Environmental/Innergex, shows the two locations.

Human activity in the area is occasional and varies per the season. For example, snowmobiles and heli-skiing are most prevalent during the winter whereas logging and mining trucks are most active during the summer. There may also be some seasonal variation in natural sounds. During the winter, for example, rivers and creeks may be frozen and covered over with snow and there will be minimal noise from birds and insects.

Lillooet River FSR Realignment Environmental Constraints



Appendix C: Noise Measurement Results

Methodology

Baseline noise samples were collected using 01dB DUO Smart Noise Monitors, capable of logging data and audio. These instruments have a dynamic measuring range from 20 to 137 dBA, enabling it to capture both low and very loud sound levels that are typical for undisturbed wilderness areas and blast related construction. Each DUO was equipped with a weatherproof microphone unit type DMK01 that incorporated a noise cone and a windscreen. Each microphone was placed in a protected elevated location typically attached to a tree. A weather resistant case protected the meter and battery pack for each kit.

The equivalent continuous sound level (Leq) was measured in addition to metrics using slow, fast and impulsive time averaging schemes. Non-weighted, A-Weighted and C-weighted frequency weightings were recorded for each of the aforementioned schemes. The A-weighted Fast-time averaging maximum sound level was used for the analysis of the noises monitored at the sites.

The noise monitoring was ongoing for each of the measurement periods mentioned. The lapses that did occur were only for the time required for the field personnel change batteries and/or memory cards. Outside of these times the measurements are close to 24 hour measurements.

The Upper Truckwash and Lower noise measurement locations were approximately 350m and 125m from the tunnel portal, respectively. Blasting locations varied per day per the progress of the project.

Results

The noise monitoring is summarized for each location in Tables C1 & C2. Each table indicates the following for each noise measurement location:

1. Period Start Time
2. Period End Time
3. Time Elapsed/Measurement Duration
4. 65 dBA (Fast) Exceeded: Number & Times
5. 75 dBA (Fast) Exceeded: Number, Times & Level

The noise environment throughout the measurements was inclusive of wind-generated tree noises, insect and bird vocalizations, rain induced noise and the water flow noise from Truckwash Creek.

The Lower Truckwash location recorded a total of 61 times when the noise levels recorded were higher than 65 dBA. Of the times that the 65 dBA threshold was exceeded, 75 dBA was exceeded 2 times during construction activity. Therefore, roughly 3% of the 65+ dBA events (exceeded the 75 dBA level.

The two construction-related events that took place were documented blasts on November 1st and 8th, with levels of 78 dBA and 77dBA, respectively. The remainder of the events above 75 dBA were associated with environmental noise and atypical aircraft activity due to a search & rescue effort.

The Upper Truckwash location recorded a total of 78 times when the noise levels recorded were higher than 65 dBA. Of the times in which the 65 dBA threshold was exceeded, none that exceeded 75 dBA were conclusively associated with construction or project related activity.

There were a total of 10 recorded instances that exceeded 75 dBA, representing 10% of the 65 dBA+ noise events. Of those: 8 were due to staff activity noise at the meter (i.e. not relevant), 1 was due to unknown environmental noise and 1 was inconclusive.

Table C1
BKL1 - Lower Truckwash

Location Coordinates:
50 40' 01.65 N
123 27' 19.05 W

Statistics of Measurements
with Fast Time Constant

Year	Date	Start Time (24 hr)	End Time (24 hr)	Time Elapsed (hh:mm:ss)	65 dBA Exceeded			75 dBA Exceeded		
					Y/N	Number of Occurances	Times	Y/N	Number of Occurances	Times
2013	30-Oct	10/30/13 13:32	10/30/13 13:32	0:00:03	---					
2013	30-Oct	10/30/13 13:33	10/31/13 0:00	10:26:31	N			N		
2013	30-Oct	10/31/13 0:00	11/1/13 0:00	23:59:02	Y	**5**	13:30 13:40 14:27 15:22 17:19	N		
2013	1-Nov	11/1/13 0:00	11/1/13 7:57	7:56:50	Y	**1**	7:53	N		
2013	1-Nov	11/1/13 8:01	11/1/13 23:59	15:58:51	Y	**5**	11:08 **11:12** 13:24 14:27 19:08	Y	**1**	**11:12** (78 dBA)
2013	2-Nov	11/2/13 0:00	11/3/13 0:00	23:59:03	Y	**4**	14:40 14:46 15:00 15:14	N		
2013	3-Nov	11/3/13 0:00	11/3/13 1:00	0:59:03	N			N		
2013	3-Nov	11/3/13 1:00	11/3/13 7:27	6:27:25	N			N		
2013	3-Nov	11/3/13 7:28	11/3/13 23:59	16:31:56	Y	**27**	9:42 9:50 9:59 10:09 10:32 10:45 10:56 11:07 11:19 11:29 11:31 11:35 11:47 11:57 12:11 12:24 12:47 12:54 12:58 13:06 13:10 13:22 13:33 13:43 13:50 13:55 14:06	N		
2013	4-Nov	11/4/13 0:00	11/4/13 7:34	7:33:55	N			N		
2013	4-Nov	11/4/13 7:35	11/5/13 0:00	16:24:19	Y	**4**	9:59 12:13 12:26 15:37	N		
2013	5-Nov	11/5/13 0:00	11/5/13 19:59	19:58:07	Y	**9**	12:36 12:47 12:57 13:02 13:16 13:24 14:05 14:22 19:01	N		
2013	5-Nov	11/5/13 19:59	11/6/13 0:00	4:00:33	N			N		
2013	6-Nov	11/6/13 0:00	11/6/13 10:22	10:21:53	N			N		
2013	6-Nov	11/6/13 10:23	11/7/13 0:00	13:36:27	Y	**1**	19:11	N		
2013	7-Nov	11/7/13 0:00	11/7/13 23:59	23:59:01	N			N		
2013	8-Nov	11/8/13 0:01	11/8/13 14:57	14:56:18	Y	**1**	**9:20**	Y	**1**	**9:20** (77 dBA)
2013	8-Nov	11/8/13 14:57	11/8/13 15:03	0:06:05	N			N		
2013	8-Nov	11/8/13 15:05	11/9/13 0:00	8:54:34	Y	**1**	15:07	N		
2013	9-Nov	11/9/13 0:00	11/9/13 23:59	23:59:01	N			N		
2013	10-Nov	11/10/13 0:00	11/11/13 0:00	23:59:03	N			N		
2013	11-Nov	11/11/13 0:00	11/11/13 2:25	2:24:47	N			N		
2013	11-Nov	11/11/13 2:26	11/12/13 0:00	21:33:53	Y	**1**	10:00	N		
2013	12-Nov	11/12/13 0:00	11/12/13 11:47	11:46:17	N			N		
2013	12-Nov	11/12/13 11:49	11/13/13 0:00	12:10:43	N			N		
2013	13-Nov	11/13/13 0:00	11/13/13 23:59	23:59:01	N			N		
2013	14-Nov	11/14/13 0:00	11/14/13 9:13	9:12:02	N			N		
2013	14-Nov	11/14/13 9:14	11/14/13 23:59	14:45:47	Y	**1**	19:08	N		
2013	15-Nov	11/15/13 0:00	11/16/13 0:00	23:59:03	Y	**1**	23:02	Y	**1**	23:02
2013	16-Nov	11/16/13 0:00	11/16/13 3:25	3:24:02	N			N		
2013	16-Nov	11/16/13 3:25	11/17/13 0:00	20:34:38	Y	**5**	10:17 10:25 10:28 10:29 11:55	Y	**4**	10:26 10:28 10:29 11:55
2013	17-Nov	11/17/13 0:00	11/18/13 0:00	23:59:02	N			N		
2013	18-Nov	11/18/13 0:00	11/18/13 12:56	12:55:32	Y	**1**	12:56	N		
2013	2-Dec	12/2/13 9:08	12/3/13 0:00	14:52:02	Y	**5**	9:50 12:49 15:05 18:29 18:55	N		
2013	3-Dec	12/3/13 0:00	12/4/13 0:00	23:59:03	Y	**1**	1:54	N		
2013	4-Dec	12/4/13 0:00	12/4/13 7:39	7:38:04	Y	**1**	19:30	N		
2013	4-Dec	12/4/13 7:42	12/5/13 0:00	16:17:03	N			N		
2013	5-Dec	12/5/13 0:00	12/5/13 11:59	11:59:01	N			N		
2013	6-Dec	12/6/13 0:00	12/6/13 8:59	8:58:32	Y	**2**	7:56 8:58	N		
2013	6-Dec	12/6/13 9:00	12/6/13 23:59	14:59:04	N			N		
2013	7-Dec	12/7/13 0:00	12/7/13 23:59	23:59:01	N			N		
2013	8-Dec	12/8/13 0:00	12/8/13 13:05	13:04:55	N			N		
2013	8-Dec	12/8/13 13:06	12/9/13 0:00	10:53:42	N			N		
2013	9-Dec	12/9/13 0:00	12/9/13 8:39	8:38:38	N			N		
2013	9-Dec	12/9/13 8:40	12/10/13 0:00	15:20:03	N			N		
2013	10-Dec	12/10/13 0:00	12/11/13 0:00	23:59:02	N			N		
2013	11-Dec	12/11/13 0:00	12/11/13 17:12	17:11:54	N			N		

STAFF	checking equipment
CONSTRUCTION	vehicles moving, rattling
BLAST	obvious blast
DRILLING	drilling noise
OTHER	planes (typically), non-staff humans, undiscernable, environmental noise

Table C2
BKL2 - Upper Truckwash

Location Coordinates:
50 40' 16.91 N
123 27' 11.26 W

Statistics of Measurements
with a Fast Time Constant

Year	Date	Start Time (24 hr)	End Time (24 hr)	Time Elapsed (hh:mm:ss)	65 dBA Exceeded (fast)			75 dBA Exceeded (fast)		
					Y/N	Number of Occurances	Times	Y/N	Number of Occurances	Times
2013	30-Oct	10/30/13 13:03	10/31/13 0:00	10:56:32						
2013	31-Oct	10/31/13 0:00	11/1/13 0:00	23:59:02	Y	22	6:53 7:08 7:24 7:34 7:36 8:18 8:20 8:28 9:07 9:37 9:41 11:16 11:42 13:05 13:19 13:41 15:20 15:23 16:20 17:34 19:15	Y	1	9:41
2013	1-Nov	11/1/13 0:00	11/1/13 8:32	8:31:07	Y	1	8:30	N		
2013	1-Nov	11/1/13 8:37	11/1/13 14:55	6:18:12	Y	10	8:37 8:39 10:36 10:42 11:08 **11:13** 13:40 14:17 14:27 14:54	Y	2	8:37 8:39
2013	1-Nov	11/1/13 14:57	11/2/13 0:00	9:02:17	Y	4	14:58 15:23 15:39 19:09	N		
2013	2-Nov	11/2/13 0:00	11/3/13 0:00	23:59:02	Y	3	12:28 15:01 15:51	N		
2013	3-Nov	11/3/13 0:00	11/3/13 1:00	0:59:03	N			N		
2013	3-Nov	11/3/13 1:00	11/3/13 12:16	11:16:31	Y	4	10:14 10:45 11:03 12:16	N		
2013	3-Nov	11/3/13 12:22	11/4/13 0:00	11:37:39	Y	1	12:22	Y	1	12:22
2013	4-Nov	11/4/13 0:00	11/4/13 12:23	12:22:39	Y	4	9:40 10:28 10:32 11:38 ram limitation	N		
2013	4-Nov	11/4/13 12:58	11/5/13 0:00	11:01:45	Y	3	12:59 13:22 13:57	Y	1	12:59
2013	5-Nov	11/5/13 0:00	11/6/13 0:00	23:59:02	Y	3	11:45 11:58 13:32 ram limitation	N		
2013	8-Nov	11/6/13 0:00	11/6/13 10:06	10:05:38	Y	5	10:04 10:05 10:06	N		
2013	8-Nov	11/8/13 15:45	11/8/13 15:46	0:00:31	N			N		
2013	8-Nov	11/8/13 15:46	11/9/13 0:00	8:13:31	Y	1	15:46	Y	1	15:46
2013	9-Nov	11/9/13 0:00	11/9/13 23:59	23:59:01	N			N		
2013	10-Nov	11/10/13 0:00	11/11/13 0:00	23:59:02	N			N		
2013	11-Nov	11/11/13 0:00	11/12/13 0:00	23:59:03	N			N		
2013	12-Nov	11/12/13 0:00	11/12/13 10:55	10:54:31	Y	4	10:25 10:42 10:49 10:55	N		
2013	12-Nov	11/12/13 10:57	11/13/13 0:00	13:02:35	Y	3	10:58 10:59 11:19	Y	2	10:58 10:59
2013	13-Nov	11/13/13 0:00	11/13/13 0:26	0:25:20	N			N		
2013	13-Nov	11/13/13 0:26	11/14/13 0:00	23:33:21	N			N		
2013	14-Nov	11/14/13 0:00	11/14/13 11:23	11:22:58	N			N		
2013	14-Nov	11/14/13 11:26	11/14/13 23:59	12:33:31	Y	1	11:26	N		
2013	15-Nov	11/15/13 0:00	11/16/13 0:00	23:59:03	N			N		
2013	16-Nov	11/16/13 0:00	12/17/13 0:00	23:59:02	Y	4	10:26 10:29 11:57 11:58 12:00	Y	1	10:26
2013	17-Nov	11/17/13 0:00	11/17/13 5:00	4:59:34	N			N		
2013	17-Nov	11/17/13 5:00	11/18/13 0:00	18:59:06	N			N		
2013	18-Nov	11/18/13 0:00	11/18/13 12:24	12:23:21	N			N		
2013	18-Nov	11/18/13 12:27	11/18/13 12:27	0:00:23	N			N		
2013	2-Dec	12/2/13 14:56	12/3/13 23:23	8:27:35	Y	4	14:56 14:57 17:17 23:35		1	14:57
2013	3-Dec	12/3/13 0:00	12/4/13 0:00	23:59:02	N					
2013	4-Dec	12/4/13 0:00	12/4/13 11:54	11:53:05	Y	1	10:22			
2013	4-Dec	12/4/13 11:55	12/5/13 0:00	12:04:14	N					
2013	5-Dec	12/5/13 0:00	12/6/13 0:00	23:59:02	N					
2013	6-Dec	12/6/13 0:00	12/7/13 9:26	9:25:07	N					
2013	6-Dec	12/6/13 9:31	12/7/13 0:00	14:28:11	N					
2013	7-Dec	12/7/13 0:00	12/8/13 0:00	23:59:02	N					
2013	8-Dec	12/8/13 0:00	12/8/13 12:30	12:29:54	N					
2013	8-Dec	12/8/13 12:31	12/9/13 0:00	11:28:37	N					
2013	9-Dec	12/9/13 0:00	12/9/13 10:59	10:58:59	N					
2013	9-Dec	12/9/13 11:00	12/10/13 0:00	12:59:32	N					
2013	10-Dec	12/10/13 0:00	12/10/13 23:59	23:59:01	N					
2013	11-Dec	12/11/13 0:00	12/11/13 12:12	12:11:15	N					
2013	11-Dec	12/11/13 12:12	12/11/13 16:44	4:31:21	N					

STAFF	checking equipment
CONSTRUCTION	vehicles moving, rattling
BLAST	obvious blast
DRILLING	drilling noise
OTHER	planes (typically), non-staff humans, environmental, undiscernable

August 5, 2014

File: 3396-13A

Sartori Environmental Services
106 - 185 Forester Street
North Vancouver, BC
V7H 0A6

Attention: Tom Hicks

Dear Tom:

Re: Spring 2014 Construction Noise Monitoring Report

Background

Monitored was carried out in the spring of 2014, in order to document noise levels associated with construction of the Upper Lillooet Hydro Project. The project's construction includes new roads, a bridge, tunnelling and installation of penstocks.

Mountain goats are a legally protected species present in this area. The sensitivity of goats to noise is a concern of the project, as excessive noise has been associated with disturbance and mortality. Due to the presumption that high noise levels associated with the construction of this project could potentially affect the mountain goats, activity has been designed to be executed in a manner that will minimize noise. The main noise source of concern is blasting.

The Upper Lillooet Hydro Project is located in a generally uninhabited area in Upper Lillooet, British Columbia (BC), 45 kilometres north of Pemberton, BC. There is very limited human activity within the study area so on most occasions, ambient noise levels are established by natural sources such as wind, rain, thunder, water flow in creeks, birds, animals and insects.

Human activity in the area is occasional and varies according to the season. For example, snowmobiles and heli-skiing are most prevalent during the winter whereas logging and mining trucks are most active during the summer. There may also be some seasonal variation in natural sounds. During the winter, for example, rivers and creeks may be frozen and covered over with snow and there will be minimal noise from birds and insects.

A previous report by BKL Consultants Ltd. dated March 5, 2014 presents the results of baseline noise monitoring conducted in the fall of 2013 at two locations within the Upper Lillooet Hydro Project study area. Additional noise monitoring has now been conducted at the same two locations during the spring of 2014 while construction activities were under way.

The attached site plan shows the locations of the two noise monitoring locations, referred to as the Upper Truckwash and Lower Truckwash sites. Both were in heavily forested areas, within approximately 40 metres of Upper Lillooet Forest Service Road and within the Mountain Goat winter range and migration corridor buffer. The Upper and Lower Truckwash measurement locations were approximately 350m and 125m from the south tunnel portal, respectively.

Construction Noise Monitoring in Spring of 2014

The monitoring equipment used and procedures followed for construction noise monitoring were the same as those employed previously for the baseline monitoring. The attached Appendix provides a brief introduction to the physics of sound and the metrics used to describe environmental noise.

Two identical 01dB DUO Smart Noise Monitors were used to continuously log noise data and to record audio files. These instruments have a wide dynamic measuring range, from 20 to 137 dBA, enabling them to capture both very low sound levels such as those which can occur in undisturbed wilderness areas as well as higher intensity construction noise levels, including blasting.

Noise monitoring was conducted at the Lower Truckwash site from April 15th to at April 22nd and at both Lower and Upper Truckwash sites from May 18th to June 16th, 2014. During the April monitoring, there was no construction activity on April 15th or 16th. Snow removal was being carried out in the area throughout April 17th to 22nd. During the May and June monitoring, construction activity at the Truckwash creek road realignment, on the west side of the bridge, included some blasting. An exploratory drilling program commenced on May 23rd at the south tunnel portal.

Both noise monitors recorded data continuously but "triggers" were also set to identify all noise events that exceeded 75 dBA. Whenever these trigger levels were exceeded, audio files were recorded to aid in identification of the noise sources during subsequent analysis.

Monitoring Results

The only noise events above 75 dBA that occurred during the April monitoring were non-construction related. Throughout the majority of the May/June monitoring, noise levels were below 75 dBA. Of the noise events that exceeded 75 dBA, it was possible to identify construction noise events, in most cases, by listening to the associated audio files. Some of these events were clearly the result of blasting, some were clearly due to drilling and others were identified as construction noise but the construction equipment or operation could not be conclusively determined. There were also a number of noise events that exceeded 75 dBA which were identified as aircraft, hikers, natural environmental sounds such as wind or birds, and in a few cases, indiscernible sound sources that likely triggered the monitor

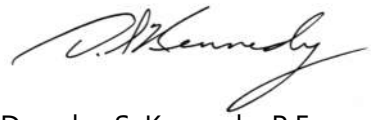
only because they occurred very close to the microphone. Tables 1 and 2 list the times, durations, maximum levels and average levels (Leq) of all noise events that exceeded 75 dBA at the Lower and Upper Truckwash sites respectively.

Conclusions

Apart from a few occasions when noise from drilling and construction vehicles briefly exceeded 75 dBA, the only construction noise events of concern throughout the 30 day monitoring period were (7) blasts with maximum noise levels ranging from 75 to 86 dBA. The durations of these blasts above 75 dBA ranged from 2 seconds to 5 seconds with the majority having a duration of 4 seconds.

Sincerely,

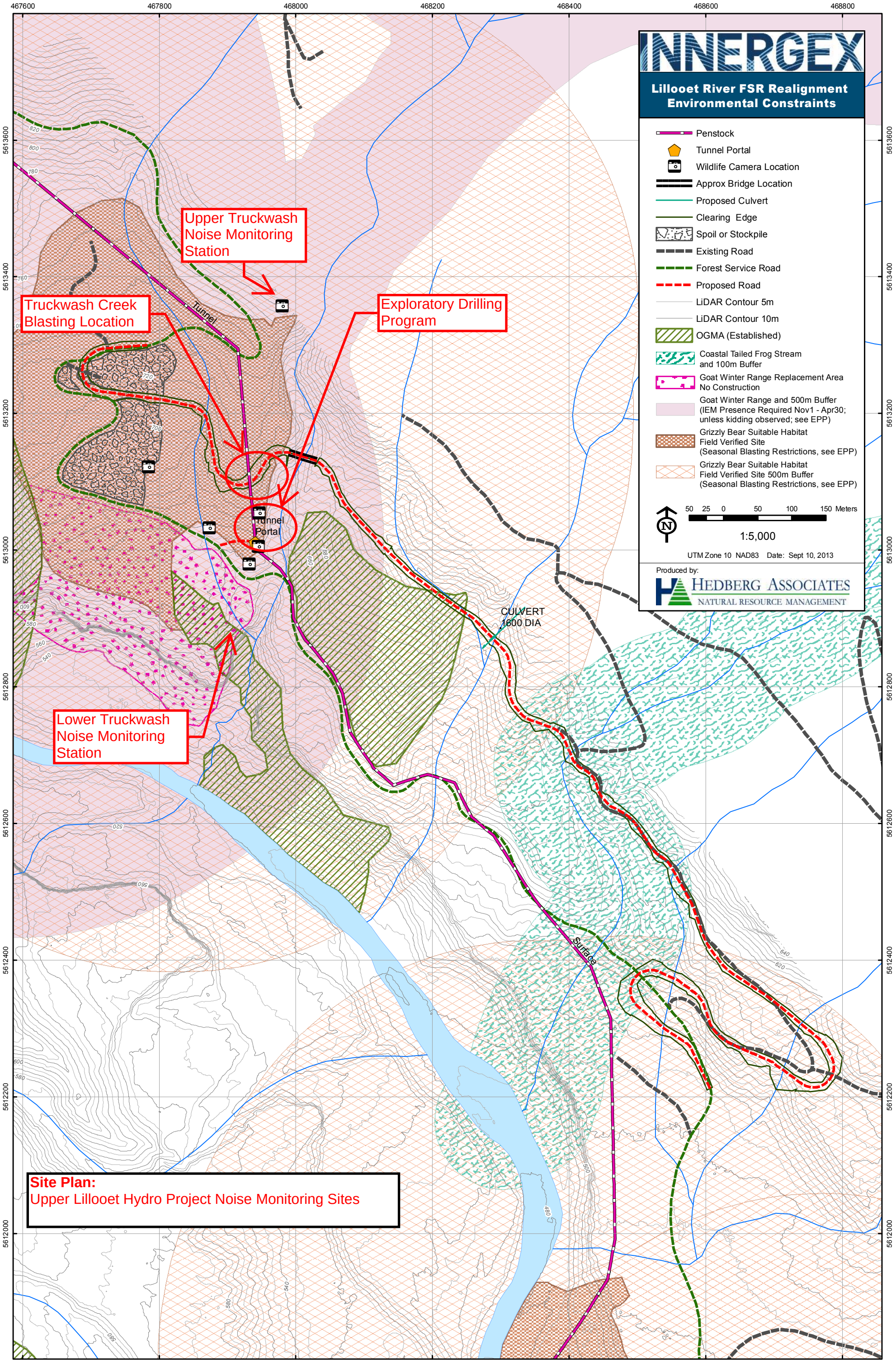
BKL Consultants Ltd.
per



Douglas S. Kennedy, P.Eng.

Enclosures: Site Plan
Monitoring results table
Appendix A: Acoustic Fundamentals

Lillooet River FSR Realignment Environmental Constraints



Date	Time	Duration & Level >75 dBA			Description
		Duration	Max.	Leq	
April 18	9:53	3 sec.	76.7	74.7	non-construction related *
April 20	20:46	12 sec.	84.6	80.4	non-construction related
May 20	10:57	2 sec.	81.3	78.3	non-construction related
May 21	07:47:41	3 sec.	76.2	72.5	non-construction related
"	08:26:38	4 sec.	79.7	75.1	blast
"	08:39:36	4 sec.	76.8	70.4	blast
"	09:32:31	4 sec.	75.3	70.4	blast
May 23	14:51	4 sec.	77.3	74.8	drilling
"	16:13:01	5 sec.	75.4	71.9	construction vehicles
"	16:13:12	6 sec.	75.1	73.5	construction vehicles
"	16:13:32	3 sec.	77.2	74.9	construction vehicles
"	17:39	2 sec.	85.6	82.6	blast
May 24	12:59	5 sec.	80.5	77.6	non-construction related
"	13:04:39	5 sec.	77.8	74.9	non-construction related
"	13:04:44	3 sec.	75.2	72.8	non-construction related
"	13:05:24	4 sec.	75.3	71.3	non-construction related
"	13:05:27	3 sec.	76.9	74.7	non-construction related
June 3	19:33:41	12 sec.	76.9	72.6	non-construction related
June 5	09:44:58	1 sec.	80.3	80.3	non-construction related
June 6	17:23:53	4 sec.	89.3	83.4	non-construction related
June 6	17:30:45	1 sec.	86.8	86.8	non-construction related
Total		75 sec.			0.0029% of 30 days monitoring time
Total Construction		32 sec.			0.0012% of 30 days monitoring time

* "non-construction" events included aircraft, hikers/campers, environmental and indiscernible noise events.

Table 1: Lower Truckwash Noise Monitoring Results

Date	Time	Duration & Level >75 dBA			Description
		Duration	Max.	Leq	
May 20	00:00:05	5 sec.	76.2	71.2	non-construction related *
May 22	10:09:19	11 sec.	81.5	76.4	non-construction related
May 25	07:49	4 sec.	83.6	77.7	non-construction related
May 26	14:25:02	6 sec.	80.1	74.4	non-construction related
May 29	9:01:15	3 sec.	75.5	70.8	non-construction related
May 30	11:59:36	5 sec.	89.7	85.5	non-construction related
"	12:09:22	3 sec.	76.7	71.0	non-construction related
June 3	09:07:15	8 sec	76.5	72.5	non-construction related
"	09:09:28	5 sec	78.5	72.0	non-construction related
"	19:40:08	17 sec	80.1	74.8	non-construction related
June 11	14:01:56	5 sec	80.9	74.8	blast
June 12	10:59:15	4 sec	82.0	76.1	blast
"	11:12:58	4 sec	77.5	73.2	blast
Total		80 sec.			0.0031% of 30 days monitoring time
Total Construction		13 sec.			0.00050% of 30 days monitoring time

* "non-construction" events included aircraft, hikers/campers, environmental and indiscernible noise events.

Table 2: Upper Truckwash Noise Monitoring Results

Appendix A - Acoustic Fundamentals

The two principle components used to characterize sound are loudness (magnitude) and pitch (frequency). The basic unit for measuring magnitude is the decibel (dB), which represents a logarithmic ratio of the pressure fluctuations in air relative to a reference pressure. The basic unit for measuring pitch is the number of cycles per second, or Hertz (Hz). Bass tones are low frequency and treble tones are high frequency. Audible sound occurs over a wide frequency range, from approximately 20 Hz to 20,000 Hz, but the human ear is less sensitive to low and very high frequency sounds than to sounds in the mid frequency range (500 to 4,000 Hz). "A-weighting" networks are commonly employed in sound level meters to simulate the frequency response of human hearing, and A-weighted sound levels are often designated "dBA" rather than "dB". Mountain Goats are reported to have an audible frequency range from 125 to 40,000 Hz. However, the A-weighting scale is also commonly used when assessing potential noise effects on wildlife.

If a continuous sound has an abrupt change in level of 3 dB it will generally be noticed while the same change in level over an extended period of time will probably go unnoticed. A change of 6 dB is clearly noticeable subjectively and an increase of 10 dB is generally perceived as being twice as loud.

Sound levels theoretically reduce by 6 dB every time the distance from a point source to the receiver is doubled due to geometric spreading of the sound energy. In practice, the propagation of sound can also be affected by the nature of the intervening terrain and ground cover, weather effects, sound reflections, etc.

A "time weighting" is also applied when assessing the maximum sound level from specific sound sources. Most municipal noise bylaws specify the use of a "Slow" weighting, the World Health Organization (WHO) recommends that the "Fast" weighting best represents how the human brain processes sound, and sometimes the "Impulse" weighting is used for highly impulsive sounds such as firing noise. For a given noise event, the Impulse sound level is always higher than the Fast sound level which is always higher than the Slow sound level.

While the decibel or A-weighted decibel is the basic unit used for noise measurement, other indices are also used to describe environmental noise. The Equivalent Sound Level, abbreviated L_{eq}, is commonly used to indicate the average sound level over a period of time. The L_{eq} represents the steady level of sound which would contain the same amount of sound energy as the actual time-varying sound level. Although the L_{eq} is an average, it is strongly influenced by the loudest events occurring during the time period, because these loudest events contain most of the sound energy.

Noise is generally defined as "unwanted sound", which carries no useful information and tends to interfere with activities or the ability to receive and interpret useful sound. The intrusiveness and potential disturbance caused by impact noise depends largely upon the background noise level that

exists when the noise occurs. For humans, the response to noise depends on factors such as the absolute level of sound, the time of day, local attitudes toward the noise maker and expectations for quiet by the individual. For wildlife, common responses to noise includede avoidance or fleeing from the noise since, depending upon the nature of the noise and its familiarity, it may be perceived as a threat. For example, in the case of mountain goats, blast noise might be associated with landslides and hence could lead to panic and flight.

January 5, 2015

File: 3396-13A

Sartori Environmental Services
106 - 185 Forester Street
North Vancouver, BC
V7H 0A6

Attention: Tom Hicks

Dear Tom:

Re: Fall 2014 Construction Noise Monitoring Report

Background

Noise monitoring was carried out in the fall of 2014, in order to document noise levels associated with construction of the Upper Lillooet Hydro Project. The project's construction includes new roads, a bridge, tunnelling and installation of penstocks.

Mountain goats are a legally protected species present in this area. The sensitivity of goats to noise is a concern of the project, as excessive noise has been associated with disturbance and mortality. Due to the presumption that high noise levels associated with the construction of this project could potentially affect the mountain goats, activity has been designed to be executed in a manner that will minimize noise. The main noise source of concern is blasting.

The Upper Lillooet Hydro Project is located in a generally uninhabited area in Upper Lillooet, British Columbia (BC), 45 kilometres north of Pemberton, BC. There is very limited human activity within the study area so on most occasions, ambient noise levels are established by natural sources such as wind, rain, thunder, water flow in creeks, birds, animals and insects.

Human activity in the area is occasional and varies according to the season. For example, snowmobiles and heli-skiing are most prevalent during the winter whereas logging and mining trucks are most active during the summer. There may also be some seasonal variation in natural sounds. During the winter, for example, rivers and creeks may be frozen and covered over with snow and there will be minimal noise from birds and insects.

A previous report by BKL Consultants Ltd. dated March 5, 2014 presents the results of baseline noise monitoring conducted in the fall of 2013 at two locations within the Upper Lillooet Hydro Project study area. The results of construction noise monitoring conducted at the same two locations during the spring of 2014 were presented in BKL's August 5, 2014 report. The current report presents the results of construction noise monitoring conducted during the fall of 2014.

The two attached site plans show the locations of the noise monitoring locations. The Upper Truckwash and Lower Truckwash sites are in heavily forested areas, within approximately 40 metres of Upper Lillooet Forest Service Road and within the Mountain Goat winter range and migration corridor buffer. The Upper and Lower Truckwash measurement locations were approximately 350m and 125m from the south tunnel portal, respectively. Noise measurements were also conducted at a third site, near Keyhole Falls, during the latter half of the fall 2014 monitoring session. As indicated on the attached site plan, the Keyhole Falls site is at the northern extent of the mountain goat wintering range, close to the intake construction area.

Construction Noise Monitoring in Fall of 2014

The noise monitoring equipment used and procedures followed were the same as those used for previous sessions. Two identical 01dB DUO Smart Noise Monitors were used to continuously log noise data and to record audio files. These instruments have a wide dynamic measuring range, from 20 to 137 dBA, enabling them to capture both very low sound levels such as those which can occur in undisturbed wilderness areas as well as higher intensity construction noise levels, including blasting.

Noise monitoring was conducted at the Lower Truckwash site from 14:00 hrs on October 31st to 17:20 hrs on November 26th. The second noise monitor was used initially to measure noise levels at the Upper Truckwash site and then it was relocated to the Keyhole Falls site. Due to some intermittent equipment malfunctions, there were several interruptions in data acquisition at these two sites. At the Upper Truckwash site, noise data was acquired from 15:00 hrs on October 31st to 17:10 hrs on November 4th and from 13:20 hrs on November 11th to 9:00 hrs on November 12th. At the Keyhole Falls site, noise data was acquired from 14:00 hrs on November 15th to 0:00 hrs on November 19th, from 14:00 hrs on November 22th to 13:30 hrs on November 23rd, and from 0:00 hrs to 9:10 hrs on November 26th.

Both noise monitors recorded data continuously but "triggers" were also set to identify all noise events that exceeded 75 dBA. Whenever these trigger levels were exceeded, audio files were recorded to aid in identification of the noise sources during subsequent analysis. The attached Appendix provides a brief introduction to the physics of sound and the metrics used to describe environmental noise.

Monitoring Results

Table 1 lists the times, durations, maximum levels and average levels (Leq) of all noise events that exceeded 75 dBA at the three monitoring sites.

Date	Time	Duration & Level >75 dBA			Description
		Duration	Max.	Leq	
Lower Truckwash					
Nov 1	6:22	5 sec.	83.2	77.6	blast
Upper Truckwash					
Nov 3	12:42:21	2 sec.	87.2	84.2	non-construction related *
"	12:42:26	2 sec.	87.8	84.8	non-construction related
"	12:42:30	2 sec.	88.9	85.9	non-construction related
Keyhole Falls					
Nov 26	9:09:38	2 sec.	75.8	73.1	non-construction related

* "non-construction" events included aircraft, hikers/campers, environmental and indiscernible noise events.

Table 1: Lower Truckwash Noise Monitoring Results

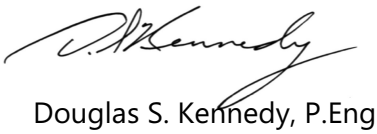
There was only one construction noise event above 75dBA (a blast) and several non-construction noise events. Throughout the majority of the November monitoring, noise levels were below 75 dBA. The audio files associated with events over 75 dBA indicate that the event recorded on November 1st at the Lower Truckwash site was a blast. The non-construction events that exceeded 75 dBA on November 3rd at the Upper Truckwash site and on November 26th at the Keyhole Falls site could not be positively identified. They were indiscernible sound sources that likely triggered the monitor only because they occurred very close to the microphones.

Conclusions

There were some interruptions in the otherwise continuous noise monitoring but throughout all of the time during which data was acquired, there was only one noise event above 75 dBA (a blast) that was attributable to construction activity. The maximum noise level of that blast was 83 dBA and its duration was approximately 5 seconds.

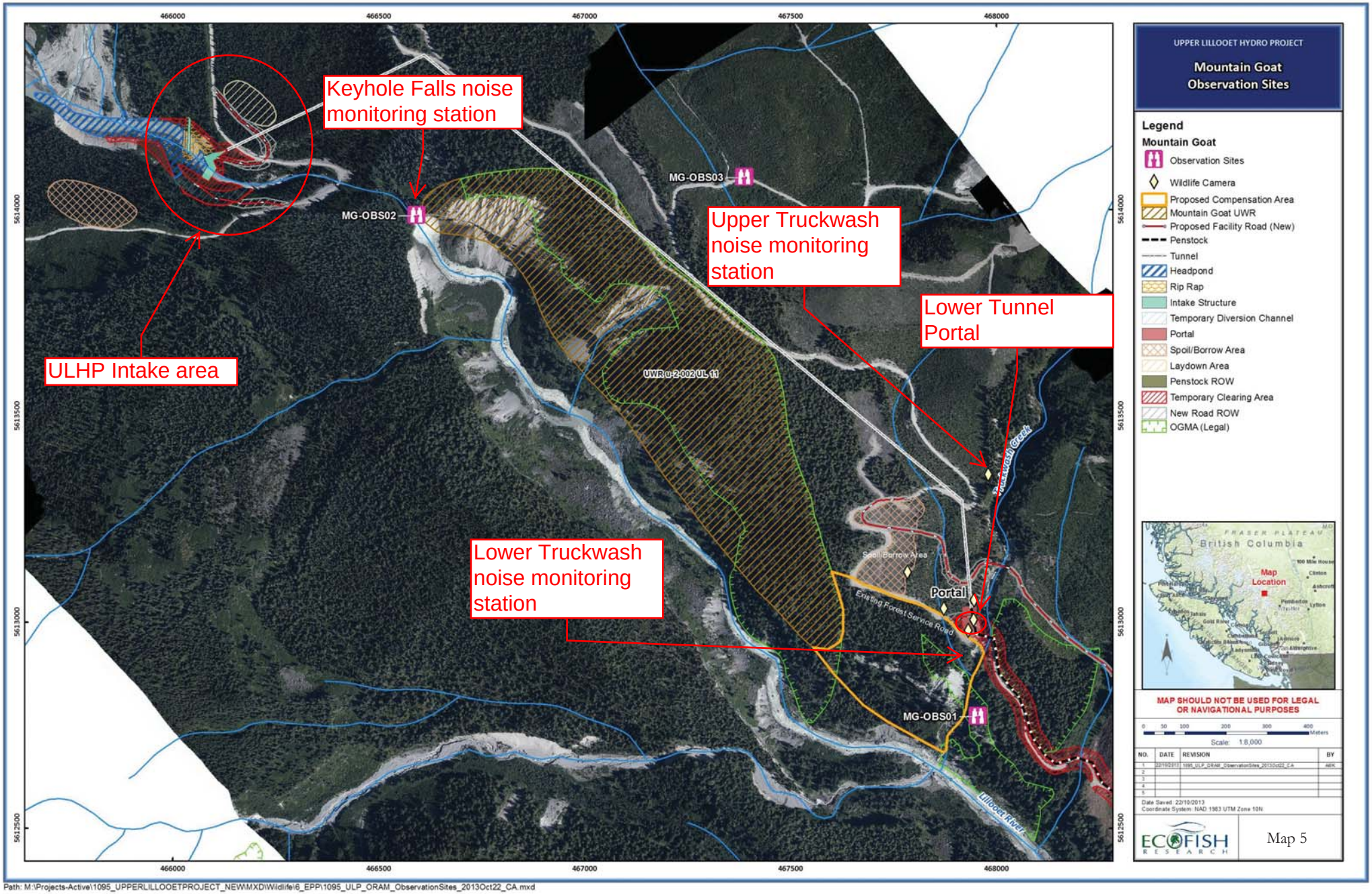
Sincerely,

BKL Consultants Ltd.
per



Douglas S. Kennedy, P.Eng.

Enclosures: Site Plans
Appendix A: Acoustic Fundamentals



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Lillooet River FSR Realignment Environmental Constraints

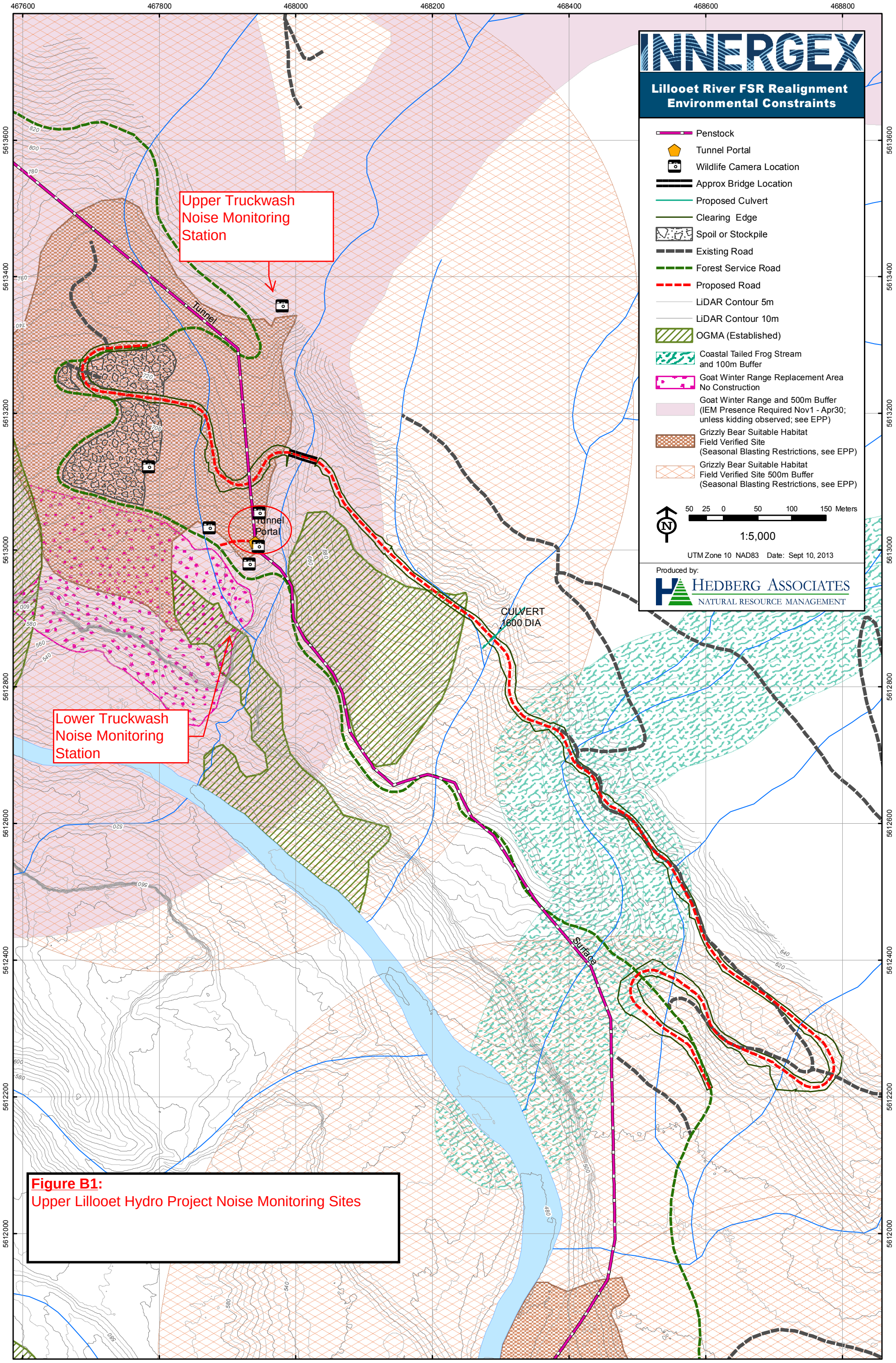

Figure B1:
Upper Lillooet Hydro Project Noise Monitoring Sites

Appendix A - Acoustic Fundamentals

The two principle components used to characterize sound are loudness (magnitude) and pitch (frequency). The basic unit for measuring magnitude is the decibel (dB), which represents a logarithmic ratio of the pressure fluctuations in air relative to a reference pressure. The basic unit for measuring pitch is the number of cycles per second, or Hertz (Hz). Bass tones are low frequency and treble tones are high frequency. Audible sound occurs over a wide frequency range, from approximately 20 Hz to 20,000 Hz, but the human ear is less sensitive to low and very high frequency sounds than to sounds in the mid frequency range (500 to 4,000 Hz). "A-weighting" networks are commonly employed in sound level meters to simulate the frequency response of human hearing, and A-weighted sound levels are often designated "dBA" rather than "dB". Mountain Goats are reported to have an audible frequency range from 125 to 40,000 Hz. However, the A-weighting scale is also commonly used when assessing potential noise effects on wildlife.

If a continuous sound has an abrupt change in level of 3 dB it will generally be noticed while the same change in level over an extended period of time will probably go unnoticed. A change of 6 dB is clearly noticeable subjectively and an increase of 10 dB is generally perceived as being twice as loud.

Sound levels theoretically reduce by 6 dB every time the distance from a point source to the receiver is doubled due to geometric spreading of the sound energy. In practice, the propagation of sound can also be affected by the nature of the intervening terrain and ground cover, weather effects, sound reflections, etc.

A "time weighting" is also applied when assessing the maximum sound level from specific sound sources. Most municipal noise bylaws specify the use of a "Slow" weighting, the World Health Organization (WHO) recommends that the "Fast" weighting best represents how the human brain processes sound, and sometimes the "Impulse" weighting is used for highly impulsive sounds such as firing noise. For a given noise event, the Impulse sound level is always higher than the Fast sound level which is always higher than the Slow sound level.

While the decibel or A-weighted decibel is the basic unit used for noise measurement, other indices are also used to describe environmental noise. The Equivalent Sound Level, abbreviated L_{eq}, is commonly used to indicate the average sound level over a period of time. The L_{eq} represents the steady level of sound which would contain the same amount of sound energy as the actual time-varying sound level. Although the L_{eq} is an average, it is strongly influenced by the loudest events occurring during the time period, because these loudest events contain most of the sound energy.

Noise is generally defined as "unwanted sound", which carries no useful information and tends to interfere with activities or the ability to receive and interpret useful sound. The intrusiveness and

potential disturbance caused by impact noise depends largely upon the background noise level that exists when the noise occurs. For humans, the response to noise depends on factors such as the absolute level of sound, the time of day, local attitudes toward the noise maker and expectations for quiet by the individual. For wildlife, common responses to noise includede avoidance or fleeing from the noise since, depending upon the nature of the noise and its familiarity, it may be perceived as a threat. For example, in the case of mountain goats, blast noise might be associated with landslides and hence could lead to panic and flight.