

8. Cumulative Risk Assessment

A traffic cumulative risk assessment (CRA) was conducted in response to concerns raised by the Working Group during the July 9, 2012 Traffic meeting. This section includes cumulative risk assessments of traffic effects on socio-economics and land use, fish and aquatic habitat, wildlife, terrestrial ecosystems, wetlands, climate and air quality, human health and heritage. The chapter is organized into the following sections:

- **Traffic Considered** – A description of traffic considered in the cumulative effects assessment including KSM and other projects related traffic.
- **Potential Cumulative Increases in Traffic** – A description of expected overall increase in the volume of development-related traffic.
- **Vehicle Collision Prediction Modelling** – Results of the analysis predicting the potential for cumulative traffic-related accidents, considering traffic from KSM and other projects.
- **Risk Assessment Methods** – A step-by step explanation of the cumulative risk assessment methods used to assess potential effects of traffic on environmental and socio-economic valued components (VCs).
- **Assessment of the Potential Risks of Cumulative Traffic** – An assessment of potential risks related to cumulative traffic, grouped by assessment topic (i.e., socio-economics, fish and aquatic habitat, wildlife, terrestrial ecosystems, wetlands, noise, climate and air quality, human health, and heritage).

8.1 TRAFFIC CONSIDERED

Current and reasonably foreseeable future traffic along highways 37 and 37A is considered in the cumulative risk assessment. Traffic estimates are based on publicly available information. Traffic from past projects is included in Section 2.1.3, Historical Traffic. Section 2.1.3 also explains the contributions of traffic from the Eskay Creek and Huckleberry mines, forestry, and other industry to historic traffic levels.

The cumulative risk assessment uses publicly available traffic estimates. An approximation is used, where possible, when information is not publicly available. For other mine projects, estimates of product-related haul traffic are calculated based on available concentrate production amounts or production rates, ore grades, and/or concentrate grades and on the assumption that 50-t trucks are used. Estimates of other mine traffic are calculated based on the KSM ratio between trips per day and production rate. Forestry has contributed to higher traffic volumes in the past and forestry traffic could increase again in the future, but publicly available information on planned activities (e.g., quantities of timber to be harvested) is not available. Information to base estimates of the potential cumulative increases in non-commercial vehicles on highways 37 and 37A are also not available.

The CRA aims on taking a conservative approach, as it:

- **considers operation phase traffic estimates** – the majority of proposed projects are mines, for which, the highest levels of traffic are expected to occur during the operation phase when product is being transported from site;

- **assumes all reasonably foreseeable mine and hydro projects will become operational** – most “foreseeable future projects” do not have approved EA certificates, and/or have not yet entered the EA process; any number of these projects, for one reason or another, may or may not become operational; and
- **assumes all projects will occur at the same time** – some projects may or may not operate at the same time as KSM or other projects considered (e.g., Wolverine Mine production may cease before KSM is operational; Snowfield Project is assumed to begin in 2027 once the Kutcho Mine Project has finished). It is unlikely that all projects considered will be operating at the same time.

Spatial overlap was evaluated by considering the Project-related traffic routes along highways 37 and 37A, and other proposed project traffic routes. Other present and future projects identified as sharing or potentially sharing highways 37 and 37A traffic routes with the KSM Project are shown in Figure 8.1-1. These projects include:

Present Projects:

- Forrest Kerr Hydroelectric;
- Red Chris Mine; and
- Wolverine Mine.

Reasonably Foreseeable Future Projects:

- Bronson Slope Mine;
- Brucejack Mine;
- Galore Creek Mine;
- Kitsault Mine;
- Kutcho Mine;
- McLymont Creek Hydroelectric;
- Schaft Creek Mine;
- Snowfield Project;
- Storie Moly Mine; and
- Turnagain Mine.

The location of each project and the overlapping transportation routes are illustrated in Figure 8.1-1. Further details regarding each project will be included in Chapter 5 of the Application/EIS.

8.2 POTENTIAL CUMULATIVE INCREASES IN TRAFFIC

Due to the number of proposed projects in the region (including the KSM Project), an overall increase in the volume of development-related traffic is expected. Estimated traffic volumes are presented in Table 8.2-1. Figures 8.2-1 and 8.2-2 further illustrate how KSM Project and cumulative traffic volumes are divided along transportation routes.

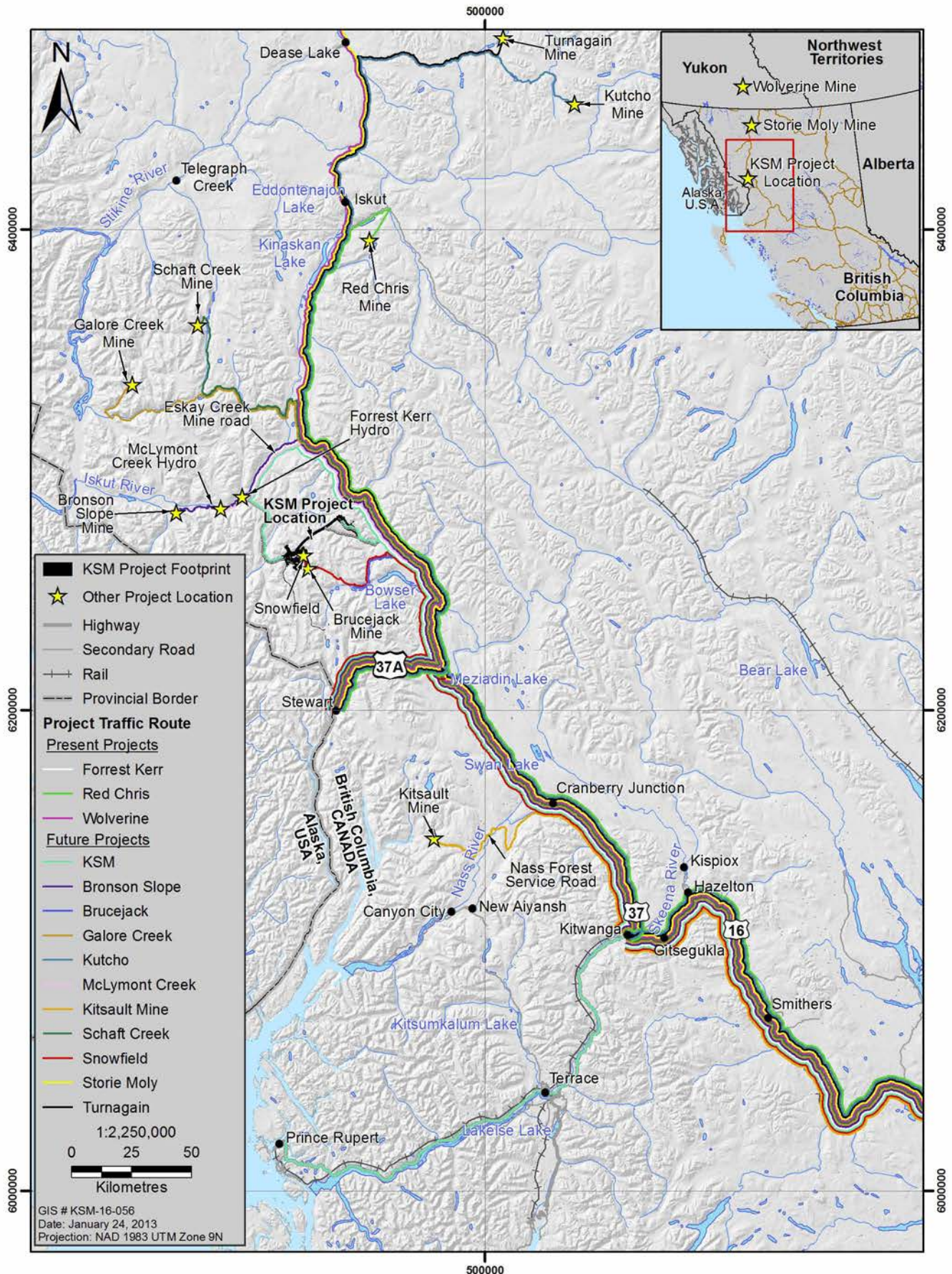


Figure 8.1-1

Table 8.2-1. Potential Cumulative One-way Trips per Day as a Result of KSM and Other Projects during Operation

Project		Estimated Timing of Operation	Average Annual Trips per Day for All Project Traffic per Highway Segment					Highway 37A
			Highway 37 North Segment			Highway 37 South Segment		
			Eskay Creek Mine Road to Treaty Creek Access Road	Treaty Creek Access Road to Newhawk Access Road	Newhawk Access Road to Meziadin Junction	Meziadin Junction to Cranberry Junction	Craberry Junction to Kitwanga	
Present	Forrest Kerr Hydroelectric**	2014-2074	1	1	1	1	1	0
	Red Chris Mine	2014-2042	39	39	39	11	11	28
	Wolverine Mine	2010-2019	19	19	19	1	0	18
Reasonably Foreseeable Future	Bronson Slope Mine*	2022-2042	9	9	9	6	6	3
	Brucejack Mine*	2016-2032	0	0	12	1	1	11
	Galore Creek Mine*	2023-2033	70	70	70	36	36	34
	Kitsault Mine*	2016-2030	0	0	0	0	73	0
	Kutcho Mine*	2015-2027	13	13	13	1	1	12
	McLymont Creek Hydroelectric**	2016-2056	1	1	1	1	1	0
	Schaft Creek Mine*	2017-2032	111	111	111	57	57	54
	Snowfield Project*	2027-2054	0	0	83	45	45	38
	Storie Moly Mine*	2020-2040	9	9	9	8	8	1
	Turnagain Mine*	2017-2045	46	46	46	33	33	13
Total Non-KSM Project Traffic			318	318	413	201	273	212
KSM Project		2019-2071	3	85	85	49	49	36
Total Cumulative Traffic by Route			321	403	498	250	322	248
Estimated Baseline Traffic			224	224	224	799	799	244
Total Cumulative Traffic			545	627	722	1049	1121	492
Historical Peak Volume			1014	1014	1014	917	917	917
% Above Current Baseline			143%	180%	222%	31%	40%	102%
% of Historical Peak Volume			54%	62%	71%	114%	122%	54%
% of Highway 37 Capacity ¹			9%	10%	12%	17%	19%	n/a

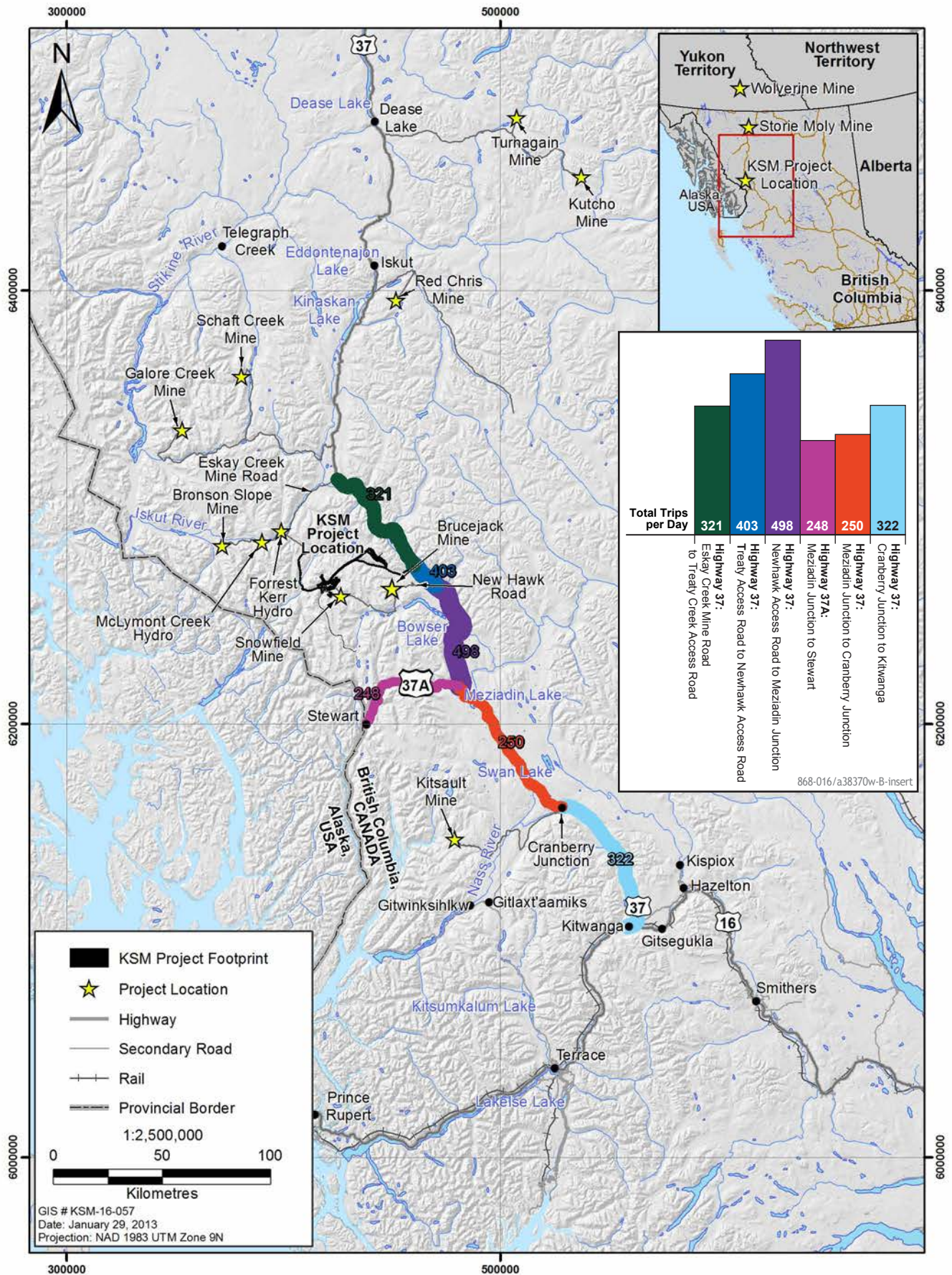
Sources: BC EAO (2005); Tobin (2009); Wardrop (2010); Avanti Mining Inc. (2012).

* = unless otherwise referenced, estimates of product-related haul traffic were calculated based on available concentrate production amounts or production rates, ore grades, and/or concentrate grades and on the assumption that 50 tonne trucks are used. Estimates of cargo traffic were calculated based on ratios of trips per day to production rate for KSM and assumed to travel along highway 37 south to Highway 16 rather than through Stewart.

** = estimates were calculated based on the assumption that employees would stay in camp.

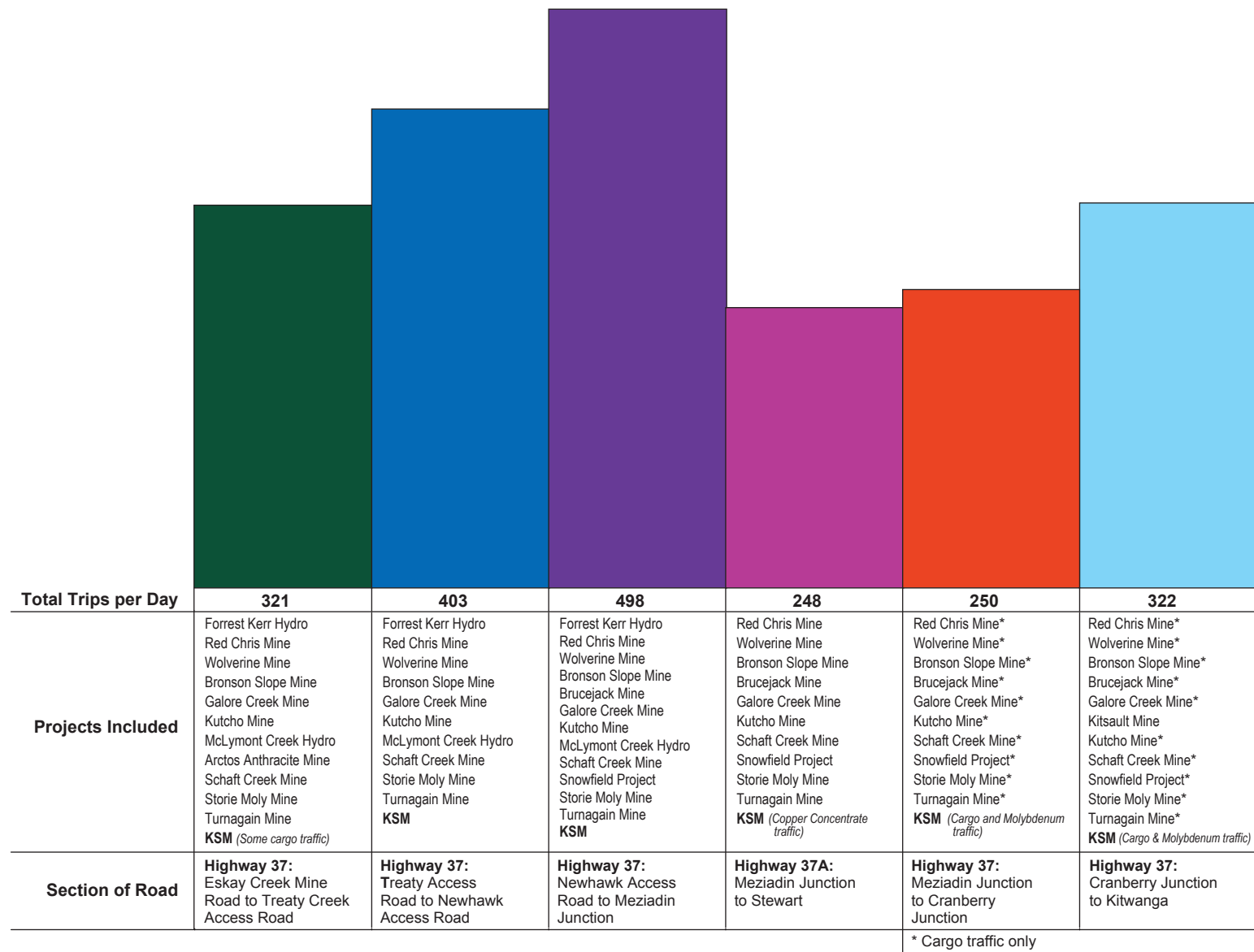
Note: NTL is not included as only a limited amount (e.g., 0.05 trips per day) is expected.

¹Based on Highway 37 modified capacity of 252 commercial vehicles per hour one-way (equivalent to 252 one-way trips per hour) or 6,048 one-way trips per day.



Potential Cumulative One-Way Trips per Day
as a Result of KSM and Other Projects

Figure 8.2-1



Potential Cumulative One-way Trips per Day

Figure 8.2-2

8.3 CUMULATIVE VEHICLE COLLISION PREDICTION MODELLING

The CPMs used in Section 3.2 were also applied to the estimated cumulative traffic increases on highways 37 and 37A described in Table 8.2-1. used because the relationship between collision frequency and exposure is frequently non-linear (Sayed and de Leur 2008). Although it is unlikely that all projects listed in Table 8.2-1 will occur at the same time, all other projects were assumed to occur during the KSM operation phase (the period of highest Project-related traffic volumes). The results of the cumulative CPM analysis are presented in Figures 8.3-1 to 8.3-3 and summarized in Table 8.3-1.

Table 8.3-1. Predicted Number of Collisions per Year – Baseline vs. Cumulative Traffic

Collision Type	Highway 37 North Segment			Highway 37 South Segment			Highway 37 A		
	Baseline	Cumulative Traffic	Change	Baseline	Cumulative Traffic	Change	Baseline	Cumulative Traffic	Change
PDO	1.036	1.536	+0.500	3.693	3.829	+0.136	0.973	1.219	+0.246
Severe	1.525	2.006	+0.481	5.889	6.051	+0.162	1.016	1.300	+0.284
Total	2.561	3.542	+0.981	9.582	9.880	+0.298	1.989	2.519	+0.530

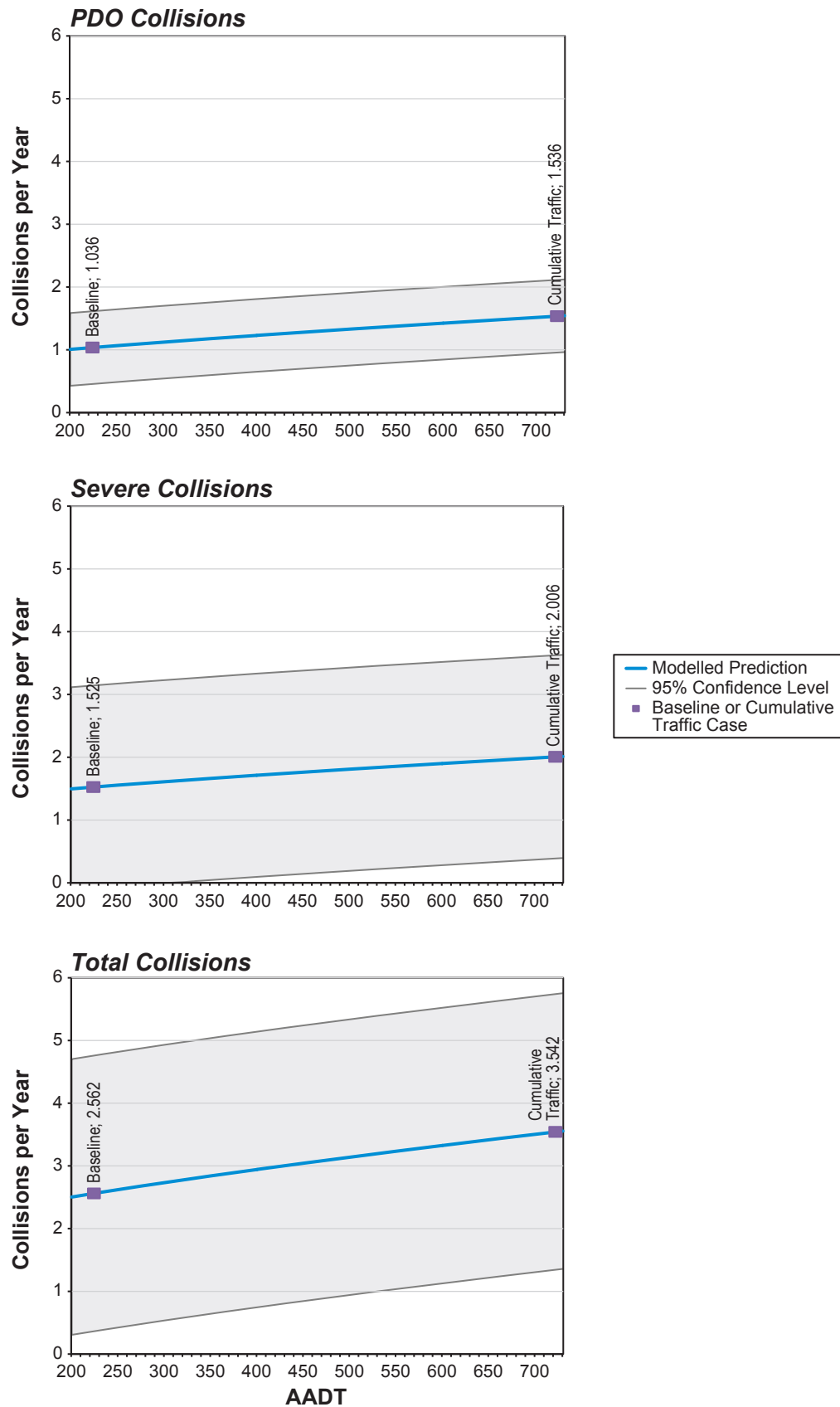
As in the Project-specific results (Section 3.2.3), the largest increase in collisions predicted by the model occurs on the northern segment of Highway 37: a total increase of 0.981 collisions (0.500 PDO collisions and 0.481 severe collisions). The southern segment of Highway 37 is predicted to have the smallest collision increase: 0.298 collisions per year (0.136 PDO collisions and 0.162 severe collisions). Highway 37A is predicted to experience a total increase of 0.530 collisions per year (0.246 PDO collisions and 0.284 severe collisions).

8.4 CUMULATIVE RISK ASSESSMENT METHODOLOGY

The CRA methodology follows a similar method to the one used to assess potential risks associated with Project traffic and traffic accidents along highways 37 and 37A. The CRA for each topic follows three steps:

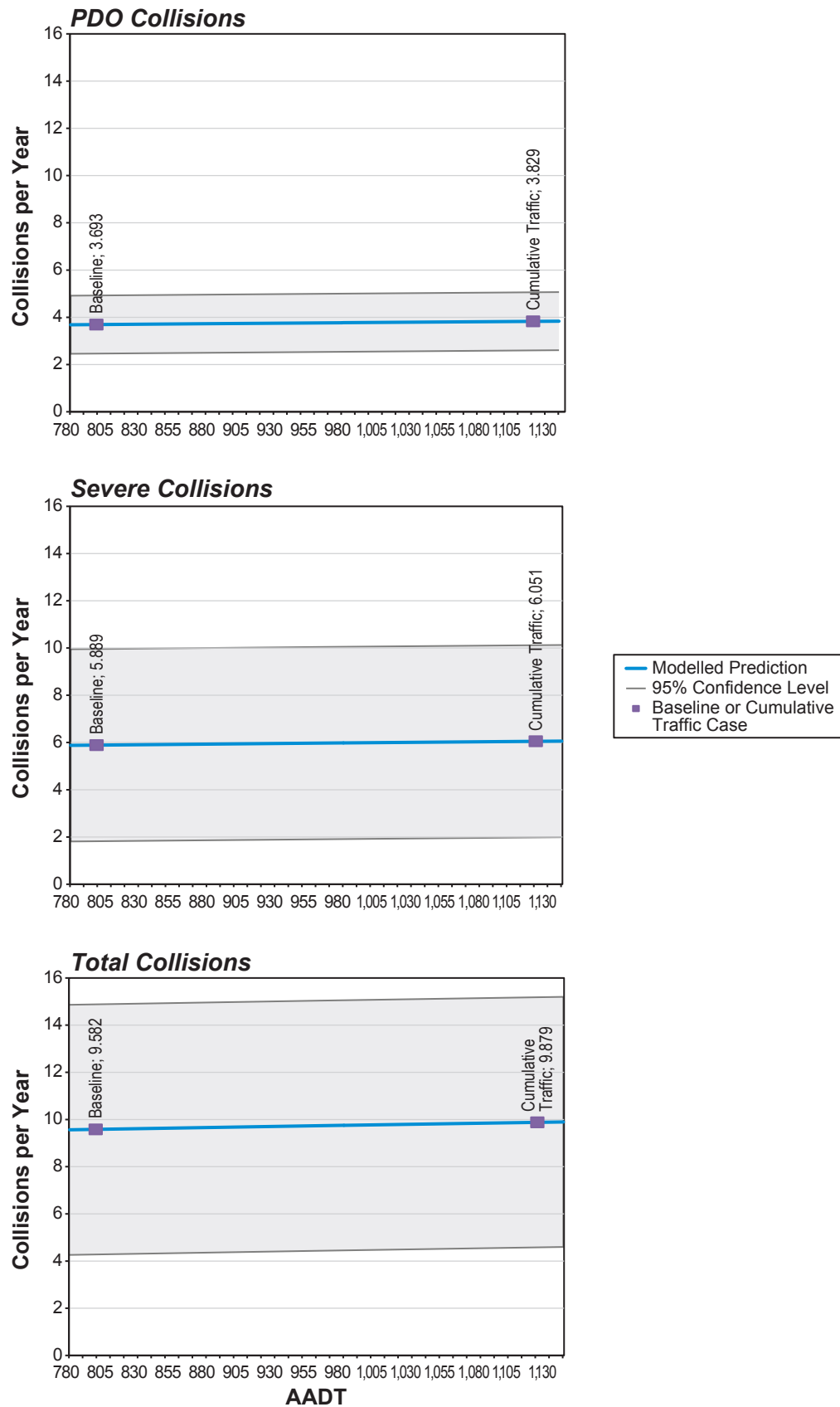
- Review of traffic and potential for traffic accidents from other project's** – Traffic from other projects that has the potential to spatially and temporally overlap with KSM Project traffic along highways 37 and 37A was identified in Sections 8.1 and 8.2 (Step 1). Additionally, cumulative collision prediction modelling was completed in Section 8.3 to gain an understanding of potential increases in traffic accidents as a result of both KSM Project and other traffic;
- Cumulative issue scoping** – The Project-specific traffic risk assessment identified interactions between traffic-related risks and selected VCs for each environmental topic. Potential interactions between traffic-related risks and VCs were identified, are carried forward and considered in the CRA.
- Cumulative risk analysis** – Potential cumulative traffic-related risks to the VCs that were identified during issue scoping are characterized, as follows:
 - cumulative risk identification** – for each VC, potential risks associated with other project and activity traffic are identified and described;
 - cumulative risk mitigation** – for each potential cumulative risk, any additional measures proposed by the proponent to mitigate cumulative traffic risks are described; and
 - cumulative risk characterization** – taking additional mitigation measures into consideration, the likelihood and severity of any realized cumulative risks are characterized according to the definitions provided for each topic in Chapter 5.

Steps two and three are described in more detail in Sections 8.4-1 to 8.4-3, depicted in Figure 8.4-1.



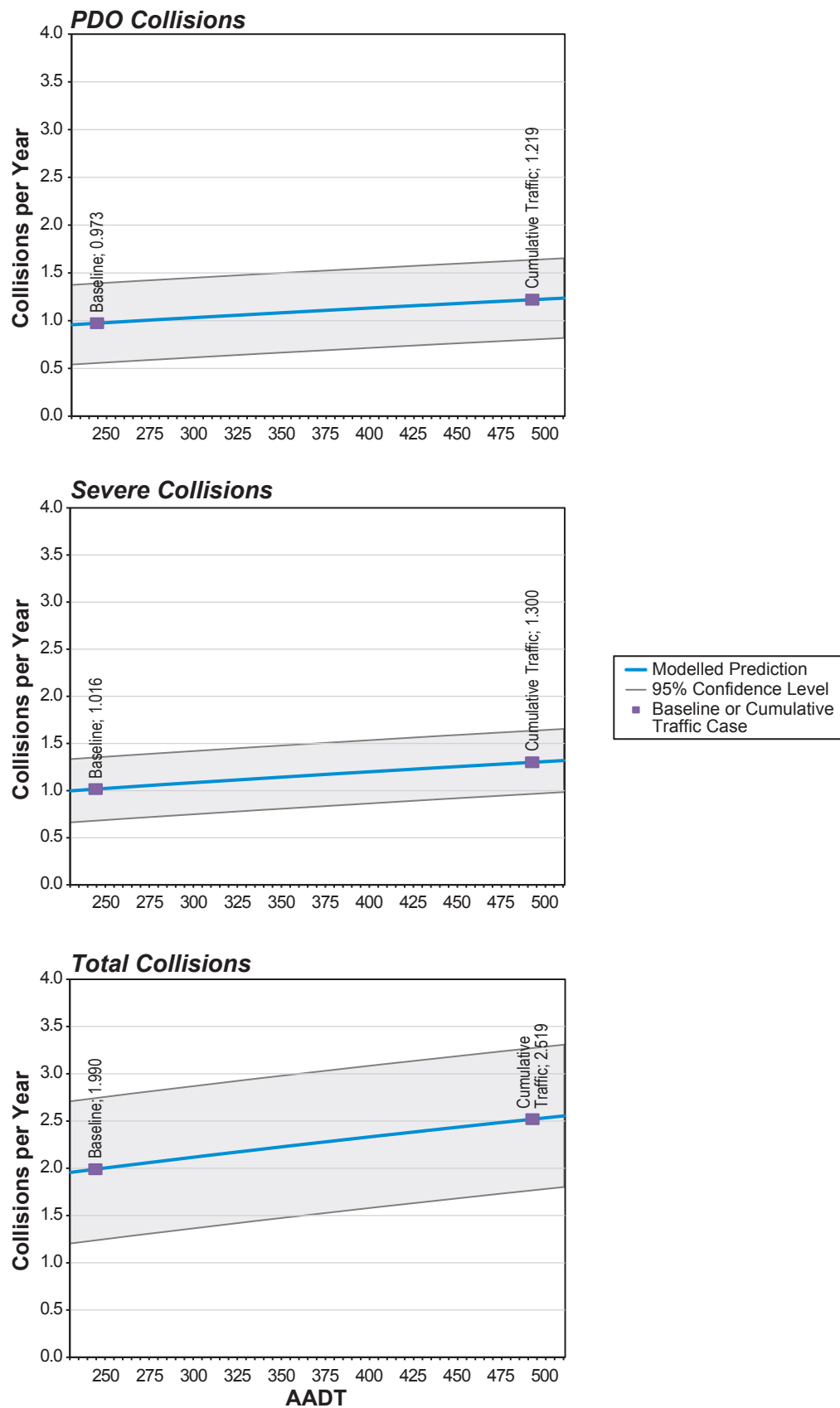
**Predicted Number of Collisions per Year
on Highway 37 North - Baseline Average
Annual Daily Trips vs. Cumulative Traffic**

Figure 8.3-1



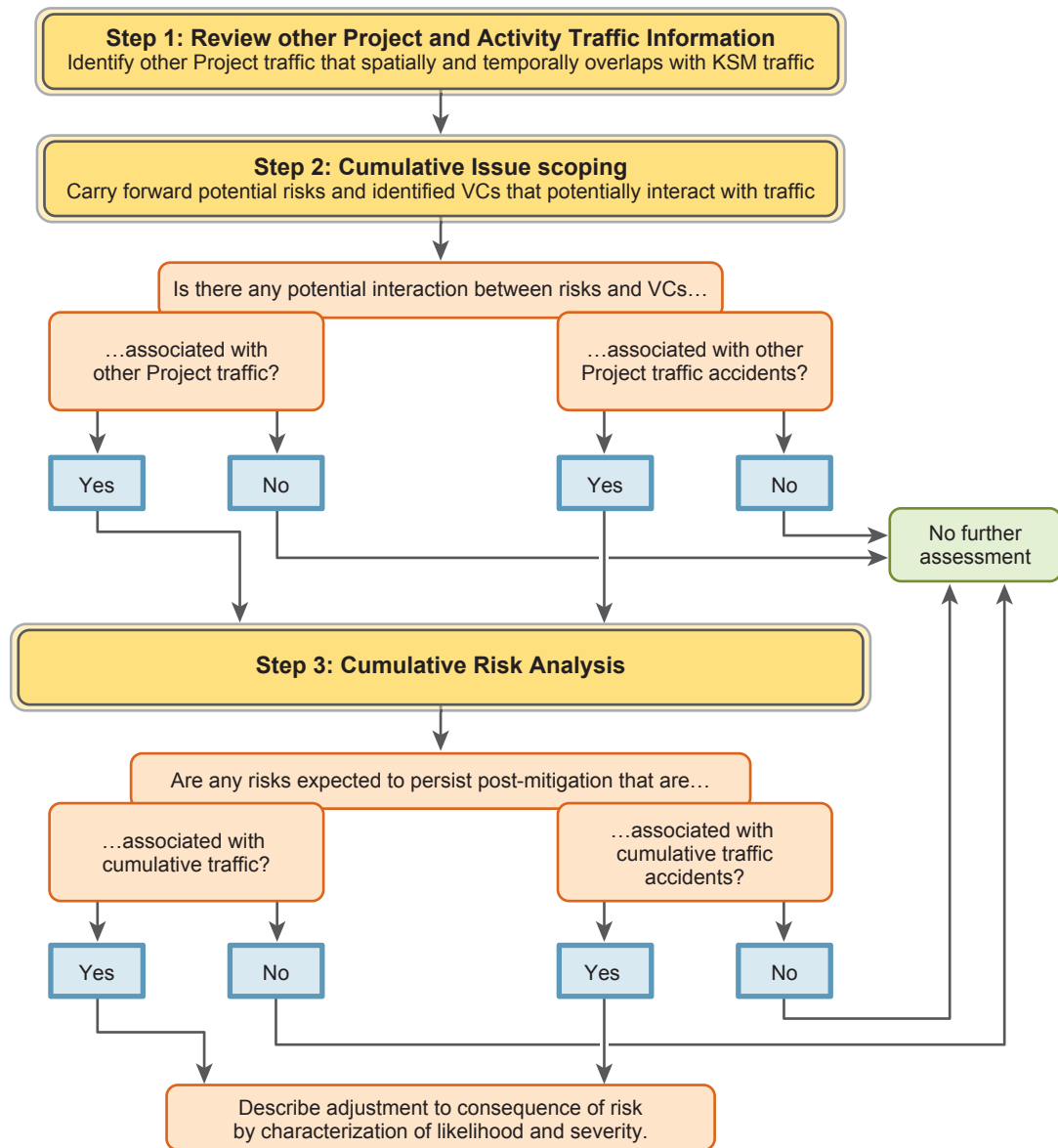
**Predicted Number of Collisions per Year
on Highway 37 South - Baseline Average
Annual Daily Trips vs. Cumulative Traffic**

Figure 8.3-2



**Predicted Number of Collisions per Year
on Highway 37A- Baseline Average
Annual Daily Trips vs Cumulative Traffic**

Figure 8.3-3



8.4.1 Cumulative Issue Scoping (Step 2)

Using an interaction matrix, each potential Project-related traffic risk that was identified as interacting with identified VCs in Sections 5.1 through 5.9, is carried forward to the CRA. Each Project-traffic related risk is described in a table (see Example Table 8.4-1, where the example of wetlands is used). Details such as the project phase, the types of traffic or traffic accidents that the risk may be associated with are recorded.

Table 8.4-1. Potential Cumulative Interaction Matrix (Example)

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
<i>e.g., Deposition of deleterious substances into wetlands through vehicle crashes or hazardous cargo spills</i>	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

Project-specific risks are then considered in the context of the risks associated with other projects and activity traffic. If a Project-related risk has been fully mitigated or does not have the potential to interact cumulatively with traffic from other projects, then the cell in the matrix is left empty, a rationale as to why it is not likely to combine cumulatively with traffic from other projects is provided in the text, and no further consideration is given to that potential cumulative risk.

If there is a potential for interaction between a Project-related risk and that of traffic from other projects, that cell is marked with an "X" and the interaction is examined in detail. A marked cell does not indicate that there will be a cumulative risk, only that there is a potential for cumulative interaction.

Traffic from other projects considered is limited to those identified during Step 1, described in Sections 8.1.1 and 8.2.2.

8.4.2 Cumulative Risk Analysis (Step 3)

In the cumulative risk analysis: (a) interactions with traffic from other projects are examined; (b) any additional measures to mitigate cumulative traffic risks are described; and (c) the realized cumulative risk (a cumulative risk that cannot be fully mitigated) is characterized. Similar to the process for the characterization of Project-specific risks described in Section 4.4.3, cumulative risks are characterized in terms of their likelihood and severity.

8.4.2.1 Cumulative Risk Identification

Table 8.4-1 identified the potential interactions between Project-specific risks and risks associated with traffic from other projects. In the cumulative risk identification sections, the interaction is examined in detail. The potential synergistic and additive risks of overlapping cumulative traffic are described for each assessment topic.

8.4.2.2 Cumulative Risk Mitigation

The determination of likely mitigation by parties responsible for traffic from other projects is considered in the CRA. If applicable, these expected mitigation measures are described, as well as any additional mitigation commitments made by the Proponent to address potential cumulative risks.

8.4.2.3 Cumulative Risk Characterization

The resulting realized cumulative risks, post-cumulative mitigation, are briefly described in a final table. An example using wetlands is shown in Example Table 8.4-2.

Table 8.4-2. Assessment Matrix for Cumulative Risks (Example)

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
<i>e.g., Wetland Function</i>	<i>e.g., Deposition of deleterious substances into wetlands through vehicle crashes or hazardous cargo spills</i>	<i>e.g., Limit the extent of contamination; limit the time a contaminant may be in contact with a wetland, and follow Spill Prevention and Emergency Response Plan</i>	<i>e.g., Unlikely</i>	<i>e.g., Major</i>	<i>e.g., Unlikely</i>	<i>e.g., Major</i>	<i>e.g., A loss of wetland function within a specific wetland or wetland complex</i>

Two aspects of cumulative risks, (1) the likelihood and (2) the severity of any risks that are expected to persist post-mitigation, are characterized in the table, using the same method described in Section 4.4.3. Cumulative risks are defined by demonstrating the expected adjustment, if any, to the Project-specific likelihood and severity.

If a particular risk was judged to be fully mitigated, this is indicated in the final column and the likelihood and severity adjusted for CRA columns are marked with “NA.”

8.5 CUMULATIVE RISK OF TRAFFIC ON SOCIO-ECONOMICS AND LAND USE

All traffic from other projects identified in Sections 8.1 and 8.2, if approved and into operation, are expected to contribute to increased traffic volumes along highways 37 and 37A. If all combined projects proceed, historic traffic peaks may be exceeded on the southern segment of Highway 37. Most of the people who are resident in the Study Area (approximately 784 combined for Gitwangak and Gitanyow) live along this segment.

8.5.1 Cumulative Issue Scoping for Socio-economics and Land Use

As described in Section 5.1, CWB is a multi-dimensional concept that refers to individual and collective levels of health, satisfaction, quality of life, and standard of living (Kusel 1996; Costa, Silvana, and Scoble 2006; Sirgy et al. 2009).

Apart from CWB, no other socio-economic VC is anticipated to be at risk from Project-related traffic (see Section 5.1.2). Table 8.5-1 highlights each risk to CWB that was identified in Chapter 5. All identified risks to CWB (including reduced ambient air quality, nuisance from increased vehicle noise, and reduced public safety from both increased traffic and traffic accidents) have the potential to interact cumulatively with other traffic since traffic from all projects will be using Highway 37 and/or 37A to varying degrees.

Table 8.5-1. Potential Cumulative Interaction Matrix: Socio-economics and Land Use

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Reduced ambient air quality from increased vehicle emissions affecting CWB	X
Nuisance from increased vehicle noise affecting CWB	X
Perceived reduced quality of the natural environment affecting CWB	-
Reduced public safety resulting from an increase in traffic accidents affecting CWB	X
Reduced public safety resulting from traffic accidents, and potential spills of hazardous cargo affecting CWB.	X
Change in availability of wildlife resources affecting hunting and trapping.	X

“X” indicates that a potential interaction has been identified.

“-” indicates that no potential interaction was identified.

The effects of Project-specific traffic on perceived reduced quality of the natural environment is expected to be fully mitigated, by measures such as minimizing the number of trips required, following maintenance procedures and schedules provided by vehicle manufacturers, and using vehicle noise suppression technologies where possible. Therefore, does not have the potential to interact with the same effect from other traffic and is not considered further in this assessment.

Hunting and trapping was identified as a land use VC anticipated to be at risk as a result of changes in availability of moose and bear as resources. Additional traffic from both KSM and other projects have the potential to interact cumulatively with this effect (Table 8.5-1).

8.5.2 Cumulative Risk to Community Well-being

8.5.2.1 Cumulative Risk Identification

Ambient Air Quality Effects

Although any potential effects to ambient air quality are anticipated to be highly localized and experienced within 50 m of the highway corridor, Project traffic is expected to contribute to ambient air quality concentrations of CACs. Traffic from other projects’ activities also has the potential to result in increased ambient air quality concentrations of CACs.

Noise Effects

With regards to nuisance impacts from KSM Project traffic-related noise, the risk from noise on CWB is expected to be negligible in the context of daytime activities and normal sleep patterns (see Sections 5.1.3 and 5.8.3.2). Cumulative increases in traffic volume has the potential to increase these risks to those living within 30 m of the highways.

While the noise level along highways 37 and 37A may be more consistently elevated from baseline conditions over a 24-hour period due to cumulative traffic increases, sound levels cannot be added in an arithmetic way. The sound pressure level from two equal sources has been shown to be only 3 dB higher than the sound pressure level of one source. For example, two trucks producing 90 dB each will combine to produce 93 dB, not 180 dB. In other words, a doubling of the noise source produces only a 3 dB increase in the sound pressure level (FHWA 1995). See Section 8.10 for a discussion of results from the cumulative noise model.

Reduced Public Safety/Increase in Accidents

A minor increase in traffic accidents (maximum 0.191 collisions per year along the north segment of Highway 37 during operation) is anticipated as a result of KSM Project activities. As shown in Section 8.3, even with cumulative project traffic, a maximum increase of only 0.959 collisions per year (along the north segment of Highway 37) is predicted. Traffic accident predictions were lower for other highway segments were lower.

8.5.2.2 Cumulative Risk Mitigation

Cumulative effects' mitigations for CWB are the same as those proposed in Section 5.1.3. No additional measures are considered necessary to address cumulative effects. Vehicle emissions and noise will be minimized using the following mitigation measures:

- switching fuel to more efficient blends;
- optimizing vehicle load rates to minimize the number of trips;
- following procedures and schedules provided by vehicle manufacturers to increase fuel efficiency and decrease noise;
- minimizing idling;
- ensuring diesel vehicles use low sulphur content fuel, as required by law;
- ensuring Project-related vehicles avoid local roads and remain on the highways;
- using vehicle noise suppression technologies where possible;
- avoiding the use of engine brakes near communities; and
- providing noise awareness training for Project transportation personnel.

Speed limits and other traffic rules will be enforced and adhered to by Project personnel. All contractors and workers will be required to adhere to the BC Occupational Health and Safety Regulation (BC Reg 296/97), as well as a zero-tolerance policy on alcohol and drugs. Procedures for emergency response and occupational first aid will be developed and workers and contractors will undergo required training. Information on weather and highway conditions will be made available to all Project drivers before departure. Finally, information regarding increases in traffic volume and type will be made available to local communities so that residents are aware of and/or can plan their activities along the highway accordingly (e.g., during large load transfers).

It is anticipated that other projects will adopt similar mitigation strategies as those proposed for the KSM Project.

8.5.2.3 Cumulative Risk Characterization

Ambient Air Quality Effects

Even with cumulative traffic, ambient air quality concentrations of CACs are well below BC air quality objectives and standards (Government of BC 2009b). Risk to ambient air quality as a result of cumulative traffic will not alter the highly localized nature of this risk. As the same kind of mitigation is expected to be used by all projects, the cumulative risk to CWB from changes in air quality remains minor in severity (see Table 8.5-2).

Table 8.5-2. Assessment Matrix for Cumulative Risks: Socio-economics and Land Use

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Community Well-being	Reduced ambient air quality from increased vehicle emissions	Using well-maintained vehicles to optimize combustion, using low sulphur fuel, minimize trips on highway	Possible	Minor	Possible	Minor	Reduced local ambient air quality with minimal risk to community well-being
Community Well-being	Nuisance from increased vehicle noise	Using well-maintained vehicles, minimize trips on highway	Likely	Minor	Likely	Moderate	Minor increase in noise levels on the southern segment of Highway 37, and a moderate increase in noise levels on the northern segment of Highway 37. Changes in noise levels are of a very localized nature
Community Well-being	Reduced public safety	Using well-maintained vehicles, minimize trips on highway, increase awareness/communicate traffic volumes and types to local communities	Possible	Minor	Possible	Minor	Increase of vehicle accidents and decreased public safety
Community Well-being	Accidents of varying severity leading to injury or death of drivers, passengers, and other highway users. Hazardous cargo spills from accidents may expose local residents or emergency responders to additional safety risks	Ensure appropriate signage along the highway corridor; enforce speed limits and other traffic rules; appropriate driver safety training; company zero-tolerance policy on alcohol; adhere to accident first aid, emergency response and other procedures; ensure emergency responders are appropriately equipped and maintained; highway maintenance, Increase awareness/communicate traffic volumes and types to local communities	Possible	Catastrophic	Possible	Catastrophic	Additional traffic from other projects may potentially increase the risk for accidents affecting human health and safety to a large degree, including death.
Hunting and Trapping	Change in availability of wildlife resources affecting hunting and trapping	Traffic Management Plan; Noise Management Plan; Fish and Aquatic Habitat Management Plan; Terrestrial Ecosystems Management and Monitoring Plans; Wildlife Management Plan	Possible	Minor	Possible	Moderate	Additional traffic from other projects may potentially increase the risk for wildlife-vehicle interactions and disruption of movement.

Noise Effects

For the assessment of KSM Project traffic on the north and south segments of Highway 37, the appropriate criteria for expected noise levels at the nearest receiver are met. Noise predictions considering cumulative increases in traffic, indicate that noise levels will approach the “absolute” criteria of 55 dBA set by the CMHC (1986) for Outdoor Recreation Areas on the north segment of Highway 37 and may have potential for disturbance. Cumulative noise levels on the south segment of Highway 37 are expected to remain below the maximum allowable increase in noise for that segment (BKL 2013, Appendix E). As a result the cumulative risk to CWB from changes in noise levels remains likely, but severity is adjusted to moderate (see Table 8.5-2).

Reduced Public Safety and Increase in Accidents

Considering mitigation, the effects to safety and direct human health risks from accidents resulting in spilled hazardous material cannot be eliminated; however, the increase in the predicted number of accidents is small (less than one additional accident per year). The cumulative risk to CWB from reduced public safety due to accidents remains possible, and ranging from minor to catastrophic depending on the severity of the accident (see Table 8.5-2).

8.5.3 Cumulative Risk to Hunting and Trapping

8.5.3.1 Cumulative Risk Identification

Cumulative Effect of Quantity of Resources

The proposed Project will be developed in an area that is characterized by remote and largely undeveloped wilderness. Land users in the Study Area, including subsistence users as well as commercial recreationalists, hunters and trappers, rely on wildlife in order to carry out their activities. Project traffic may contribute to a change in the quantity of these harvest resources due to disruption of wildlife movement. Increased pressure on wildlife as a result of wildlife collisions with vehicles in the Study Area could also contribute to a change in the quantity of resources.

Other present and foreseeable future traffic in the Study Area has the potential to act cumulatively by contributing to the potential increase in the disruption of movement and direct mortality of wildlife.

8.5.3.2 Cumulative Risk Mitigation

Potential risks of Project traffic to wildlife will be mitigated through actions such as giving the right-of-way to wildlife on the highways; adhering to posted speed limits; adhering to wildlife warning signs posted along the highways; documenting wildlife/vehicle interactions; and communicating the observance of wildlife to other trucks.

Changes in the availability of wildlife as a resource will be mitigated through the implementation of the Traffic and Access Management Plan, and it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project and comply with relevant government legislation with respect to wildlife.

To effectively address cumulative effects to moose caused by increased traffic along highways 37 and 37A, an integrated management strategy is required that includes all stakeholders that have regulatory oversight both with respect to transportation activities on provincial highways and for managing wildlife populations. Other stakeholders including road users, particularly heavy industrial traffic users, and Aboriginal groups that depend on the regional moose population for subsistence purposes (i.e., hunting) must also participate in the establishment of a management plan that addresses all proximal causes contributing to the predicted decline in the moose population. The Proponent is willing to participate in a regional initiative, approved and led by government agencies, with other stakeholders as described.

8.5.3.3 Cumulative Risk Characterization

With the additional effects of traffic from other projects, the severity of the effect on the quantity of resources is predicted to increase due to increased direct mortality, and is rated as moderate.

8.6 CUMULATIVE RISK OF TRAFFIC ON FISH AND AQUATIC HABITAT

All of the projects identified in the cumulative issue scoping exercise (Sections 8.1 and 8.2), if approved, are expected to contribute to increased traffic volumes along highways 37 and 37A.

8.6.1 Cumulative Issue Scoping for Fish and Aquatic Habitat

As described in Section 5.2, potential Project-specific traffic risks to both fish species and aquatic habitat are expected in the event of an accident resulting from spilled hazardous cargo. Spills as a result of Project traffic-related accidents was the only risk identified (see Table 5.2-1) and since this risk cannot be fully mitigated and traffic from other projects is using highway 37 and/or 37A to varying degrees, the risk to fish and aquatic habitat from hazardous cargo spills has the potential for cumulative interaction (Table 8.6-1).

Table 8.6-1. Potential Cumulative Interaction Matrix: Fish and Aquatic Habitat

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Accident-related spills of diesel fuel/lubricants, concentrates, lime/reagents, and/or explosives	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

8.6.2 Cumulative Risk to Fish and Aquatic Habitat

8.6.2.1 Cumulative Risk Identification

Risks identified and analyzed in Section 5.2.3 are assumed to be the same for other Project traffic, especially considering other project traffic is mainly from mining projects that will also be carrying dangerous goods and hazardous materials to and from the respective project site. All risks from spills of fuel/lubricants, concentrate, lime/reagents, and explosives were characterized as being unlikely, as the risk of accidents along highways 37 and 37A are minimal even with the cumulative increase in traffic. Moreover, as long as a spill is limited to the immediate vicinity of the spill site, with effective mitigation measures, the temporal and spatial effects of a spill should be limited, particularly (as in the case of concentrates) when the spilled substance has low solubility in water.

8.6.2.2 Cumulative Risk Mitigation

Cumulative effects mitigations for spills are the same as those proposed in Section 5.2.3. Spills will be mitigated by implementing BMPs which are described in detail in the Spill Prevention and Emergency Response Plan. This plan provides specifications for preventing and controlling the release of spills during traffic accidents. Prompt containment and clean-up of spills is essential to mitigating risks to aquatic habitat and organisms. The plan will minimize response time and maximize clean-up efficiency, preventing long-term or geographically extensive effects.

Adhering to speed limits and safe traffic practices will prevent off-road accidents. Cyanide transportation will follow guidelines established in the International Cyanide Management Code (ICMI n.d.).

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project. Mitigation measures proposed for the KSM Project are standards stated in federal and provincial

guidelines, such as DFO's *Land Development Guidelines for the Protection of Aquatic Habitat* (DFO 1993), the DFO Pacific Region *Operational Statements* (DFO 2010), and a spill containment and emergency response plan, to which all projects are subject.

8.6.2.3 Cumulative Risk Characterization

Potential spills were assessed as unlikely to occur and negligible to moderate in severity (Table 8.6-2) due to their small size and since the implemented mitigation plan and BMPs will reduce the magnitude of any potential spill. Furthermore, the duration of any spill will be short, and fish and aquatic habitat will be able to recover and recolonize. As the same kind of mitigation is expected to be used by all projects, the cumulative risk to fish and aquatic habitat from accident-related spills will remain unlikely and negligible to moderate in severity.

8.7 CUMULATIVE RISK OF TRAFFIC ON WILDLIFE

All of the projects identified in the cumulative issue scoping exercise (Section 8.1 and 8.2) are expected to contribute to increased traffic volumes along highways 37 and 37A.

8.7.1 Cumulative Issue Scoping for Wildlife

Wildlife VCs identified in Section 5.3 include moose, bears, western toads, and birds. The potential effects to wildlife VCs from disruption of movement, direct mortality, and chemical hazards were identified in Section 5.3.3. Since these risks were not considered to be fully mitigated (see Tables 5.3-5 and 5.3-6), they have the potential for cumulative interaction (see Table 8.7-1), since all traffic from other projects will be using highways 37 and/or 37A to varying degrees.

8.7.2 Cumulative Risk Analysis for Moose

8.7.2.1 Cumulative Risk Identification

Disruption of Movement

The Project-specific traffic risk assessment predicted a minor risk of disruption of movement for moose (Section 5.3.3.1). Cumulative traffic from other potential traffic along highways 37 and 37A was evaluated for its cumulative potential to act as a barrier to movement for moose.

Moose may avoid crossing roads that have high traffic volumes. Thresholds above which moose in BC will not cross roads are unavailable. Müller and Berthoud (1997) used data from a variety of locations to distinguish three stepped levels of barrier effects based on road traffic: (1) Roads with less than 1,000 vehicles per day (42 vehicles per hour [VPH]) are permeable to most wildlife species (see grizzly bear for exception) – many individuals successfully cross roads at these traffic rates and casualties are limited; (2) Roads with traffic between 4,000 and 10,000 vehicles per day (166 to 416 VPH) impose a strong barrier to movement – noise and movements from the traffic will repel many individuals, and many that cross will get hit; and (3) Highways with traffic levels above 10,000 vehicles per day (more than 416 VPH) are impermeable to most species. These traffic rates were used as thresholds to evaluate effects of cumulative vehicle traffic along highways 37 and 37A on moose.

All of highways 37 and 37A within the Study Area were estimated to have hourly vehicular traffic rates below the traffic value threshold of 42 VPH (see Table 8.7-2), and hence roads are expected to be permeable to moose. The section of road with the highest estimated traffic rate (39.5 VPH) is projected to be along Highway 37 between Meziadin and the Newhawk access road. This rate was close to the threshold value of 42 VPH, and if traffic increases from sources not anticipated or accounted for in this analysis, the threshold could be exceeded in the future.

Table 8.6-2. Assessment Matrix for Cumulative Risks: Fish and Aquatic Habitat

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Fish and Aquatic Habitat	Accident-related spills of diesel fuel/lubricants, concentrates, lime/reagents, and/or explosives	Use of best management practices to minimize spill entry into waterbodies; enforced speed limits and traffic safety; adhere to Spill Containment and Emergency Response Plan; prompt containment and clean-up; concentrate dewatered to a low moisture content before transport	Unlikely	Negligible to Moderate	Unlikely	Negligible to moderate	Localized, short-term effects on fish and aquatic habitat. Negligible to major severity on a short term basis dependent on the type and volume of spill. Negligible to moderate effects outside of the immediate area of the spill.

Table 8.7-1. Potential Cumulative Interaction Matrix: Wildlife

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Disruption of movement	X
Direct mortality	X
Increase in chemical Hazards from accidental spills	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

Table 8.7-2. Estimated Traffic Rates (Vehicles per Hour) of all Cumulative Risk Assessment Projects Based on Projected Traffic Estimates (all Projects) and Existing Background Traffic Levels

Road Segment	Traffic Rate (VPH) as Projected Traffic and Existing Background Traffic	Total Traffic (VPH) from all Projects Considered for the Cumulative Risk Assessment (including KSM)	# of Vehicles from KSM per Day (VPH and % of Total)
*Highway 37 (Eskay Creek Mine road to TCAR)	13.4 Projected Traffic 18.7 Background Traffic	*32.1	3 (0.1 VPH; 0.4%)
*Highway 37 (TCAR to Newhawk access road)	16.8 Projected Traffic 18.7 Background Traffic	*35.5	85 (3.5 VPH; 10%)
*Highway 37 (Newhawk access road to Meziadin Junction)	20.8 Projected Traffic 18.7 Background Traffic	*39.5	85 (3.5 VPH; 9.0%)
*Highway 37A (Meziadin Junction to Stewart)	10.3 Projected Traffic 18.7 Background Traffic	*29.0	36 (1.5 VPH; 5.2%)
*Highway 37 (Meziadin Junction to Cranberry Junction)	10.2 Projected Traffic 18.7 Background Traffic	*28.9	49 (2.0 VPH; 7.1%)

*indicates above threshold value for grizzly bears of 10 VPH at existing background traffic levels.

TCAR = Treaty Creek access road.

Direct Mortality

The Project traffic risk assessment predicted a moderate risk of direct mortality for moose (Section 5.3.3.2). Cumulative traffic from all potential projects along highways 37 and 37A were evaluated for the cumulative potential to result in direct mortality of moose.

Increased traffic in the Study Area was evaluated for the potential to increase moose-vehicle collisions and thereby direct moose mortality. Due to the social, cultural, and economic importance of moose in the region, their sensitivity to moose-vehicle collisions, and concerns raised at KSM Working Group meetings, the potential cumulative effects of increased traffic were examined quantitatively, where possible. Data on moose populations were not available for all areas that may experience increased traffic. Hence, the analysis was conducted using data from the area south of the Study Area boundary and applied to the entire Study Area, as moose population data were only available for the Nass Wildlife Area (NWA).

Surveys of moose populations within the NWA, combined with hunting returns and estimates of existing moose mortality, provided sufficient data to conduct a quantitative Population Viability Analysis (PVA) for the highways 37 and 37A road corridor (Appendix D). The moose population in the NWA is declining, potentially due to overharvesting (Appendix D), as there were an estimated 1,595 animals in 2001,

638 animals in 2004, and 517 animals in 2011 (Demarchi 2011). Although the majority of this area is south of the Study Area boundary for the traffic effects assessment, the PVA is used for this cumulative risk assessment to represent the cumulative effects of traffic on moose.

The PVA predicted that the increased traffic from the KSM Project would not cause a decline in the NWA moose population (Appendix D). However, results suggested that an additional increase in mortality, above what is expected due to KSM Project traffic, could cause the population to decline. Hence, assuming conditions remain constant (much-reduced moose population, current hunting rates, etc.), if all projects in the Study Area were to operate simultaneously, the PVA predicted that moose-vehicle collisions from these projects may be sufficient to have an effect on the moose population in the NWA.

Chemical Hazards

Habitats along the highway used by moose, particularly the calving area on the Bell-Irving River below Bell II, may be vulnerable to effects from traffic accidents, such as chemical spills. Considering the cumulative traffic from all projects, the risk of vehicle accidents remains (Section 8.3), and it is possible that individuals may ingest chemicals through soil, water, or vegetation, particularly if the contaminant is in the form of a salt. Although effects on individuals are possible, the fact that moose move great distances indicate that no population level effects from exposure to chemicals along the highway in the event of a spill are expected to occur. An event of this nature occurring is unlikely.

8.7.2.2 Cumulative Risk Mitigation

With respect to direct mortality, it is expected that all other projects will include similar mitigation measures as adopted by the KSM Project and will follow all relevant legislation, regulations, and BMPs for the activities that they carry out. To effectively address cumulative effects to moose caused by increased traffic along highways 37 and 37A, an integrated management strategy is required that includes all stakeholders that have regulatory oversight both with respect to transportation activities on provincial highways and for managing wildlife populations. Other stakeholders including road users, particularly heavy industrial traffic users, and Aboriginal groups that depend on the regional moose population for subsistence purposes (i.e., hunting) must also participate in the establishment of a management plan that addresses all proximal causes contributing to the predicted decline in the moose population. The Proponent is willing to participate in a regional initiative, approved and led by government agencies, with other stakeholders as described.

It is expected that spills will be mitigated by following a spill prevention and emergency response plan. Part of this plan would be immediate clean-up, which will minimize if not eliminate effects on wildlife receptors. In addition, wildlife would be excluded from the spill site until effective clean-up of the area. However, in the event of a major spill, soil, water, and vegetation within the spill area will be monitored to ensure that the chemical levels are within the appropriate regulatory guidelines.

8.7.2.3 Cumulative Risk Characterization

Disruption of Movement

Assuming other projects will be adopting similar mitigation measures, it is still possible that disruption of movement to moose may occur as a result of increased traffic on the highways (particularly Highway 37), but the severity is expected to be minor (see Table 8.7-3).

Table 8.7-3. Assessment Matrix for Cumulative Risks: Wildlife

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Moose	Disruption of Movement	Adhere to speed limits and wildlife warning signs along highways, give wildlife right of way, limit traffic disturbance where possible	Possible	Minor	Possible	Minor	Roads with traffic may act as a barrier to movement for a few individual moose.
	Direct Mortality	Adhere to and enforce speed limits, yield to wildlife along roads, document vehicle-wildlife interactions, communicate observations of wildlife to other trucks	Possible	Moderate	Unlikely	Major	An average of approximately 20 moose are killed per year due to vehicle collisions along Highway 37 between Kitwanga and Burrage (within the Study Area). Cumulative project traffic will increase the traffic volume along the highways and direct mortality to moose is possible.
	Chemical Hazards (Traffic Accidents)	Spills will be mitigated as per the Emergency Response and Spill Management Plan. Part of the spill response plan is immediate cleanup, which will minimize if not eliminate effects on wildlife receptors. Wildlife will be excluded from the spill site if cleanup cannot occur immediately.	Unlikely	Minor	Unlikely	Minor	In the rare event of a traffic accident, chemical hazards may pose a risk to moose. It is anticipated that the cleanup will occur immediately and moose will be excluded from the spill site, reducing the risk.
Grizzly and Black Bears	Disruption of Movement	Adhere to speed limits and wildlife warning signs along highways, give wildlife right of way, limit traffic disturbance where possible	Possible	Minor	Possible	Minor	Roads with traffic may act as a barrier to movement for a few individual bears.

(continued)

Table 8.7-3. Assessment Matrix for Cumulative Risks: Wildlife (completed)

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Grizzly and Black Bears (<i>cont'd</i>)	Direct Mortality	Adhere to and enforce speed limits, yield to wildlife along roads, document vehicle-wildlife interactions, communicate observations of wildlife to other trucks	Possible	Minor	Possible	Minor	Between 1991 and 2010, there were 29 reported vehicle accidents (average 1.5 bears/year) with bears along Highway 37 near the KSM Project. Cumulative project traffic will increase the traffic volume along the highways and direct mortality to bears is possible.
	Chemical Hazards (Traffic Accidents)	Spills will be mitigated per the Emergency Response and Spill Management Plan. Part of the spill response plan is immediate cleanup, which will minimize if not eliminate effects on wildlife receptors. Bears will be excluded from the spill site if cleanup cannot occur immediately.	Unlikely	Minor	Unlikely	Minor	In the rare event of a traffic accident, chemical hazards may pose a risk to bears. It is anticipated that the cleanup will occur immediately and bears will be excluded from the spill site, reducing the risk.
Western Toads	Direct Mortality	Adhere to and enforce speed limits, document vehicle-wildlife interactions where possible	Possible	Minor	Possible	Minor	Western toads may be impacted by increased traffic if migration events occur across the highways.
	Chemical Hazards (Traffic Accidents)	Spills will be mitigated per the Emergency Response and Spill Management Plan. Part of the spill response plan is immediate cleanup, which will minimize the effects on toads.	Unlikely	Moderate	Unlikely	Moderate	In the rare event of a traffic accident, chemical hazards may pose a risk to western toads if the spill occurs in a wetland occupied by toads.
Birds	Direct Mortality	Adhere to and enforce speed limits, document vehicle/wildlife interactions where possible.	Possible	Minor	Possible	Minor	Mortality events involving flocking bird species (e.g., pine siskin or crossbill) and vehicles may occur along the highway, particularly in winter or spring.

Direct Mortality

Assuming other projects will be adopting similar mitigation measures, it is still possible that disruption of movement to moose may occur as a result of increased traffic on the highways (particularly Highway 37). Moose have already been pushed below their natural population level in the Nass Wildlife Area by hunting and/or other factors, and the moose vehicle collision modelling indicates that the cumulative effect of all project traffic (regardless of KSM) will depress survival below the 2.5% surplus mortality that the population currently has (although KSM alone would not cause the moose population to decline). For these reasons, severity is adjusted moderate to major.

However, because the model structure is posited to cause it to be overly sensitive to small reductions in survival, the level of future industrial development along the highway 37 corridor is uncertain, and it is unlikely that all currently proposed mine projects will be developed at the same time, the likelihood of this effects is adjusted from possible to unlikely.

Chemical Hazards

Assuming other projects will be adopting similar mitigation measures, the likelihood of vehicle crashes or hazardous cargo spills into moose habitat will still be unlikely and the severity will be minor, depending on the location and the amount of time that lapses between occurrence and clean-up (see Table 8.7-3).

8.7.3 Cumulative Risk Analysis for Bears

8.7.3.1 Cumulative Risk Identification

Disruption of Movement

The Project-specific traffic risk assessment predicted a minor risk of disruption of movement for grizzly and black bears (Section 5.3.3.1). Cumulative traffic from all potential projects along highways 37 and 37A was evaluated for the cumulative potential to act as a barrier to movement for bears.

Traffic along the highway may disrupt movements of grizzly bears. Waller and Servheen (2005) reported that bears will cross roads when traffic volumes are less than 10 VPH, but natural crossing rates can be disrupted when traffic rates exceed this value. Traffic volumes from all present and future projects were converted to hourly rates based on an assumed 24-hour driving day along the highways in the Study Area, because industrial driving occurs throughout a 24-hour period. Background traffic data were estimated from periodic traffic counts taken in 2005 and 2008 on Highway 37, north of Meziadin Junction and in 2006 north of Dease Lake (BC MOTI 2011d).

The average background traffic of 224 vehicles per day was converted to an hourly rate based on an assumed 12-hour driving day, because most driving occurs between 7 a.m. and 7 p.m. Therefore a background traffic rate of 18.7 VPH was added to all sections of Highway 37 and 37A (Table 8.7-2).

The background traffic levels on highways 37 and 37A are approximately twice the 10 VPH threshold, potentially causing a detectable barrier to grizzly bear movement across the highway (Waller and Servheen 2005). The addition of all projects to the baseline brings the total traffic to approximately three times over the threshold on highways 37 and 37A (Table 8.7-2). Traffic due to the KSM Project alone is not enough to cause a disruption of movement for grizzly bears (maximum addition of 3.5 VPH).

The prediction that highways 37 and 37A are currently acting as a barrier to grizzly bear movement may affect the bear populations by fragmenting the population, which increases the chance of local population fluctuations (Lande 1988; Woodroffe and Ginsberg 1998) and reduced gene flow across the

barrier (Frankham, Ballou, and Briscoe 2002). The highway may also cause changes to energy budgets of bears that have to travel farther to reach seasonal habitats or that may be excluded from good quality habitat. However, these effects are potentially already occurring at baseline conditions, prior to addition of projected traffic.

Direct Mortality

The Project-specific traffic risk assessment predicted a minor risk of direct mortality for grizzly and black bears (Section 5.3.3.2). Cumulative traffic from all potential projects along highways 37 and 37A were evaluated for the cumulative potential to result in direct mortality of bears.

Vehicle strikes could increase in some parts of the Study Area due to increased traffic from multiple projects. The number of mortalities due to vehicles strikes may increase with traffic levels (as was predicted for moose) or may remain constant. Grizzly bears are known to avoid highways at even low traffic levels (Section 8.7.2.1), which may act to curb any increases in traffic mortality.

Chemical Hazards

Habitats along the highways may be used by bears during spring, summer, and fall (near salmon spawning habitat). Considering the cumulative traffic from all projects, the risk of vehicle accidents remains (Section 8.3), and it is possible that individuals may ingest chemicals through soil, water, vegetation, and prey in the event of a traffic accident and accidental spill. Although effects on individuals are possible, the relatively large home ranges of grizzly bears, and the fact that their home ranges do not substantially overlap, indicate that no population level effects from exposure to chemicals along the highway in the event of a spill are expected to occur.

8.7.3.2 Cumulative Risk Mitigation

The Proponent will consider participating in government-led monitoring programs by contributing to regionally based monitoring initiatives where those monitoring initiatives replace proposed KSM Project-specific monitoring and are approved by relevant provincial authorities and stakeholders.

It is expected that all other projects will follow relevant acts, regulations, and BMPs for the activities that they carry out. Projects may also be required to participate in any regional, provincially led, joint venture monitoring and mitigation programs that would allow for adaptive management to be triggered when cumulative traffic rates are causing a disruption to grizzly bear movements that threaten the population.

It is expected that for other projects, spills will be mitigated by following a spill prevention and emergency response plan. Part of this plan would be immediate clean-up, which will minimize if not eliminate effects on wildlife receptors. In addition, wildlife would be excluded from the spill site until effective clean-up of the area. However, in the event of a major spill, soil, water, and vegetation within the spill area will be monitored to ensure that the chemical levels are within the appropriate regulatory guidelines.

8.7.3.3 Cumulative Risk Characterization

Disruption of Movement

Assuming other projects will be adopting similar mitigation measures, it is still possible that disruption of movement to bears may occur as a result of increased traffic on the highways, but the severity is expected to be minor (see Table 8.7-3).

Direct Mortality

Assuming other projects will be adopting similar mitigation measures, it is still possible that vehicle-bear collisions may occur resulting in direct mortality due to cumulative traffic from all projects on the highways. The severity will be minor; even though traffic volumes will be increasing, the number of animal collisions may not increase by an equal percentage (see Table 8.7-3).

Chemical Hazards

Assuming other projects will be adopting similar mitigation measures, the likelihood of vehicle crashes or hazardous cargo spills into bear habitat will still be unlikely and the severity will be minor, depending on the location and the amount of time that lapses between occurrence and clean-up (see Table 8.7-3).

8.7.4 Cumulative Risk Analysis for Western Toads

8.7.4.1 Cumulative Risk Identification

Direct Mortality

The project-specific traffic risk assessment predicted a minor risk of direct mortality for western toads (Section 5.3.3.2). Cumulative traffic from all potential projects along highways 37 and 37A were evaluated for the cumulative potential to result in direct mortality of western toads.

Direct mortality of adults and newly emerged terrestrial juveniles may occur near roads and close to wetlands during the spring and late summer. The risk of direct mortality may increase as cumulative traffic is added to the area. Increases in traffic rates due to additional projects within the Study Area could increase the risk of vehicle collisions for western toads.

Chemical Hazards

Western toads have the potential to be exposed to chemicals in the event of a traffic accident involving the spill of chemicals into a wetland occupied by western toads. Considering cumulative traffic from all projects the risk of vehicle accidents remains (Section 8.3) and toads could be exposed to the chemicals via the ingestion of soil, water, and prey species and via dermal absorption. When considering the cumulative traffic from all projects, an event of this nature occurring is possible, but unlikely (Section 8.3).

8.7.4.2 Cumulative Risk Mitigation

It is expected that all other projects will include similar mitigation measures as adopted by the KSM Project and will follow all relevant acts, regulations, and BMPs for the activities that they carry out.

Additionally, it is expected that other projects' spills will be mitigated by following a spill prevention and emergency response plan that is developed specific to each project. Part of such plans should be immediate clean-up, which should minimize if not eliminate effects on wildlife receptors. In addition, wildlife would be excluded from the spill site until effective clean-up of the area. However, in the event of a major spill, soil, water, and vegetation within the spill area will be monitored to ensure that the chemical levels are within the appropriate regulatory guidelines.

8.7.4.3 *Cumulative Risk Characterization*

Direct Mortality

Assuming other projects will be adopting similar mitigation measures, western toad mortality is still possible along the highways, but the severity will be minor, as traffic already exists on the highways (see Table 8.7-3).

Chemical Hazards

Assuming other projects will be adopting similar mitigation measures, the likelihood of vehicle crashes or hazardous cargo spills into western toad breeding habitat will still be unlikely; however, the severity of the event if it occurred could be moderate, depending on the location (i.e., breeding pond) and the amount of time that lapses between occurrence and clean-up (see Table 8.7-3).

8.7.5 **Cumulative Risk Analysis for Birds**

8.7.5.1 *Cumulative Risk Identification*

The Project-specific traffic risk assessment predicted a minor risk of direct mortality for birds (Section 5.3.3.2). Cumulative traffic from all potential projects along highways 37 and 37A were evaluated for the cumulative potential to result in direct mortality of birds.

Direct mortality of birds, particularly flocking species such as pine siskins and crossbills, may occur as a result of increased traffic along the highways. Most road mortalities to these species occur during winter or early spring (Campbell et al. 1997). Crossbills, grosbeaks, and siskins are particularly vulnerable to vehicle collisions on highways, as they are attracted to road salts, gravel, and sand (Mineau and Brownlee 2005). It has also been noted that high traffic volume roads can have a repelling or avoidance effect on small vertebrates, thus potentially decreasing the risk of mortality to birds (Clevenger, Chruszcz, and Gunson 2003). When the cumulative traffic from all projects combined is considered, it is likely that the road would have an avoidance effect, rather than increase mortality to birds.

8.7.5.2 *Cumulative Risk Mitigation*

It is expected that all other projects will include similar mitigation measures as adopted by the KSM Project and will follow all relevant acts, regulations, and BMPs for the activities that they carry out.

8.7.5.3 *Cumulative Risk Characterization*

Assuming other projects will be adopting similar mitigation measures, it is still possible that bird mortality may occur along the highways; however, the severity will be minor (see Table 8.7-3).

8.8 **CUMULATIVE RISK OF TRAFFIC ON TERRESTRIAL ECOSYSTEMS**

All of the projects identified in the cumulative issue scoping exercise (Section 8.1 and 8.2) are expected to contribute to increased traffic volumes along highways 37 and 37A.

8.8.1 **Cumulative Issues Scoping for Terrestrial Ecosystems**

The potential impact to terrestrial ecosystems (including rare and sensitive ecosystems, old growth forests, and other terrestrial ecosystems) from invasive plants, wildfires and chemical contamination were identified in Section 5.4.3. Since these risks were not considered to be fully mitigated (see Tables 5.4-5 and 5.4-6), they have the potential for cumulative interaction (see Table 8.8-1), since all project traffic will be using Highway 37 and/or 37A to varying degrees.

Table 8.8-1. Potential Cumulative Interaction Matrix: Terrestrial Ecosystems

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Increase in invasive plants	X
Increase in wildfire incidence	X
Increase in chemical contamination from spills	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

8.8.2 Cumulative Risk Analysis for Terrestrial Ecosystems

8.8.2.1 Cumulative Risk Identification

Invasive Plant Species

As discussed in Section 5.4.3, risks to old growth forests or rare and sensitive ecosystems from invasive plant species is unlikely, with a negligible severity rating, since invasive plants do not thrive in the low light conditions of these ecosystems. It is likely, however, that invasive plants could propagate in other terrestrial ecosystems, along the forest edge near the highway. Cumulative increases in traffic, then, could only have a potential effect on invasive plants along the forest edge.

Wildfires

As discussed in Section 5.4.3, the low baseline level of fire incidence in this area of BC makes the probability of a wildfire due to increased traffic to be rare. Cumulative increases in traffic would only increase the risk of wildfires if other projects did not have their own mitigation measures in place.

Chemical Contamination

As discussed in Section 5.4.3, after mitigation, the likelihood of chemical contamination to Terrestrial Ecosystem VCs is rare. Cumulative increases in traffic would only increase the risk of chemical contamination if other projects did not have their own mitigation measures in place, which they are required to have by law.

8.8.2.2 Cumulative Risk Mitigation

Cumulative effects mitigations for invasive plants are the same as those proposed in Section 5.4.3. Preventing the initial establishment of invasive plants is the most effective method of control (Clark 2003; Polster 2005; BC MOFR 2010a). Where risk of invasive plant introduction and establishment is identified, appropriate action will be taken. Identification of target plants will be based on the management plans outlined by the Northwest Invasive Plant Council (NIPC 2011).

Cumulative effects mitigations for wildfires are the same as those proposed in Section 5.4.3. Preventing an increase in wildfire incidence will involve reducing the risk of vehicle accidents and enacting strong policies requiring the proper disposal of smoking materials. Reduction of vehicle accidents will be accomplished with policies that address vehicle maintenance, speed limits, driver attention, drug and alcohol prohibition, and driving under poor weather conditions.

Cumulative effects mitigations for spills are the same as those proposed in Section 5.4.3. Preventing the introduction of deleterious substances into the environment is the most effective way to avoid effects to terrestrial VCs. Specific preventative measures that will be implemented include conducting a vehicle assessment (for oil leaks, secure cargo, etc.), checking road conditions prior to departure,

maintaining an appropriate driving distance between vehicles, adhering to speed limits, and adjusting driving styles to suit road conditions.

In the event of a spill, the guidelines and procedures outlined in the Proponent's Spill Prevention and Emergency Response Plan will be followed in order to avoid contamination and degradation of terrestrial VCs. However, in the event of a major spill, soil, water, and vegetation within the spill area will be monitored and managed to ensure that the chemical levels are within the appropriate regulatory guidelines.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.8.2.3 *Cumulative Risk Characterization*

Invasive Plant Species

As the same kind of mitigation is expected to be used by all projects, the cumulative effect of invasive plants will remain likely but negligible in severity (see Table 8.8-2).

Wildfires

As the same kind of mitigation is expected to be used by all projects, the cumulative effect of wildfires should remain rare and highly variable in severity, depending on local climate conditions, time of wildfire ignition, and resources available to respond (see Table 8.8-2).

Chemical Contamination

Assuming other projects will be adopting the same or similar mitigation measures to those proposed by the Proponent, the likelihood of chemical contamination to terrestrial VCs will remain rare and ranging from negligible to moderate due to the type, frequency and size of spill, as well as the elapsed time between the occurrence and the removal of contaminants (see Table 8.8-2).

8.9 CUMULATIVE RISK OF TRAFFIC ON WETLANDS

All of the projects identified in the cumulative issue scoping exercise (Section 8.1.1) are expected to contribute to increased traffic volumes along highways 37 and 37A.

8.9.1 *Cumulative Issues Scoping for Wetlands*

The potential for effects to wetland function from vehicle accidents associated with hazardous cargo spills as a result of Project traffic-related accidents was the only risk identified (see Table 5.5-3). This risk could not be fully mitigated (see Table 5.5-6); thus, the risk to wetland function from vehicle accidents involving hazardous cargo spills have the potential for cumulative interaction (Table 8.9-1), since traffic from all projects will be using highways 37 and/or 37A to varying degrees.

8.9.2 *Cumulative Risk Analysis for Wetland Function*

8.9.2.1 *Cumulative Risk Identification*

The use of existing highways will not affect wetlands ability to continue to perform the functions they currently provide, nor will increased use affect wetland extent. Wetlands within 10 m of either side of highways 37 and 37A were considered at risk due to traffic accidents and hazardous cargo spills (Section 5.5.3). The probability of a Project-related traffic accident that involves vehicles crashing into a wetland or releasing deleterious substances into a wetland is very unlikely. Cumulative increases in traffic from other projects would only increase the risk of vehicle crashes or chemical contamination if these projects did not have their own mitigation measures in place, which they are required to have by law.

Table 8.8-2. Assessment Matrix for Cumulative Risks: Terrestrial Ecosystems

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Rare and Sensitive Ecosystems	Increase in invasive plants	Ensure vehicles are washed during appropriate time of year prior to leaving areas with known invasive weeds.	Unlikely	Minor	Unlikely	Minor	Increase in invasive weeds along cleared road rights of way. Some of these cleared rights of way may intersect with riparian areas and floodplains
Rare and Sensitive Ecosystems	Increase in wildfire incidence	No smoking in vehicle policies, proper disposal of smoking materials, proper vehicle maintenance	Rare	Moderate	Rare	Moderate	Wildfire is not common in the ecosystems associated with Highway 37. Risk going forward will depend greatly on larger climate trends. Many rare ecosystems are associated with riparian areas, which are at limited risk for fire. Depends on duration and severity of the wildfire. Ranges from beneficial to detrimental to the ecosystem depending on the extent of removal of the forested ecosystems from the landscape.
Rare and Sensitive Ecosystems	Increase in chemical contamination from spills	None	Rare	Negligible to Moderate	Rare	Negligible to Moderate	Tissue damage to vegetation and contamination of soil. Circumstances of spill will determine extent and severity of damage.
Old Growth Forests	Increase in invasive plants	Ensure vehicles are washed during appropriate time of year prior to leaving areas with known invasive weeds.	Unlikely	Minor	Unlikely	Minor	Old growth forests do not usually have a light regime that promotes invasive plant establishment, as many are not shade tolerant. Old growth forest tend to be located away from the highway
Old Growth Forests	Increase in wildfire incidence	No smoking in vehicle policies, proper disposal of smoking materials, proper vehicle maintenance	Rare	Moderate	Rare	Moderate	Wildfire is not common in the ecosystems associated with Highway 37. Risk going forward will depend greatly on larger climate trends. Depends on duration and severity of the wildfire. Ranges from beneficial to detrimental to the ecosystem depending on the extent of removal of the forested ecosystems from the landscape.

(continued)

Table 8.8-2. Assessment Matrix for Cumulative Risks: Terrestrial Ecosystems (completed)

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Old Growth Forests	Increase in chemical contamination from spills	None	Rare	Negligible to Moderate	Rare	Negligible to Moderate	Tissue damage to vegetation and contamination of soil. Circumstances of spill will determine extent and severity of damage.
Other Terrestrial Ecosystems	Increase in invasive plants	Ensure vehicles are washed during appropriate time of year prior to leaving areas with known invasive weeds.	Likely	Minor	Likely	Minor	Increase in invasive weeds along cleared road rights of way, which can lead to migration of invasive plants into the adjacent terrestrial ecosystems. Since many invasive plants are not shade tolerant, compromise of ecosystem function is not expected
Other Terrestrial Ecosystems	Increase in wildfire incidence	No smoking in vehicle policies, proper disposal of smoking materials, proper vehicle maintenance	Rare	Minor	Rare	Minor	Wildfire is not common in the ecosystems associated with Highway 37. Risk going forward will depend greatly on larger climate trends. Depends on duration and severity of the wildfire. Ranges from beneficial to detrimental to the ecosystem depending on the extent of removal of the forested ecosystems from the landscape.
Other Terrestrial Ecosystems	Increase in chemical contamination from spills	None	Rare	Negligible to Moderate	Rare	Negligible to Moderate	Tissue damage to vegetation and contamination of soil. Circumstances of spill will determine extent and severity of damage.

Table 8.9-1. Potential Cumulative Interaction Matrix: Wetlands

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Deposition of deleterious substances into wetlands through vehicle crashes or hazardous cargo spills.	X

“X” indicates that a potential interaction has been identified.

“-” indicates that no potential interaction was identified.

8.9.2.2 Cumulative Risk Mitigation

Cumulative effects mitigations for wetland function are the same as those proposed for Project-related effects (Section 5.5.3). Mitigation measures include:

- limiting the time any vehicle or deleterious substance remains in a wetland after a traffic accident (Spill Prevention and Emergency Response Plan); and
- limiting the extent to which a deleterious substance can migrate through a wetland; and following standard spill prevention and emergency response planning.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.9.2.3 Cumulative Risk Characterization

Assuming other projects will be adopting similar mitigation measures, the likelihood of vehicle accidents resulting in hazardous cargo spills into wetlands will still be unlikely and highly variable in severity, depending on the location of the accident and type of vehicle, but is generally rated as major (see Table 8.9-2).

Table 8.9-2. Assessment Matrix for Cumulative Risks: Wetland Function

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Wetland Function	Deposition of deleterious substances into wetlands through vehicle crashes or hazardous cargo spills	Limit the extent of contamination; limit the time a contaminant may be in contact with a wetland, and follow Spill Prevention and Emergency Response Plan	Unlikely	Major	Unlikely	Major	A loss of wetland function within a specific wetland or wetland complex

8.10 CUMULATIVE RISK OF TRAFFIC ON NOISE

All of the projects identified in the cumulative issue scoping exercise (Section 8.1 and 8.2) are expected to contribute to increased traffic along highways 37 and 37A.

8.10.1 Cumulative Issues Scoping for Noise

The potential effects on noise levels from increased traffic cannot be fully mitigated (see Table 5.6-5), thus the risk to human and wildlife receptors from increases in noise has the potential for cumulative interaction (Table 8.10-1), since all project traffic will be using highways 37 and/or 37A to varying degrees.

Table 8.10-1. Potential Cumulative Interaction Matrix: Noise

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Increased noise levels	X

“X” indicates that a potential interaction has been identified.

“-” indicates that no potential interaction was identified.

8.10.2 Cumulative Risk Analysis for Noise

8.10.2.1 Cumulative Noise Modelling

As reported by BKL (BKL 2013, Appendix E), and using the same parameters and methodology used in Section 5.6, KSM-related traffic is estimated to increase noise levels in the northern segment by 2 to 3 dB based on a road traffic speed of 90 km/h. This is a noticeable increase, but will still be well below the limit of 55 dBA for an Outdoor Recreation Area or where “indoor conditions are unacceptable unless adequate sound insulation is provided” as recommended in the CMHC guideline (CMHC 1986).

The cumulative effect of nearby project-related traffic (including KSM traffic) at this location is estimated to increase noise levels in the northern segment above the current condition by approximately 6 to 8 dB (to 55 dB) as shown in Table 8.10-2. This is equal to the guideline limit set forth by the CMHC.

Table 8.10-2. Cumulative Traffic Estimates for Noise at the Closest Receiver

Count Station	Case	Present Noise Level (dBA)	Future Noise Level with KSM Project (dBA)	Future Cumulative Noise Level (dBA)	Receiver Distance (m)
47-016-NS	AADT	47	50	55	50
	SADT	49	51	55	
P 47-9-NS	AADT	58	59	61	25
	SADT	59	60	63	

AADT - average annual daily traffic

SADT - summer average daily traffic

Source: BKL (BKL 2013, Appendix E)

With regard to the southern segment, the additional KSM Project related traffic is estimated to increase noise levels at this location by 1 dBA based on a road traffic speed of 90 km/h. This is well below the 4.2 dBA allowance. The cumulative project related traffic is estimated to increase noise levels at this location by 3 to 4 dBA above the current condition based on a road traffic speed of 90 km/h. This is within the 4.2 dBA allowance.

The assessment of additional traffic at both locations meets the appropriate criteria for noise levels at the nearest receiver when viewing KSM Project-related noise contributions only. When assessing cumulative noise levels from all nearby projects, the noise levels are very close to guideline limits, and may have potential for disturbance (BKL 2013, Appendix E). These disturbances are characterized in the

CRA of community well-being and human health in Sections 8.5, and 8.12, as well as being considered in the wildlife cumulative risk assessment as a barrier to wildlife movement (Section 8.7).

8.11 CUMULATIVE RISK OF TRAFFIC ON CLIMATE AND AIR QUALITY

All of the projects identified in the cumulative issue scoping exercise (Section 8.1.1) are expected to contribute to increased traffic volumes along highways 37 and 37A.

8.11.1 Cumulative Issues Scoping for Climate and Air Quality

Potential risks to climate and air quality from GHG and CAC emissions as a result of KSM Project traffic and accidents were identified as risks (see Table 5.7-3). Since these risks were not considered to be fully mitigated (see Tables 5.7-7 and 5.7-8), they have the potential for cumulative interaction (Table 8.11-1), since traffic from all projects will be using highways 37 and/or 37A to varying degrees.

Table 8.11-1. Potential Cumulative Interaction Matrix: Climate and Air Quality

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Increase in GHG emissions from fuel combustion	X
Increase in air contaminant emissions from fuel combustion and hence increase in ambient concentrations	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

Risks to the atmosphere are not anticipated as a result of incremental increases in GHG emissions from Project traffic. Project traffic GHG emissions will be cumulative to the global atmospheric pool, along with provincial, national and international GHG emissions; however, a cumulative risk assessment is not conducted due to the negligible value of Project traffic GHG emissions compared to aggregate world emissions and the impossibility of determining the contribution of the emissions from this individual Project traffic to climate change at the global scale.

8.11.2 Cumulative Risks Analysis for Air Quality

8.11.2.1 Cumulative Risk Identification

Given the low baseline levels of CACs and the level of expected increase in traffic, CACs contribution to ambient air quality due to increased traffic on highways 37 and 37A is expected to remain well below BC air quality objectives and standards. Background concentrations of CACs were approximately 10 times below the maximum desirable concentrations for all CACs. The annual average background concentration of SO₂ was estimated at 2.0 µg/m³, while the *2009 Air Quality Objectives and Standards for British Columbia* state the desirable maximum annual arithmetic mean for SO₂ is 30 µg/m³ (Government of BC 2009b). Background annual average concentration of NO₂ was estimated at 5.0 µg/m³, while BC air quality objectives state that 60.0 µg/m³ is the desirable maximum annual arithmetic mean. While the likelihood of emissions from Project operation is certain, the severity of the effect is considered to be minor.

Even with cumulative increases in traffic (222% higher than baseline estimates on the northern segment of Highway 37; 102% higher than baseline estimates along Highway 37A; and 40.4% higher than baseline estimates along the southern segment of Highway 37), the contribution of additional CACs is still far below BC air quality objectives and standards (Government of BC 2009b).

8.11.2.2 *Cumulative Risk Mitigation*

Cumulative effects mitigations for climate and air quality are the same as those proposed in Section 5.7.3. Air emissions cannot be eliminated from Project traffic activities, since most vehicles will likely have to use fossil-fuel-based engines. However, in addition to the expected emission reductions from technology improvements over the Project lifespan, emissions will be minimized using the following mitigation measures:

- switching fuel to more efficient blends to reduce GHGs;
- optimizing the vehicle load rates to minimize the number of trips;
- following maintenance procedures and schedules provided by the vehicle manufacturers to increase fuel efficiency;
- having fleets with newer engines;
- minimizing idling; and
- ensuring diesel vehicles use low sulphur content fuel as required by law (or lower) to reduce SO₂ emissions.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.11.2.3 *Cumulative Risk Characterization*

As the same kind of mitigation is expected to be used by all projects, the cumulative risk to air quality from increases in CAC emissions will remain certain but minor in severity (see Table 8.11-2).

8.12 CUMULATIVE RISK OF TRAFFIC ON HUMAN HEALTH

All of the projects identified in the cumulative issue scoping exercise (Section 8.1.1) are expected to contribute to increased traffic volumes along highways 37 and 37A; if all projects scoped into the assessment are approved and become operational, historic traffic peaks may be exceeded on the southern segment of Highway 37. Most of the people who are resident in the Study Area (approximately 784 combined for Gitwangak and Gitanyow) live along this segment.

8.12.1 **Cumulative Issues Scoping for Human Health**

Potential risks to human health from adverse effects to country foods, noise, air quality, drinking water quality, and increased traffic accidents as a result of KSM Project traffic and/or traffic accidents were identified as risks (see Table 5.8-2). Since these risks were not considered to be fully mitigated (see Tables 5.8-5 and 5.8-6), they have the potential for cumulative interaction (Table 8.12-1), since all traffic from other projects will be using Highway 37 and/or 37A to varying degrees.

8.12.2 **Cumulative Risk Analysis for Country Foods**

8.12.2.1 *Cumulative Risk Identification*

As stated in Section 5.8.3, contamination of country foods is not expected to occur during normal Project traffic, but may result from a traffic accident that causes a spill. The probability of spills occurring are unlikely and their severity ranges from negligible to moderate depending on the type and extent of the spill. Cumulative increases in traffic would only increase this risk if other projects did not have similar mitigation measures in place to prevent and control spills.

Table 8.11-2. Assessment Matrix for Cumulative Risks: Climate and Air Quality

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Climate	Increase in GHG emissions from fuel combustion	Use well-maintained vehicles to optimize combustion; use hybrid or electric vehicles	Certain	Minor	-	-	No effect at a local or regional level, rather contribution to a global GHG pool
Air Quality	Increase in air contaminant emissions from fuel combustion and hence increase in ambient concentrations	Use well-maintained vehicles to optimize combustion; use low sulphur fuel for diesel vehicles or use biodiesel; use hybrid or electric vehicles	Certain	Minor	Certain	Minor	Contribution to air contaminant emissions and reduction of ambient air quality

Table 8.12-1. Potential Cumulative Interaction Matrix: Human Health

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Effects to country foods from spills of diesel fuel/lubricants, concentrates, lime/reagents, and/or explosives.	X
Effects to air quality from increased vehicle emissions or fuel fires.	X
Effects to drinking water quality from spills.	X
Effects from increases in noise	X
Effects to human safety from increases in traffic accidents	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

8.12.2.2 *Cumulative Risk Mitigation*

Cumulative effects mitigations for country foods are the same as those proposed in Section 5.8.3. BMPs will be used to minimize spill entry into bodies of water or the terrestrial environment. This will include regular vehicle inspections, a scheduled maintenance program, and operation of vehicles that meet or exceed Transport Canada's minimum requirements (Transport Canada n.d.). The Proponent's Spill Prevention and Emergency Response Plan will be implemented to limit effects on country foods and human health. As part of the Proponent's Emergency Response Plan, procedures for emergency response and occupational first aid will be developed, and workers and contractors will undergo required training. In the unlikely event of a fire, emergency response procedures to minimize fire duration and extent will be initiated promptly.

Drivers will be TDG, WHMIS and CPPI certified as required. Speed limits and traffic safety rules will be enforced. Communication devices (VHF radio, satellite phone) and emergency contacts will be readily accessible to drivers.

The Spill Prevention and Emergency Response Plan will limit the infiltration of leachate from spilled concentrate into the soil environment. In the event of a spill into the aquatic environment, metal concentrations would be monitored in the sediment and water. Exceedance of guidelines will be included in human health and ecological risk assessments, if required.

It is anticipated that other projects will adopt similar mitigation strategies to the KSM Project.

8.12.2.3 *Cumulative Risk Characterization*

Assuming other projects will be adopting similar mitigation measures, the likelihood of chemical contamination of country foods from hazardous cargo spills will still be unlikely and variable in severity (Table 8.12-2).

8.12.3 **Cumulative Risk Analysis for Noise**

8.12.3.1 *Cumulative Risk Identification*

With regards to human health impacts from traffic-related noise, the risk is expected to be negligible in the context of daytime activities and normal sleep patterns (see Sections 5.1.3 and 5.8.3.2). Cumulative increases in traffic volume may increase these risks but only to those living within 30 m of the highways (FHWA 1995). Also, while the noise level along highways 37 and 37A may be more consistently elevated from baseline conditions over a 24-hour period due to cumulative traffic increases, sound levels cannot be added in an arithmetic way. The sound pressure level from two equal sources has been shown to be only 3 dB higher than the sound pressure level of one source. Therefore, two trucks producing 90 dB each will combine to produce 93 dB, not 180 dB. In other words, a doubling of the noise source produces only a 3 dB increase in the sound pressure level (FHWA 1995).

See Section 8.10 for a discussion of results of the cumulative noise model.

8.12.3.2 *Cumulative Risk Mitigation*

Cumulative effects mitigations for noise are the same as those proposed in Section 5.8.3. Risk mitigation for traffic noise can include measures at the source as well as measures at the receptor. Source risk mitigation will include: reducing speeds to 50 km/h in residential areas; avoiding the use of engine brakes in residential areas; adhering to a truck maintenance program; and avoiding reversing (use of reverse-alarm) in residential areas.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

Table 8.12-2. Assessment Matrix for Cumulative Risks: Human Health

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Country Foods	Effects to country foods from spills of diesel fuel/lubricants, concentrates, lime/reagents, and/or explosives	Use of best management practices to minimize spill entry to the environment; enforced speed limits and traffic safety; adhere to Spill Prevention and Emergency Response Plan; Prompt containment and clean-up	Unlikely	Negligible to Moderate	Unlikely	Negligible to moderate	Localized, short-term effects on consumption of country foods.
Air Quality	Effects to air quality from increased vehicle emissions or fuel fires	Enforce speed limits; use well-maintained vehicles to optimize combustion; use low sulphur fuel	Certain	Minor	Certain	Minor	Increase in local ambient air quality concentrations with minor health risks
Drinking Water Quality	Effects to drinking water quality from spills	Use of best management practices to minimize spill entry to the environment; enforced speed limits and traffic safety; adhere to Spill Prevention and Emergency Response Plan; Prompt containment and clean-up	Unlikely	Minor to Moderate	Unlikely	Minor to Moderate	Localized, short-term effects on drinking water; water should be tested before consumption
Noise	Effects from increases in noise	Source mitigation: Enforce speed limits; avoid use of engine brakes and reversing in residential areas; vehicle maintenance	Certain	Minor	Certain	Moderate	Localized increase in percentage of highly annoyed receptors, particularly on the northern segment of Highway 37
Human Safety	Effects to human safety from increases in traffic accidents	Enforce speed limits and other traffic rules; company zero-tolerance policy on alcohol; adhere to accident first aid, emergency response and other procedures; vehicle maintenance	Possible	Minor to Catastrophic	Possible	Minor to Catastrophic	Accidents are rare, but may affect human health to a large degree, including death

8.12.3.3 *Cumulative Risk Characterization*

Even though other projects are assumed to be adopting similar noise mitigation measures to the KSM Project, predicted noise levels considering cumulative traffic increases approach the guideline limit of 55 dB along the north segment of Highway 37, and may have increased potential for disturbance (BKL 2013, Appendix E). As a result the cumulative risk to human health effects from increased noise remains certain, and severity is adjusted to moderate (Table 8.12-2).

8.12.4 **Cumulative Risk Analysis for Air Quality**

8.12.4.1 *Cumulative Risk Identification*

Given baseline levels of CACs and the level of expected traffic increase, CACs' contribution to ambient air quality is expected to remain well below BC air quality objectives and standards. Background concentrations of CACs were approximately ten times below the maximum desirable concentrations for all CACs. The annual average background concentration of SO₂ was estimated at 2.0 µg/m³, while the *2009 Air Quality Objectives and Standards for British Columbia* state the desirable maximum annual arithmetic mean for SO₂ is 30 µg/m³ (Government of BC 2009b). Background annual average concentration of NO₂ was estimated at 5.0 µg/m³, while BC air quality objectives state that 60.0 µg/m³ is the desirable maximum annual arithmetic mean. While the likelihood of emissions from traffic during Project operation is certain, the severity of the effect is considered to be minor.

Even with cumulative increases in traffic from other projects (222% higher than baseline estimates on the northern segment of Highway 37; 102% higher than baseline estimates along Highway 37A; and 40.4% higher than baseline estimates along the southern segment of Highway 37), the contribution of additional CACs is still far below BC air quality objectives and standards (Government of BC 2009b, see Section 5.7.3).

8.12.4.2 *Cumulative Risk Mitigation*

Cumulative effects mitigations for air quality are the same as those proposed in Section 5.8.3. Risks to human health from increases in air emissions from normal traffic will be minimized by enforcing speed limits and operating well-maintained vehicles powered by low sulphur fuel to optimize combustion. Further mitigation measures can be found in Section 5.7.

In the event of traffic accidents, emergency response procedures to prevent fires or minimize fire duration and extent will be initiated promptly. Responsible personnel will be trained in spill response procedures to contain the spill, thereby minimizing vaporization or evolution of concentrate dust. Personnel will also be trained in safety and personal protection procedures to avoid contact with spilled material. Potentially affected residents will be informed of a spill, and access to the spill site will be restricted in consultation with regulators. These actions will largely eliminate health risks from inhaling dust, vapours or combustion fumes.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.12.4.3 *Cumulative Risk Characterization*

Assuming other projects will be adopting similar mitigation measures, the likelihood of human health impacts due to changes in air quality will still be certain but minor in severity (Table 8.12-2).

8.12.5 Cumulative Risk Analysis for Drinking Water Quality

8.12.5.1 Cumulative Risk Identification

As stated in Section 5.8.3, human health effects from the ingestion of contaminated drinking water are unlikely. This assessment is based on the low number of historic and predicted traffic accidents (as described in Chapter 2) and the commitment to BMPs in spill management planning. Cumulative increases in traffic would only increase the risk if other projects did not have similar mitigation measures in place.

8.12.5.2 Cumulative Risk Mitigation

Cumulative effects mitigations for drinking water quality are the same as those proposed in Section 5.8.3. BMPs will be used to minimize spill contact with waterbodies or the terrestrial environment. This will include regular truck inspections, a scheduled maintenance program, and operation of trucks that meet or exceed Transport Canada's minimum requirements (Transport Canada n.d.). Drivers and personnel will receive training and industry-related education and conduct monthly safety meetings in order to handle challenges effectively. Drivers will be TDG, WHMIS and CPPI-certified as required. Speed limits and traffic safety rules will be enforced. Communication devices (VHF radio, satellite phone) and emergency contacts will be readily accessible to drivers. The Spill Prevention and Emergency Response Plan will be developed and implemented to limit effects on drinking water and human health. Water quality will be monitored in the event that a spill enters the aquatic environment.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.12.5.3 Cumulative Risk Characterization

Assuming other projects will be adopting similar mitigation measures, the likelihood of human health impacts due to changes in drinking water quality will still be unlikely and minor to moderate in severity depending on the type and extent of the spill (Table 8.12-2).

8.12.6 Cumulative Risk Analysis for Human Safety

8.12.6.1 Cumulative Risk Identification

A minor increase in traffic accidents (maximum 0.191 collisions per year along the north segment of Highway 37 during operation) is anticipated as a result of KSM Project activities. As shown in Section 8.3, even with cumulative project traffic, a maximum increase of only 0.959 collisions per year (along the north segment of Highway 37) is predicted.

8.12.6.2 Cumulative Risk Mitigation

Cumulative effects mitigations for human safety are the same as those proposed in Section 5.8.3. Speed limits and other traffic rules will be strictly enforced. All contractors and workers are required to adhere to the BC Occupational Health and Safety Regulation (BC Reg 296/97), as well as a zero-tolerance policy on alcohol and drugs. Procedures for emergency response and occupational first aid will be developed, and workers and contractors will undergo required training. Information on weather and highway conditions as well as communication devices (VHF radio, satellite telephone) will be made available to all drivers before departure.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.12.6.3 Cumulative Risk Characterization

Assuming other projects will be adopting similar mitigation measures, the likelihood of human health risks due to an increase in traffic accidents will still be possible and, depending on the type and conditions of the accident, highly variable in severity (Table 8.12-2).

8.13 CUMULATIVE RISK OF TRAFFIC ON HERITAGE

All of the projects identified in the cumulative issue scoping exercise (Section 8.1 and 8.2) are expected to contribute to increased traffic volumes along highways 37 and 37A; if all projects scoped in the assessment are approved and become operational, historic traffic peaks may be exceeded on the southern segment of Highway 37. Therefore, the potential for cumulative interaction with effects from project traffic and accidents on heritage has been identified (Table 8.13-1).

Table 8.13-1. Potential Cumulative Interaction Matrix: Heritage

Description of KSM Project-related Risk	Potential for Cumulative Interaction with Traffic from Other Projects
Damage to archaeological or heritage sites due to spills of hazardous cargo	X
Damage to archaeological or heritage sites due to increased incidence of wildfires	X

"X" indicates that a potential interaction has been identified.

"-" indicates that no potential interaction was identified.

8.13.1 Cumulative Issues Scoping for Heritage

The potential risks to archaeological or heritage sites from hazardous cargo spills or wildfires as a result of KSM Project-related traffic accidents were risks identified (see Table 5.9-2). Since these risks were not considered to be fully mitigated (see Table 5.9-6), the risk to archaeological or heritage sites from hazardous cargo spills or wildfires has the potential for cumulative interaction, since all traffic from other projects will be using highways 37 and/or 37A to varying degrees.

8.13.2 Cumulative Risks Analysis for Archaeological and Heritage Sites

8.13.2.1 Cumulative Risk Identification

Risk of Hazardous Cargo Spills

As stated in Section 5.9.3, the incremental risk of chemical contamination of soils at archaeological or heritage sites as a result of an accident is characterized as rare with mitigation measures in place. Cumulative increases in traffic would only increase the risk of chemical contamination of heritage VCs if these projects did not have similar mitigation measures in place.

Risk of Wildfires

As discussed in Section 5.9.3, the low baseline level of fire incidence in this area of BC makes the probability of a wildfire due to increased traffic rare.

8.13.2.2 Cumulative Risk Mitigation

Risk of Hazardous Cargo Spills

Cumulative effects mitigations for hazardous cargo spills are the same as those proposed in Section 5.9.3. Preventing the introduction of hazardous substances into the environment is the most

effective way to avoid effects to heritage VCs. Specific preventative measures that may be implemented include conducting a vehicle assessment (for oil leaks, secure cargo, etc.) and checking road conditions prior to departure, maintaining an appropriate driving distance between vehicles, adhering to speed limits, and adjusting driving styles to suit road conditions.

In the event of a spill, the guidelines and procedures outlined in the Spill Prevention and Emergency Response Plan will be followed in order to avoid contamination and degradation of archaeological sites.

Risk of Wildfires

Cumulative effects mitigations for wildfires are the same as those proposed in Section 5.9.3. Preventing an increase in wildfire incidence will involve reducing the risk of vehicle accidents and enacting strong policies requiring the proper disposal of smoking materials. Reduction of vehicle accidents will be accomplished with policies that address vehicle maintenance, speed limits, driver attention, drug and alcohol prohibition and driving under poor weather conditions.

It is anticipated that other projects will adopt similar mitigation strategies as the KSM Project.

8.13.2.3 Cumulative Risk Characterization

Risk of Hazardous Cargo Spills

Assuming other projects will be adopting similar mitigation measures, the likelihood of chemical contamination of heritage VCs from hazardous cargo spills will still be rare and negligible in severity, considering that most archaeological or heritage sites are more than 50 m from the highway (see Table 8.13-2).

Risk of Wildfires

As the same kind of mitigation is expected to be used by all projects, the cumulative effect of wildfires should remain rare and highly variable in severity, depending on local climate conditions, time of wildfire ignition, and resources available to respond (see Table 8.13-2).

Table 8.13-2. Assessment Matrix for Cumulative Risks: Heritage

Valued Component	Description of Potential Risk (pre-mitigation)	Description of Mitigation Measures	Post-mitigation				
			Likelihood	Severity	Likelihood Adjusted for CRA	Severity Adjusted for CRA	Description of Consequence of Realized Cumulative Risk
Archaeological and Heritage Sites	Chemical contamination of sites due to hazardous cargo spills	Conducting a vehicle assessment; checking road conditions prior to departure; maintain appropriate driving distance between vehicles; adhering to speed limits; adjusting driving styles to suit road conditions; and adhering to the Spill Prevention and Emergency Response Plan	Rare	Negligible	Rare	Negligible	The circumstances of the spill will determine the extent of potential contamination of subsurface components of the site
	Increased incidence and severity of wildfires due to flammable material spills	Policy requiring the proper disposal of smoking materials; and fire watch and reporting program	Rare	Moderate	Rare	Moderate	Depends on the duration and severity of the wildfire; can range from minor disturbance of the site to removal of surficial features if present and contamination of subsurface components

9. Summary

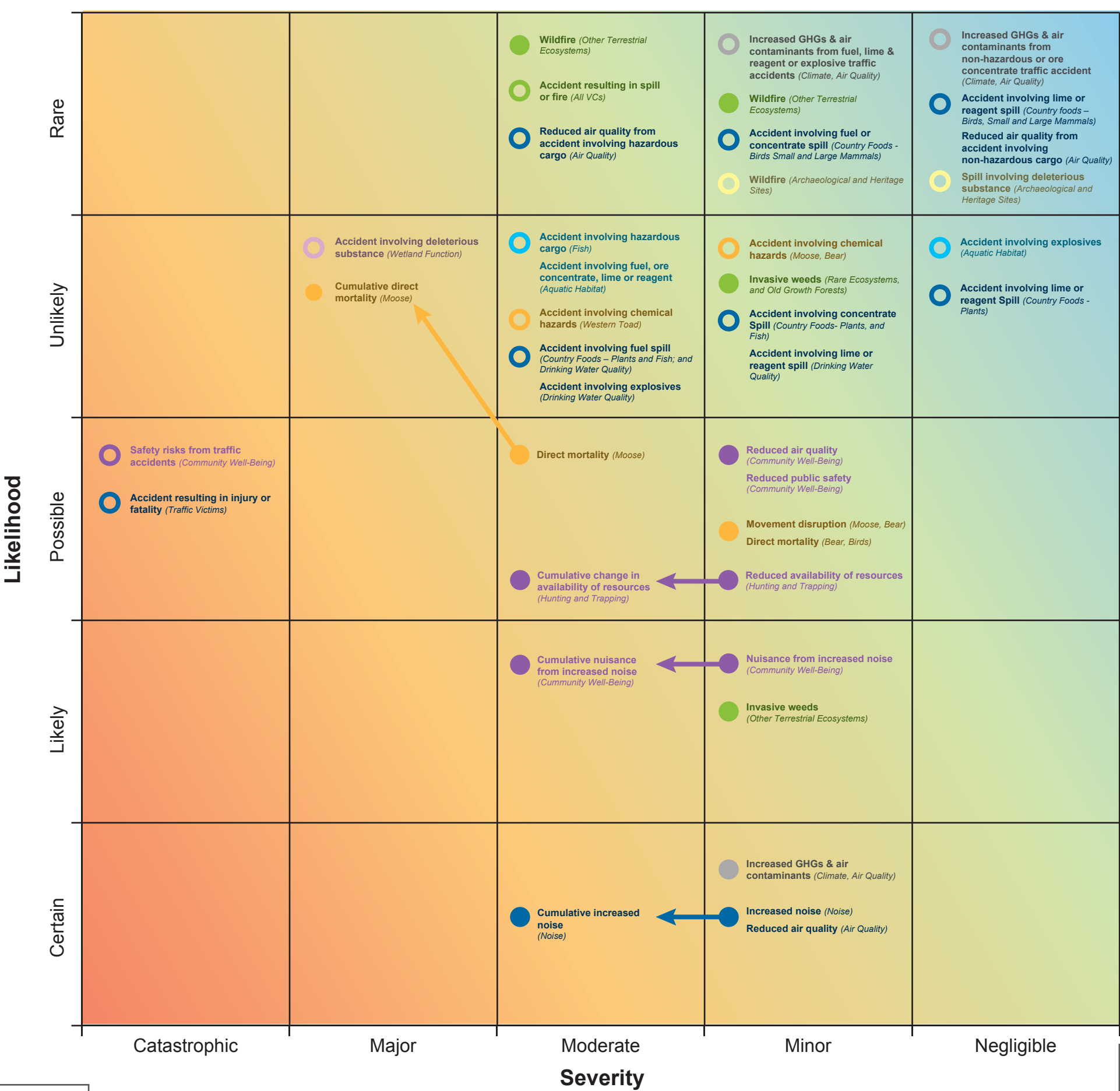
As described in Chapter 5, the potential effects of KSM Project-related traffic on highways 37 and 37A were assessed by considering normal Project traffic and traffic accidents. The potential risk of traffic accidents was also assessed, as described in Section 6. A summary of proposed mitigation and environmental management measures to avoid or mitigate effects from KSM Project traffic is provided in Section 7.

In general, most potential effects identified in this assessment are characterized as being of minor or negligible severity (see Figure 9-1).

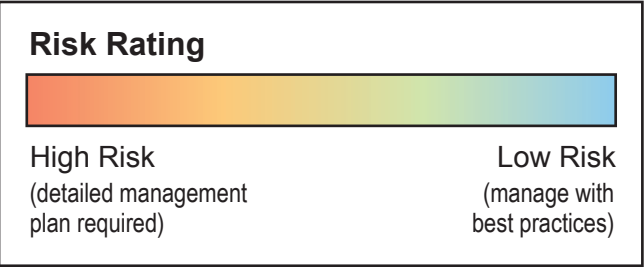
The KSM Project-specific traffic assessment concludes there will primarily be minor to negligible effects on wildlife, terrestrial ecosystems, and climate VCs. Some minor effects to human health and socio-economic VCs may also occur. There are two moderately severe effects to Terrestrial Ecosystem VCs (the risk of increased wildfire incidence on rare and sensitive ecosystems and old growth forests), which are characterized as rare; and one moderately severe effect to Wildlife (the risk of moose mortality), which has a likelihood of possible.

In the event of traffic accidents, most potential risks to VCs are characterized as unlikely or rare occurrences. The two potential risks characterized as possible and catastrophic (represented by the two hollow circles on the left side of Figure 9-1) both refer to the potential for a collision resulting in severe human injury or fatality. While the collision model described in Chapter 3 does not predict any significant increase to collisions as a result of Project traffic on the highways, the serious consequence of such a collision is reflected in this risk rating. The Proponent's proposed Traffic and Access Management and Emergency Response plans described in Sections 7.3 and 7.4 are designed to prevent KSM Project-related traffic accidents from occurring, and to promptly take appropriate measures in the unlikely event that an accident occurs.

The cumulative traffic assessment conducted concludes that effects will remain primarily minor to negligible for traffic effects on wildlife, terrestrial ecosystems, and climate VCs. Effects of increases noise on human health and social VCs that were rated as minor in the KSM Project-specific analysis were adjusted to moderate as a result of other predicted traffic from other projects. Additionally, effects relating to moose mortality were adjusted to major, but unlikely, and the reduced availability of resources for hunting and trapping was adjusted to moderate severity as a result of the potential increased pressure on moose populations along highways 37 and 37A from moose-vehicle collisions involving both KSM and other project traffic (see Figure 9-1).



Project Traffic	Traffic Accidents	Topic
		Socio-economics and Land Use
		Fish and Aquatic Habitat
		Wildlife
		Terrestrial Ecosystems
		Wetlands
		Climate and Air Quality
		Human Health
		Heritage
		Adjusted Risk Rating for Cumulative Effects



References

Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

1992. *Transportation of Dangerous Goods Act*, SC. C. 34.

1994. *Migratory Birds Convention Act*, SC. C. 22.

1996. *Wildlife Act*, RSBC. C. 488.

1999. *Canadian Environmental Protection Act*, SC. C. 33.

British Columbia Occupational Health and Safety Regulation, BC Reg 296/97.

Hazardous Waste Regulation, BC Reg. 63/2009.

AANDC. 2010. *First Nation and Inuit Community Well-being: Describing Historical Trends (1981-2006)*. Aboriginal Affairs and Northern Development Canada. <http://www.aadnc-aandc.gc.ca/eng/1100100016600> (accessed May 2012).

AANDC. 2011. *2006 Community Well-being Database*. Aboriginal Affairs and Northern Development Canada. <http://www.aadnc-aandc.gc.ca/eng/1298468006542> (accessed May 2012).

AANDC. 2012a. *First Nation Profile: Gitanyow*. Aboriginal Affairs and Northern Development Canada. http://pse5-esd5.aainc-inac.gc.ca/fnp/Main/Search/FNRegPopulation.aspx?BAND_NUMBER=537&lang=eng (accessed July 2012).

AANDC. 2012b. *First Nation Profile: Gitwangak*. Aboriginal Affairs and Northern Development Canada. http://pse5-esd5.aainc-inac.gc.ca/fnp/Main/Search/FNMain.aspx?BAND_NUMBER=536&lang=eng (accessed May 2012).

Alkindi, A. Y. A., J. A. Brown, C. P. Waring, and J. E. Collins. 1996. Endocrine, osmoregulatory, respiratory and haematological parameters in flounder exposed to the water soluble fraction of crude oil. *Journal of Fish Biology*, 49: 1291-305.

AMEC. 2012. *Kitsault Mine Project Environmental Assessment*. Prepared for Avanti Mining Inc. by AMEC. http://a100.gov.bc.ca/appsdata/epic/documents/p356/d34296/1335994161033_c972ed43a4f0a29ee25796d6b050c5ba9d0f1f3a2c79eb6501fa247c9b6b170a.pdf (accessed January 2013).

Armleder, H. M., R. J. Dawson, and R. Thomson. 1986. *Handbook for timber and mule deer management co-ordination on winter ranges in the Cariboo Forest Region*. Land Management Handbook No. 13. British Columbia Ministry of Forests: Victoria, BC.

Arthur, J. W., C. W. West, K. N. Allen, and S. F. Hedtke. 1987. Seasonal toxicity of ammonia to five fish and nine invertebrate species. *Bulletin of Environmental Contamination and Toxicology*, 38 (2): 324-31.

Banfield, A. W. F. 1981. *The Mammals of Canada*. Toronto, ON: University of Toronto Press.

Banner, A., W. MacKenzie, S. Haeussler, S. Thompson, J. Pojar, and R. Trowbridge. 1993. *A field guide to site identification and interpretation for the Prince Rupert Forest Region*. Land Management Handbook No. 26. BC Ministry of Forests, Research Branch: Victoria, BC.

- Bartelt, P. E. and C. R. Peterson. 1994. *Riparian habitat utilization by western toads (Bufo boreas) and spotted frogs (Rana pretiosa) on the Targee National Forest*. Contract #INT-93780-CCSA Final Report. USDA Forest Service: n.p.
- BC Air Smart. 2010. *Commercial Vehicle Safety and Enforcement. Diesel Retrofit- Frequently Asked Questions*. http://www.th.gov.bc.ca/cvse/diesel_retrofit/faq.htm (accessed January 2013).
- BC EAO. 2005. *Red Chris Mine Review: Summary of Red Chris Development Company (RDCD) Commitments*. Red Chris Development Company (RDCD) http://a100.gov.bc.ca/appsdata/epic/documents/p238/1274210615261_c190ee3799f7ec4693da8203b4055089116465886b53103c69231cd83c631bee.pdf (accessed January 2013).
- BC Forest Service Protection Branch. 2008. *Wildfire history*. <http://www.bcwildfire.ca> (accessed December 2011).
- BC Government. 2008. *Climate Action Plan*. http://www.livesmartbc.ca/attachments/climateaction_plan_web.pdf (accessed August 2012).
- BC ILMB. 2000a. *Cassiar Iskut-Stikine Land and Resource Management Plan*. British Columbia Integrated Land Management Bureau. <http://ilmbwww.gov.bc.ca/slrp/lrmp/smithers/cassiar/index.html> (accessed January 2013).
- BC ILMB. 2000b. *Cassiar Iskut-Stikine Land and Resource Management Plan*. <http://www.ilmb.gov.bc.ca/slrp/lrmp/smithers/cassiar/index.html> (accessed September 2009).
- BC ILMB. 2004. *Dease-Liard sustainable resource management plan*. British Columbia Integrated Land Management Bureau. <http://ilmbwww.gov.bc.ca/slrp/srmp/north/dease-liard/index.html> (accessed January 2013).
- BC MEMPR. 2008. *Health, Safety and Reclamation Code for Mines in British Columbia*. <http://www.empr.gov.bc.ca/Mining/HealthandSafety/Documents/HSRC2008.pdf> (accessed December 2012).
- BC MEMPR. 2012. *British Columbia- Mines and Mineral Exploration Overview 2011*. http://www.empr.gov.bc.ca/Mining/Geoscience/PublicationsCatalogue/MineralExplorationReview/Documents/EX-OVERVIEW_IC2012-1.pdf (accessed June 2012).
- BC MFLNRO. 2012a. *Cranberry Sustainable Resource Management Plan*. British Columbia Ministry of Sustainable Resource Management. http://www.ilmb.gov.bc.ca/slrp/srmp/north/cranberry/docs/Cranberry_SRMP.docx (accessed July 2012).
- BC MFLNRO. 2012b. *Nass South Sustainable Resource Management Plan*. http://www.ilmb.gov.bc.ca/slrp/srmp/south/nass/docs/Nass_South_SRMP_final.docx (accessed July 2012).
- BC MFML. 2010a. *Forest Regions and Districts - Kalum District*. <http://www.for.gov.bc.ca/mof/maps/regdis/ndkm.htm> (accessed November 2010).
- BC MFML. 2010b. *Historic Forest Harvest 1995 - 2009*. British Columbia Ministry of Forests Mines and Lands: n.p.
- BC MOE. 2006. *British Columbia approved water quality guidelines. 2006 Edition*. British Columbia Ministry of Environment, Environmental Protection Division.: Victoria, BC.
- BC MOE. 2007. *Air Quality*. British Columbia Ministry of Environment: Victoria, BC.
- BC MOE. 2008. *British Columbia Air Dispersion Modelling Guidelines*. British Columbia Ministry of Environment: Victoria, BC.

- BC MOE. 2009. *Habitat Wizard*. BC Ministry of Environment, Ecosystems Branch.
<http://webmaps.gov.bc.ca/imfx/imf.jsp?session=954648956850> (accessed January 2012).
- BC MOE. 2012. *BC Water Resources Atlas*.
http://www.env.gov.bc.ca/wsd/data_searches/wrbc/index.html (accessed January 2012).
- BC MOFR. 2008. *Wildfire history*. Forest Service Protection Branch, British Columbia Ministry of Forests and Range. <http://www.bcwildfire.ca> (accessed December 2011).
- BC MOFR. 2010a. *Invasive Alien Plant Program Reference Guide*. British Columbia Ministry of Forests and Range, Range Branch: Victoria, BC.
- BC MOFR. 2010b. *Ministry of Forest and Range 2010/11 - 2012/13 Service Plan*. British Columbia Ministry of Forests and Range: n.p.
- BC MOTI. 2006. *Satellite-Based Provincial Truck Travel Speed Analysis*.
http://www.th.gov.bc.ca/publications/planning/Provincial%20Highways/Truck_Travel_Time_Study.pdf (accessed January 2012).
- BC MOTI. 2009. *Collision Prediction Models and Collision Modification Factors for British Columbia*. Technical Circular T-04/09 from Joy Sengupta, Senior Highway Safety Engineer, Engineering Branch, British Columbia Ministry of Transportation and Infrastructure.
http://www.th.gov.bc.ca/publications/Circulars/Current/T_Circ/2009/t04-09.pdf (accessed January 2012).
- BC MOTI. 2010. *Increased Weight Limits for Trucks Creates Local Jobs*. BC MOTI press release. April 23, 2010. http://www2.news.gov.bc.ca/news_releases_2009-2013/2010TRAN0015-000463.htm (accessed June 2012).
- BC MOTI. 2011a. British Columbia Ministry of Transportation and Infrastructure Wildlife Accident Reporting System. *Received from Leonard Sielecki on December 5, 2011*:
- BC MOTI. 2011b. *Highway 37 North: Route information*. http://www.th.gov.bc.ca/popular-topics/driver_info/route-info/hwy37/hwy37.htm (accessed December 2011).
- BC MOTI. 2011c. *Highway Travellers Route Information: Highway 37 North*.
http://www.th.gov.bc.ca/popular-topics/driver_info/route-info/hwy37/hwy37.htm (accessed December 2011).
- BC MOTI. 2011d. *Ministry of Transportation and Infrastructure: Traffic Data Program*.
<http://www.th.gov.bc.ca/trafficData/index.asp> (accessed December 2012).
- BC MOTI. 2011e. *Traffic Data Program*. <http://www.th.gov.bc.ca/trafficData/index.asp> (accessed December 2011).
- BC Motor Vehicle Branch. 2007. *Traffic Collision Statistics, Police-attended Injury and Fatal Collisions*.
<http://www.icbc.com/road-safety/safety-research/traffic-coll-stats-2007.pdf> (accessed January 2013).
- Bell 2 Lodge. 2012. *Welcome to Bell 2 Lodge*. <http://bell2lodge.com/> (accessed January 2012).
- Bennett, A. F. 2003. *Linkages in the landscape: The role of corridors and connectivity in wildlife conservation*. Gland, Switzerland and Cambridge, UK.
- BKL. 2013. *Updated Highway 37 traffic noise predictions for KSM project at nearby residences including cumulative effects from nearby projects*. BKL Consultants in Acoustics: Vancouver, BC.

- Blood, D. A. 2000. *Moose in British Columbia: Ecology, conservation and management*. BC Ministry of Environment, Lands and Parks: n.p.
- Bocking, R. C. and D. Peacock. 2004. *Habitat-based production goals for coho salmon in Fisheries and Oceans Statistical Area 3*. Canadian Science Advisory Secretariat 2004/129. Fisheries and Oceans Canada: n.p.
- Bowyer, R. T., V. V. Ballenberghe, and J. G. Kie. 2003. Moose. In *Wild mammal of North America: Biology, management and conservation*. 931-64. Baltimore, ML: Johns Hopkins University Press.
- Brandrud, T. E. 2002. Effects of liming on aquatic macrophytes, with emphasis on Scandinavia. *Aquatic Botany*, 73 (4): 395-404.
- Camargo, J. A. and A. Alonso. 2006. Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment. *Environment International*, 32: 831-49.
- Camargo, J. A., A. Alonso, and A. Salamanca. 2005. Nitrate toxicity to aquatic animals: a review with new data for freshwater invertebrates. *Chemosphere*, 58 (9): 1255-67.
- Campbell, R. W., N. K. Dawe, I. McTaggart-Cowan, J. M. Cooper, G. W. Kaiser, M. C. E. McNall, and G. E. J. Smith. 1997. *The Birds of British Columbia. Volume III Passerines: Flycatchers through Vireos*. Vancouver, BC: UBC Press.
- Canadian Food Inspection Agency. 2008. Invasive Alien Plants In Canada- Summary Report.
- CCME. n.d. *CCME Publications/Guidelines*. http://www.ccme.ca/publications/list_publications.html#link2 (accessed October 2012).
- CEA Agency. 2003. *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practicioners*. Canadian Environmental Assessment Agency. <http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=A41F45C5-1> (accessed July 2012).
- Cirrus. 1998. *Diavik Diamond Project - Environmental Effects Report, Climate and Air Quality*. Report prepared for Diavik Diamond Mines Inc. By Cirrus Consultants: Yellowknife, NT.
- City of Terrace. 2002. *Terrace official community plan: An update*. City of Terrace: Terrace, BC.
- Clark, J. 2003. *Invasive plant prevention guidelines*. Centre for Invasive Plant Management: Bozeman, MT.
- Clevenger, A. P., B. Chruszcz, and J. R. Gunson. 2003. Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. *Biological Conservation*, 109 (1): 15-26.
- Clobert, J., E. Danchin, A. A. Dhondt, and J. D. Nichols. 2001. *Dispersal*. New York, NY: Oxford University Press.
- CMHC. 1986. *Road and Rail Noise: Effects on Housing*. Canada Mortgage and Housing Corporation: Ottawa, ON.
- COSEWIC. 2003. *Wildlife Species Search- Wolverine*. http://www.cosewic.gc.ca/eng/sct1/searchdetail_e.cfm?id=172&StartRow=1&boxStatus=All&boxTaxonomic=All&location=All&change=All&board=All&commonName=wolverine&scienceName=&returnFlag=0&Page=1 (accessed January 2013).
- Costa, Silvana, and M. Scoble. 2006. *Mine Accommodation Strategies - Case Studies in Developing Countries*. <http://graduate.mining.ubc.ca/files/Costa.pdf> (accessed January 2013).
- Demarchi. 2011. *A Stratified Random Block Survey of Moose in the Nass River Watershed*. Prepared for the Nisga'a Lisims Government: Smithers, BC.

- Demarchi, M. W. 2000. *Moose in the Nass Wildlife Area*. British Columbia Ministry of Environment Lands and Parks: Smithers, BC.
- Demarchi, M. W. 2003. Migratory patterns and home range size of moose in the central Nass Valley, British Columbia. *Northwest Naturalist*, 84: 135-41.
- Demarchi, M. W. 2011. *A Stratified Random Block Survey of Moose in the Nass River Watershed*. Prepared by LGL for the Nisga'a Lisims Government: Smithers, BC.
- Demarchi, M. W. and S. R. Johnson. 2000. *Grizzly bears in the Nass Wildlife Area*. Unpublished report to Forest Renewal BC and British Columbia Ministry of Environment, Lands and Parks: Smithers, BC.
- DFO. 1993. *Land Development Guidelines for the Protection of Aquatic Habitat*. Department of Fisheries and Oceans: n.p.
- DFO. 2004. *Pacific Wild Salmon Fishery, Nass River Sockeye*. Pacific Region. Department of Fisheries and Oceans: n.p.
- DFO. 2010. *DFO Pacific Region Operational Statements*. <http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/index-eng.htm> (accessed October 2012).
- Eisler, R. 1989. *Molybdenum Hazards to Fish, Wildlife and Invertebrates: A Synoptic Review*. Biological Report 85. U.S. Fish and Wildlife Service: n.p.
- Eisler, R. 1998. *Copper Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review*. Biological Science Report 1998-0002. U.S. Geological Survey, Biological Resources Division: n.p.
- Eisler, R., D. R. J. Clark, S. N. Wiemeyer, and C. J. Henny. 1999. Sodium Cyanide Hazards to Fish and Other Wildlife from Gold Mining Operations. In *Environmental Impacts of Mining Activities: Emphasis on Mitigation and Remedial Measures*. Ed. J. M. Azcue. 55-67. Berlin: Springer-Verlag.
- Environment Canada. 2010. *The Canadian Air and Precipitation Monitoring Network (CAPMoN)*. <http://www.ec.gc.ca/rs-mn/default.asp?lang=En&n=752CE271-1> (accessed January 2013).
- Environment Canada. n.d. *Environmental Code of Practice for Metal Mines*. <http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=CBE3CD59-1&offset=1&toc=show> (accessed December 2012).
- Evans, D. H. 1987. The fish gill: site of action and model for toxic effects of environmental pollutants. *Environmental Health Perspectives*, 71: 41-58.
- Fahrig, L. and T. Rytwinski. 2009. Effects of Roads on Animal Abundance: an Empirical Review and Synthesis. *Ecology and Society*, 14 (1):
- FHWA. 1995. *Highway Traffic Noise Analysis and Abatement Policy and Guidance*. U.S. Department of Transportation, Federal Highway Administration: Washington, DC.
- Forsynth, B., A. Cameron, and S. Miller. 1995. *Explosives and water quality*. Sudbury '95 Mining and the Environment. Montreal, Quebec, Canada: Mine Environment Neutral Drainage.
- Frankham, R., J. D. Ballou, and D. A. Briscoe. 2002. *Introduction to conservation genetics*. Cambridge, UK: Cambridge University Press.
- Fryday, S. N. L., D. M. Andrew, A. D. M. Hart, and S. D. Langton. 1996. Effects of exposure to an organophosphate pesticide on the behaviour and use of cover by captive starlings. *Environmental Toxicology and Chemistry*, 15: 1590-96.
- Futuyma, D. J. 1979. *Evolutionary biology*. Sinauer Associates, Inc: Sunderland, MA.

- Gitanyow Hereditary Chiefs. 2006. *Building a New Relationship: Recognition, Reconciliation, Respect & the Gitanyow Huwilp*. Presented at BC's Northern Interior Forests: Planning for Sustainability in a Dynamic Landscape, Prince George, BC.
- Gottesfeld, A. S., K. A. Rabnett, and P. E. Hall. 2002. *Conserving Skeena Fish Populations and their Habitat*. Skeena Fisheries Commission: Hazelton, BC.
- Government of BC. 2009a. *Air Quality Objectives and Standards*. <http://www.bcairquality.ca/reports/pdfs/aqotable.pdf> (accessed January 2012).
- Government of BC. 2009b. *BC Air Quality Objectives and Standards*. <http://www.bcairquality.ca/reports/pdfs/aqotable.pdf> (accessed January 2012).
- Government of Canada. 2010. *Species at Risk Public Registry*. Environment Canada. www.sararegistry.gc.ca (accessed May 2010).
- Gyug, L., T. Hamilton, and M. Austin. 2004. *Grizzly bear Ursus arctos. Accounts and measures for managing identified wildlife. Southern Interior Forest Region*. British Columbia Ministry of Water, Lands and Air Protection: Victoria, BC.
- Haddad, N. M., D. R. Bowne, A. Cunningham, B. J. Danielson, D. J. Levey, S. Sargent, and T. Spira. 2003. Corridor use by diverse taxa. *Ecology*, 84 (3): 609-15.
- Hamilton, A. N. 1987. Classification of coastal grizzly bear habitat for forestry interpretations and the role of food in habitat use by coastal grizzly bears. M.Sc. diss., University of British Columbia.
- Health Canada. 1991. *Cyanide*. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/water-eau/cyanide-cyanure/cyanide-cyanure-eng.pdf (accessed January 2013).
- Health Canada. 2011. *Draft: Guidance for evaluating human health impacts in environmental assessment: Noise*. Environmental Health Bureau, Healthy Environments and Consumer Safety Branch, Health Canada: Ottawa, ON.
- Hesse, G. R., R. V. Rea, N. Klassen, S. Emmons, and D. L. Dickson. 2010. Evaluating the potential of the Otto® Wildlife GPS device to record roadside moose and deer locations for use in wildlife vehicle collision mitigation planning. *Wildlife Biology in Practice*, (6): 1-13.
- Holmes, W. G. 1984. *The Ecological Basis of Monogamy in Alaskan Hoary Marmots*. J. O. Murie and G. R. Michener, Eds. *The Biology of Ground-Dwelling Squirrels: Annual Cycles, Behavioral Ecology and Sociality: Symposium on Sociality in Ground Squirrels, Prairie-Dogs, and Marmots Banff, AB*: University of Nebraska Press, Lincoln, Nebraska.
- Horne, G. 2009. *British Columbia Local Area Economic Dependencies: 2006*. BC Stats, Government of British Columbia: n.p.
- Hultbert, H. and I. B. Andersson. 1982. Liming of acidified lakes: induced long-term changes. *Water, Air and Soil Pollution*, 18: 331-31.
- IARC. 1998. *Diesel and Gasoline Engine Exhausts and Some Nitroarenes- Summary of Data Reported and Evaluation*. Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 46. World Health Organization, International Agency for Research on Cancer: Geneva, Switzerland.
- ICBC. 2011a. *Corridor Crashes for Hwy 37 from Bob Quinn Camp to Hwy 16*. Insurance Corporation of British Columbia: North Vancouver, BC.
- ICBC. 2011b. *Corridor Crashes for Hwy 37A from Stewart to Meziadin Lake Junction, Meziadin*. Insurance Corporation of British Columbia: North Vancouver, BC.
- ICMI. n.d. *International Cyanide Management Code*. <http://www.cyanidecode.org/about-code/cyanide-code> (accessed December 2012).

- Imperial Metals Corp. 2012. *Huckleberry Mine*.
<http://www.imperialmetals.com/s/HuckleberryMine.asp> (accessed June 2012).
- IPCC. 2007. *Climate Change 2007: The Physical Science Basis*. Cambridge University Press: Cambridge, UK.
- IUCN. 2010. *The IUCN Red List of Threatened Species Version 2010.1*. www.iucnredlist.org (accessed April 2010).
- Jalkotzy, M. G., P. I. Ross, and M. D. Nasserden. 1997. *The Effects of Linear Developments on Wildlife: A Review of Selected Scientific Literature*. Prepared by the Canadian Association of Petroleum Producers for the Arc Wildlife Services Ltd.: Calgary, AB.
- Koski, W. R., M. R. Link, and K. K. English. 1996. *Distribution, timing, fate and numbers of Chinook salmon returning to the Nass River watershed in 1992*. Canadian Technical Report of Fisheries and Aquatic Sciences 2129. Department of Fisheries and Oceans: n.p.
- Kusel, J. 1996. *Well-Being in Forest-Dependent Communities, Part I: A New Approach. Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessments and scientific basis for management options (Vol. II, pp. 361-374)*. University of California, Centers for Water and Wildland Resources: Davis, CA.
- Lande, R. 1988. Genetics and demography in biological conservation. *Science*, 241: 1455-60.
- Lesbarrères, D., T. Lodé, and J. Merilä. 2004. What type of amphibian tunnel could reduce road kills? *Oryx*, 38 (2): 220-23.
- Levit, S. M. 2010. *A literature review of effects of ammonia on fish*. The Nature Conservancy: n.p.
- Little, E. E. and A. J. DeLonay. 1996. Measures of fish behaviour as indicators of sublethal toxicosis during standard toxicity tests. In *Environmental toxicology and risk assessment*. Eds. T. W. L. Point, F. T. Price, and E. E. Little. 4th Vol. West Conshohocken, PA: American Society for Testing and Materials.
- Liu, L. 2004. *Human Health Effects of Fine Particulate Matter: Update in Support of the Canada-wide Standards for Particulate Matter and Ozone*. Working Paper Prepared for the Canadian Council of Ministers of the Environment. Health Canada: Ottawa, ON.
- Lordi, D. T., C. Lue-Hing, S. W. Whitebloom, N. Kelada, and S. Dennison. 1980. Cyanide Problems in Municipal Wastewater Treatment Plants. *Water Pollution Control Federation*, 52 (3): 597-609.
- Lytle, D. A. and B. L. Peckarsky. 2001. Spatial and temporal impacts of a diesel fuel spill on stream invertebrates. *Freshwater Biology*, 46: 693-704.
- Mahon, T., A. Edie, D. Fillier, L. Malkow, M. Marsland, D. Morgan, D. Reid, G. Schultze, L. Turney, and J. Warren. 2005. *Winter Habitat Suitability Model for Moose in the Kispiox and Cranberry TSAs*. British Columbia Ministry of Water, Air and Land Protection, Skeena Region: Smithers, BC.
- McElhanney. 2007. *Moose Winter Range Identification: North Nass TSA*. Report Prepared for the Ministry of Environment by McElhanney Consulting Ltd.: Vancouver, BC.
- McElhanney. 2008. *Galore Creek bridge overload evaluations for heavy equipment transport*. Prepared for NovaGold Inc. by McElhanney Consulting Ltd.: n.p.
- McKendry, I. G. 2006. *Background Concentrations of PM2.5 and Ozone in British Columbia, Canada*. Prepared for British Columbia Ministry of Environment by the Geography/Atmospheric Science, University of British Columbia: Vancouver, BC.
- Mineau, P. and L. J. Brownlee. 2005. Road salts and birds: an assessment of the risk with particular emphasis on winter finch mortality. *Wildlife Society Bulletin*, 33 (3): 835-41.

- Mitchell, B. 2006. *Kispiox and Cranberry TSA Critical Stream Reach Inventory*. Ministry of Forests and Range: Smithers, BC.
- Müller, S. and G. Berthoud. 1997. *Fauna and traffic safety*. Lavoc, Lausanne, Chapter 1, 19pp.
- Murphy, H. T. and J. Lovett-Doust. 2004. Context and connectivity in plant metapopulations and landscape mosaics: Does the matrix matter? *Oikos*, 105: 3-14.
- NIPC. 2011. *2011 Strategic Plan and Plant Profiles*. Northwest Invasive Plant Council. http://www.nwipc.org/documents/2011_strategicplanandplantprofiles.pdf (accessed January 2013).
- Nisga'a Fisheries. 2010. *2010 Nass River Salmon Escapement Update - Tuesday, 20 July*. Nisga'a Lisims Government, Fish and Wildlife Department: n.p.
- NLG. 2002. *A Land Use Plan for Nisga'a Lands*. Lands Department, Directorate of Lands and Resources, Nisga'a Lisims Government: New Aiyansh, BC.
- NLG. 2009. *Nisga'a Final Agreement- Implementation Report- 2008-2009*. <http://www.nisgaalisims.ca/files/nlg/u3/NLG-AR08-09SinglePages.pdf> (accessed October 2012).
- Nyberg, J. B. and D. W. Janz. 1990. *Deer and elk habitats in coastal forests of southern British Columbia*. Special Report Series 5. British Columbia Ministry of Forests Victoria, BC.
- Omorie, E. and B. C. Ufodike. 2000. Effects of water soluble fractions of crude oil on growth of the Nile tilapia, *Oreochromis niloticus* (L.). *Bull Environ Contam Toxicol*, 64: 601-05.
- Pierce Lefebvre Consulting. 2008. *Nass South Sustainable Resource Management Plan Socio-economic Assessment* Presented to the BC Ministry of Agriculture and Lands by Pierce Lefebvre Consulting: Vancouver, BC.
- Pollard, B. 2007. *Moose winter range identification: North Nass TSA*. Unpublished report for the BC MOE: Smithers, BC.
- Polster, D. F. 2005. The role of invasive plant species management in mined land reclamation. *Canadian Reclamation*, Summer/Fall 2005: 24-32.
- Poole, K. G., A. D. Porter, A. de Vries, C. Maundrell, S. D. Grindal, and C. C. St Clair. 2004. Suitability of a young deciduous-dominated forest for American marten and the effects of forest removal. *Canadian Journal of Zoology*, 82 (3): 423-35.
- Poulton, B. C., S. E. Finger, and S. A. Humphry. 1997. Effects of a crude oil spill on the benthic invertebrate community in the Gasconade River, Missouri. *Archives of Environmental Contamination Toxicology*, 33: 268-76.
- Rea, R. V., E. K. Rapaport, D. P. Hodder, M. V. Hurley, and N. Klassen. 2006. Using Wildlife Vehicle Collision Data, Expert Opinions and GPS Technology to More Accurately Predict and Mitigate Vehicular Collisions with Wildlife in Northern British Columbia. *Wildlife Afield*, (3): 111-16.
- Rescan. 2009. *Northwest Transmission Line Project: Ecosystems and Vegetation Baseline Report*. Prepared for British Columbia Transmission Corporation by Rescan Environmental Services Ltd.: Vancouver, BC.
- Rescan. 2010a. *Application for an Environmental Assessment Certificate*. Prepared for British Columbia Transmission Corporation by Rescan Environmental Services Ltd.: Vancouver, BC.
- Rescan. 2010b. *KSM Project: 2009 Wildlife Habitat Suitability Baseline Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

- Rescan. 2012a. *KSM Project: 2012 Economic Baseline Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.
- Rescan. 2012b. *KSM Project: Nisga'a Business Survey Statistical Report*. Seabridge Gold Inc.: Vancouver, BC.
- Rittenhouse, T. A. G. and R. D. Semlitsch. 2007. Distribution of amphibians in terrestrial habitat surrounding wetlands. *Wetlands*, 27 (1): 153-61.
- Ross, P. I. 2002. *Update COSEWIC status report on the grizzly bear Ursus arctos in Canada*. Committee on the Status of Endangered Wildlife in Canada: Ottawa, ON.
- RTEC. 2006. *Galore Creek Meteorology, Air Quality and Noise Baseline Studies Report*. Prepared for NovaGold Canada Inc. by Rescan Tahltan Environmental Consultants: Dease Lake, BC.
- Sayed, T. and P. de Leur. 2008. *Collision Prediction Models for British Columbia*. Prepared for Engineering Branch, British Columbia Ministry of Transportation and Infrastructure by Tarek Sayed (Professor of Civil Engineering, University of British Columbia and Paul de Leur (Highway Safety Engineer, de Leur Consulting Limited). http://www.th.gov.bc.ca/publications/eng_publications/safety/CPMs_for_BC_2008.pdf (accessed January 2012).
- Seiler, A. 2005. Predicting locations of moose-vehicle collisions in Sweden. *Journal of Applied Ecology*, 42 (2): 371-82.
- Sielecki, L. E. 2004. *WARS 1983 - 2002: wildlife accident reporting and mitigation in British Columbia: special annual report*. British Columbia Ministry of Transportation: Victoria, BC.
- Sielecki, L. E. 2010. *WARS 1988-2007: Wildlife Accident Reporting and Mitigation in British Columbia Special Annual Report*. British Columbia Ministry of Transportation and Infrastructure: n.p.
- Sirgy, M. J., R. N. Widgery, D. J. Lee, and G. B. Yu. 2009. Developing a Measure of Community Well-Being Based on Perceptions of Impact in Various Life Domains. *Social Indicators Research*, 96 (2): 295-311.
- SNDS. 2006. *2006 Labour Market Census*. Skeena Native Development Society. <http://www.snds.bc.ca/lmc06.htm> (accessed June 2010).
- Statistics Canada. 2007. *2006 community profiles*. <http://www12.statcan.ca/english/census06/data/profiles/community/Index.cfm?Lang=E> (accessed April 2008).
- Statistics Canada. 2012. *2011 Census Profiles*. <http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E> (accessed May 24, 2012).
- Struhsaker, J. W. 1977. Effects of benzene (a toxic component of petroleum) on spawning Pacific herring, *Clupea harengus pallasii*. *FB*, 75: 45-50.
- Tatogga Lake Resort. 2012. *Tatogga Lake Resort home page*. <http://www.karo-ent.com/tatogga.htm> (accessed January 2012).
- Teck. 2010. *Highland Valley Copper Concentrate Material Safety Data Sheet*. Teck Metals Ltd.: Vancouver, BC.
- Tobin, C. 2009. Wolverine moves towards production by middle of 2010. *The Claim Post*, 3 (19): <http://www.ycmine.ca/June09.pdf> (accessed December 2010).
- Todd, A. S., D. M. McKnight, C. L. Jaros, and T. M. Marchitto. 2006. Effects of acid rock drainage on stocked rainbow trout (*Oncorhynchus mykiss*): and in-situ, caged fish experiment. *Environmental Monitoring and Assessment*, 130: 111-27.

- Transport Canada. 2008. *Emergency Response Guidebook*. <http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/ergmenu.aspx> (accessed May 2012).
- Transport Canada. n.d. *Transportation of Dangerous Goods Regulations*. <http://www.tc.gc.ca/eng/tdg/clear-tofc-211.htm> (accessed December 2012).
- TRB. 2000. *Highway Capacity Manual*. Transportation Research Board, National Academy of Sciences, United States: Washington, DC.
- Udovcic, P. 2012. *Photos of Trucks*. Wardrop.
- US EPA. 1994. *Treatment of Cyanide Heap Leaches and Tailings. Prepared for the Office of Solid Waste Special Waste Branch*. https://fs.ogm.utah.gov/pub/mines/minerals_related/EPApublications/Cyanide.pdf (accessed January 2013).
- Waller, J. S. and C. Servheen. 2005. Effects of transportation infrastructure on grizzly bears in northwestern Montana. *Journal of Wildlife Management*, 69 (3): 985-1000.
- Wardrop. 2010. *KSM Traffic Volume Study by Vehicle Type*. Prepared for Seabridge Gold Inc. by Wardrop Engineering Inc.: Vancouver, BC.
- Wardrop. 2011. *Kerr-Sulphurets-Mitchell (KSM) Prefeasibility Study Update 2011*. Prepared for Seabridge Gold Inc. by Wardrop Engineering Inc.: Vancouver, BC.
- Wendelaar Bonga, S. E. 1997. The stress response of fish. *Physiological Reviews*, 77: 591-625.
- WHO. 1999. *Guidelines for Community Noise*. World Health Organization: Geneva, Switzerland.
- Wind, E. I. and L. A. Dupuis. 2002. *COSEWIC assessment and status report on the western toad Bufo boreas in Canada*. Committee on the Status of Endangered Wildlife in Canada: Ottawa, ON.
- Wood, C. M. 1992. Flux measurements as indices of H⁺ and metal effects on freshwater fish. *Aquatic Toxicology*, 22: 239-64.
- Woodroffe, R. and J. R. Ginsberg. 1998. Edge effects and the extinction of populations inside protected areas. *Science*, 280: 2126-28.
- Ye, X. and D. J. Randall. 1991. The effect of water pH on swimming performance in rainbow trout (*Salmo gairdneri*, Richardson). *Fish Physiology and Biochemistry*, 9 (1): 15-21.
- Zbanyszek, R. and L. S. Smith. 1984. The effect of water-soluble aromatic hydrocarbons on some haematological parameters of rainbow trout, *Salmo gairdneri* Richardson, during acute exposure. *Journal of Fish Biology*, 24: 545-52.

Personal Communications

- Applegate, Sherrie. BC MOTI. Working Group Meeting July 9, 2012.
- Applegate, Sherrie. BC MOTI. Personal Communication, December 13, 2012.
- Arrow Mining Services Ltd. (AMS). Data obtained regarding industrial mining traffic, 2010.
- Cleveland, Mark. Gitanyow Hereditary Chiefs Office. Working Group meeting, July 9, 2012.
- McKendry, Ian. Atmospheric Science Program, University of British Columbia. Personal Communication: Email correspondence and phone conversation, September 9, 2009.
- Olsen, Gail. Ministry of Forests, Lands and Natural Resource Operations - Skeena Stikine Forest District. Personal Communication: January 2011.
- Van Essen. Bandstra Transportation Ltd. Personal Communication, November 2010.

Appendix A

KSM Project Section 13 Order



Telephone: 250-387-1032
Facsimile: 250-387-2208
File: 30200-20/KSMP-04-01

Ref: 100826

October 4, 2011

Brent Murphy
Vice President, Environmental Affairs
Seabridge Gold Inc.
400, 106 Front St E
Toronto ON M5A 1E1

Dear Mr. Murphy:

Please find enclosed an Order issued under section 13 of the *Environmental Assessment Act* regarding the proposed (KSM) Kerr Suphurets Mitchell Mine Project (proposed Project). This Order amends the section 11 Order dated November 6, 2009 by changing the scope of the assessment to include potential transportation impacts from the proposed Project along Hwy 37 to the junction of Hwy 16 at Kitwanga as well as clarifying consultation opportunities for Gitanyow *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam and *wilp* Gwinuu.

This section 13 Order will be posted on the Environmental Assessment Office's electronic Project Information Centre website at www.eao.gov.bc.ca. If you have any questions or require further information, please contact me by telephone at 250-387-1032, or by email at Chris.Hamilton@gov.bc.ca, or contact Karie Hardie, Project Assessment Officer, by telephone at 250-356-5327 or by email at Karie.Hardie@gov.bc.ca.

Yours truly,


Chris Hamilton
Project Assessment Director

.../2

Enclosure: Section 13 Order

pc: Garrett Cooper, Project Manager
Canadian Environmental Assessment Agency

Elizabeth Miller, Manager, Environmental Affairs
Seabridge Gold Inc.

Karie Hardie
Environmental Assessment Office

**IN THE MATTER OF THE ENVIRONMENTAL ASSESSMENT ACT S.B.C. 2002, c.43
(Act)
AND
AN ENVIRONMENTAL ASSESSMENT OF THE
KSM (Kerr-Sulpherets-Mitchell) Project (proposed Project)**

ORDER UNDER SECTION 13 AMENDING SECTION 11 ORDER

WHEREAS:

- A. Seabridge Gold Inc. (Proponent) proposes to develop an open pit gold, copper and silver mine located approximately 65 km northwest of Stewart and 20 km southeast of the Eskay Creek mine.
- B. The proposed Project constitutes a reviewable project pursuant to Part 3 of the *Reviewable Projects Regulation* (B.C. Reg. 370/02), because the proposed Project is a new mine facility that, during operations, will have a production capacity of equal to or greater than 75,000 tonnes per year of mineral ore.
- C. On April 25, 2008, a Project Assessment Director issued an Order under section 10(1)(c) of the Act, stating that the proposed Project requires an environmental assessment (EA) certificate, and that the Proponent may not proceed with the Project without an EA.
- D. On November 6, 2009, a Project Assessment Manager issued an Order under Section 11 of the Act outlining the scope, procedures and methods for conducting the EA.
- E. On March 7, 2011, the Gitanyow Hereditary Chiefs' Office, on behalf of Gitanyow *huwilp*, wrote to the Environmental Assessment Office (EAO), asking that the Gitanyow Hereditary Chiefs' Office, and Gitanyow *huwilp*, be consulted about the proposed Project.
- F. On April 28, 2011, the undersigned Project Assessment Director wrote to the Gitanyow Hereditary Chiefs' Office to confirm that EAO would consult with the potentially affected Gitanyow *wilps* and identified ways in which consultation would take place.
- G. In view of the recent decision of the British Columbia Court of Appeal in *NNTC v. Griffin*, the undersigned Project Assessment Director considers it appropriate to amend the Order made under section 11 of the Act so as to incorporate therein the consultation referred to in Recitals F and G above.

NOW THEREFORE:

Pursuant to section 13 of the Act I order that the Order made under section 11 of the Act, dated November 6, 2009, be amended as follows:

- i. By replacing the last bullet under 3.1 that reads "transportation of ore processing reagents and other hazardous chemicals to the plant site, and of explosives to the mine, along the access roads" with the following new bullet:

"Use of the access roads to the proposed Project site, and Highway 37 between the proposed Project site and its junction with Highway 16 at Kitwanga (as shown in Figure 2), including those potential effects arising from the transport of people, goods and materials, including, but not limited to, fuel, hazardous chemicals and explosives."
- ii. By adding a new section 4.2 as follows:

"4.2 For purposes of section 4.1.2, the term "First Nations" includes Gitanyow *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam and *wilp* Gwinuu."

iii. By adding a new section 20.8 as follows:

"20.8 The Environmental Assessment Office will, in relation to the environmental assessment of the proposed Project, consult with Gitanyow *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam and *wilp* Gwinuu (either directly or, if requested, through the Gitanyow Hereditary Chief's Office) in the following manner:

20.8.1 The Environmental Assessment Office will form a technical working group to discuss road use and potential effects on the aboriginal interests of the Gitanyow *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam, *wilp* Gwinuu and other potentially affected First Nations and the Nisga'a Nation arising from the use of Highway 37 by Project-related traffic. The Environmental Assessment Office will inform the Proponent that they are required to participate in these technical working group meetings.

20.8.2 The Environmental Assessment Office will inform Gitanyow *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam and *wilp* Gwinuu of all major milestones with respect to the environmental assessment of the Project."

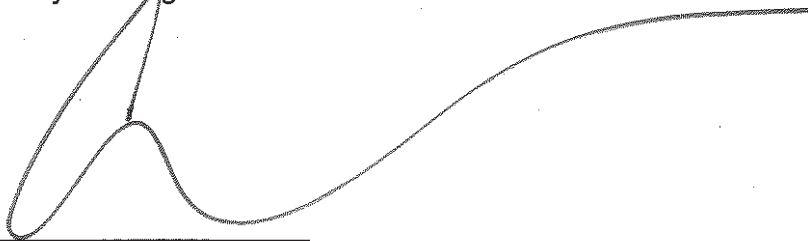
iv. In sections 23.1, 24.1, 25.1 and 27.1.1 by adding "Gitanyow *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam and *wilp* Gwinuu after "First Nations".

v. By adding a new section 25.2 as follows:

"25.2 The Nisga'a Nation, First Nations, *wilp* Malii, *wilp* Gamlaxyeltxw, *wilp* Gwaas Hlaam and *wilp* Gwinuu will have the opportunity to provide to the Environmental Assessment Office their respective written submissions about the Assessment Report, which written submissions will be included in the package of materials sent to ministers when the Project is referred to ministers for decision."

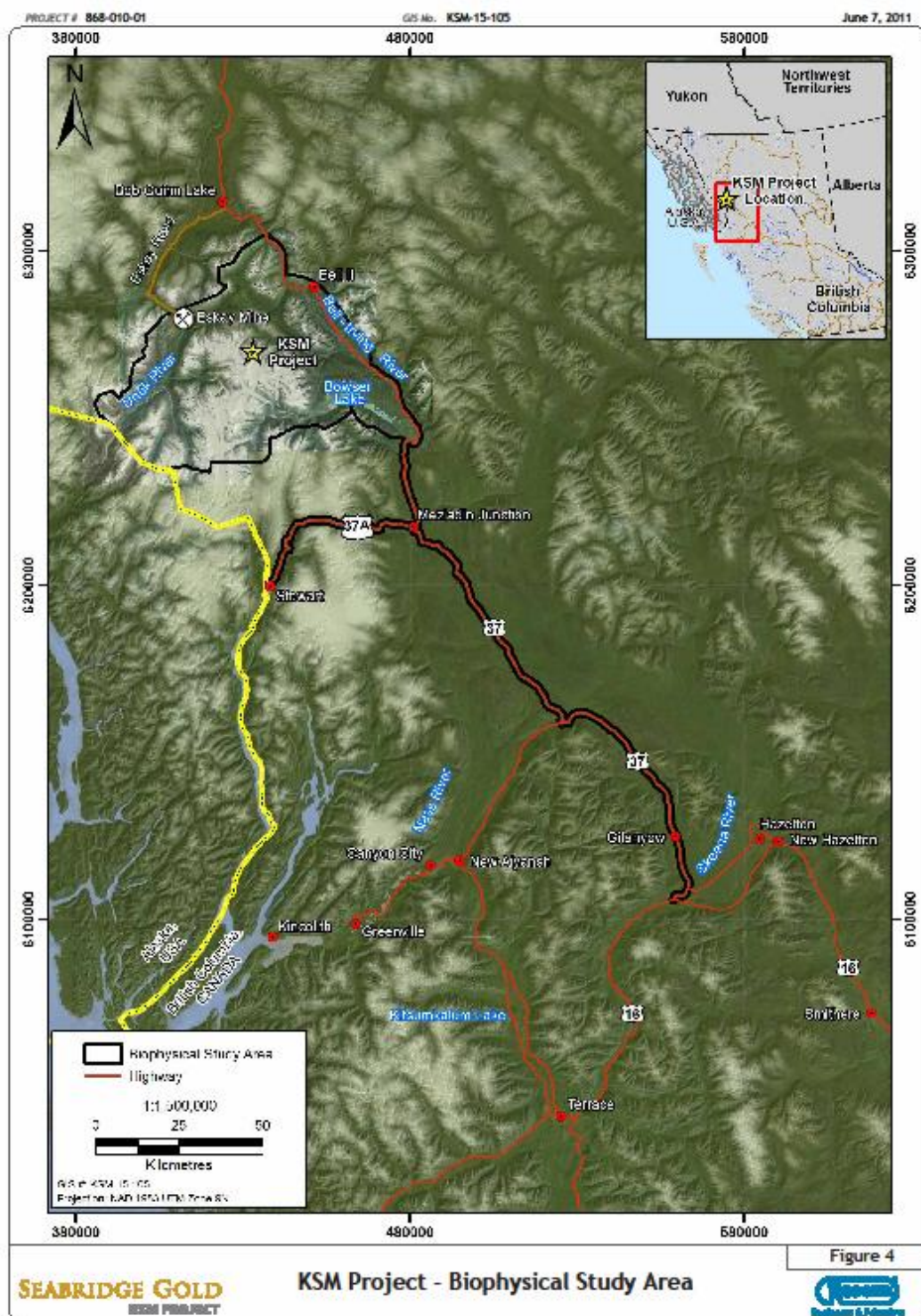
vi. By adding Figure 2 attached hereto.

vii. By deleting sections 27.1.2

A handwritten signature in dark ink, appearing to read 'Chris Hamilton', is written over a horizontal line. The signature is fluid and cursive, with a large loop at the end.

Chris Hamilton
Project Assessment Director
Proposed KSM (Kerr-Sulphurets-Mitchel) Project

Dated September 29, 2011



Appendix B

**Review of Historical Traffic Patterns and Capacity on
Highway 37 in Proximity to the Proposed KSM Project**

May 2, 2011
Our File: 2341-01506-0

Brent Murphy
Seabridge Gold Inc.
400 – 106 Front Street. East
Toronto, ON M5A 1E1

REVIEW OF HISTORICAL TRAFFIC PATTERNS AND CAPACITY ON HIGHWAY 37 IN PROXIMITY TO THE PROPOSED KSM PROJECT

McElhanney Consulting Services Ltd. has been retained by Seabridge Gold to review historical traffic volumes and estimate the capacity of Highway 37 in proximity to the proposed KSM Project.

Available Data

Traffic count data on Highway 37 is available at five locations between Dease Lake and Kitwanga. These sites are: Kitwanga sta: 47-9NS, Cranberry Connector sta: 47-024NS, Meziadin Lake Junction Sta: 47-016NS, Stikine River Bridge Sta: 47-026NS, and Dease Lake Sta: 47-019NS. For the purposes of this analysis station 47-016NS was used as there was data available since 1980 and it is situated at a midpoint between Kitwanga and Dease Lake. Traffic volumes from 2008 were used in this analysis. Traffic count data has been included in Appendix A



Historical Traffic Volumes

Upon review of the historical Ministry of Transportation (MoT) traffic count data published in the historical “Traffic Volumes in BC¹” publication it was determined that count station 017-016NS located approximately 1km North of Meziadin Lake Junction has been in place since 1980. Traffic counting at this station was not performed annually until 1989 except in the years, 1985 and 1987. Between 1980 and 1993 only the Summer Average Daily Traffic (SADT) values were calculated. This value represents the average peak daily traffic volume for the months of July and August in the particular year. Using the SADT data is a conservative approach as traffic volumes are averaged between the two peak traffic months opposed to an average between all 12 months. Based on the SADT volumes shown in Figure 1, traffic on Highway 37 has been decreasing steadily from 1100 vehicles per day (vpd) in 1992 to less than 400 vpd in 2008.

The decrease in total traffic volumes may be attributable to a reduction in both industrial, commercial (forestry), and private vehicle traffic (including tourism). Data pre-2005 does not include a breakdown in the distribution of traffic; therefore it is not possible to determine the distribution of each vehicle type.

Using methodologies outlined in Part 20 of the 2000 Highway Capacity Manual, the service flow rates were calculated for 2008 and 1992 assuming the following:

1 “Traffic Volumes in BC 1979-1994, BC Ministry of Transportation, Multiple Documents



Table 1 Analysis Criteria

Percentage Trucks & Buses	40% of Total Volume ^a
Percent No Passing	40% ^b
Access Points per km	0.1
Peak Hour Factor (PHF)	0.88 ^c
Road Grade	<3% ^d

^a Data from MoT count station 47-016NS located 1km north of Meziadin Lake Junction.

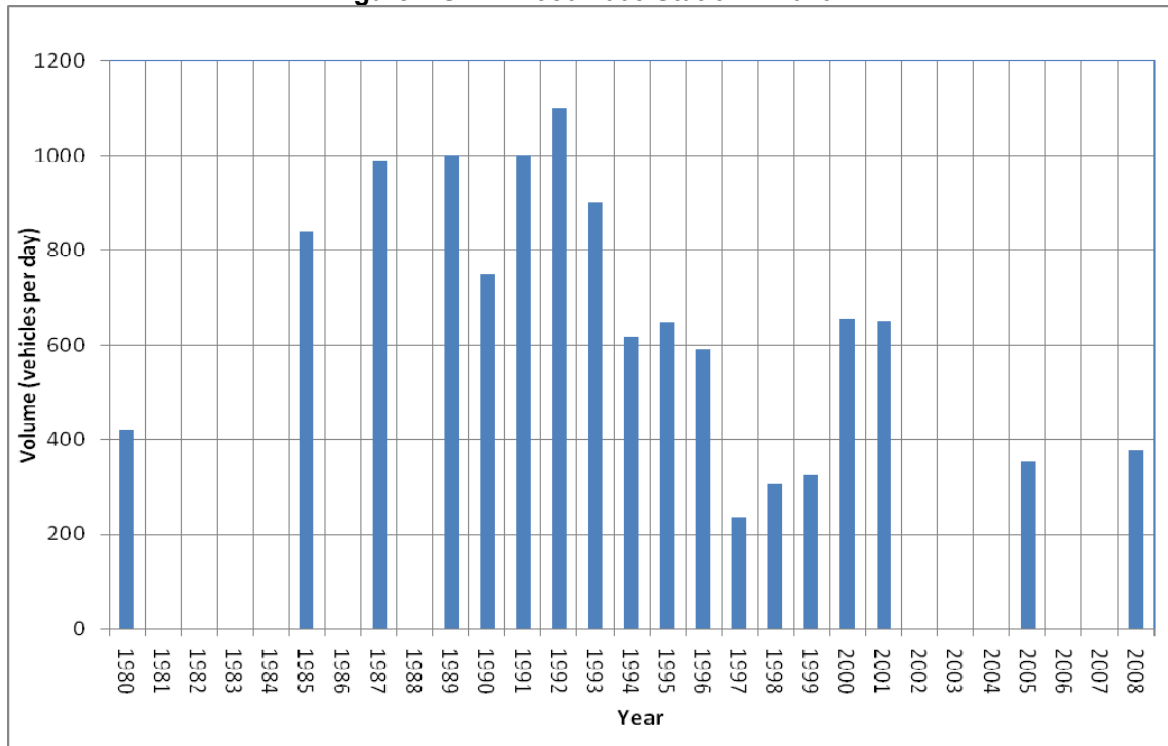
^b Proportion of segment length in which passing is prohibited.

^c Assuming rural two lane highway, this value adjusts hourly volumes to an equivalent 15 minute flow rate.

^d Two-way segmental analysis is only valid for segments with grades less than 3%.

Using the “Two-Way Two-Lane Highway Segment Worksheet” the two-way flow rates (V_p) were calculated to be 90 pc/h² in 2008 and 261 pc/h in 1992.

Figure 1 SADT 1980-2008 Station 47-016



² pc/h = equivalent number of passenger cars per hour, one truck = 2.5 passenger cars



Analysis

Using methodologies outlined in the Highway Capacity Manual (HCM) 2000 Edition, the capacity of Highway 37 was estimated for both 1992 and 2008 conditions. As the methodology of analyzing the Level of Service (LOS) changed between the 1994 and 2000 editions, some adjustments were required to estimate the ultimate capacity of the Highway. The fundamental difference between HCM 2000 edition and HCM 1994 edition is that the HCM 1994 used the volume to capacity ratio (v/c) as its primary performance measure while the HCM 2000 uses the Average Travel Speed method. The Level of Service (LOS) and highway capacity were calculated using methods from HCM 2000. The calculated highway capacity was adjusted to present the data as a passenger car equivalent flow rate instead of an average travel speed.

The indicated capacity of Highway 37 is a two-way volume of 1260 pc/h (630 pc/h in each direction). For reference purposes, the base level capacity of a two-lane highway assuming ideal conditions is 1700 passenger cars per hour (pc/h) for each direction of travel or a two-way capacity of 3200 pc/h³. Short sections of highways such as bridges may reach a capacity of up to 3200 – 3400 pc/h. The capacity of the highway occurs when the road is at LOS “E”. This level of service represents a situation where operating conditions are unstable and difficult to predict, travel speeds tend to be less than posted, and travel delays occur more than 80 percent of the time. Passing at LOS “E” is virtually impossible.

Table 2 outlines the approximate ranges of traffic volumes required to meet a particular Level of Service requirement. The third column represents the number of vehicles travelling in both directions including trucks (assuming approximately 40% of vehicles are trucks). The fourth column represents the total number of vehicles expressed in equivalent passenger cars during a peak 15 minute interval on a grade up to 3%.

³ Two-way capacity slightly less than twice the one-way capacity for extended analysis sections. (Highway Capacity Manual, 2000)



Table 2 Volume Based Requirement for Each Level of Service

Level of Service	Percent Time Following (%) ¹	Two-way hourly Volume (vph) ²	Two-way flow rate V_p (pc/h) ³
A	≤ 35	< 115	< 223
B	>35-50	115 - 218	233 - 423
C	>50-65	218 - 343	423 - 666
D	>65-80	343 - 870	666 - 1260
E	>80	>870	> 1260
F	Undetermined		

¹Percent time following represents the percentage of the time a driver is driving immediately behind another vehicle.

²Two-way Volume assumes 40% Trucks

³ Pc/h – Equivalent Passenger Cars per hour

Note: The above table is unique and is only valid per the analysis criteria outlined in Table 1.

For a rural highway such as Highway 37 the desired LOS is “A” which represents the highest level of service that can be achieved. At LOS “A” motorists are able to travel at their desired speed, the need for passing other vehicles is well below the capacity for passing, and few (if any) platoons of three or more vehicles are observed. Also, the 2000 edition of the Highway Capacity Manual states that the LOS of a two-lane highway is calculated based on the percentage of time traffic is travelling in platoons of three or more vehicles. The roadway operates at LOS “A” if vehicles are travelling in platoons less than 35% of the time.

Using the “Two-Way Two-Lane Highway Segment Worksheet” the two-way flow rates (V_p) were calculated to be 198 pc/h¹ vph in 1992 and 73 pc/h¹ in 2008. From the worksheets, Highway 37 had platooning 33.6% of the time in 1992 and 23.4% of the time in 2008. Therefore based on the criteria, the highway operated at LOS “A” in both 1992 and 2008. It is predicted that traffic volumes would have to increase by 300% over 2008 volumes for the highway to operate at LOS “B”. Analysis for both 1992 and 2008 has been included in Appendix B.



Summary

- Highway 37 has significant excess capacity for the majority of the year as this analysis was performed to study the typical peak hour during the summer.
- Traffic volumes in 2008 were approximately one third of the traffic experienced in 1992.
- Because the hourly volume in 1992 of 198 pc/h (102 vph) was less than the highway capacity of 1260 pc/h at LOS "E", the roadway had surplus capacity.
- Because the hourly volume in 2008 of 73 pc/h (35 vph) was less than the highway capacity of 1260 pc/h at LOS "E", the highway currently has surplus capacity.
- The highway currently operates at LOS "A". Traffic volumes would have to more than triple from 2008 volumes to begin to operate at LOS "B".



Closure

This report includes an assessment of Highway 37 between Meziadin Lake Junction and Dease Lake, BC. This assessment has been prepared by McElhanney Consulting Services Ltd. for the benefit of Seabridge Gold Inc. The information and data contained herein represent MCSL's best professional judgment in light of the knowledge and information available to MCSL at the time of preparation.

McElhanney Consulting Services Ltd. denies any liability whatsoever to other parties who may obtain access to this report for any injury, loss or damage suffered by such parties arising from their use of, or reliance upon, this document or any of its contents without the express written consent of MCSL and Seabridge Gold Inc.

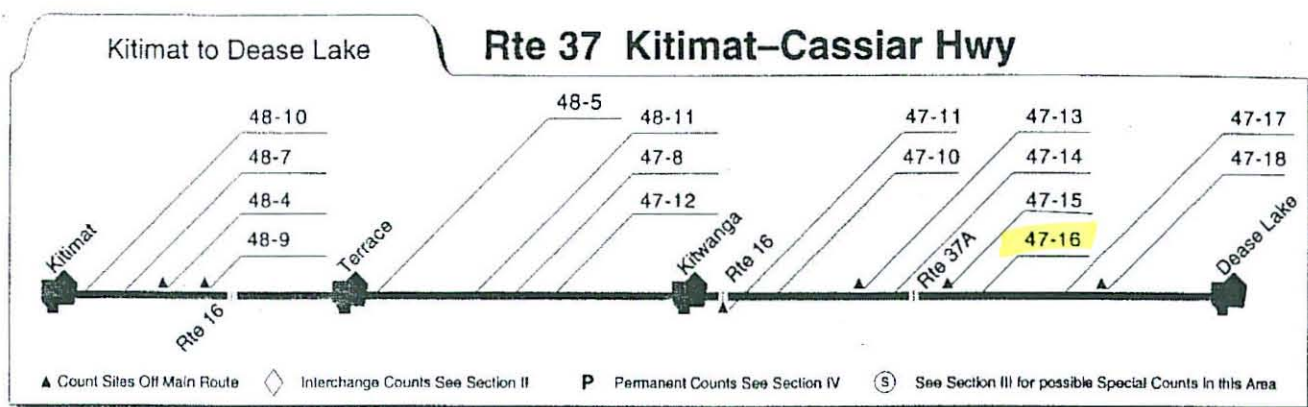
Yours truly,

McElhanney Consulting Services Ltd.

Brendon Masson EIT
Transportation Engineer

Appendix A
Historical Traffic Count Data

1986-1990



Stn	Dir	Rte	Location description	SADT:	1986	1987	1988	1989	1990
48-10	NS	37	At Kitimat River Bridge, north of Kitimat		<u>2100</u>	1900	2600	2500	2400
48-7	NS	37	0.3 km south of Rte 16/37 in Terrace		<u>4100</u>	4300	6000	5800	5500
48-4	EW		On west end of Old Skeena River Bridge in Terrace		<u>5300</u>	6600	7300	<u>7600</u>	<u>7300</u>
48-9	EW	16	Rte 16, 0.2 km west of Rte 37 in Terrace		8300	8800	11900	11200	11700
48-5	EW	16/37	0.2 km east of Rte 37 in Terrace		<u>9900</u>	11400	13100	13300	13500
48-11	EW	16/37	On Kleanza (Gold) Creek Bridge, west of Kleanza Creek Provincial Park		<u>2800</u>	<u>3200</u>	2700	2600	2500
47-8	EW	16/37	On Coyote Creek Bridge, west of Cedarvale Rd		<u>1500</u>	<u>2200</u>	<u>2600</u>	<u>2900</u>	<u>2800</u>
47-12	EW	16/37	0.3 km west of Rte 37, near Kitwanga		1800	1900	2700	2400	2200
47-11	EW	16	Rte 16, 0.3 km east of Rte 37, near Kitwanga		1500	2100	2200	2200	2000
47-10	NS	37	At Skeena River Bridge at Kitwanga		<u>1700</u>	<u>2100</u>	<u>2400</u>	<u>3800</u>	<u>3800</u>
47-13	NS		Nass River Rd, 0.1 km south of the entrance to Rte 37		n/a	<u>110</u>	n/a	n/a	<u>80</u>
47-14	NS	37	16 km south of Meziadin Junction		<u>700</u>	<u>890</u>	n/a	<u>1500</u>	<u>1200</u>
47-15	EW	37A	Stewart-Meziadin Hwy, 18 km west of Meziadin Junction		<u>1100</u>	<u>1200</u>	n/a	<u>2100</u>	<u>1300</u>
47-16	NS	37	1.0 km north of Meziadin Junction		n/a	<u>990</u>	n/a	<u>1000</u>	<u>750</u>
47-17	NS	37	0.5 km south of Dease Lake Junction		n/a	<u>530</u>	n/a	<u>870</u>	<u>600</u>
47-18	EW		Telegraph Creek Rd, 0.5 km west of Rte 37		n/a	<u>600</u>	n/a	<u>880</u>	<u>600</u>

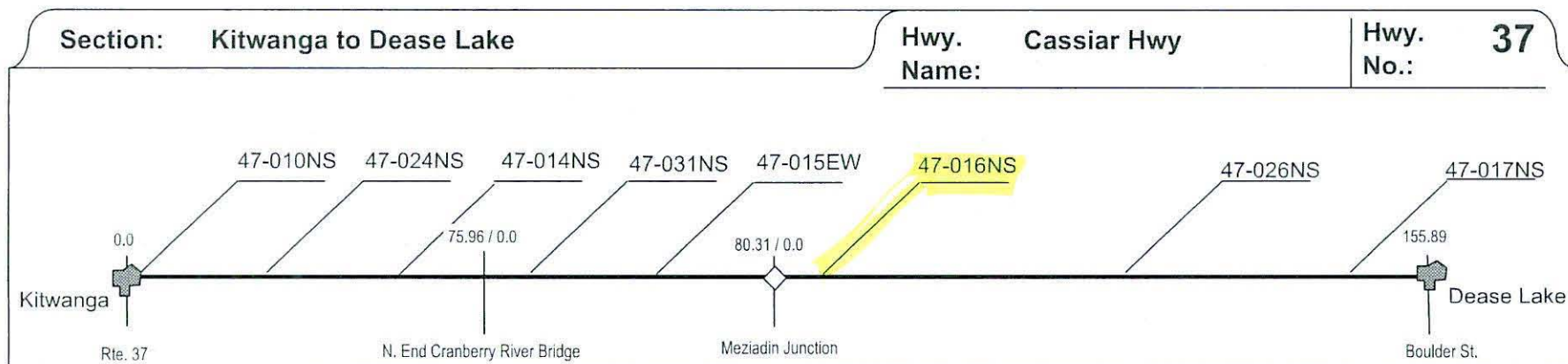
1982 - 1985

ROUTE NUMBER 37
KITIMAT - CASSIAR HIGHWAY
(Kitimat to Cassiar)

Station No.	Location Description	Class. Hwy. Ref. No.	July			August
			1982	1983	1984	1985
48-10-37	At Kitimat River Bridge north of Kitimat		2,400	---	....	3,000
48-7-37	0.3 km south of Route 16&37 at Terrace		4,600	---	....	<u>5,100</u>
48-4E&W	**On west end of Old Skeena River Bridge at Terrace		5,700	6,100	....	7,700
48-9-16	**Route 16, 0.2 km west of Route 37 at Terrace		9,000	<u>8,500</u>	....	<u>11,400</u>
48-5-16&37	0.2 km east of Route 37 at Terrace		10,000	<u>9,600</u>	....	<u>14,000</u>
48-11-16&37	On Kleanza (Gold) Creek Bridge west of Kleanza Creek Provincial Park		2,200	2,000	....	<u>2,000</u>
47-8-16&37	On Coyote Creek Bridge west of Cedarvale Ferry Road		1,700	1,300	....	2,000
47-12E&W -16&37	0.3 km west of Route 37		1,800	1,700	....	<u>1,500</u>
47-11E&W-16	**Route 16, 0.3 km east of Route 37		1,900	1,900	....	<u>1,700</u>
47-10N&S-37	At Skeena River Bridge at Kitwanga		1,300	1,600	....	2,100
47-23N&S-37	0.1 km south of the southern entrance to Nass River Road		....	....	....	*50
47-14N&S-37	16 km south of Meziadin Junction		....	....	....	530
47-15E&W-37A	**Stewart-Meziadin Highway, 18 km west of Meziadin Junction		....	....	....	480
47-16N&S-37	1.0 km north of Meziadin Junction		....	....	....	840
47-17N&S-37	0.5 km south of Dease Lake Junction		....	....	....	590
47-18E&W	**Telegraph Creek Road, 0.5 km west of Route 37		....	....	....	820

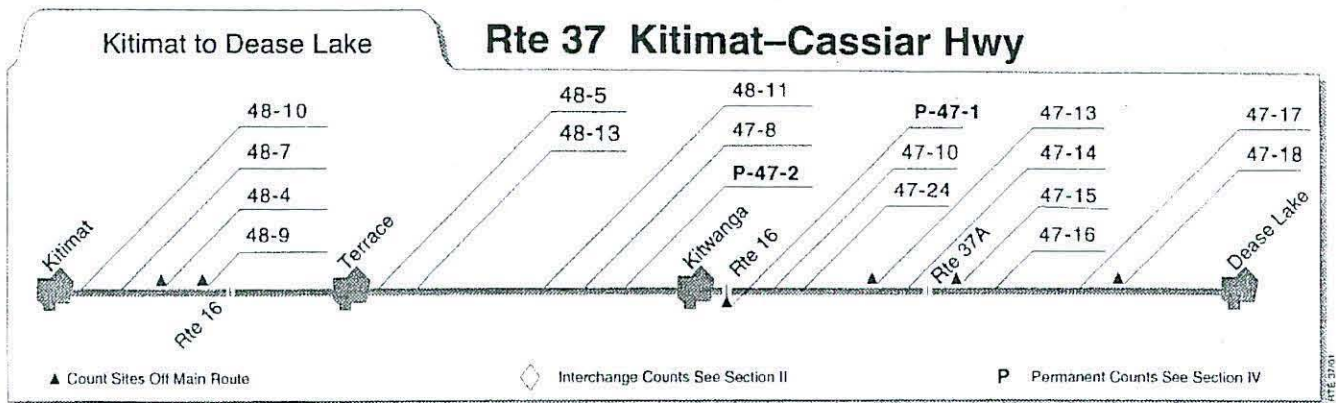
1995-2005

1995-2005



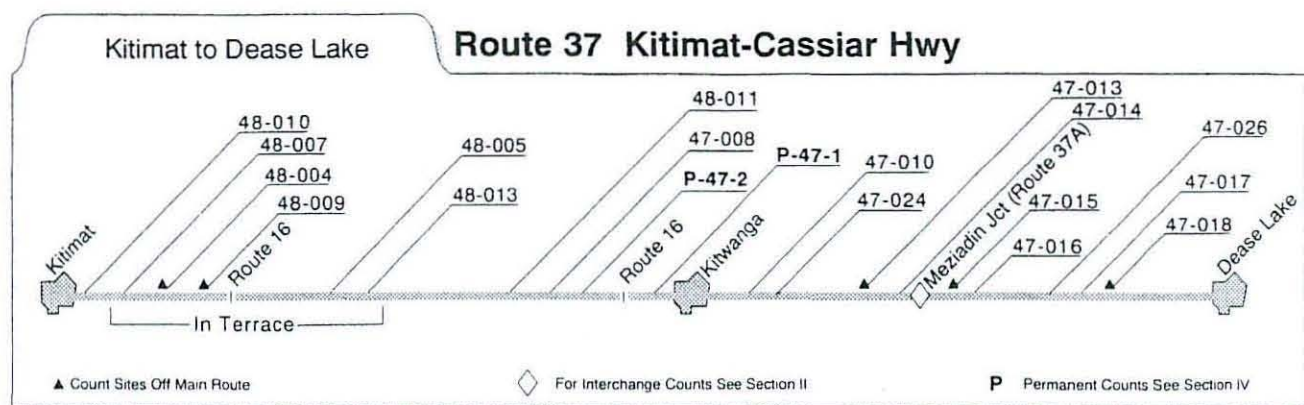
								S A	A A	D D	T T				
	Traffic Measure Pt.	L.K.I. SEG.	L.K.I. KM.	LOCATION DESCRIPTION	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
D	47-010NS	3710	0.2	AT NORTH END OF SKEENA RIVER BRIDGE, 0.1 KM NORTH OF ROUTE 16, KITWANGA (DISCONTINUED - REPLACED BY P-47-1EW IN '92)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D	47-024NS	3720	5.0	0.1 KM SOUTH OF NASS FOREST SERVICE ROAD, APPROX. 80 KM NORTH OF KITWANGA	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C	47-014NS	3720	66.3	AT THE NASS RIVER BRIDGE, 16.0 KM SOUTH OF MEZIADIN LAKE JUNCTION	1170 1006	1268 954	1312 953	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C	47-031NS	3725	6.8	ROUTE 37A, AT AVALANCHE GATE, STEWART	886	600	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	435 295
D	47-015EW	3725	46.8	18.0 Km. WEST OF MEZIADIN JCT. AT WINDY POINT BRIDGE	886 834	708 608	917 775	n/a	n/a	647 551	645 548	n/a	n/a	n/a	n/a
C	47-016NS	3730	1.0	1.0 KM NORTH OF OF MEZIADIN LAKE JUNCTION	647 608	591 525	n/a	n/a	n/a	655 502	650 506	n/a	n/a	n/a	355 272
C	47-026NS	3750	104.8	AT THE STIKINE RIVER BRIDGE, 49.0 KM SOUTH OF DEASE LAKE JUNCTION	749 835	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D	47-017NS	3750	155.4	0.5 KM SOUTH OF DEASE LAKE JUNCTION	979	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

1989-1993



Loc	Dir	Rte	Location description	SADT:	1989	1990	1991	1992	1993
48-10	NS	37	At Kitimat River Bridge, north of Kitimat		2500	2400	2200	2300	2100
48-7	NS	37	0.3 km south of Rte 16/37 at Terrace		5800	5500	5200	5300	6200
48-4	EW		On west end of Old Skeena River Bridge at Terrace		7600	7300	6500	n/a	n/a
48-9	EW	16	Rte 16, 0.2 km west of Rte 37 at Terrace		11200	11700	11300	11700	12100
48-5	EW	16/37	0.2 km east of Rte 37 at Terrace		13300	13500	12200	13100	13000
48-13	EW	16/37	0.5 km east of Clark Street at Terrace						6600
48-11	EW	16/37	On Kleanza (Gold) Creek Bridge, west of Kleanza Creek Provincial Park		2600	2500	n/a	2500	n/a
47-8	EW	16/37	On Coyote Creek Bridge, west of Cedarvale Rd		2900	2800	n/a	n/a	2000
P-47-2	EW	16/37	just west of Rte 37, near Kitwanga (formerly Location 47-12)		2400	2200	2000	1900	2174
P-47-1	EW	16	Rte 16, just east of Rte 37, near Kitwanga (formerly Location 47-11)		2200	2000	2200	2200	2102
47-10	NS	37	At Skeena River Bridge at Kitwanga		3800	3800	n/a	2000	n/a
47-24	NS	37	0.1 km south of Forest Service Rd, north of Kitwanga		n/a	n/a	1000	n/a	1100
47-13	NS		Nass River Rd, 0.1 km south of the entrance to Rte 37		n/a	80	n/a	100	n/a
47-14	NS	37	16 km south of Meziadin Junction		1500	1200	1200	1400	1900
47-15	EW	37A	Rte 37A, Stewart-Meziadin Hwy, 18 km west of Meziadin Junction		2100	1300	1200	1200	1200
47-16	NS	37	1.0 km north of Meziadin Junction		1000	750	1000	1100	900
47-17	NS	37	0.5 km south of Dease Lake Junction		870	600	n/a	800	n/a
47-18	EW		Telegraph Creek Rd, 0.5 km west of Rte 37		880	600	n/a	200	n/a

1990-1994



Loc	Dir	Rte	Location description	SADT:	1990	1991	1992	1993	1994
48-010	NS	37	AT KITIMAT RIVER BRIDGE, APPROX. 34.0 KM SOUTH OF ROUTE 16, SOUTH OF TERRACE		2400	2200	2300	2100	2400
48-007	NS	37	0.3 KM SOUTH OF ROUTE 16, TERRACE		5500	5200	5300	6200	6200
48-004	EW		LAKELSE ROAD, 0.2 KM WEST OF THE OLD SKEENA RIVER BRIDGE, TERRACE		<u>7300</u>	<u>6500</u>	n/a	n/a	7000
48-009	EW	16	0.2 KM WEST OF ROUTE 37, TERRACE		11700	11300	11700	12100	12900
48-005	EW	16/37	0.2 KM EAST OF ROUTE 37, TERRACE		13500	12200	13100	13000	14200
48-013	EW	16/37	0.5 KM EAST OF CLARK STREET, TERRACE					<u>6600</u>	6300
48-011	EW	16/37	ON KLEANZA CREEK BRIDGE, WEST OF KLEANZA CREEK PROVINCIAL PARK, APPROX. 13.0 KM EAST OF TERRACE		2500	n/a	2500	n/a	2700
47-008	EW	16/37	AT COYOTE CREEK BRIDGE, 1.5 KM WEST OF CEDARVALE ROAD, APPROX. 20.0 KM WEST OF KITWANGA		<u>2800</u>	n/a	n/a	<u>2000</u>	2100
P-47-2	EW	16/37	JUST WEST OF ROUTE 37, KITWANGA		2200	2000	1900	2174	2357
P-47-1	EW	16	JUST EAST OF ROUTE 37, KITWANGA		2000	2200	2200	2102	2256
47-010	NS	37	AT NORTH END OF SKEENA RIVER BRIDGE, KITWANGA		<u>3800</u>	n/a	2000	n/a	n/a
47-024	NS	37	0.1 KM SOUTH OF NASS FOREST SERVICE ROAD, APPROX. 80.0 KM NORTH OF KITWANGA		n/a	<u>1000</u>	n/a	<u>1100</u>	n/a
47-013	NS		NASS ROAD, 0.1 KM SOUTH OF ROUTE 37 AT CRANBERRY JUNCTION, APPROX. 80.0 KM NORTH OF KITWANGA		<u>80</u>	n/a	<u>100</u>	n/a	n/a
47-014	NS	37	AT THE NASS RIVER BRIDGE, 16.0 KM SOUTH OF MEZIADIN LAKE JUNCTION		<u>1200</u>	<u>1200</u>	<u>1400</u>	<u>1400</u>	1100
47-015	EW	37A	18.0 KM WEST OF MEZIADIN LAKE JUNCTION		<u>1300</u>	<u>1200</u>	<u>1200</u>	<u>1100</u>	900
47-016	NS	37	1.0 KM NORTH OF MEZIADIN LAKE JUNCTION		<u>750</u>	<u>1000</u>	<u>1100</u>	<u>900</u>	<u>600</u>
47-026	NS	37	AT THE STIKINE RIVER BRIDGE, 49.0 KM SOUTH OF DEASE LAKE JUNCTION		<u>500</u>	n/a	<u>800</u>	n/a	<u>600</u>
47-017	NS	37	0.5 KM SOUTH OF DEASE LAKE JUNCTION		<u>600</u>	n/a	<u>800</u>	n/a	<u>900</u>
47-018	EW		TELEGRAPH CREEK ROAD, 0.5 KM WEST OF ROUTE 37		<u>600</u>	n/a	<u>200</u>	n/a	n/a

1980

ROUTE NUMBER 37
CASSIAR HIGHWAY
(Kitwanga to Cassiar)

Station No.	Location Description	Class. Hwy. Ref. No.	July 1979	- 1980	August 1981	1982
47-12E&W-16	**Route 16, 0.3 km west of Route 37		....	*1,900	1,600	1,800
47-11E&W-16	**Route 16, 0.3 km east of Route 37		....	*2,200	1,600	1,900
47-10N&S-37	At Skeena River Bridge at Kitwanga		1,200	1,200	1,100	1,300
47-13N&S	**Nass River road, 0.1 km south of Cranberry Junction		....	*430	....	....
47-14N&S-37	16 km south of Meziadian Junction		....	*480	....	....
47-15E&W	**Stewart-Meziadian Highway, 18 km west of Meziadian Junction		....	*540	....	....
47-16N&S-37	1.0 km north of Meziadin Junction		....	*420	....	....
47-17N&S-37	0.5 km south of Dease Lake Junction		....	*650	....	....
47-18E&W	**Telegraph Creek Road, 0.5 km west of Route 37		....	*690	....	....
47-19N&S-37	2.0 km north of Dease Lake Junction		....	*480	....	....
47-20N&S-37	2.0 km south of Cassiar Junction		....	*530	....	....
47-21E&W	**Cassiar Road, 0.2 km west of Cassiar Junction		....	*700	....	....
47-22N&S-37	0.1 km north of Cassiar Junction		....	*480	....	....

* Denotes new station.

** Denotes a station on a feeder road

1980

ROUTE NUMBER 37
CASSIAR HIGHWAY
(Kitwanga to Cassiar)

Station No.	Location Description	Class. Hwy. Ref. No.	July 1977	- 1978	August 1979	1980
47-11E&W-16	**Route 16, 0.3 km east of Route 37		....	....	....	*2,200
47-12E&W-16	**Route 16, 0.3 km west of Route 37		....	....	....	*1,900
47-10N&S-37	At Skeena River Bridge at Kitwanga		810	1,500	1,200	1,200
47-13N&S	**Nass River Road, 0.1 km south of Cranberry Junction		....	....	....	* 430
47-14N&S-37	16 km south of Meziadian Junction		....	....	....	* 480
47-15E&W	**Stewart-Meziadian Highway, 18 km west of Meziadian Junction		....	....	....	* 540
47-16N&S-37	1.0 km north of Meziadian Junction		....	....	....	* 420
47-17N&S-37	0.5 km south of Dease Lake Junction		....	....	....	* 650
47-18E&W	**Telegraph Creek Road, 0.5 km west of Route 37		....	....	....	* 690
47-19N&S-37	2.0 km north of Dease Lake Junction		....	....	....	* 480
47-20N&S-37	2.0 km south of Cassiar Junction		....	....	....	* 530
47-21E&W	**Cassiar Road, 0.2 km west of Cassiar Junction		....	....	....	* 700
47-22N&S-37	0.1 km north of Cassiar Junction		....	....	....	* 480

ROUTE NUMBER 37
KITIMAT - CASSIAR HIGHWAY
(Dease Lake to Cassiar)

Station/ Dir/ Hwy	Location Description	S.A.D.T. July - August			
		1985	1986	1987	1988
47-19 NS 37	2.0 km north of Dease Lake Junction	—	....	610	....
47-20 NS 37	2.0 km south of Cassiar Junction	550	....	740	....
47-21 EW	Cassiar Road, 0.2 km west of Cassiar Junction	490	....	420	....
47-22 NS 37	0.1 km north of Cassiar Junction	410	....	440	....

Hourly Volumes

BC Ministry of Transportation and Infrastructure

24 Hour Roadway Summary for August 23, 2008

47-016NS

FC0 DIST 4701 Posted Speed = 90 kph Co

Route 37 1.0 Km North Of Route 37A At Meziadin Lake Junction

	Total	Total	Peak	Peak
Private:	225.6	59.6	22.0	62.5
Single:	85.8	22.7	7.2	20.5
Combo:	67.1	17.7	6.0	17.0
Trucks:	152.9	40.4	13.2	37.5
Total:	378.5		35.2	

Peak Hour: 13

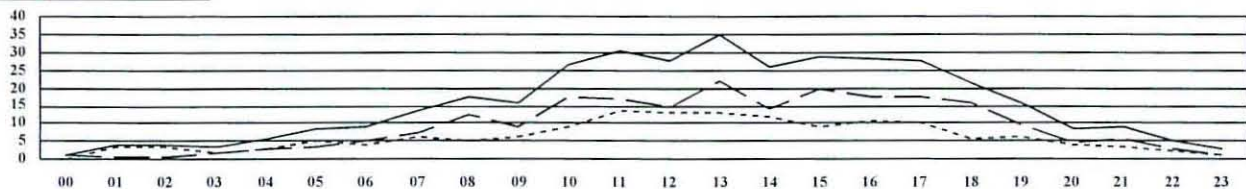
Axle Factor:

Peak Hour = 1 PM

Vol 1 PM = 35.2 vph

Vol 0800 = 378.5 vph

% in Peak hour = $35.2 / 378.5 = 9.3\%$



	1	2	3	4	5	6	7	8	9	10	11	12	13
0	0	0.3	0.7	0	0	0	0	0	0.2	0	0	0	0.2
1	0	0	0.7	0	1.3	0	1.2	0	0.5	0	0	0.2	0.2
2	0	0.7	0	0.5	1.0	1.2	0.5	0	0.2	0	0	0	0
3	0	1.0	0.7	0	0	0.8	0.7	0	0	0.2	0	0.2	0
4	0	1.3	1.3	0	0.8	0.2	0	0	0.5	0.7	0	0	0.7
5	0	2.0	1.5	0	2.0	0	0	0	0.3	1.8	0	0.2	1.0
6	0	4.8	0.5	0	1.5	0.2	0	0	0.2	1.0	0	0	1.2
7	0	4.0	3.3	0.2	2.3	0.8	1.5	0.3	0.3	0.7	0	0.2	0
8	0.2	8.0	4.2	0.3	2.2	1.0	0.5	0.7	0	0.5	0	0	0
9	0	5.8	3.5	0	3.0	0.7	0.3	0.8	0.2	0.3	0	0	1.2
10	0.3	8.7	8.7	0	3.3	0.2	0	1.7	0.5	2.5	0	0	0.8
11	0.2	8.2	8.4	0	5.8	0.6	0.6	3.2	1.6	0.8	0	0	1.0
12	0.2	5.2	9.2	0	6.2	0.4	0.4	3.6	1.0	0.2	0	0.2	1.0
13	0.8	13.0	8.2	0.4	5.4	0.8	0.6	3.0	1.0	1.2	0	0	0.8
14	0.2	6.6	7.6	0	4.8	0.2	0.4	2.8	0.8	1.2	0	0.2	1.4
15	1.2	8.8	10.0	0	5.2	0	0	1.4	0.2	1.4	0	0	1.0
16	0.6	7.6	9.4	0	7.0	0.2	0	1.8	0	0.8	0	0	0.8
17	0	7.0	10.6	0	6.4	0	0	1.0	1.4	0.4	0	0.2	0.8
18	1.4	6.0	8.4	0	4.4	0	0	0.8	0.2	0.2	0	0	0.2
19	0.5	4.2	4.8	0.3	2.8	0	0	1.3	0.8	0.5	0	0	0.7
20	0	2.3	2.5	0	2.2	0	0	0.3	0.3	0.5	0.2	0.2	0.3
21	0.2	4.0	1.8	0	1.3	0.2	0	0.2	0.8	0.3	0	0	0.5
22	0	1.7	1.2	0	0.5	0	0	0.2	0.8	0.5	0	0	0.3
23	0	0.5	1.0	0	0.5	0	0	0.3	0.2	0.2	0	0	0.2
Total	5.8	111.7	108.1	1.7	70.0	7.4	6.7	23.4	12.0	15.9	0.2	1.4	14.2
%	1.5	29.5	28.6	0.5	18.5	1.9	1.8	6.2	3.2	4.2	0.0	0.4	3.7

= 35.2 vph

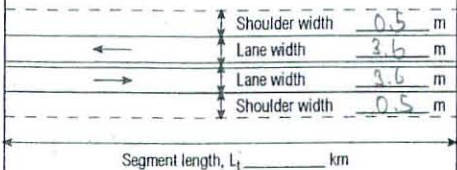


Appendix B

HCM 2000 Analysis

time-spent-following is estimated by adjusting the base percent time-spent-following value for the percentage of no-passing zones. Finally, LOS is determined by average travel speed, percent time-spent-following, or both, depending on the highway classification.

EXHIBIT 20-28. TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET	
General Information Analyst: <u>Brendan Masson</u> Agency or Company: <u>McElhenny</u> Date Performed: <u>April 17, 2011</u> Analysis Time Period: _____	
Site Information Highway: <u>Highway 37</u> From/To: <u>Melville to Dense Lake</u> Jurisdiction: <u>Northern Region</u> Analysis Year: <u>2011</u>	
☐ Operational (LOS) ☐ Design (v_p) ☐ Planning (LOS) ☐ Planning (v_p)	
Input Data  ☒ Class I highway ☐ Class II highway Terrain: ☐ Level ☒ Rolling Two-way hourly volume: <u>102</u> veh/h Directional split: <u>50</u> / <u>50</u> Peak-hour factor, PHF: <u>0.88</u> % Trucks and buses, P_T: <u>40</u> % % Recreational vehicles, P_R: <u>0</u> % % No-passing zone: <u>40</u> % Access points/km: <u>0.1</u> /km	
Average Travel Speed Grade adjustment factor, f_g (Exhibit 20-7): <u>0.71</u> Passenger-car equivalents for trucks, E_T (Exhibit 20-9): <u>2.5</u> Passenger-car equivalents for RVs, E_R (Exhibit 20-9): <u>1.8</u> Heavy-vehicle adjustment factor, f_{HV} : $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ = <u>0.625</u> Two-way flow rate, v_p (pc/h): $v_p = \frac{V}{PHF \cdot f_g \cdot f_{HV}}$ = <u>261</u> v_p * highest directional split proportion ² (pc/h): <u>130</u>	
Free-Flow Speed from Field Measurement Field measured speed, S_{FM} : _____ km/h Observed volume, V_f : _____ veh/h Free-flow speed, FFS: _____ km/h FFS = $S_{FM} + 0.0125 \left(\frac{V_f}{f_{HV}} \right)$	Estimated Free-Flow Speed Base free-flow speed, BFFS: <u>90</u> km/h Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5): <u>0.8</u> km/h Adj. for access points, f_A (Exhibit 20-6): <u>0</u> km/h Free-flow speed, FFS: <u>83.2</u> km/h FFS = BFFS - f_{LS} - f_A Adj. for no-passing zones, f_{np} (km/h) (Exhibit 20-11): <u>2.91</u> Average travel speed, ATS (km/h): $ATS = FFS - 0.0125v_p - f_{np}$ = <u>86.8 km/h</u>
Percent Time-Spent-Following Grade adjustment factor, f_g (Exhibit 20-8): <u>0.77</u> Passenger-car equivalents for trucks, E_T (Exhibit 20-10): <u>1.8</u> Passenger-car equivalents for RVs, E_R (Exhibit 20-10): <u>1.5</u> Heavy-vehicle adjustment factor, f_{HV} : $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ = <u>0.76</u> Two-way flow rate, v_p (pc/h): $v_p = \frac{V}{PHF \cdot f_g \cdot f_{HV}}$ = <u>198 pc/h</u> v_p * highest directional split proportion ² (pc/h): <u>99 pc/h</u> Base percent time-spent-following, BPTSF (%): <u>15.9%</u> BPTSF = $100(1 - \exp(-0.000879v_p))$ Adj. for directional distribution and no-passing zone, f_{dnp} (%): <u>17.7%</u> linear interpolated Percent time-spent-following, PTSF (%): $PTSF = BPTSF + f_{dnp}$ = <u>33.6%</u>	
Level of Service and Other Performance Measures Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II): <u>A 33.6% < 35 20.2</u> Volume to capacity ratio, v/c : $v/c = \frac{v_p}{3,200}$ = <u>0.08</u> Peak 15-min vehicle-kilometers of travel, $VkmT_{15}$ (veh-km): _____ $VkmT_{15} = 0.25L_1 \left(\frac{V}{PHF} \right)$ Peak-hour vehicle-kilometers of travel, $VkmT_{60}$ (veh-km): $VkmT_{60} = V \cdot L_1$ Peak 15-min total travel time, TT_{15} (veh-h): $TT_{15} = \frac{VkmT_{15}}{ATS}$	
Notes 1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F. 2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.	

SADT = 1100 vpd
 Volume = 1100 * 0.093
 Two-way hourly volume = 102 vph

$$f_{HV} = \frac{1}{1 + 0.4(2.5 - 1) + 0} = 0.625$$

$$v_p = \frac{102}{(0.88)(0.71)(0.625)} = 261 \text{ vph}$$

$$ATS = 90 - 0.0125(261) - 2.91 = 86.8 \text{ km/h}$$

$$f_{HV} = \frac{1}{1 + 0.4(1.8 - 1)} = 0.76$$

$$v_p = \frac{102}{(0.88)(0.77)(0.76)} = 198 \text{ vph}$$

$$BPTSF = 100(1 - \exp(-0.000879v_p)) = 15.9\%$$

$$PTSF = 17.7\% + 15.9\% = 33.6\%$$

$$v_p = 261 \text{ pc/h}$$

time-spent-following is estimated by adjusting the base percent time-spent-following value for the percentage of no-passing zones. Finally, LOS is determined by average travel speed, percent time-spent-following, or both, depending on the highway classification.

EXHIBIT 20-28. TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET	
General Information Analyst Agency or Company Date Performed Analysis Time Period Site Information Highway From/To Jurisdiction Analysis Year	
☐ Operational (LOS) ☐ Design (v_p) ☐ Planning (LOS) ☐ Planning (v_p)	
Input Data Class I highway ☒ Class II highway ☐ Terrain ☐ Level ☒ Rolling Two-way hourly volume <u>35</u> veh/h Directional split <u>50</u> / <u>50</u> Peak-hour factor, PHF <u>0.88</u> % Trucks and buses, P_T <u>40</u> % % Recreational vehicles, P_R <u>0</u> % % No-passing zone <u>40</u> % Access points/km <u>0.1</u> /km	
Average Travel Speed Grade adjustment factor, f_G (Exhibit 20-7) <u>0.71</u> Passenger-car equivalents for trucks, E_T (Exhibit 20-9) <u>2.5</u> Passenger-car equivalents for RVs, E_R (Exhibit 20-9) <u>1.8</u> Heavy-vehicle adjustment factor, $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ <u>0.625</u> Two-way flow rate, V_p (pc/h) <u>90 pc/h</u> V_p * highest directional split proportion² (pc/h) <u>45 pc/h</u> Free-Flow Speed from Field Measurement Estimated Free-Flow Speed Field measured speed, S_{FM} _____ km/h Base free-flow speed, BFFS <u>90</u> km/h Observed volume, V_f _____ veh/h Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) <u>6.8</u> km/h Free-flow speed, FFS _____ km/h Adj. for access points, f_A (Exhibit 20-6) <u>0</u> km/h $FFS = S_{FM} + 0.0125 \left(\frac{V_f}{V_p} \right)$ Free-flow speed, FFS <u>83.2</u> km/h $FFS = BFFS - f_{LS} - f_A$ FFS <u>83.2</u> km/h Adj. for no-passing zones, f_{np} (km/h) (Exhibit 20-11) <u>2.3</u> Average travel speed, ATS (km/h) $ATS = FFS - 0.0125 V_p - f_{np}$ <u>80.3</u>	
Percent Time-Spent-Following Grade adjustment factor, f_G (Exhibit 20-8) <u>0.77</u> Passenger-car equivalents for trucks, E_T (Exhibit 20-10) <u>1.8</u> Passenger-car equivalents for RVs, E_R (Exhibit 20-10) <u>1.0</u> Heavy-vehicle adjustment factor, $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ <u>0.71</u> Two-way flow rate, V_p (pc/h) <u>73</u> V_p * highest directional split proportion² (pc/h) <u>37</u> Base percent time-spent-following, BPTSF (%) <u>6.2%</u> $BPTSF = 100(1 - \exp(-0.000879 V_p))$ Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) <u>17.2%</u> (Exhibit 20-12) Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$ <u>23.4%</u>	
Level of Service and Other Performance Measures Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) <u>A</u> $23.4 < 35$ Volume to capacity ratio, v/c $v/c = \frac{V_p}{3,200}$ <u>0.03</u> Peak 15-min vehicle-kilometers of travel, $V_{kmT_{15}}$ (veh-km) <u>N/A</u> $V_{kmT_{15}} = 0.25 L \left(\frac{V}{PHF} \right)$ Peak-hour vehicle-kilometers of travel, $V_{kmT_{60}}$ (veh-km) $V_{kmT_{60}} = V * L$ <u>N/A</u> Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{V_{kmT_{15}}}{ATS}$ <u>N/A</u>	
Notes 1. If $V_p \geq 3,200$ pc/h, terminate analysis—the LOS is F. 2. If highest directional split $V_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.	

SADT = 378 vpd
volume = 378 * 0.093
Two way volume = 35 vph

$f_{HV} = \frac{1}{1 + 0.40(2.5 - 1) + 0}$
 $f_{HV} = 0.625$
 $V_p = 35$
 $(0.88)(0.71)(0.625)$
 $V_p = 89.6 \approx 90$ vph
 $AST(km/h) = 83.2 - 0.0125(45) - 2.3$
 $ATS = 80.3$ km/h
 $f_{HV} = \frac{1}{1 + 0.5(1.8 - 1) + 0}$ $f_{HV} = 0.71$
 $V_p = 35$
 $(0.88)(0.77)(0.71)$ $V_p = 73$ vph
 $BPTSF = 100(1 - \exp(-0.000879 * 73))$
 $BPTSF = 6.2\%$

$V_p = 90$ pc/h

Appendix C

KSM Project Traffic Volume Study

To Elizabeth Miller, Seabridge Gold Inc.

From Peter Udovicic, Tetra Tech-Wardrop

Date May 29, 2012

Document No. 1252880100-MEM-R0001-03

Project Name Kerr-Sulphurets-Mitchell (KSM) Pre-feasibility Study Update 2012

Subject Traffic Volume Study –May 2012 Final

Introduction

Tetra Tech-Wardrop (Tt WEI) performed an updated assessment of the potential traffic volumes on the access roads to the Kerr-Sulphurets-Mitchell (KSM) project site as well as on Highways 16, 37, and 37A.

The information provided in this memo is Tt WEI's interpretation of the data that was provided by various consultants who are currently working on the KSM Project.

Assumptions

This memo is based on the following assumptions:

- This memo is based on 130,000 t/d throughput, a 6-year Construction phase, a 55-year Operation phase, and a 3-year Decommissioning phase. Post-closure data is provided on a per annum basis and no duration was assumed.
- The Construction phase of the project has been broken down into quarterly averages to more accurately reflect the seasonality of this phase. The Operation, Decommissioning, and Post-closure phases are presented by year.
- All figures are based on 'trips'; for example, one trip equals a loaded truck delivering cargo to site and then returning empty via the same route.
- All trips will be made by vehicles that are permitted to operate within the laws of the Province of British Columbia.
- Equipment, materials, reagents, and supplies will be shipped using standard commercial trucks. Personnel will be transported in standard coach-type busses or passenger vehicles.
- Grinding media will be shipped on super-B trucks from a staging yard/warehouse in Smithers, BC, in trucks with 40-tonne capacity.
- Diesel fuel is assumed to be sourced from Terrace, BC, and delivered in super-B tanker trucks with a capacity of 45,000 litres per truck.

- Explosives will be delivered by super-B trucks with a capacity of 40 tonnes per truck.
- Copper concentrate will be shipped in bulk form in super-B trucks with a capacity of 50 tonnes to Stewart Bulk Terminals. The heavier payload assumes the allowance of heavier loads under the Bulk Haul Program introduced by the Ministry of Transportation and Infrastructure in 2010. Under the Bulk Haul Program, shipping companies can enter into agreements with the Province to operate trucks that comply with axle weight limits, but exceed gross vehicle weight restrictions.
- Molybdenum concentrate will be loaded in 2 tonne bags and transported on super-B flat deck trucks to Prince Rupert, BC.
- Gold and silver doré will be shipped from site via air transport for security reasons.
- Major mining equipment will be replaced every 10 years.
- The KSM plant site will be accessed via the proposed Treaty Creek access road, which will connect to Highway 37.
- Traffic on the Frank Mackie Winter Access Road will originate in Stewart, BC. Half of the cargo will be delivered to Stewart by barge, and the other half will be delivered to Stewart by truck (via Highway 16, Highway 37, and Highway 37A). Any traffic travelling along the Frank Mackie Winter Access Road will not travel along the Eskay/Coulter Creek or Treaty Creek access roads.
- During initial construction, the KSM site will be accessed via the Frank Mackie Winter Access Road. During the remaining years of construction, the Eskay/Coulter Creek or Treaty Creek access roads will provide site access, once they are commissioned.
- During Operation, liners, diesel fuel, lubricants, personnel, camp supplies, and parts/machinery have been assumed to be shipped via the Mitchell-Teigen Tunnel (MTT) from the Teigen side to the Mitchell side. Explosives and major mine equipment will be routed via the Coulter Creek access road.
- During Decommissioning, all equipment and material except foundations (concrete and rebar) will be removed.
- Volumes for the Decommissioning phase are estimated at approximately 70% of material/equipment from the Construction phase.
- During Decommissioning and Post-closure, it is assumed that all traffic will move via the MTT and Treaty Creek access road as it is assumed that the Eskay/Coulter Creek access road will be decommissioned at this time.
- During Post-closure, it is assumed that activities and traffic volumes are consistent throughout the entire phase.

The following assumptions were provided by Moose Mountain Technical Services regarding the movement of explosives materials:

- Assuming the potentially hazardous materials are AN prill, diesel fuel, initiation systems, ANFO, and emulsion:
 - Approximately 80% of the traffic on the explosive facilities road will carry potentially hazardous materials.
 - Less than 5% of the traffic on the mine site will carry potentially hazardous explosives materials.

Notes

It should be noted that during the 55-year Operation period, the annual traffic volumes for both diesel fuel and explosives will vary significantly from year to year. Table 1 outlines average traffic volumes during 10-year increments (except Years 51 to 55).

Table 1 Average Fuel and Explosives Traffic during Operation

Vehicle Type	Cargo	Year 1-10	Year 11-20	Year 21-30	Year 31-40	Year 41-50	Year 51-55
Tanker (45,000 L)	Diesel Fuel	4,489	2,812	3,184	756	894	442
Vans (Enclosed Trailers)	Explosives	1,828	912	1,384	606	360	0

Appendices

The following appendices are included with this memo:

- **Appendix A:** Summary of the Average Quarterly Traffic for the 6-year Construction Phase
- **Appendix B:** Summary of the Average Annual Traffic for the 55-year Operation Phase
- **Appendix C:** Summary of the Average Annual Traffic for the 3-year Decommissioning Phase
- **Appendix D:** Summary of the Average Annual Traffic for Post-closure Phase

APPENDIX A

SUMMARY OF THE AVERAGE QUARTERLY TRAFFIC FOR THE 6-YEAR CONSTRUCTION PHASE

Frank Mackie Winter Access Road						
Average Quarterly Traffic for Construction Phase by Route/Cargo		Route				
		Frank Mackie Winter Access Road				
Vehicle Type	Cargo	Q4	Q1	Q2	Q3	Total
48' Flat-Deck	Infrastructure	218	218	0	0	436
Vans (Enclosed Trailers)	Infrastructure	73	73	0	0	146
48' Flat-Deck	Camps & Support Facilities	0	0	0	0	0
Vans (Enclosed Trailers)	Camps & Support Facilities	0	0	0	0	0
48' Flat-Deck	Mine Site	375	375	0	0	750
Vans (Enclosed Trailers)	Mine Site	125	125	0	0	250
48' Flat-Deck	Plant Site	0	0	0	0	0
Vans (Enclosed Trailers)	Plant Site	0	0	0	0	0
Bus & Passenger Vehicles	Crew Transport	10	10	0	0	20
48' Flat-Deck	Equipment	29	29	0	0	58
Vans (Enclosed Trailers)	Equipment	10	10	0	0	20
48' Flat-Deck	Materials	0	0	0	0	0
Vans (Enclosed Trailers)	Materials	0	0	0	0	0
48' Flat-Deck	Flocculant	0	0	0	0	0
Bulk Tanker	Lime	0	0	0	0	0
Tanker (45,000 L)	Fuel	30	30	0	0	60
Vans (Enclosed Trailers)	Explosives	10	10	0	0	20
Grand Total		880	880	0	0	1,760

ACCESS ROADS: Treaty & Eskay/Coulter											
Average Quarterly Traffic for Construction Phase by Route/ Cargo		Route Treaty					Route Eskay/Coulter				
		Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
Vehicle Type	Cargo										
48' Flat-Deck	Infrastructure	74	84	69	57	284	25	33	28	25	111
Vans (Enclosed Trailers)	Infrastructure	25	28	23	19	95	8	11	9	8	36
48' Flat-Deck	Camps & Support Facilities	160	137	108	80	485	69	75	74	74	292
Vans (Enclosed Trailers)	Camps & Support Facilities	53	46	36	27	162	23	25	25	25	98
48' Flat-Deck	Mine Site	2	2	4	5	13	268	209	176	121	774
Vans (Enclosed Trailers)	Mine Site	1	1	1	2	5	89	70	59	40	258
48' Flat-Deck	Plant Site	851	678	513	338	2,380	0	0	0	0	0
Vans (Enclosed Trailers)	Plant Site	284	226	171	113	794	0	0	0	0	0
Bus & Passenger Vehicles	Crew Transport	88	103	117	126	434	95	105	112	115	427
48' Flat-Deck	Equipment	18	21	26	29	94	55	44	35	24	158
Vans (Enclosed Trailers)	Equipment	6	7	9	10	32	18	15	12	8	53
48' Flat-Deck	Materials	98	74	58	33	263	52	39	27	14	132
Vans (Enclosed Trailers)	Materials	33	25	19	11	88	17	13	9	5	44
48' Flat-Deck	Flocculant	0	0	0	0	0	5	5	5	5	20
Bulk Tanker	Lime	0	0	0	0	0	59	48	36	136	279
Tanker (45,000 L)	Fuel	70	56	52	39	217	61	50	49	38	198
Vans (Enclosed Trailers)	Explosives	4	4	4	4	16	2	1	1	1	5
Grand Total		1,767	1,492	1,210	893	5,362	846	743	657	639	2,885

HIGHWAY ACCESS																
Average Quarterly Traffic for Construction Phase by Route/ Cargo		Route					Route					Route				
		Highway 37					Highway 37A					Highway 16				
Vehicle Type	Cargo	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
48' Flat-Deck	Infrastructure	208	117	97	191	613	109	0	0	109	218	208	117	97	191	613
Vans (Enclosed Trailers)	Infrastructure	69	39	32	64	204	36	0	0	36	72	69	39	32	64	204
48' Flat-Deck	Camps & Support Facilities	229	212	182	154	777	0	0	0	0	0	229	212	182	154	777
Vans (Enclosed Trailers)	Camps & Support Facilities	76	71	61	51	259	0	0	0	0	0	76	71	61	51	259
48' Flat-Deck	Mine Site	457	211	180	314	1,162	188	0	0	188	376	457	211	180	314	1,162
Vans (Enclosed Trailers)	Mine Site	152	70	60	105	387	63	0	0	63	126	152	70	60	105	387
48' Flat-Deck	Plant Site	851	678	513	338	2,380	0	0	0	0	0	851	678	513	338	2,380
Vans (Enclosed Trailers)	Plant Site	284	226	171	113	794	0	0	0	0	0	284	226	171	113	794
Bus & Passenger Vehicles	Crew Transport	188	208	229	246	871	5	0	0	5	10	188	208	229	246	871
48' Flat-Deck	Equipment	87	65	62	67	281	14	0	0	14	28	87	65	62	67	281
Vans (Enclosed Trailers)	Equipment	29	22	21	22	94	5	0	0	5	10	29	22	21	22	94
48' Flat-Deck	Materials	149	113	85	47	394	0	0	0	0	0	149	113	85	47	394
Vans (Enclosed Trailers)	Materials	50	38	28	16	132	0	0	0	0	0	50	38	28	16	132
48' Flat-Deck	Flocculant	5	5	5	5	20	0	0	0	0	0	5	5	5	5	20
Bulk Tanker	Lime	59	48	36	136	279	0	0	0	0	0	59	48	36	136	279
Tanker (45,000 L)	Fuel	146	106	101	92	445	15	0	0	15	30	146	106	101	92	445
Vans (Enclosed Trailers)	Explosives	11	5	5	10	31	5	0	0	5	10	11	5	5	10	31
Grand Total		3,050	2,234	1,868	1,971	9,123	440	0	0	440	880	3,050	2,234	1,868	1,971	9,123

APPENDIX B

SUMMARY OF THE AVERAGE ANNUAL TRAFFIC FOR THE 55-YEAR OPERATION PHASE

Traffic Study 2012 (MAY FINAL)**SEABRIDGE - KSM PROJECT****Average Annual Traffic for Operation Phase by Route/ Cargo (55-year Period)**

Average Annual Traffic for Operation Phase by Route/Cargo (55 year period)		Route				
Vechicle Type	Cargo	Treaty	Eskay/ Coulter	Highway 37	Highway 37A	Highway 16
Bulk B-Train	Copper Concentrates	13,200	-	13,200	13,200	-
Super-B Trucks	Molybdenum Concentrates	86	-	86	-	86
Vans (Enclosed Trailers)	Lime & All Other Reagents	8,440	-	8,440	-	8,440
Super-B Trucks	Grinding Media	2,810	-	2,810	-	2,810
48' Flat-Deck	Liners	226	-	226	-	226
Tanker (45,000 L)	Diesel Fuel	2,246	-	2,246	-	2,246
Vans (Enclosed Trailers)	Lubricants	50	-	50	-	50
Bus & Passenger Vehicles	Personnel and Visitors & Maintenance	408		408	-	408
Vans (Enclosed Trailers)	Camp Supplies	480	-	480	-	480
Super-B Trucks	Explosives	-	925	925	-	925
Bulk Tanker	Lime - Water Treatment	1,278	-	1,278	-	1,278
48' Flat-Deck	Flocculant - Water Treatment	10	-	10	-	10
48' Flat-Deck	Parts & Machinery	910	-	910	-	910
48' Flat-Deck	Major Mine Equipment	-	79	79	-	79
Grand Total		30,144	1,004	31,148	13,200	17,948

APPENDIX C

SUMMARY OF THE AVERAGE ANNUAL TRAFFIC FOR THE 3-YEAR DECOMMISSIONING PHASE

Traffic Study 2012 (MAY FINAL)**SEABRIDGE - KSM PROJECT****Average Annual Traffic for Decommissioning Phase by Route/Cargo (3-year Period)**

Average Annual Traffic for Decommissioning Phase by Route/Cargo (3-year Period)		Route				
Vehicle Type	Cargo	Treaty	Eskay/ Coulter	Highway 37	Highway 37A	Highway 16
48' Flat-Deck	Infrastructure	221	0	221	0	221
48' Flat-Deck	Camps & Support Facilities	250	0	250	0	250
48' Flat-Deck	Mine Site	662	0	662	0	662
48' Flat-Deck	Plant Site	1,511	0	1,511	0	1,511
48' Flat-Deck	Materials	143	0	143	0	143
Bus & Passenger Vehicle	Personnel	210	0	210	0	210
Super-B Trucks	Infrastructure	74	0	74	0	74
Super-B Trucks	Camps & Support Facilities	84	0	84	0	84
Super-B Trucks	Mine Site	221	0	221	0	221
Super-B Trucks	Plant Site	504	0	504	0	504
Super-B Trucks	Materials	48	0	48	0	48
Super-B Trains	Lime	1,000	0	1,000	0	1,000
48' Flat Deck	Flocculant - Water Treatment	18	0	18	0	18
Tanker (45,000 L)	Fuel	888	0	888	0	888
Grand Total		5,834	-	5,834	-	5,834

APPENDIX D

SUMMARY OF THE AVERAGE ANNUAL TRAFFIC FOR THE POST-CLOSURE PHASE

Traffic Study 2012 (MAY FINAL)**SEABRIDGE - KSM PROJECT****Average Annual Traffic for Post-closure Phase by Route/Cargo**

Average Annual Traffic for Post-closure Phase by Route/Cargo		Route				
Vehicle Type	Cargo	Treaty	Eskay/ Coulter	Highway 37	Highway 37A	Highway 16
Bulk Truck	Reagent (Lime)	2,190	0	2,190	0	2,190
Lowboy Flat Deck	Sludge Haul & Maintenance Equipment	20	0	20	0	20
48' Flat Deck	Flocculant	18	0	18	0	18
Bus & Passenger Vehicles	Personnel	24	0	24	0	24
Vans	Food & Misc Supplies	12	0	12	0	12
Tanker (45,000 L)	Fuel	16	0	16	0	16
Passenger Vehicles	Visitors & Maintenance	8	0	8	0	8
Grand Total		2,288	-	2,288	-	2,288

Appendix D

Moose and Highway 37/37A Traffic; a Population Viability Approach

Executive summary

This report contains a population viability assessment of the Nass moose population. A population dynamics model received from the British Columbia Ministry of Environment was used to perform a historical reconstruction of the Nass population under known harvests and demographic rates. A statistical reconstruction produced a best fitting model to empirical trends of abundance survey data and harvest survey data. A moose vehicle collision model was imbedded into the population dynamics model to emulate the fraction of moose mortality that could be explained by the current level of vehicle collisions. The parameters estimated in the statistical reconstruction were treated as predictors of how the Nass population behaves, and used to perform a sensitivity analysis of population predictions under future assumed conditions of harvest and vehicle traffic. The harvest examined was a continued annual harvest of 50 bulls per year.

The vehicle traffic examined several traffic scenarios, including 1) the addition of traffic from the KSM Project during operations and 2) the addition of KSM and other foreseeable mining and hydroelectric projects along the Highway 37 corridor. Finally, the moose population was modeled under a variety of possible future survival rates and hunting rates to examine the models sensitivity to these variables. Monte-Carlo simulations of future scenarios were then conducted using variable inter-annual survival to predict a possible future moose populations under each of the traffic scenarios.

This modeling exercise makes several assumptions about the moose population. Whenever possible, conservative assumptions were made:

- The analysis makes the assumption that birth rates and survival rates in the future will differ from the past only in proportion to vehicle collisions, but will otherwise be the same as the average rates over the period 2001 to 2011.
- The current rate of moose mortality was estimated from the Wildlife Accident Reporting System database where it was assumed that reported moose mortality accounted

for only 30% of the true moose mortality on the highway and with this correction yielded a projected current value of 18.5 moose/year in the traffic assessment area.

- It is assumed that hunting will continue on the moose population with a base harvest rate of 30 bulls from 2012 onward. The model incorporates historic hunting of females, but assumes that initiatives to alter hunting practices towards males are successful going forward from 2012.

This report describes the process of historical reconstruction, parameter estimation, modeling of future traffic scenarios and discusses the data limitations and assumptions in the model. The primary limitation was in the scarcity of data to fit the historical reconstruction. Only three moose estimates have been conducted during the period of 2000-2012. Historical licensed hunting, Nisgaa Nation and First Nations hunting, and mortality due to poaching, existing traffic and carnivores (wolf and black bear) are poorly defined or unknown. Also, assumptions about moose distribution and movement rates were made that likely over-estimate the sensitivity of the population to increased mortality. Results of the historical reconstruction and Monte-Carlo simulations of future scenarios are:

- Overall, the modeled population is very sensitive to small changes in survival rate. This result is partly due to the many age classes (20) used in the BC MOE model yielding a modeled population which is likely more sensitive to changes in mortality than the true Nass moose population. Typical moose models use only 3 age classes and are typically less sensitive to small changes in survival.
- Historic reconstruction of the moose population indicates that hunting rates were the likely initial cause of the moose population decline from 1595 to 517 animals during 2001 - 2011.
- Under a scenario of current traffic and hunting levels, the model predicts that the Nass moose population will not decline substantially, on average, by 2030.

- The addition of traffic from the KSM project is projected to cause an additional 0.89% mortality to the moose population at the current population size, a mortality rate that does not predict a substantial decline from the base case scenario.
- Results indicate that additional mortality of as little as 1% more than the predicted KSM traffic (from vehicles or otherwise) could be enough to cause the population to decline which is less than the projected scenario if all projects in the region were to concurrently enter operations which is unlikely to happen.
- Under a scenario of baseline traffic plus KSM traffic, if the modeled survival rate of moose is increased a small amount (1-2%) and/or if hunting rates are altered, the model predicts an increase in the Nass moose population by 2030 from current conditions.

1 Introduction

1.1 The Issues

During the 2012 working group meetings for KSM Project Traffic, members of the working group expressed concern over the potential effect that increased traffic from the KSM Project on Highway 37 and 37A may have on moose populations. Since the Nass moose population may have already declined from estimated abundance of 1595 animals in 2001 to 638 animals in 2004, and then to 517 animals in 2011 (DeMarchi and Shultze 2011), members of the working group expressed concern that the population might not be able to recover if traffic increases lead to significantly higher mortality rates from vehicle collisions. The concern arises from two factors: 1. the potential increase in the amount of road, and 2. the potential increase in traffic on those roads. Also, since collisions between moose and heavy trucks have a higher mortality rate for moose than with lighter vehicles, and since the majority of mining traffic will involve heavy vehicles, whatever collisions occur will likely be fatal to moose. If both the amount of road with which moose come into contact increase, as well as

the amount of traffic on said road, then the expectation is that vehicle collisions will increase and so will the moose vehicle mortality rate.

1.2 Objectives

The goal of this project is to develop a tool to explore the effect of increased highway traffic and vehicle collisions on the Nass moose population. The Nass moose population is considered to inhabit the Nass Wildlife Area, with a Northern extent at Bell II. The population assessment and analysis contained in this report describes the historical population trends of the Nass moose population, and predicts the effect of increased highway traffic caused mortality on the potential for the Nass population to be sustainable under planned moose harvest management.

The basis for predicting moose population dynamics was an existing model used by the British Columbia Ministry of Environment in Smithers, BC. The moose population dynamics model was originally developed in Excel (i.e.: Moose Model 2000.xls) by BC MOE. Rescan Environmental Services Ltd. (Rescan) contracted model improvement work to include a sub-model that simulates moose vehicle collision mortality under assumed traffic conditions, as well as have the capability to perform extensive sensitivity analysis using various assumptions about variability in survival, harvest rates, and collision mortality.

The MOE moose model was re-coded into the Open Source R statistical language so that the additional highway dynamics could be included, as well as for the statistical and graphical capabilities in R. The goal was to examine the effect of the KSM project on the Nass moose population, and to examine the threshold of activities that the populations may potentially be able to sustain. The updated model is included in Appendix 1.

2 Methods

The population assessment draws upon a broad range of empirical evidence and statistical model fitting. Hunter survey data and abundance survey data are both used to calibrate the model so that it can reconstruct empirical trends. Historical traffic collision data were used to construct a future predictor of vehicle collisions that weds past collision rates with future traffic patterns in a way that makes best use of the spatial heterogeneity of encounters and traffic patterns. The result is a predictive tool that examines population patterns across a range of assumptions and management options.

2.1 Data and trends

The Nass moose population spans management units (MUs) 614, 615, 616, and 630. The British Columbia natural resource managers allocate harvest in conjunction with Nisga'a Nation and Gitanyow First Nation. The Nass population abundance was assessed in 2001, 2007, and 2011. Estimated abundance was 1595, 638, and 517 animals respectively (DeMarchi and Shultze 2011), a 68% decline in 10 years ($\lambda = 0.89$). Since the official Nass population spans all four MUs, a closer look at population trends was warranted. Provided in Figures 1 and 2 are kill per hunter-day (KPHD) trends from 1975 to 2010, which represent a relative population abundance index. It is assumed that the kill rate per hunter remains constant with the number of hunters, so a change in the kills per hunter-day translates to a change in moose abundance. The indices were obtained from provincial hunter survey records, and only account for a portion of the total kills sustained by the Nass populations. The index was obtained by dividing the number of resident kills by the total number of hunter-days in each MU, for each year. The trends are shown in Figure 1 for each MU. Figure 2 shows kills per hunter-day when the kills and hunter days are aggregated across all MUs. The individual MU indices and the aggregated index both show variability around an approximate mean of 0.05 kills per hunter-day. The apparent pattern is that there was

an increase in the relative abundance of moose from the late 1970's until the early 1990's. The trend seems to have been driven by MU 615. The opposite trend seems to be apparent in MU 630. The largest average number of annual reported kills over the surveyed period occurred in MU 615, with 65 kills per year. MUs 614, 616, and 630 had 8, 21, and 23 kills per year respectively. Since MU 615 has more kills per hunter day, it is probably a more influential component of the Nass trend than MU 614. Despite the increase apparent in MU 615 from the late 1970's, and despite the relatively high variability in KPHD, MU 615 is still trending downward. The downward trend in MU 630 appears to have begun in the early 1990's, whereas a decline in MU 615 does not appear to have begun until the early 2000's.

Figure 1: Kills per hunter-day represents inter-annual relative abundance of moose in each MU.

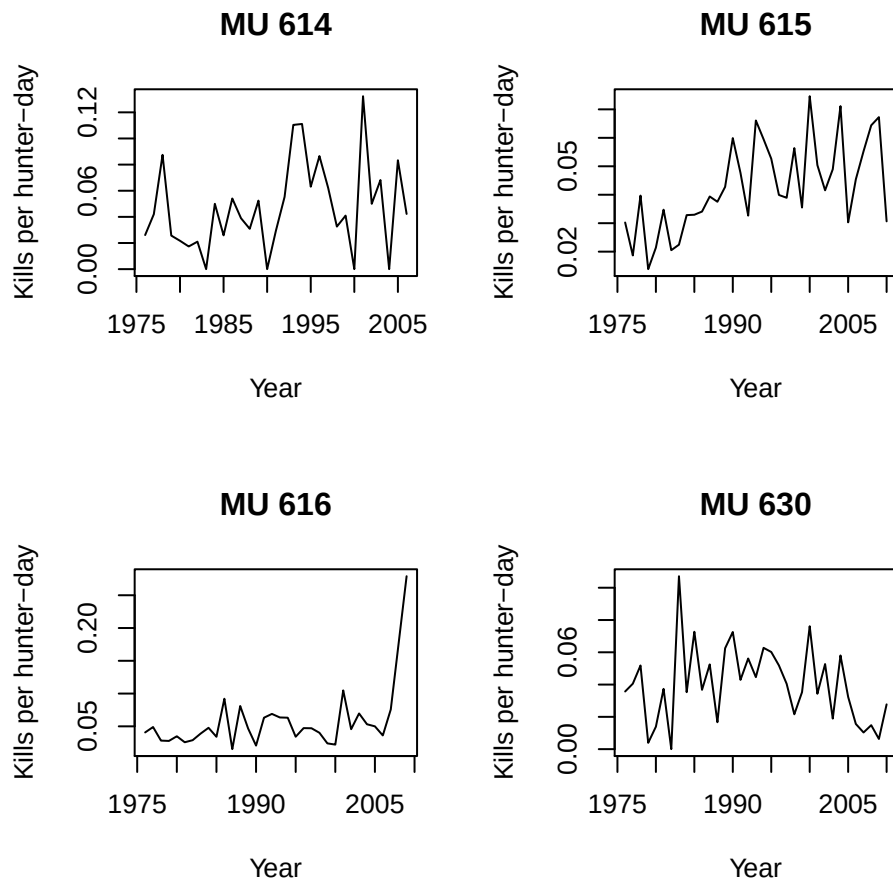
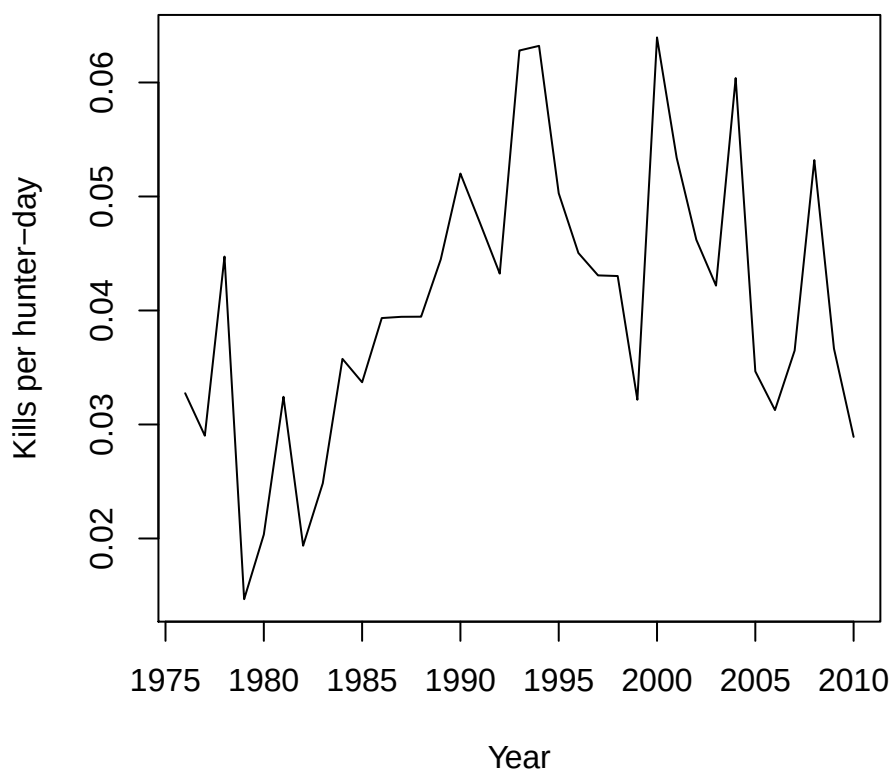


Figure 2: Kills per hunter-day represents inter-annual relative abundance of moose aggregating across all MUs.



2.2 Moose modelling methods

The BC MOE moose model used to evaluate population dynamics is an age-specific fecundity model coupled with age-specific mortality. The model predicts the number of animals from ages zero to twenty, with age-zero being sub-yearlings. In spring, the model predicts an abundance at age from the abundance at the previous age the previous year. Within a given year, the model predicts animals at a series of life stages more or less corresponding to seasons. The first life stage is births, followed by fall females and males, then mid-winter males and females, and finally spring males and females. Harvest is sex-specific, such that harvests can be allocated according to total males and females. Relative numbers at each

age predicts the numbers of males and females at a given age that are harvested.

The model has the capability to scale harvest by vulnerability at age and sex, but by default, all adults of all sexes are equally vulnerable to harvest, with the exception of sub-yearlings. For a set harvest quota, animals at each age are harvested in proportion to their abundance. For example, if 100 males are scheduled for harvest, and if age 5 males accounted for 10 percent of the total male abundance, then 10 age 5 males would be harvested and the remaining 90 moose would come from the remaining age classes in proportion to their relative abundances.

Some critical assumptions are imbedded in the BC MOE model, and include:

Sex ratio threshold parameter Below a certain ratio of bulls to cows, there will be an insufficient number of bulls for every cow to find a mate. The value of this parameter is set to 35 bulls per 100 cows in the BC MOE model. Once the ratio falls below that number, the fecundity of each age class of females begins to drop linearly, until fecundity reaches zero when there are no bulls.

Age specific fecundities of females Age zero cows do not mate. All other ages do, with fecundity rates rising to an average of 5% twinning rate by age 6. Fecundity as defined by the BC MOE values begins to decline by age 13. The fecundity schedule from the BC MOE model is provided in Table 1.

Reproductive multiplier parameter The age specific fecundities are in fact just relative numbers at age. A multiplier parameter can be used to scale all fecundities higher to match observed birth rates. This number is currently set to 0.95, meaning that fecundities are 5% lower than the values in Table 1.

Winter survival scaling parameters It is assumed that overwinter survivals are lower than summer survivals. A scaling parameter is estimated in this analysis to capture this relative quantity. The statistical fitting procedure will confirm if there is a winter effect if the value of the scaling parameter is below 1.

Female survival scaling parameters It is assumed that overwinter survival of females is lower than males, owing to the increased stress of maternity and the demonstrated relative rate of vehicle collisions. A scaling parameter is estimated in this analysis to capture this relative quantity. The statistical fitting procedure will confirm if there is a winter effect if the value of the scaling parameter is below 1.

Historic and Future Hunting It is assumed that historic hunting consisted of a mixture of males and females. The exact mixture is unknown but the historic reconstruction process is robust to a variety of sex ratios. Future hunting in this analysis is conducted with and all male harvest, and with a mixture of male and female harvest.

Table 1: Age specific fecundity table. Fecundities indicate an average number of births per female, i.e., numbers above 1 indicate some females are twinning, and numbers below 1 indicate substantial number of females not producing calves.

Age	Fecundity
0	0
1	0.17
2	0.76
3	0.8
4	0.9
5	1
6	1.05
7	1.05
8	1.02
9	1
10	1
11	1
12	1
13	0.9
14	0.8
15	0.8
16	0.7
17	0.7
18	0.7
19	0.7
20	0.7

2.2.1 Moose model fitting

To estimate the moose model parameters, a maximum likelihood estimation was implemented. The method involved fitting the model to both survey data and relative abundance data. Log-normal observation error models were constructed for both data sources. The survey data assumed an unknown level of observation error as did the relative abundance data. The equations for each likelihood are shown below. Beginning with the relative abundance data, Equation 1 shows a linear relationship between abundance and an index of relative abundance.

$$Y_i = qN_i e^{\beta} \quad \text{where} \quad \beta \sim N(0, \sigma_{\beta}) \quad (1)$$

$\{Y_i\}$ (the index) is an empirical quantity (kills per hunter-day). q is a scaling quantity used to describe the relationship between the actual values $\{N_i\}$ and the set of observed quantities $\{Y_i\}$. β is a gaussian random variable with mean 0 and standard deviation σ_W . Taking the log of both sides we get:

$$\log\left(\frac{Y_i}{N_i}\right) = \log(q) + \beta \quad (2)$$

Setting $Z_i = \log(Y_i/N_i)$ and using the MLE $\hat{q}' = \widehat{\log(q)} = \frac{1}{n} \sum_i^n Z_i^2$ minimises the following negative log-likelihood function:

$$L = \frac{(n-1)}{2} \log \sum_i^n (Z_i - \hat{q}')^2 \quad (3)$$

This generic likelihood kernel will self-weight to the reciprocal of the variance of the observation process. The abundance estimate likelihood is given by

$$N_{obs,i} = N_{pred,i} e^{\gamma} \quad \text{where} \quad \gamma \sim N(0, \sigma_{\gamma}) \quad (4)$$

where it is assumed that the model makes an accurate prediction of the dynamics, but

that the data are prone to being incorrectly observed by an amount proportional to σ_γ , the observation error term. Adding up the two likelihoods and searching for parameter combinations that maximize the likelihood provides a statistically credible evaluation of the relative rates of the parameters that most likely predict population dynamics, i.e., the highest likelihood that parameters could explain the data observed.

A proper computational search of parameters (an exhaustive algorithmic optimization) would have required more abundance data than was available, but a profile of the relative likelihoods shows that there are parameter combinations that do a much better job than others at predicting empirical trends. Figure 3 shows the relative likelihoods as parameters are adjusted away from the optimal value. These plots are showing negative log-likelihood (NLLs) profiles, so the smaller the NLL, the more likely the parameter is the right choice. Thus the model fits the data best with a male survival rate of just under 94%. The female survival rate is approximately 10% lower, i.e., 0.90 of the male rate. The reproductive multiplier is a scaling factor that accounts for observation uncertainty in birth surveys. It's value is estimated to be 0.95. The fitting procedure estimates that the population in mid winter prior to the first surveyed year was 1800 animals. The 1800 animals were subject to mortalities and were then compared to the surveyed abundance in 2001 (1595 total animals). When the optimal parameter values are used, the model is considered a “best fit”. The best fitting model is shown in Figures 4 and 5.

2.3 Vehicle collision modelling methods

Moose vehicle collisions (MVCs) are a documented source of moose mortality, both in the broad literature as well as in the British Columbia Wildlife Accident Reporting System (WARS) (Sielecki 2007). Typically, the frequency of collisions is higher in winter months (see Figure 6). Additionally, surveys conducted by Gitanyow resource managers from 2009-2011 show that females account for the greatest portion of identifiable kills, and the greatest proportion (70%) of sightings on the road. Vehicle collision modelling involved integrating

Figure 3: Likelihood profiles of key estimate population parameters. Each panel shows the negative log of the likelihood of predicting the data given the parameters.

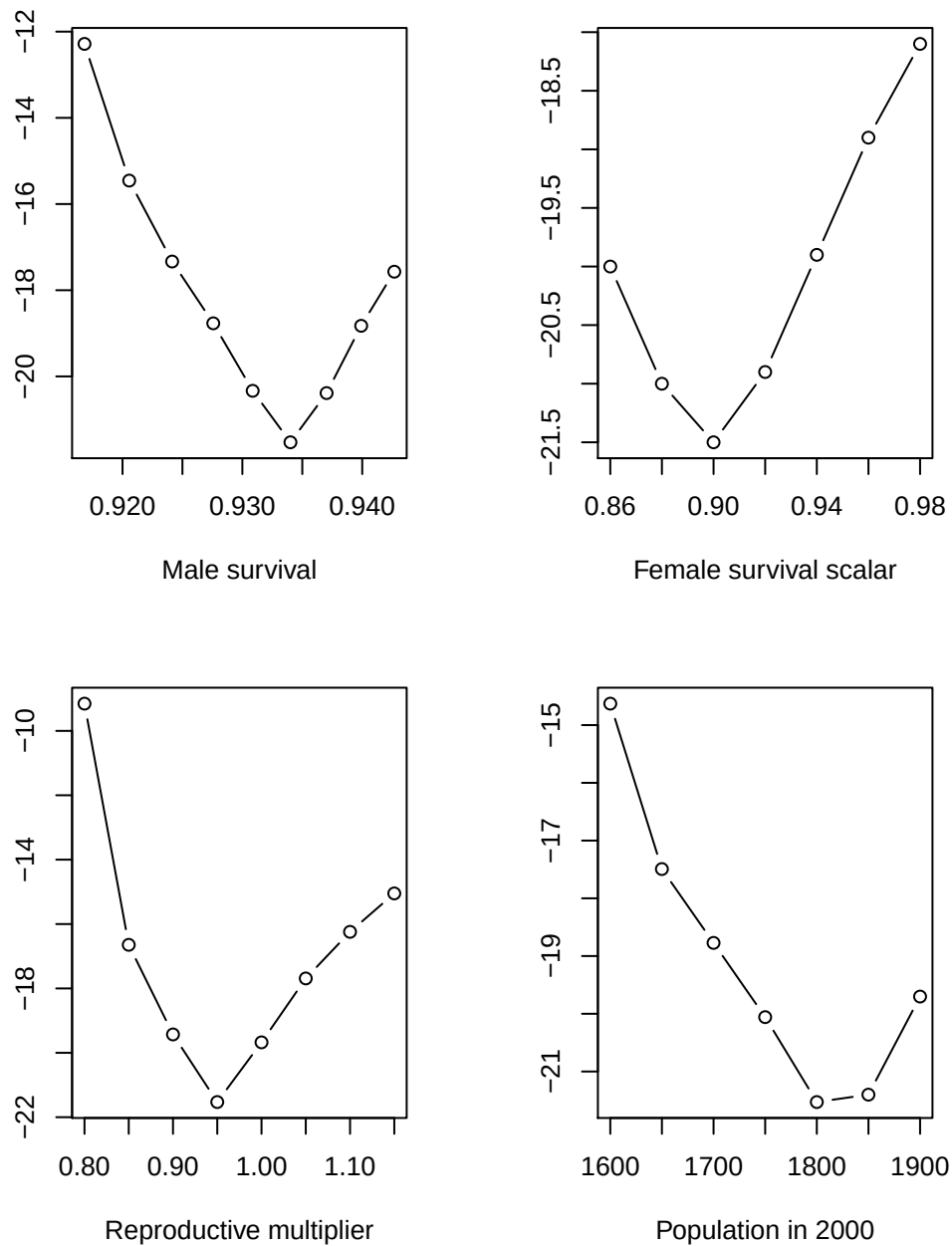
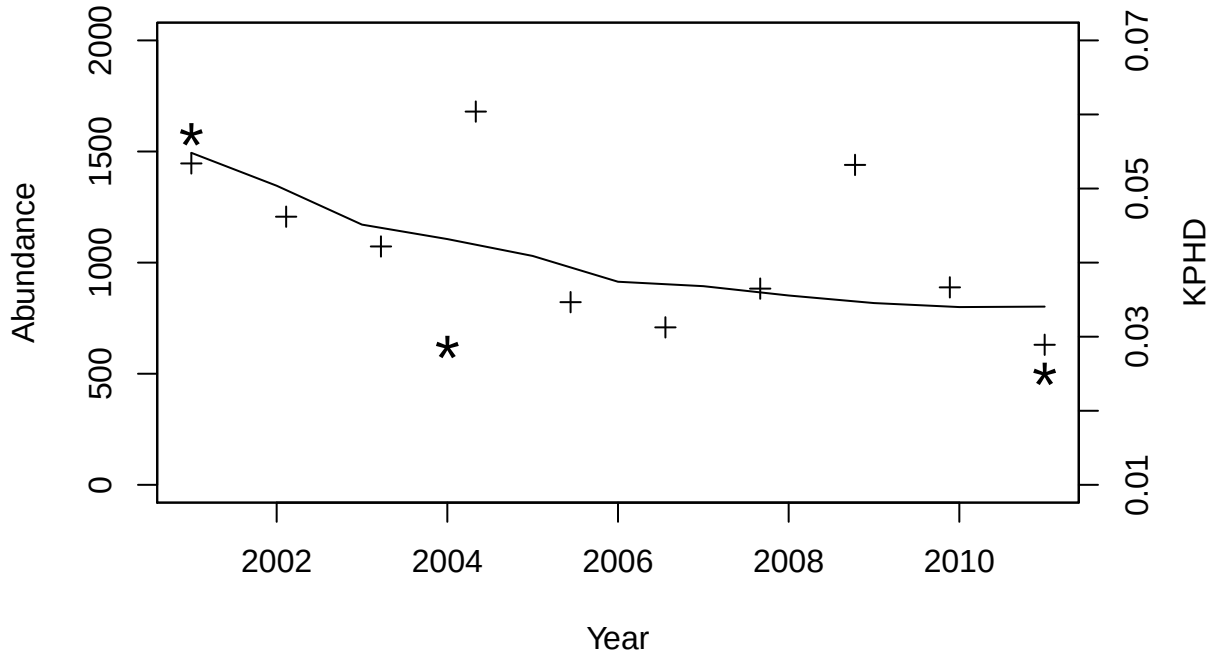


Figure 4: Plot of predicted and observed trends. Line shows the best fitting model using maximum likelihood parameter estimates. The star symbols show the abundance survey values. The plus symbols show the relative abundance trends from kills per hunter-day.



two sources of vehicle collision data (WARS database and Gitanyow survey) with a result obtained from the scientific literature (Seiler 2005). The regional WARS data indicate that collision rates are higher in the Southern part of highway 37 than in the Northern part (see Figure 6). The Gitanyow survey covers approximately 25% of Highway 37 and reported 14 kills in 2010 and 2011 between fall and spring. The WARS database recorded 111 moose vehicle collisions across the entire stretch of Highway 37 from Kitwanga to Bell II between 1991 and 2010, an average of 5.8 collisions per year with incident, but averaging 5.55 collisions if years without collisions are included.

Data on moose vehicle collisions are sparse, but a rough estimate is possible. The assumption is that vehicle mortalities can be partitioned into different sections of the highway, where the sections are defined by relative lengths and relative amounts of historical and forecasted vehicle traffic. A study by Rolandsen et al. (2011) showed a rough estimate 0.07-0.09

Figure 5: Plot of predicted and observed trends of bulls, cows and calves. Lines show trend in predicted abundances. Plus symbols show the survey abundances.

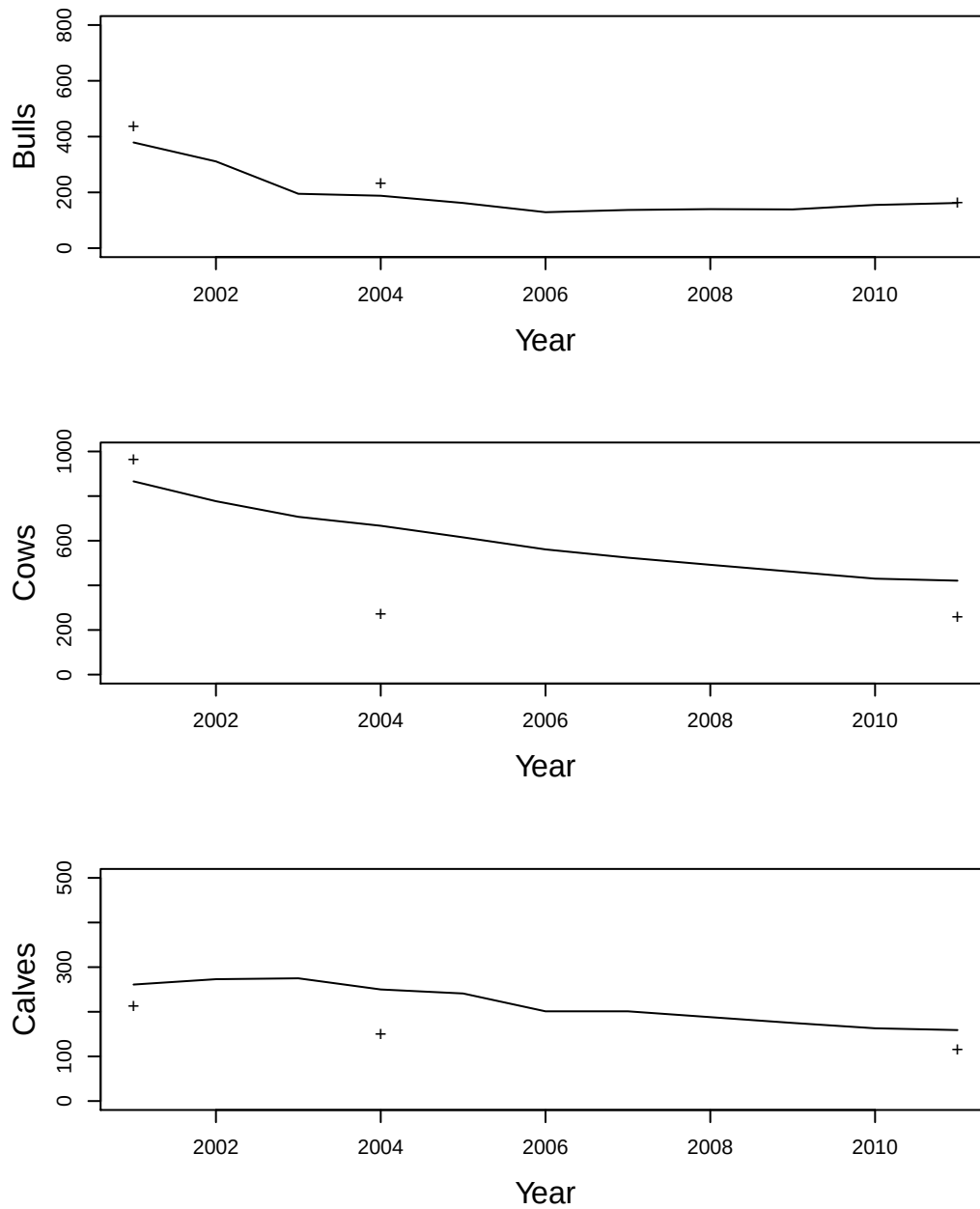
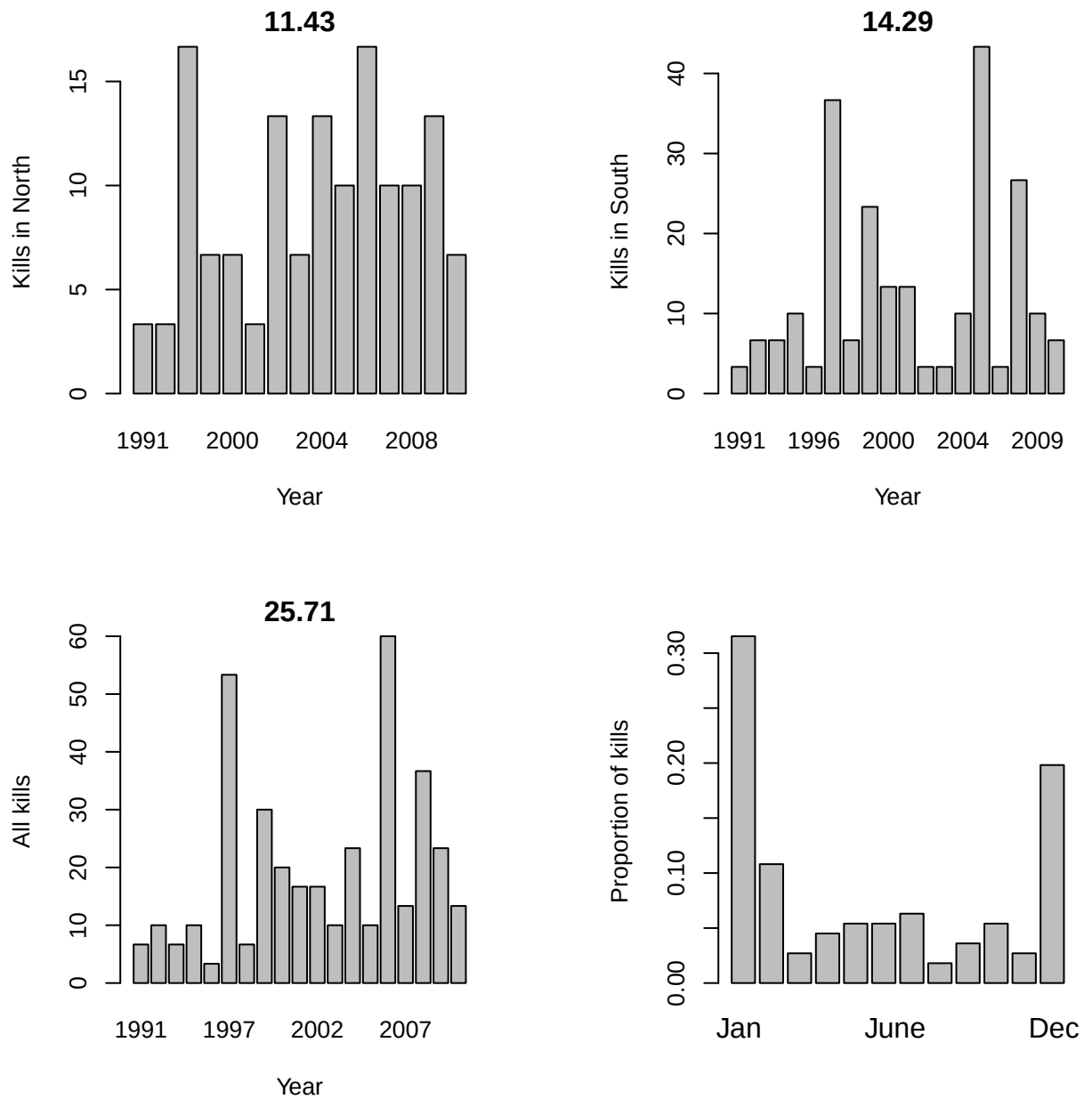


Figure 6: Wildlife accident reporting system recorded moose kills North and South of Meziadin junction from 1991 to 2010. Figures show the reported number of kills, corrected for a reporting rate of approximately 30% of actual kills. Mean 2004-2010 values are shown in bold above each panel.



moose kills per 10 km of road, which would translate to only about 3 moose kills in the KSM transportation corridor. However, the study was conducted over an area well beyond the Nass population range and may have reflected lower average moose densities. To convert projected increases in amount of road into MVCs, along with projected increases in amount of traffic, assumptions need to be made about how those projections translate into kills. This analysis builds upon first principles of probability and exposure to mortality risk, to construct a rough estimate of the effect of changes to traffic conditions from the perspective of moose distribution.

The first assumption is that moose are randomly distributed across distinct areas in some assumed density. For the purpose of addressing traffic dynamics in conjunction with moose population dynamics, we will make no assumption about the distribution of moose across the entire Nass Wildlife Area, but rather assume that the relative probabilities of being hit per vehicle will reflect the relative moose densities. As vehicle traffic increases, the relative number of kills will also increase. This is based on the simple assumption that kills are a product of the relative magnitude of risk and the availability of moose to that risk. The availability of moose is a product of their relative distribution and how many per unit area will be exposed, i.e., $K = N p \alpha L T$, where K is kills, N is total moose, p is portion of moose within an area, α is the number of kills per vehicle trip per km, L is length of road with said traffic, and T is trips. Note that $p \alpha$ can be collapsed into a single parameter if all you know is N , so the number of kills can be predicted with an increase in either L or T . More importantly, if K and N are known, we can assume that as long as L and T don't change, that the proportion of moose killed will be equal to $p \alpha L T$.

Research on moose collisions in Sweden (Seiler 2005) indicates that the number of kills increases linearly with the amount of traffic at low traffic volumes, but curvilinear at higher traffic volumes. The study was conducted over more than 10 years, where abundance changed, so there is some variability in the kill rates, but the trend still suggests linearity in relation to traffic (again, at low traffic volumes similar to those on highway 37). Only

sparse population abundance is available for the Nass population, and the WARS road kill surveys are known to include as little as 25-35% of kills (WARS 1988-2007 Special annual report), but recent years were surveyed within the Gitanyow area as well. If the WARS database only reports 30% of kills, the number of kills per year would be $5.55/0.30 = 18.5$ kills per year. If the Gitanyow survey covers only 50% of the entire stretch of Highway 37 from Kitwanga to Meziadin, then the 9 observed kills South of Cranberry in 2011 translate to 18 kills per year just in the Kitwanga to Meziadin stretch, which is higher than the WARS database average of 12 in the Southern segment alone once corrected for underreporting, but not higher than some of the peak years reported in the WARS data (summarized in this section). It might be said that densities varied throughout the multiple decades of WARS data, but since the KPHD trends indicate that abundance may now be similar to what it was in the mid 1970's, the the average number of 5.55 is credible (especially since it was recently reported in that range).

If we assume that the MVC is a probabilistic process, then we can translate the kills into a mortality rate and thus make the abundance implicit in the model. The 2001 abundance estimate for the Nass moose population was 1595 animals. Since the abundance was 638 animals in 2004, $\lambda = 0.97$ between 2001 and 2004. If the recent trend of $\lambda = 0.97$ is assumed then the 2010 population would have been 532 animals (and the average abundance across year 2010-2011 would have been 524.5). Therefore, the mean rate of mortality at an assumed status quo traffic volume across the entire range of highway 37 that spans the Nass moose territory would be $18.5 / 524.5$, or about 3.5% mortality from vehicle collision.

This estimate constitutes the simplest possible assumption, i.e., that that moose are distributed evenly across a long uniform road length from Kitwanga, past Meziadin junction, and all the way to Bell II. It makes no assumption about different traffic patterns, nor does it allow for traffic conditions to change or for more roads to be built. We will refine the assumptions about the traffic model to account for some spatial variability so traffic increases can be encapsulated. We will assume three different road segments: 1. Highway 37 from

Kitwanga to Meziadin junction (156 km), 2. Highway 37 from Meziadin North, including Eskay Creek and Treaty Creek areas (177 km), and 3. Highway 37A (65 km).

The WARS database is subdivided into highway Landmark Kilometre Inventory (LKI) segments. These data are also an under-representation of the actual number of wildlife collisions, mainly due to reporting error; however, they are the best available data, but numbers must be interpreted with caution.

The KSM transport route covers a portion of Highway 37 from Kitwanga to the Eskay Creek Mine Access Road, which is included in LKI segments 3710, 3720, 3730, and 45 km of 3740 (LKI 3740 extends north from Bell II to Burrage, approximately 39 km north of the Eskay Creek Road). LKI segment 3740 will be included in this assessment, as the Study Area includes 54% of this segment. The transport route along Highway 37A is LKI segment 3725.

An aggregate of all moose kills in the WARS database relevant to the Nass is shown in Figure 6. Kills have been corrected for the approximate reporting rate of 30%, i.e., 3 reported kills representing 10 actual kills. There is no demonstrable evidence for an increase or decline in MVCs between 1991 and 2010, but if anything, there may have been an increase until around 2000, and subsequently a decrease. This would be consistent with MVCs representing a constant percentage of moose mortality assuming constant traffic conditions. To construct a baseline vehicle mortality rate useful for making forward projections, it is useful to look at recent MVC rates and abundances. Since 2004 the population has averaged 577 animals if you assume a linear decline from 638 to 517 in 7 years. To convert this to a mortality rate per km per VPD, we only need to divide proportion of population killed by km of road and by VPD. The portion of the total population killed by vehicles in the North segment equates to $11.43/577 = 1.98\%$. The southern portion equates to $14.29/577 = 2.45\%$. These would be scaled using Equation 5.

$$\alpha = \frac{K}{NLT} \quad (5)$$

The historical patterns for the three segments are shown in Table 2. For simulation purposes, it is assumed that there will be traffic increases on all three segments. The North segment traffic represents the average of the Treaty-Meziadin portion and the Eskay-Treaty section (227 and 313 VPD). The number of kills per km per VPD during historical traffic conditions is given by α . During the KSM operation phase, there will be both more traffic and also more operation road km being driven, therefore the predicted MVC will be scaled accordingly. For example, when vehicle traffic increases to 313 VPD (an extra 89 VPD from KSM traffic), the vehicle mortality rate would increase to $0.0198 \times (309/224) = 0.0273$ and the southern rate would increase to $0.0245 \times (848/799) = 0.0259$, representing a 40% increase in vehicle mortalities in the North and a 6% increase in the South.

Table 2: Historical and projected trends in road vehicle traffic. Vehicle traffic per day (VPD) and the number of km of active road are used to scale MVC rates. The KSM data in the North segment represent an average of the VPD from Eskay to Treaty and that from Treaty to Meziadin. The peak foreseeable traffic volumes (including KSM traffic) are shown in the bottom row with estimated moose kills rates.

		North	South	37A
Historical	VPD	224	799	244
	km	177	156	65
	Mortality rate	1.98%	2.45%	NA
	Moose kills	10	12	NA
Historical + KSM	VPD	313	848	280
	km	177	156	65
	Mortality rate	2.73%	2.59%	NA
	Moose kills	14	13	NA
Historical + KSM + all foreseeable projects	VPD	722	1121	492
	km	177	156	65
	Mortality rate	6.4%	3.4%	NA
	Moose kills	32	17	NA

Additional projects that will add traffic to the North and South segments of Highway 37 are Bronson Slope, Brucejack, Forrest Kerr Hydroelectric, Galore Creek, Kitsault, Kutcho, McLymont Creek Hydroelectric, Red Chris, Schaft Creek, Snowfield, Storie Moly, Turnagain, and Wolverine mines. Each project will add traffic for a period of time beginning as early as

2014, and lasting anywhere from approximately 10 to 30 or 35 years. Reasonable foreseeable project schedules show traffic gradually increasing to an additional 300-400 VPD by the year 2030, adding an additional 4-5% winter mortality from MVCs when cumulative traffic is at its highest level in the North and South segments.

The estimated survival overwinter rates from model fitting were 90% for males and 88% for females. To incorporate the additional vehicle traffic, we need to add another $0.0273 - 0.0198 = 0.75\%$ for the increase coming from the North and another $0.0259 - 0.0245 = 0.14\%$ for the South, translating to a total decrease in survival of 0.89%. The KSM traffic will therefore reduce overwinter survival by just under 1%.

3 Results and discussion

3.1 Simulation analysis

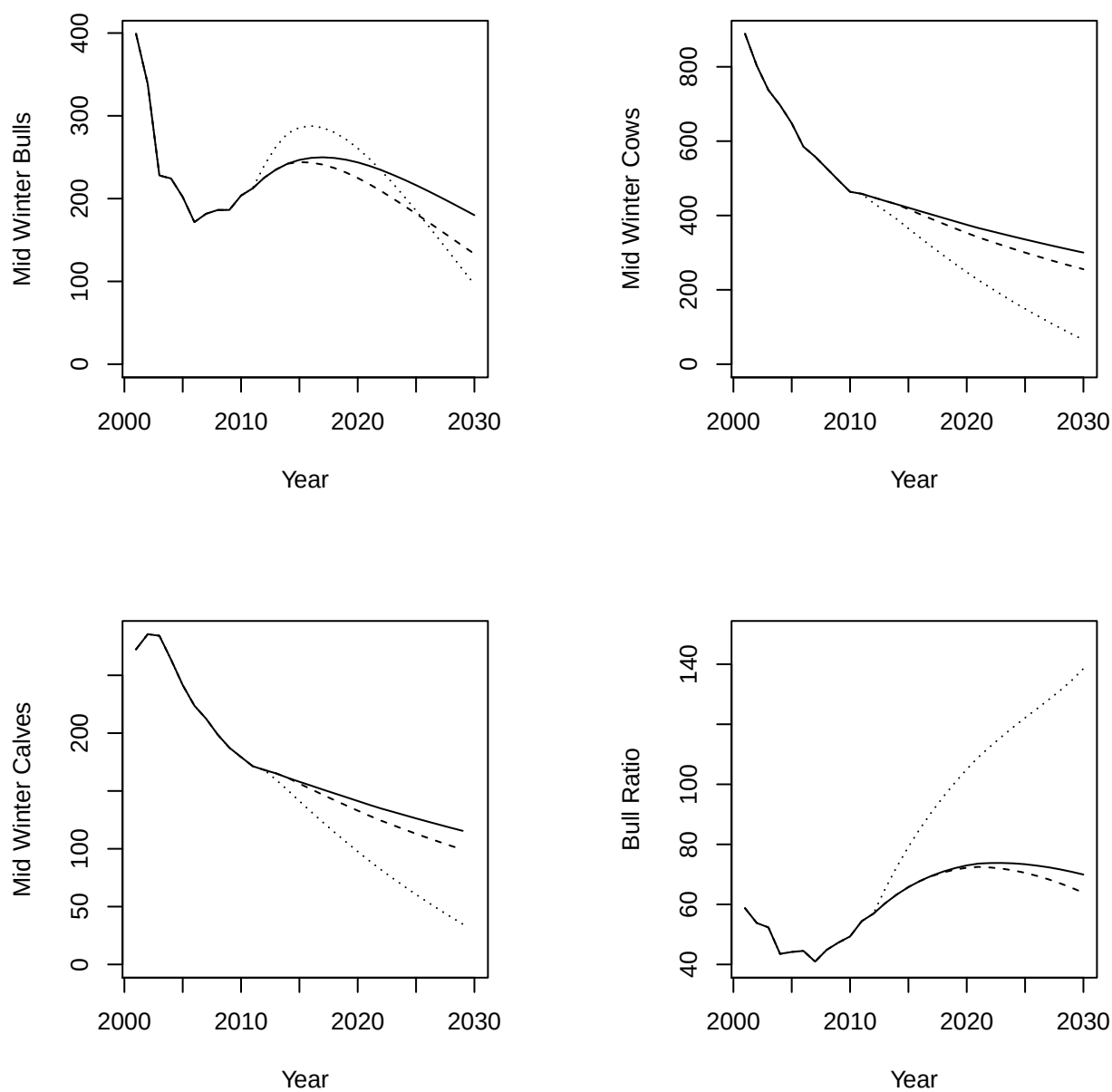
A simulation analysis was performed to examine the long term viability of the Nass moose population under alternative management assumptions and alternative assumptions about natural variability. The two management variables examined were the bull harvest rate and the rate by which the population can sustain additional mortality from vehicle collisions. Figure 7 shows a comparison of the *status-quo* situation without any further road construction or vehicle traffic, and the basic assumption of the increases in project operations traffic shown in Table 2 effective 2014. Operational traffic levels are simulated effective 2014 despite the fact that operational level traffic may not occur until 2019, but simulating those levels a few years earlier partially compensates for the fact that construction traffic levels will be effective as well as accounting for potential early operations (i.e., a precautionary prediction).

The simulation assumes the maximum likelihood parameter estimates obtained using the likelihood profiles in Figure 3, and using the historical bull, cow and calf harvests as well as the 2012 and forward harvest of 40 bulls per year. Survival rates are assumed to be

deterministic. These simulations show that KSM road traffic is predicted to result in about 23% fewer bulls, 14% fewer cows, and 14% fewer calves in 2030 with a 30 bull harvest than if no traffic increase had not occurred. If the harvest is split 50:50 among bulls and cows, the bull abundance improves on the short term, but then declines to a lower abundance than when the harvest was purely bulls. Harvesting cows also causes calf abundance to decline faster than when only bulls are harvested. This comparison accounts for no variability in inter-annual survival. It is the maximum likelihood estimator of future abundance, but in no way accounts for the range of possible outcomes. For this we look to a Monte-Carlo simulation analysis.

To account for inter-annual variability in survival, random draws from a normal distribution with $N(\mu_s, \sigma_s)$ were taken to produce survival rates of μ_s where 95% of random draws are contained in the ranged plus or minus σ_s/μ_s (see Figure 8). Using an average survival rate of $\mu_s = 0.94$ and $\sigma_s = 0.30$ produces annual survival rates that fluctuate around the mean by about plus or minus 5%. When simulations are performed under variable survival assumptions, outcomes are different in each simulation. Monte-Carlo simulations were performed 1000 times by drawing different random values of the survivals in Figure 8 and using those survivals in each year of the 1000 different simulations. 1000 different 30-year predicted outcomes were simulated, each of which implements KSM road traffic conditions in 2014 (except the *status-quo* simulation, which maintains current road conditions). Figure 9 shows the frequencies of 2030 predicted abundances for 1000 Monte-Carlo simulations under variable survival assumptions for three cases: one case with no change in traffic or survival (survival = 93.4%, top row), a second case with KSM projected traffic patterns and the same survival rate (middle row), and a third case with a different assumed survival rate one percent higher but also with the KSM traffic (bottom row). Panels show the distribution of predicted abundances of bull, cow and calves when 1000 simulations are performed. The *status-quo* scenario shows a distribution of abundances of bulls, cows and calves that spans the MLE prediction shown in Figure 7. A small fraction of the simulations predict

Figure 7: Simulated trends in mid-winter abundances. Solid lines show abundance projections if there is no additional traffic. The dashed line shows abundance projections with 30 bulls harvested and with the traffic situation described in Table 2 becoming active in 2014. The dotted line shows abundance projections with 15 bulls and 15 cows harvested and with the traffic situation described in Table 2 becoming active in 2014



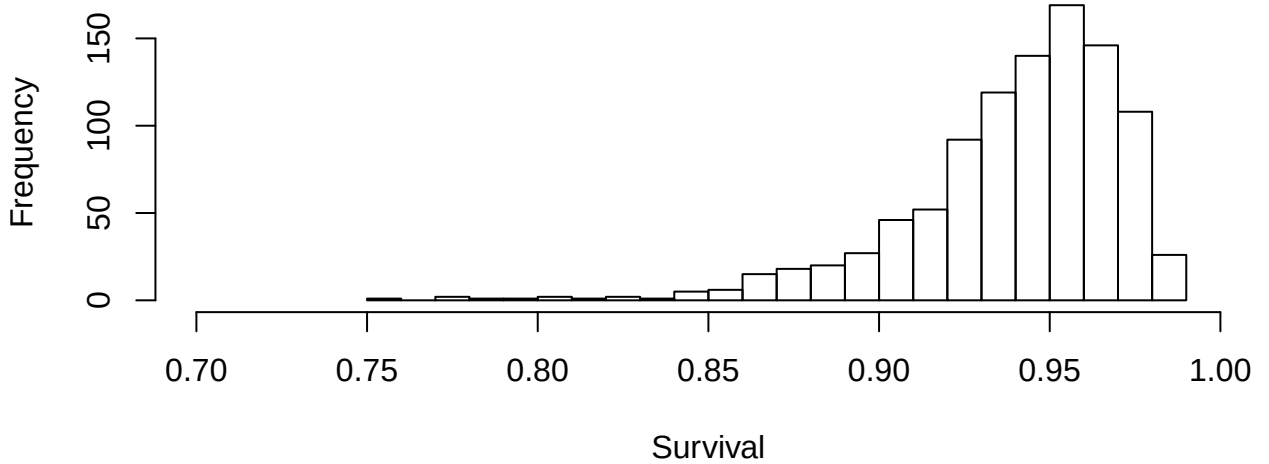
2030 bull populations near zero. This could easily result when abundances approach the 30 bulls being harvest harvested. Under the KSM traffic scenario with MLE survival estimate of 93.4% (middle row), there are soome outcomes which involve very low abundances and overall, mean 2030 abundances are somewhat lower than without the KSM traffic.

The bottom row shows a simulated outcome when survival rates are assumed to be fully 1% higher than the MLE estimate, which is shown to demonstrate a case where the MLE survival rate may biased low, or that we may be overestimating the effect of the KSM traffic (i.e., we should be assuming a higher overall survival rate accounting for statistical bias and/or traffic effects). Most importantly, we see that there is a dramatically different outcome with an adjustment of a mere 1% in survival (note that survival is summer survival, and that winter survivals for males and females are scaled downward).

Since cumulative traffic from all projects is predicted to add well over 300 additional vehicles per day by 2030, which translates to more than 4% additional mortality from project traffic, this analysis predicts a total MVC mortality rate approaching 9% (accounting for historic, KSM, and all other projects). Using the BC MOE model with these results, we predict that the Nass moose population will decline if traffic levels increase to the levels projected for all projects.

A more comprehensive view of projected population abundance can be obtained by tabulating summaries of the results of Monte-Carlo simulations across a broader range of survival rates and harvest rates. Table 3 shows the mean abundances from simulating 1000 times for each of five harvest rates between 10 and 50 bulls. Results between 93% and 94% survival are closest to the maximum likelihood estimate and should be viewed as the baseline range of prediction. The 93% results are equivalent to a situation where either the survival rate is actually lower than the estimated rate, or that traffic volume is higher by an amount that would translate to about a 0.5% decline in survival. We see from these tabulated results that small changes in the survival rate translate to large changes in long-term abundance, much more so than from variation in the bull harvest. Variation in bull harvests at the 94% level

Figure 8: Distribution of survival rates with inter-annual variability estimated by σ_s .



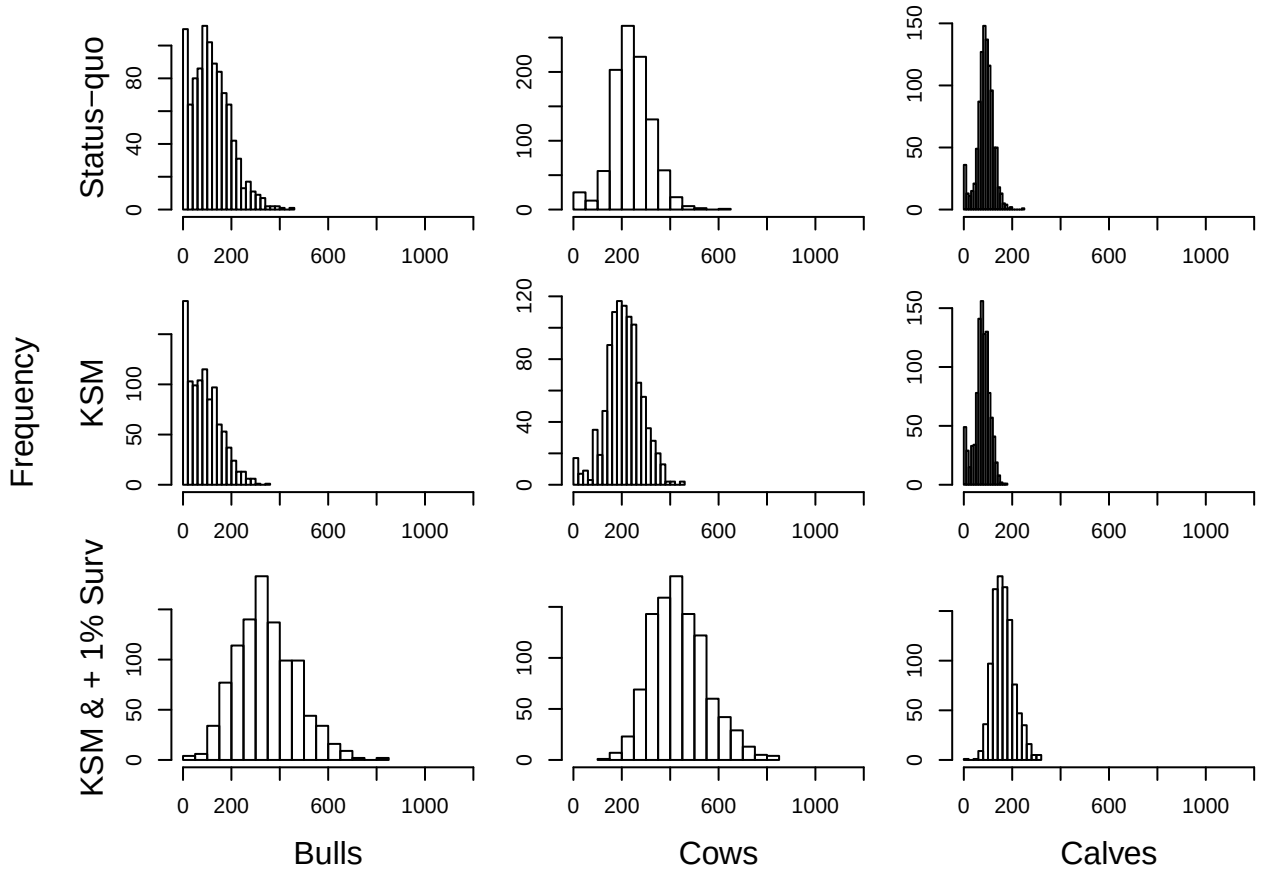
do, however, translate to mean abundance difference of 50% in bulls, though bull harvest has little effect on cows at that survival level.

These results suggest that the level of traffic arising from the KSM project will not likely lead to a substantial decline in the Nass population in the next 20 years. If the MLE survival rate is even 0.5% underestimated, it makes a substantial difference in the sustainable bull harvest. At 93% survival, a harvest of more than 30 bulls causes near extirpation. At 94%, the population appear to be able to sustain harvest of 50 bulls without any effect on cows or calves. The main concern is that the predictions change drastically with a small change in survival, and that the MLE survival rate appears to be the threshold rate at which harvest is just sustainable. The difference between 95% and 93% is the difference between a viable population and one at risk of declining if harvest is higher than 30 bulls.

3.2 Discussion

Moose population dynamics were reconstructed using a stage-structure and age-structured survival model. Vital parameters were estimated using maximum likelihood profiling tech-

Figure 9: Frequencies of 2030 population abundances under maximum likelihood survival estimate (MLE) and *status-quo* traffic conditions with a 2012-2030 bull harvest of 30 bulls (top row), MLE survival and KSM traffic conditions from Table 2 (middle row), and MLE survival + 1% and KSM traffic conditions from Table 2 (bottom row).



niques and subsequently used to simulate population trends. A moose vehicle collision model was constructed such that increases to vehicle traffic within the Nass moose territory resulted in commensurate increases in moose vehicle collision mortality. A Monte-Carlo simulation analysis indicates that under the proposed road construction and traffic volume increases projected to occur as a result of the KSM project, the Nass moose population is predicted to remain stable at a constant moose harvest of approximately 30 bulls per year. Results also indicate that the population is unlikely to be able to sustain additional mortality as a result of further vehicle traffic on roads.

Table 3: Mean of 1000 simulated bull, cow and calf abundances. Simulations involve KSM road traffic effective 2014 and 2012-2030 bull harvests of 10, 20, 30, 40 and 50 bulls. Each row block corresponds to an assumed base summer survival rate. Shown in bold are results of a 30 bull harvest when survival rates are approximately plus or minus 0.5% of the MLE survival rate (0.934), i.e, the results from Figures 7 and 9 are roughly between the two results in bold.

Survival	Mean 2030 Abundance	10	20	30	40	50
0.93	Bulls	123	69	25	4	1
	Cows	142	140	126	93	66
	Calves	53	52	40	18	8
0.94	Bulls	324	258	189	131	74
	Cows	308	305	302	305	282
	Calves	116	115	113	111	93
0.95	Bulls	721	659	577	513	441
	Cows	637	643	637	641	641
	Calves	238	240	238	239	239
0.96	Bulls	1564	1491	1402	1330	1235
	Cows	1343	1355	1348	1355	1341
	Calves	500	504	502	504	499

It is possible that survival rate estimates are biased low, and that the true long-term effect of MVCs on survival rates is higher, but the structure of the model, with constant survival rate across all ages has the effect of forcing estimation to attribute higher mortality to younger age classes, which has the compound effect of predicting fewer births. Additionally, the survival rates may have changed over time, i.e., the effective survival rate excluding hunting may not be the same in earlier vs. later years. One possible interpretation for this is that unreported harvests may have been higher in earlier years than in later years. If unreported harvest was higher in earlier years, which could be expected because there would have been less concern for the population, then the statistical fitting method used to obtain parameter estimates would have biased the survival rate downward to compensate. If actual harvest rates were truer to reported rates in years following the decline in the Nass population, the estimated survival parameters calculated in this report would be lower than in reality.

The overarching message to be taken away from this analysis is that using statistically estimated survival rates, which account for the average exogenous mortality sources between 2001 and 2011, the population will remain relatively stable even if the KSM project is implemented with the traffic patterns described. At a bull harvest of 30 bulls annually, abundances are expected to decline only slightly from the most recent survey in 2011. This would not be the expected result if cows were also harvested, since the cows survival rate is lower than that of bulls, and also because fewer cows means fewer fecund females to calve (see Figure 7).

The results assume approximately 93.5% summer survival, with winter survivals of bulls and cows commensurate with the scaling factors estimated. This also assumes survival will be reduced by the MVC rate projected to take place from 2014 onward. It also assumes that the Nass population is present in the areas where those roads will be built, and this is not necessarily the case. DeMarchi and Shultze (2011) only surveyed South of Bell II, and some of the vehicle traffic will be outside of that area. The potential dynamics of moose vehicle collisions should be viewed as occurring in the 93-95% range of survival in Table 3. Within this range we see a broad range of outcomes which include an MVC mortality factor of 0.89%, which means that as long as the 94% is the baseline scenario, any interpretation that the MVC factor should be higher or lower need only look at the relative numbers in Table 3.

The predicted future traffic effect when all scheduled projects are operational can be interpreted by assuming that the cumulative MVC rate will increase about an additional 4% by 2030. The long-term predicted population abundance from Table 3 would be predicted using a survival rate up to 4% lower than 94%, which would obviously be as low as 90%. Since 2030 abundances are already low at just 93%, they would be predicted to be much lower in the 90-92% range when more projects add traffic. Not all traffic is necessarily high risk traffic though, and it may not be as simple as just accumulating traffic volume and scaling the MVC mortalities linearly.

There are a few moderating factors worth considering in the interpretation of rate scaling:

- 1) Moose may not redistribute themselves fast enough spatially to place more animals at risk once a mortality occurs, so it may well be that ten times more vehicles does not predict ten times more kills. This is what was shown in (Seiler 2005),
- 2) More and more of the cumulative traffic will actually be of the speed-limited variety anyway, so there is reason to believe it won't generate the same relative mortality as historically observed MVCs, and
- 3) Most of the Northern segment traffic will occur outside of the surveyed population (DeMarchi and Shultze 2011).

3.3 Data limitations

The statistical reconstruction of Nass moose population and the prediction of future trends should be interpreted carefully. The data used to fit the model empirically were very limited, with only three years of abundances and kill per hunter day being averaged over statistical areas that may have extended beyond the range of the Nass population. Some of the Nass population may also have existed beyond where the trend data were sampled, so part of the true trend may not have been accounted for. Additionally, the model structure itself had more detail than the data used to parameterize it. Specifically, the model predicted moose at every age between 1 and 20 years old, whereas the data only distinguished between juveniles and adults without regard to adult age. As a result, the detailed age-specific birth rates may have created a structural imbalance between birth rates and age at survival. This structural problem is further complicated by the fact that the survival rates of adults are all assumed to be the same regardless of age, which realistically should be not be constant. Nonetheless, a reasonable fit was achieved using the likelihood profiling method. Reconstructed patterns are credibly within the range of observed abundances and simulated results are reasonable.

A preferable approach to modeling the Nass moose population would be to use a model that incorporates only three age classes, uses average birth rates for adult females, and limits the number of stages to just summer and winter. There is no need to simulate stages and

ages that cannot be empirically compared for statistical validation. A more parsimonious model would have greater management utility, and despite the loss in biological resolution, it would be a more robust analytical tool.

It would also be useful to account for loss due to predation. The most recent survey (DeMarchi and Shultze 2011) found 37 wolves in 9 packs, meaning that there are 10 wolves per 1000 square kilometers in 9 distinct hunting units. This can translate to substantial amounts of moose mortality, if moose were the only source of food for the wolf pack, it is not out the range of possibility to have each pack consuming a moose per week in winter, translating to over 100 kills per winter. Even half that number would translate to 10% winter mortality at current densities. While these are crude estimates, it demonstrates the potential severity of wolf predation at current densities. With no knowledge of the historical pattern of wolf densities it is difficult to ascertain the potential impact. The wolf predation may have been increasing or decreasing during the period 2001-2011.

Bear predation is another factor. Bears prey on moose juveniles while they are unable to run fast enough to evade capture. At the very least, if there can be any improvement to the estimation of abundances of predators, the model fitting could account for the relative impacts over time, and thus explain some of the variation in inter-annual survival.

The model's excessive accounting for age structure, the parcidity of data, and the fact that there was no accounting for predation are sources of bias in model fitting. Without a sense of the relative magnitudes of biases, it is difficult to ascertain how overall results would be affected, but it is apparent that the model simulations are extremely sensitive to small changes in survival. The range of predictions is quite broad across a relatively small range of survivals, and that range is completely within the range of variation expected from the MVC modelling, i.e., 0.89% MVC and large predicted differences in behaviour between 93-95% survival. A modelling approach that accounts for other sources of variability such as predation and accounts for less age structure may be more robust predictor and should be considered if there is concern that the MVC rate may exceed 1%.

The moose vehicle collision model does not adequately address the potential saturation effect when traffic volumes increase substantially. Traffic from project operations alone are scheduled to increase from KSM levels in the 50-100 VPD levels (once averaged spatially) to levels in the 300-400 range. There is no way of calculating the saturating effect of vehicle collision mortality without actually observing it, since it would be a property of the Nass populations movement and migration patterns. The Seiler (2005) result can't be applied directly. Only if animals move around quickly and uniformly would we expect a non-saturating linear increase in MVCs with increased traffic. When only small fractions of animals are dying from collisions, it's reasonable to assume linearity because the density remains about the same, but as the fraction increases, there are fewer animals around to move toward a road as soon as an animal dies on that road. A potential source of information to explain this would be GPS collar data, which could be used to better account for the distribution of moose spatially and temporally. This would be useful for both spatial overlap analysis as well as the rate of replacement of at-risk animals on roads.

4 Conclusions

This analysis offers a statistical reconstruction of population dynamics and simulated population prediction of the Nass moose population subject to assumptions about the dynamics of vehicle collisions and harvest policies. The tabulated long-term abundance simulation results can be used as a guideline to view the relative impacts of harvest and traffic effects. The overarching result is that the population appears to be sustainable with the projected KSM traffic pattern. It also appears that the population will decline if either MVC rates increase substantially beyond the 0.89% mortality assumed from 2014 onward, or if the actual survival rate was overestimated at 93.4%. There is no reason to believe that traffic patterns resulting in less than 0.5% additional mortality, or occurring earlier or later than 2014 would cause the population to decline significantly more than predicted as long as harvests are

not higher than 30 bulls, but the margin is very slim. All predictions are predicated on the assumption of a 93.4% summer survival and the parameters estimated.

References

- DeMarchi, M. and G. Shultze (2011). A Stratified Random Block Survey of Moose in the Nass River Watershed. Technical report, LGL Environmental Research Ltd..
- Rescan (2013). *KSM Project: Application for and Environmental Assessment Certificate / Environmental Impact Statement*. Technical report, Rescan Environmental Services Inc., Vancouver, British Columbia.
- Rolandsen, C. M., E. J. Solberg, I. Herfindal, B. Van Mooter, and B.-E. Saether (2011). Large-scale spatiotemporal variation in road mortality of moose: Is it all about population density? *Ecosphere* 10(113).
- Seiler, A. (2005). Predicting locations of moose–vehicle collisions in sweden. *Journal of Applied Ecology* 42, 371–382.
- Sielecki, L. E. (2007). WARS: Wildlife accident reporting and mitigation in british columbia. Technical report, British Columbia Ministry of Transportation and Infrastructure.

Appendix: Model Code

The following contains the R code for the moose population dynamics model.

```
nYears <- 30 #var: The number of years to simulate dynamics
nAges <- 20 #var: The number of ages of the population
iniPop <- 1800 # #var: The number of animals in the population at beginning of run
iniBullRatio <- 45 #var: The number of bulls per 100 cows in the population
iniCalfRatio <- 55 #var: The number of calves per 100 cows in the population
# Bull Ratios at Birth permits sex ratios at birth to be adjusted to those measured in calf surveys or fetus analyses.
# There is reason to expect that more males are born, and most analyses indicate this to be true, but statistical
# significance is usually low. This variable is expressed as bull calves per 100 births, and permissible values range from 0 to 100.
# Potentially realistic values range from 50 to 65.
birthBullRatio <- 50 #var: Adjustment for survey results
# Reproductive Multiplier can be used to adjust the equilibrium calf ratios in the simulated population to match ratios measured
# in a surveyed population. Using 1.0 means that the fecundity listed by age in the natality/mortality table is used to
# calculate births. Multipliers greater or lower than 1.0 raise or lower age specific natality proportionally.
reprodMult <- 0.95 #par: Reproductive multiplier.
yrBullEffectiveness <- 1 #var:
mortMidWinter <- 0 #par: The proportion of the mortality that occurs before mid winter.
sexRatioThreshold <- 35 #par: The number of bulls per 100 cows below which the reproductive success begins to decline on (0,100) and 20-50 realistic
sexRatioExp <- 1
dummyRate1 <- .761 # used for back calculation for initialization
dummyRate2 <- .24 # used for back calculation for initialization
SurvSig <- 0.3 #var:
varSurv <- array(0,c(2,nYears)) #var: An array containing the juvenile and adult survivals for each year once process error has been applied
iniBulls <- 0
iniCows <- 0
iniCalves <- 0
MVCrate <- rep(0,nYears+1) # the additional mortality that will come from vehicle collisions
simMVC <- 0 # a boolean operator to add mortality for vehicle collisions

hBulls <- array(0,nYears)
hCows <- array(0,nYears)
hCalves <- array(0,nYears)
mwBulls <- array(0,nYears)
mwCows <- array(0,nYears)
mwCalves <- array(0,nYears)
mwPop <- array(0,nYears)
pBulls <- array(0,nYears)
pCows <- array(0,nYears)
pCalves <- array(0,nYears)
BullRatio <- array(0,nYears+1)

BreedingSuccess <- array(0,nYears+1)
birthRate <- array(0,nAges+1) #par: The number of calves per female at age
ssBulls <- array(0,nAges+1) #par: The summer survival of bulls at age
ssCows <- array(0,nAges+1) #par: The summer survival of cows at age
wsBulls <- array(0,nAges+1) #par: The winter survival of bulls at age
wsCows <- array(0,nAges+1) #par: The winter survival of cows at age
wsBullsTS <- array(0,c(nAges+1,nYears+1)) #par: The winter survival of bulls at age with variability for each year simulated
wsCowsTS <- array(0,c(nAges+1,nYears+1)) #par: The winter survival of cows at age with variability for each year simulated

vulnBulls <- array(0,nAges+1) #par: The vulnerability of Bulls to harvest at age
vulnCows <- array(0,nAges+1) #par: The vulnerability of Cows to harvest at age
```

```

mwBullsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of bulls in mid winter at age
mwCowsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of cows in mid winter at age
sprBullsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of bulls in spring at age
sprCowsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of cows in spring at age
BirthsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of births from cows at age
fallBullsAge <- array(0,c(nAges+1,nYears+1)) #var: The fall bulls at age
fallCowsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of fall cows at age
hvBullsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of bulls vulnerable to harvest
hvCowsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of cows vulnerable to harvest
hBullsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of bulls of each age harvested
hCowsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of cows of each age harvested
wBullsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of bulls early winter at age
wCowsAge <- array(0,c(nAges+1,nYears+1)) #var: The number of cows early winter at age
varSurv <- rep(0,nYears+1)

birthRate <- scan("alcesRates.txt",skip=3,nlines=1,sep=" ",quiet=TRUE)
ssBulls <- scan("alcesRates.txt",skip=4,nlines=1,sep=" ",quiet=TRUE)
ssCows <- scan("alcesRates.txt",skip=5,nlines=1,sep=" ",quiet=TRUE)
wsBulls <- scan("alcesRates.txt",skip=6,nlines=1,sep=" ",quiet=TRUE)
wsCows <- scan("alcesRates.txt",skip=7,nlines=1,sep=" ",quiet=TRUE)
vulnBulls <- scan("alcesRates.txt",skip=8,nlines=1,sep=" ",quiet=TRUE)
vulnCows <- scan("alcesRates.txt",skip=9,nlines=1,sep=" ",quiet=TRUE)
BreedingSuccess <- scan("alcesRates.txt",skip=12,nlines=1,sep=" ",quiet=TRUE)

iniPop <- scan("alcesRates.txt",skip=13,nlines=1,quiet=TRUE)
iniBullRatio <- scan("alcesRates.txt",skip=14,nlines=1,quiet=TRUE)
iniCalfRatio <- scan("alcesRates.txt",skip=15,nlines=1,quiet=TRUE)
birthBullRatio <- scan("alcesRates.txt",skip=16,nlines=1,quiet=TRUE)
reprodMult <- scan("alcesRates.txt",skip=17,nlines=1,quiet=TRUE)
yrBullEffectiveness <- scan("alcesRates.txt",skip=18,nlines=1,quiet=TRUE)
mortMidWinter <- scan("alcesRates.txt",skip=19,nlines=1,quiet=TRUE)
sexRatioThreshold <- scan("alcesRates.txt",skip=20,nlines=1,quiet=TRUE)
sexRatioExp <- scan("alcesRates.txt",skip=21,nlines=1,quiet=TRUE)
dummyRate1 <- scan("alcesRates.txt",skip=22,nlines=1,quiet=TRUE)
dummyRate2 <- scan("alcesRates.txt",skip=23,nlines=1,quiet=TRUE)

hBulls <- scan("alcesHarvests.txt",skip=1,nlines=1,sep=" ",quiet=TRUE)
hCows <- scan("alcesHarvests.txt",skip=2,nlines=1,sep=" ",quiet=TRUE)
hCalves <- scan("alcesHarvests.txt",skip=3,nlines=1,sep=" ",quiet=TRUE)

PopDy <- function()
{
  iniCows <- iniPop * 100 / (100 + iniBullRatio + iniCalfRatio)
  iniCalves <- iniPop * iniCalfRatio / (100 + iniBullRatio + iniCalfRatio)
  iniBulls <- iniPop * iniBullRatio / (100 + iniBullRatio + iniCalfRatio)

  mwBullsAge[3,1] <-< dummyRate1 * iniBulls * dummyRate2
  mwCowsAge[3,1] <-< dummyRate1 * iniCows * dummyRate2
  for (a in 4:(nAges+1)){
    mwBullsAge[a,1] <-< dummyRate1 * mwBullsAge[a-1,1]
    mwCowsAge[a,1] <-< dummyRate1 * mwCowsAge[a-1,1]
  }

  mwBullsAge[1,1] <-< (birthBullRatio/100.) * iniCalves
  mwCowsAge[1,1] <-< (1-birthBullRatio/100.) * iniCalves
  mwBullsAge[2,1] <-< iniBulls - sum(mwBullsAge[3:(nAges+1),1])

```

```

mwCowsAge[2,1] <- iniCows - sum(mwCowsAge[3:(nAges+1),1])
BullRatio[1] <- 100 * (yrBullEffectiveness * mwBullsAge[2,1] + sum(mwBullsAge[3:(nAges+1),1]) + hBulls[1]) / (sum(mwCowsAge[2:(nAges+1),1]) + hCows[1])

for (yr in 2:(nYears+1)){
  if (yr == 2){
    for (age in 1:(nAges+1)){
      sprBullsAge[age,yr] <- mwBullsAge[age,1] - (mwBullsAge[age,1]/(1-mortMidWinter*(1-wsBulls[age])))*(1-mortMidWinter)*(1-wsBulls[age])
      sprCowsAge[age,yr] <- mwCowsAge[age,1] - (mwCowsAge[age,1]/(1-mortMidWinter*(1-wsCows[age])))*(1-mortMidWinter)*(1-wsCows[age])
    }
  }
  else
  {
    sprBullsAge[,yr] <- wBullsAge[,yr-1] * (wsBullsTS[,yr] - simMVC * (yr>14) * MVCrate[yr] )
    sprCowsAge[,yr] <- wCowsAge[,yr-1] * (wsCowsTS[,yr] - simMVC * (yr>14) * MVCrate[yr] )
  }

  BreedingSuccess[yr] <- 1 - (BullRatio[yr-1]<sexRatioThreshold) * (1-BullRatio[yr-1]/sexRatioThreshold)
  BirthsAge[,yr] <- sprCowsAge[,yr] * BreedingSuccess[yr] * birthRate * reprodMult
  fallBullsAge[1,yr] <- birthBullRatio * sum(BirthsAge[,yr]) * ssBulls[1] / 100
  fallBullsAge[2:(nAges+1),yr] <- sprBullsAge[1:nAges,yr] * ssBulls[2:(nAges+1)]
  fallCowsAge[1,yr] <- (100 - birthBullRatio) * sum(BirthsAge[,yr]) * ssCows[1] / 100
  fallCowsAge[2:(nAges+1),yr] <- sprCowsAge[1:nAges,yr] * ssCows[2:(nAges+1)]
  hvBullsAge[,yr] <- vulnBulls * fallBullsAge[,yr]
  hvCowsAge[,yr] <- vulnCows * fallCowsAge[,yr]

  # Harvest bulls
  hBullsAge[1,yr] <- min(hCalves[yr-1] * fallBullsAge[1,yr]
  / (fallBullsAge[1,yr]+fallCowsAge[1,yr]), fallBullsAge[1,yr])
  MatureBulls <- sum(hvBullsAge[2:(nAges+1),yr])
  for (age in 2:(nAges+1))
    hBullsAge[age,yr] <- min(hBulls[yr-1] * hvBullsAge[age,yr] / MatureBulls, fallBullsAge[age,yr])

  # Harvest cows
  hCowsAge[1,yr] <- min(hCalves[yr] * fallCowsAge[1,yr] /
  (fallCowsAge[1,yr]+fallCowsAge[1,yr]), fallCowsAge[1,yr])
  MatureCows <- sum(hvCowsAge[2:(nAges+1),yr])
  for (age in 2:(nAges+1))
    hCowsAge[age,yr] <- min(hCows[yr-1] * hvCowsAge[age,yr] / MatureCows, fallCowsAge[age,yr])

  BullRatio[yr] <- 100 * (yrBullEffectiveness * fallBullsAge[2,yr] + sum(fallBullsAge[3:(nAges+1),yr]))
  / sum(fallCowsAge[2:(nAges+1),yr])

  # Bulls and cows at age early winter following harvest
  wBullsAge[,yr] <- fallBullsAge[,yr] - hBullsAge[,yr]
  wCowsAge[,yr] <- fallCowsAge[,yr] - hCowsAge[,yr]

  # Mid winter bulls and cows at age surviving early winter mortality
  mwBullsAge[,yr] <- wBullsAge[,yr] - mortMidWinter * (1 - wsBullsTS[,yr]) * wBullsAge[,yr]
  mwCowsAge[,yr] <- wCowsAge[,yr] - mortMidWinter * (1 - wsCowsTS[,yr]) * wCowsAge[,yr]

  # Total mid winter bulls, cows and calves
  mwBulls[yr] <- sum(mwBullsAge[2:(nAges+1),yr])
  mwCows[yr] <- sum(mwCowsAge[2:(nAges+1),yr])
  mwCalves[yr] <- mwBullsAge[1,yr] + mwCowsAge[1,yr]
}

}

setSurvivalVariation <- function(){
  for (y in 1:(nYears+1)){
    s <- wsBulls[1:2]+.006 # correct for logit bias in variation simulation
    mm <- log(s/(1-s)) # Get the invlogit trasformed value
    ll <- log((1-.5*SurvSig)*s/(1-(1-.5*SurvSig)*s)) # get a range around the invlogit
  }
}

```

```

sig <- (mm - ll)/mm # convert invlogit range to a CV
ls <- rnorm(2,mm,sig) # draw the invlogit of survival
surv <- 1/(1+exp(-ls)) # logit transform
wsBullsTS[,y] <- c(surv,rep(surv[2],length(wsBulls)-2))

s <- wsCows[1:2]+.006
mm <- log(s/(1-s)) # Get the invlogit trasformed value
ll <- log((1-.5*SurvSig)*s/(1-(1-.5*SurvSig)*s)) # get a range around the invlogit
sig <- (mm - ll)/mm # convert invlogit range to a CV
ls <- rnorm(2,mm,sig) # draw the invlogit of survival
surv <- 1/(1+exp(-ls)) # logit transform
wsCowsTS[,y] <- c(surv,rep(surv[2],length(wsCows)-2))
varSurv[y] <- wsBullsTS[2,y]
}
}

Modify <- function(logits,hb,sig,simvc){
# This function contains code that overrides key parameters
#eg: ssCows <- ssCows * 1.25 would increase cow summer survival rates by 25%
#eg: ssBulls <- ssBulls * 0 + 0.90 would set all bull summer survivals to 0.90
#eg: ssBulls <- .95*(x+1)*exp(1-(x+1)/5)/5 is a survival curve
#plot(x<-seq(0,20), .95*(x+1)*exp(1-(x+1)/5)/5)
ssCows[2:(nAges+1)] <- rep(1/(1+exp(-logits)),nAges)
ssBulls[2:(nAges+1)] <- rep(1/(1+exp(-logits)),nAges)
wsCows[2:(nAges+1)] <- rep(1/(1+exp(-.82 * .9 * logits)),nAges)
wsBulls[2:(nAges+1)] <- rep(1/(1+exp(-.82 * logits)),nAges)
SurvSig <- sig # alter the process error for survival variation
iniPop <- 1800 # use the maximum likelihood estimated value
iniBullRatio <- 45 # 56 is default value used in Moose 200 Spreadsheet model
iniCalfRatio <- 55 # 68 is default value used in Moose 200 Spreadsheet model
birthBullRatio <- 50 # 50 is default value used in Moose 200 Spreadsheet model
reprodMult <- .95 # 1 is default value used in Moose 200 Spreadsheet model
yrBullEffectiveness <- 1 # 1 is default value used in Moose 200 Spreadsheet model
mortMidWinter <- 0 # 0 is default value used in Moose 200 Spreadsheet model
sexRatioThreshold <- 35 # 35 is default value used in Moose 200 Spreadsheet model
hBulls[12:nYears] <- hBulls[12:nYears] * 0 + hb # in years 2013 onward, user set value
MVCrate <- rep(0.0146,nYears+1)
simMVC <- simvc
}

runModel <- function(ss,hb,sig,simvc,doplots=FALSE){
setup()
s <- ss
hbulls <- hb
Modify(ss,hbulls,sig,simvc)
setSurvivalVariation()
PopDy()
if (doplots==TRUE){
par(mfrow=c(2,2),mai=c(1.1,1.1,.3,.3),omi=c(.1,0,0,0))
plot(2001:(2001+nYears-1),BullRatio[2:(nYears+1)],ylab="Bull Ratio",type="l",xlab="Years")
plot(2001:(2001+nYears-1),mwCalves[2:(nYears+1)],ylab="Mid Winter Calves",type="l",xlab="Years",ylim=c(0,max(mwCalves[2:nYears])))
plot(2001:(2001+nYears-1),mwBulls[2:(nYears+1)],ylab="Mid Winter Bulls",type = "l",xlab="Years",ylim=c(0,max(mwBulls)))
plot(2001:(2001+nYears-1),mwCows[2:(nYears+1)],ylab="Mid Winter Cows", type = "l",xlab="Years",ylim=c(0,max(mwCows)))
}
}
}

# The main call to the model with 50 bulls harvested, 30\% variability, and 94\% survival

```


Appendix E

Updated KSM Project Highway Traffic Noise Predictions
including Cumulative Effects



MEMORANDUM

To: Justine Greenwood - Rescan

Date: January 23, 2013

From: Brizi Coetzer

Page 1 of 5

Copies To: Tina Liu

Subject: Updated Highway 37 traffic noise predictions for KSM project at nearby residences including cumulative effects from nearby projects

The purpose of this memo is to provide Highway 37 traffic noise predictions based on available traffic counts. BKL has made calculations based on traffic estimates for the Operation phase of the KSM Project on Highway 37 between the Treaty Creek Access Road and Meziadin Junction.

The following "nearby projects" were included in the cumulative effects assessment using data provided by Rescan on January 23th, 2013:

- Forrest Kerr Hydroelectric
- Red Chris Mine
- Wolverine Mine
- Bronson Slope Mine
- Brucejack Mine
- Galore Creek Mine
- Kitsault Mine
- Kutcho Mine
- McLymont Creek Hydroelectric
- Schaft Creek Mine
- Snowfield Project
- Storie Moly Mine
- Turnagain Mine

The source of data for current traffic conditions is the BC Ministry of Transportation and Infrastructure (MoT). The Canadian Mortgage and Housing Corporation (CMHC) provides guidance on the prediction and assessment of the effects on housing from road and rail noise. CMHC's methodology was used to determine noise levels at the nearest receivers, at two locations. Existing noise levels at the northern location, are low. Accordingly, the acceptability of Project related noise was measured against the 'absolute' criteria of 55 dBA set by the CMHC for 'Outdoor Recreation Areas'. The southern location was inherently noisier than the northern location. As prescribed by

Project #: 1900-11B II

Email To: jgreenwood@rescan.com

BKL CONSULTANTS LTD.

#308 - 1200 Lynn Valley Road, North Vancouver, BC V7J 2A2

Tel: (604) 988-2508

Consultants in Acoustics

Email: Coetzer@bkl.ca

Website: www.bkl.ca

MOT, a more appropriate measure using the 'relative' change in noise levels was used. This criteria defines the maximum permissible increase in noise level as a result of Project related activity. According to these methods, the following outcome is predicted for each location:

Station 47-016-NS (Northern Segment of Highway 37)

Current Traffic Conditions

The current traffic conditions for count station 47-016NS averaged over the years 2005, 2008 and 2010 for AADT, and averaged over the years 2005 and 2008 for SADT are as follows:

- Annual Average Daily Traffic (AADT) - 224 vehicles per day
- Summer Average Daily Traffic (SADT) - 362 vehicles per day
- Approximately 40% heavy vehicles.

Future Traffic Conditions with KSM project only

The traffic estimates for *Project related* activity were given as follows:

- 31,158 Total Average Annual Trips along the specific route. This equates to approximately 85 vehicles per day passing count station 47-016NS
- 367 of the Total Average Annual Trips are light passenger vehicles (approximately 1 vehicle per day), and the rest heavy vehicles (84 vehicles per day).

Based on these traffic counts, the estimated total number of vehicles per day (project related + current traffic conditions) at location 47-016NS will be:

- Annual Average Daily Traffic (AADT) - 309 vehicles per day.
- Summer Average Daily Traffic (SADT) - 447 vehicles per day
- Approximately 56% will be heavy vehicles (based on AADT).

Cumulative Future Traffic Conditions from all Nearby Projects

Since the other reasonably foreseeable projects do not start operation at the same time, two future cumulative cases are assessed: maximum cumulative and expected cumulative. The traffic estimates for *total cumulative projects* activity were given as follows:

Maximum cumulative (KSM + Other projects) total Average Annual Trips of 181,903 and expected cumulative (KSM + Other projects) total average annual trips of 170,223 along the specific route. This equates to a maximum of 498 vehicles per day, and expected 466 vehicles per day passing count station 47-016NS. The same % heavy vehicle ratio is assumed as in the KSM project data above (99%) which gives:

- 2140 of the Total Average Annual Trips as light passenger vehicles (approximately 6 vehicles per day), and the rest heavy vehicles (492 vehicles per day) for the maximum case; and
- 2003 of the Total Average Annual Trips as light passenger vehicles (approximately 5 vehicles per day), and the rest heavy vehicles (461 vehicles per day) for the expected case.

Based on these traffic counts, the estimated total number of vehicles per day (cumulative project related + current traffic conditions) at location 47-016NS will be:

- Annual Average Daily Traffic (AADT) – maximum of 722 vehicles per day, and expected 690 vehicles per day.
- Summer Average Daily Traffic (SADT) – maximum of 860 and expected 828 vehicles per day
- Approximately maximum of 81% will be heavy vehicles, and expected 80% will be heavy vehicles (based on AADT).

Sound Level at Closest Receiver

The designated 'closest receiver' is noted to be a house 50m from the road at the same level as the road. For comparative purposes the 24-hour equivalent noise level (L_{eq24}) at the receiver location for the current condition is estimated to be in the region of 47-49 dBA¹, depending on whether AADT or SADT are used. The additional KSM-related traffic is estimated to increase noise levels at this location by 2-3 dB based on a road traffic speed of 90km/h. This is a noticeable increase, but will still be well below the limit of 55 dBA for an 'Outdoor Recreation Area' or where 'indoor conditions are unacceptable unless adequate sound insulation is provided' as recommended in the CMHC guideline.

The cumulative effect of nearby project related traffic (including KSM traffic) at this location is estimated to increase noise levels above the current condition by approximately 6-8 dB (to 55 dB) as shown in Table 1. This is equal to the guideline limit set forth by the CMHC.

Table 1: Traffic Noise Predictions at Closest Receiver – North Section 47-016-NS

Case	Present Noise Level (dBA)	Future Noise Level with KSM project (dBA)	Max Cumulative Noise Level from all Nearby Projects (dBA)	Expected Cumulative Noise Level from all Nearby Projects (dBA)	Receiver distance (m)
AADT	47	50	55	54	50
SADT	49	52	55	55	

Station P 47-9-NS (Southern Segment of Highway 37)

Current Traffic Conditions

The current traffic conditions for count station P 47-9-NS averaged over the years 2004 to 2011 are shown as:

- Annual Average Daily Traffic (AADT) - 799 vehicles per day
- Summer Average Daily Traffic (SADT) - 1093 vehicles per day
- Approximately 40% heavy vehicles.

Future Traffic Conditions with KSM project only

The traffic estimates for *Project related* activity were given as follows:

- 17,958 Total Average Annual Trips along the specific route. This equates to approximately 49 vehicles per day passing count Station P 47-9-NS
- 366 of the Total Average Annual Trips are light passenger vehicles (approximately 1 vehicle per day), and the rest heavy vehicles (48 vehicles per day).

Based on these traffic counts, the estimated total number of vehicles per day (project related + current traffic conditions) at location 47-016NS will be:

- Annual Average Daily Traffic (AADT) - 848 vehicles per day.
- Summer Average Daily Traffic (SADT) - 1142 vehicles per day
- Approximately 43% will be heavy vehicles (based on AADT).

Cumulative Future Traffic Conditions from all Nearby Projects

The traffic estimates for *total cumulative projects* activity (KSM + other projects) were given as follows:

- 117,603 Total Average Annual Trips along the specific route. This equates to 322 vehicles per day passing count station 47-016NS
- 2400 of the Total Average Annual Trips are estimated to be light passenger vehicles (approximately 7 vehicles per day), and the rest heavy vehicles (315 vehicles per day).

Based on these traffic counts, the estimated total number of vehicles per day (cumulative project related + current traffic conditions) at location 47-016NS will be:

- Annual Average Daily Traffic (AADT) - 1121 vehicles per day.
- Summer Average Daily Traffic (SADT) - 1415 vehicles per day
- Approximately 57% will be heavy vehicles (based on AADT).

Sound Level at Closest Receiver

The designated 'closest receiver' is noted to be a house 25m from the road at the same level as the road. For comparative purposes the current noise level at the receiver location is estimated to be in the region of 58-59 dBA, depending on whether AADT or SADT are used. This is already above the 55 dBA limit for an 'Outdoor Recreation Area' and is in the region where 'indoor conditions are unacceptable unless adequate sound insulation is provided' as recommended in the CMHC guideline. We therefore suggest using a different criterion as published by the MoT. This gives guidance as to the maximum allowable increase in environmental noise due to project related activity, and has been used on similar mining projects in the past. This is useful in this case where the existing environment is already noisy. For a pre-project environment with an L_{eq24} of 59 dBA, the maximum allowable increase in total noise is 4.2 dBA before mitigation is required. The additional KSM Project related traffic is estimated to increase noise levels at this location by 1 dBA based on a road traffic speed of 90km/h. This is well below the 4.2 dBA allowance.

The cumulative project related traffic is estimated to increase noise levels at this location by 3-4 dBA above the current condition based on a road traffic speed of 90km/h. This is within the 4.2 dBA allowance.

Table 2 below summarizes the present and future noise levels for the south section.

Table 2: Traffic Noise Predictions at Closest Receiver – South Section P 47-9-NS

Case	Present Noise Level (dBA)	Future Noise Level with KSM project (dBA)	Future Cumulative Noise Level from all Nearby Projects (dBA)	Receiver distance (m)
AADT	58	59	61	25
SADT	59	60	63	

In our assessment of additional traffic at two locations, both locations meet the appropriate criteria for noise levels at the nearest receiver when viewing KSM-related noise contributions. When assessing cumulative noise levels from all nearby projects, the noise levels are very close to guideline limits, and may have potential for disturbance.

Please don't hesitate to contact me if you have any questions regarding this memo.

Sincerely,

BKL Consultants Ltd.



per:
Briët Coetzer MMus(Technology), EIT

This does not include the effects of road gradient. This effect ranges from 1 dB (gradient of 1%) to 4 dB (gradient of 5%) in addition to the existing levels.

Appendix F

Working Group Comment Tracking Table

Proposed KSM Project

July 9, 2012 Working Group Meeting

KSM Project Highway 37 and 37A Traffic Effects Assessment Report: Responses to Questions and Comments Raised by the Working Group

June 29, 2012 NLG Comments

No.	Commenter / Date Received	Report	Comment	Seabridge Response
1.	NLG/June 29, 2012	KSM Highway Traffic Effects Assessment	Please confirm whether the gold is mixed in with the copper concentrate and the silver with the molybdenum concentrate resulting effects on toxicity to aquatic systems may differ between the two (which will be going to different parts)	The Project will produce three different products: copper concentrate, molybdenum concentrate, and gold-silver doré bullion. The copper concentrate will comprise the majority of product produced at the Project. The concentrates are considered hazardous material and handling will follow appropriate procedures to prevent spills.
2.	NLG/June 29, 2012	KSM Highway Traffic Effects Assessment	There needs to be more detail in the fish and aquatic risk section, including a description of the specific areas (streams, lakes, and wetlands) along the transportation routes where there will be increased risk to aquatic values either due to high fisheries or wetland values or due to an increased risk of an accident - these areas and risks should be identified/explained further along with proposed mitigation measure (e.g. guard rails, speed limits, restrictions on travel during certain times of the day etc...)	All fish-bearing streams were treated with an equally high value in the assessment. Therefore, the weight of risk is the maximum applied in the event of increased traffic or accidents. Please refer to Table 5.2-1 and Figure 5.2-1 for a table map of important fish bearing streams in the Traffic Study Area. A discussion of risks to wetlands is discussed in section 5.5. Erection of guard rails are the responsibility of BC MOTI. Mitigation to minimize effects from traffic and accidents is found in the Traffic and Access Management Plan and the Spill Prevention and Emergency Response Plan, which be part of the EA Application.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
3.	NLG/June 29, 2012	KSM Highway Traffic Effects Assessment	There needs to be a description of how BMPs will be enforced in respect trucking contractors	Enforcement of adherence to speed limits and other safe driving practices for contractors will be described in the Traffic and Access Management Plan of the EA. Enforcement may be in the form of radar guns, vehicle monitoring systems, or other similar methods. Truck drivers will be actively monitored to ensure they accurately record all wildlife sightings and incidents along the roads. Contractors as well as employees will be required to follow a specified Journey Management Procedure, including departure and arrival check-ins.
4.	NLG/June 29, 2012	KSM Highway Traffic Effects Assessment	There needs to be a description of the risk of a complete dumping of cargo into aquatic environments and the proposed response to such an incident, including how such an incident would be contained.	A Fish and Aquatic Habitat Risk Assessment Matrix for Traffic Accidents is provided in Table 5.2-6 of the report, including a description of the potential risk, mitigation measures, and the likelihood and severity of the risk. The Spill Prevention and Emergency Response Plan will be included in the EA. Road users will be trained in relevant spill response techniques and protocols. Spill kits will be available on vehicles transporting dangerous goods or hazardous materials and spill kits will also be set up at select points along the haul route.
5.	NLG/June 29, 2012	KSM Highway Traffic Effects Assessment	The Traffic Effects Assessment amounts to a generalized, qualitative impact assessment (without the usual conclusion of whether a given effect is significant or not) in that results of the study are distilled into a single figure depicting a highly generalized assessment of the severity and likelihood of a number of traffic-related risks to wildlife	A discussion of the potential effects of traffic and accidents on Wildlife is outlined in section 5.3 of the report. This includes a baseline data overview, issues scoping, and risk analysis. A Wildlife Risk Assessment Matrix is found in Table 5.3-5 for traffic and Table 5.3-6 for accidents. These matrices include potential risk to wildlife VC's, mitigation measures, and the likelihood and severity of the risk. A conclusion of significance is part of an assessment of residual effects to VC's, and will be included in the wildlife chapter of the EA/EIS.

No.	Commenter / Date Received	Report	Comment	Seabridge Response
6.	NLG/June 29, 2012	KSM Highway Traffic Effects Assessment	A quantitative analysis with respect to project VEC pathways should be undertaken given that it would provide a more comprehensive and complete understanding of the likelihood and significance of expected effects of the project, an example of which is more fully described as follows: Table 5.3-5 contains the following statement: “An average of approximately 20 moose are killed per year due to vehicle collisions along Highway 37 between Kitwanga and Burrage (within the Project study area). Project traffic will increase the traffic volume along the highways and direct mortality to moose is possible. However, even through traffic volumes will be increasing considerably, the number of animal collisions will not increase by an equal percentage.” From Table 5.3-4, the definition of a Moderate severity risk is one that “Differs substantially from the average value for baseline conditions and approaches the limits of natural variation, but below or equal to a guideline or threshold value. Effect limited to the local population.” Then section 5.3.3.2, the following conclusion is drawn: “Because of the current status of the moose population in the area (i.e., declining), the high value habitat along Highway 37, and the uncertainty around the WARS data and the current numbers of vehicle/moose interactions, the severity is expected to be moderate.”	In response to comments received during the traffic study working group meetings in Terrace (July 9, 2012), a quantitative assessment of the likely increase in moose mortality due to increased traffic was completed. The assessment analyzes the sensitivity of the current moose population to increased mortality. The assessment involved collaboration with and/or receiving data from Nass moose surveys, Nisga’a and Gitanyow hunting rates, Gitanyow road monitoring studies, and the results of non-resident hunting tags. The analysis will provides a quantitative evaluation of the effects on the moose population and is included in the final report (Appendix D).

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
(6.)	(continued)		Note that no indication of a guideline or threshold value for moose is presented (or at least discernible). Absent some quantitative backing or assessment, a risk of “Moderate” is not particularly informative and is subject to varying degrees of interpretation regarding the overall significance of the effect in the context of the project (i.e.: what does this mean for the population? Will it go down? Will hunter opportunity diminish as a result? By potentially how much?). A risk assessment which included a quantitative assessment would estimate a range of potential roadkill mortality rates and feed that into a moose population model that would be built using readily available data such as the population parameters presented in the Nisga’a moose survey reports. Through a process of Monte Carlo simulations, the range of potential outcomes of the project’s effects on the moose population would be drawn. A corresponding sensitivity analysis would examine for any tipping points (i.e., mortality [or guideline/threshold values in the case of the Proponent’s definition] levels that would cause the population to decline as opposed to being within the limits of a sustainable level of mortality). Such a method provides a basis for predicting whether the effects will be such that there is an effects on population dynamics; and by how much.	

July 9, 2012 Working Group Meeting Comments

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
7.	Joanna Tombs, BC Environmental Assessment Office (EAO)	Elizabeth Miller, Seabridge Gold	What type of concurrent permitting is Seabridge referring to?	Seabridge is planning to submit applications for provincial permits, licences and approvals for concurrent review with the EA Application for the proposed Coulter Creek and Treaty Creek access roads, construction camps and preliminary construction access and earthworks associated with Mine Site and the Processing and Tailing Management Area (pursuant to the BC Environmental Assessment Act, Concurrent Approval Regulation, B.C. Reg. 371/2002 (O.C. 1158/2002)).
8.	Mark Cleveland, Gitanyow Hereditary Chiefs Office(GHCO)	Elizabeth Miller, Seabridge Gold	Will changes in the Multiple Accounts Analysis be highlighted, so that we don't have to review the whole report?	Changes to the Multiple Accounts Analysis (Assessment of Alternatives for KSM Project Tailing Management Facility) will be highlighted in a question and answer table which will be appended to the report.
9.	Mark Cleveland, GHCO	Elizabeth Miller, Seabridge Gold	Will there be information in Seabridge's pre-feasibility report that we have not seen as the Working Group?	Seabridge files public reports on the project pursuant to NI43-101 guidelines . These reports are broader than the EA. It is possible that the updated 2012 Preliminary Feasibility Report (released in May 2012) may contain information that the Working Group has not seen. Report summaries are available here: http://www.seabridgegold.net/ksm_engineer.php#2012
10.	Jennifer Wilson, Environment Canada (EC)	Elizabeth Miller, Seabridge Gold	What are the proposed locations for next sub-Working Group meetings?	The locations for the Working Group meetings are decided by the EAO/CEA Agency. The locations depend on who is attending the meeting.
11.	Mansell Griffin, Nisga'a Lisims Government (NLG)	Elizabeth Miller, Seabridge Gold	The Nisga'a want to be part of the meeting related to fish habitat compensation, but the end of August is challenging because we go fishing at that time.	Comment noted. Seabridge met with NLG representatives on September 12, 2012 in Smithers.
12.	Mansell Griffin, NLG	Elizabeth Miller, Seabridge Gold	Will there be seasonal variations in mine traffic?	During construction, seasonal fluctuations in traffic are expected. Higher traffic levels are anticipated during the summer. During operations, traffic is not expected to fluctuate seasonally because the majority of the traffic will be from copper concentrate haul trucks operating 24 hours per day, 7 days a week, year round.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
13.	Sherrie Applegate, BC Ministry Transportation and Infrastructure (MoTI)	Elizabeth Miller, Seabridge Gold	Did the "Review of Historical Traffic Patterns and Capacity on Highway 37 in Proximity to the Proposed KSM Project" (McElhanney, May 2011) consider the section of Highway 37 north of Meziadin Junction? The highway narrows north of Bell 1.	The purpose of McElhanney's report was to review historical traffic volumes and estimate the capacity of Highway 37. The report did not consider specific highway segments. Traffic count data is available at five locations along the Highway. The analysis in the report used traffic count data from station 47-016NS as this data is available since 1980 and it is situated at a midpoint between Kitwanga and Dease Lake (see Appendix B).
14.	Bob Bocking, LGL for NLG	Elizabeth Miller, Seabridge Gold	Is there a memo on McElhanney's Highway 37 Capacity Report?	A copy of the report is appended to the final Highway 37 and 37A Traffic Effects Assessment (see Appendix B).
15.	Dwayne Day, Tahltan Heritage Resource Environmental Assessment Team (THREAT)	Elizabeth Miller, Seabridge Gold	Do KSM project traffic estimates include all trucks or only ore trucks?	KSM Project-related traffic estimates include all traffic types. Tables 2.4-1 through 2.4-4 list the vehicle types and cargo that were included in the traffic estimates in the report.
16.	Sherrie Applegate, MoTI)	Elizabeth Miller, Seabridge Gold	Do you have any sense of traffic volumes during construction versus operation?	The report considers traffic volumes for the Project, including construction, operation, closure and post-closure phases (see Tables 2.4-1 through 2.4-4 for the estimates).
17.	Mark Cleveland, GHCO	Elizabeth Miller, Seabridge Gold	Section 5-50 of the report shows different numbers and the way it is written; in particular "additional" is confusing.	The language on pg.5-50 of the report will be revised to provide further clarity. Project traffic will add a maximum of four vehicles per hour along Highway 37, remaining below volumes reported in 2000.
18.	Chris Schell, BC Ministry of Environment (MOE)	Elizabeth Miller, Seabridge Gold	Is access required along Teigen Creek?	Road access is no longer required along Teigen Creek.
19.	Sherrie Applegate, MoTI)	Elizabeth Miller, Seabridge Gold	The forestry service road near Treaty Creek may not meet current provincial standards. Seabridge will be required to discuss intersection designs with MoTI.	Seabridge consultants are currently working on a study of the proposed Project-related access road intersections with Highway 37, which will include more information on the forestry service road near Treaty Creek. Seabridge provided an intersection study to MOTI prior to submitting the EA Application.
20.	Sherrie Applegate, MoTI	Elizabeth Miller, Seabridge Gold	The speed limit on the road from Meziaden to Yukon border has changed to 90 km an hour.	Comment noted. The Highway posted speed limit noted on page 2-13 will be revised.
21.	Mansell Griffin, NLG	Elizabeth Miller, Seabridge Gold Presentation	Will KSM employees be driving themselves to work?	Shuttles will transport personnel to and from the Project. Employees will not be driving their personal vehicles to the Mine Site.

JULY 9, 2012 WORKING GROUP MEETING COMMENTS

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
22.	Mark Cleveland, GHCO	Elizabeth Miller, Seabridge Gold Presentation	Where in the report are you assessing the effects of helicopter emissions related to the transport of doré?	Environmental effects related to the use of helicopters will be assessed in the EA Application.
23.	Will Foster, Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) Teleconference	Elizabeth Miller, Seabridge Gold	Do you have traffic estimates for other mine projects to use in the cumulative impact assessment?	The cumulative effects assessment in the EA Application will use publicly available traffic estimates. An approximation will be used when information is not publicly available. Estimates of product-related haul traffic will be calculated based on available concentrate production amounts or production rates, ore grades, and/or concentrate grades and on the assumption that 50 tonne trucks are used. Estimates of other mine traffic will be calculated based on the KSM ratio between trips per day and production rate. It will be assumed that travel along Highway 37 south to Highway 16.
24.	Dwayne Day, THREAT	Elizabeth Miller, Seabridge Gold	Does the cumulative effects assessment consider potential increases in population over the next 50 years?	The EA Application will include an evaluation of cumulative environmental effects of residual effects that are likely to result from the proposed development and how they may combine with environmental effects from other past, present and reasonably foreseeable projects and activities. The cumulative effects assessment does not include population increases because it is difficult to forecast population changes 50 years from now.
25.	Norm McLean, THREAT	Elizabeth Miller, Seabridge Gold	Is traffic from the Wolverine mine in the Yukon considered?	Traffic from the Wolverine Mine in the Yukon will be included in the cumulative effects assessment.
26.	Mansell Griffin, NLG	Elizabeth Miller, Seabridge Gold	Does the traffic effects assessment consider the number of large sized Project vehicles on Highway 37 compared to historic counts of large vehicles?	The KSM Project assessment considers different vehicle types that will be used (Tables 2.4-1 through 2.4-4). Traffic counters do not record the size of vehicle.
27.	Mansell Griffin, NLG	Elizabeth Miller, Seabridge Gold	Will there be Project traffic along Highway 37A during closure and post-closure?	Project traffic is not expected to use Highway 37A during closure and post-closure.
28.	Dwayne Day, THREAT	Elizabeth Miller, Seabridge Gold .	Do you have a list of hazardous materials and the routes that will be used to transport them?	Tables 2.4-1 through 2.4-4 identify the hazardous materials to be transported along Highway 37. The average annual one-way trips expected along each segment of Highway 37 are detailed in the tables. Table 2.4-6 identifies lime and other reagents to be transported.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
29.	Mark Cleveland, GHCO	Elizabeth Miller, Seabridge Gold	Are project traffic estimates averaged over 8 hours or 24 hours? I would like to see more on peak travel times because there is a big difference in terms of impacts if all of the trucks are driving at dusk or dawn. Attention should be paid to the specific times of traffic to reduce impacts on wildlife.	The report looks at daily averages over a 24 hour period.
30.	Bob Bocking, LGL for NLG	Elizabeth Miller, Seabridge Gold	The report specifies actual accident numbers; what is the actual rate of accidents compared to the number of vehicles?	Accident rates have been updated to show rates for commercial and non-commercial vehicles by year between 1996 and 2011. Where there were gaps in historical data, AADT was extrapolated in excel where viable. These tables are incorporated in the final report (Table 3.1-3 and 3.1-4).
31.	Jennifer Wilson, EC	Elizabeth Miller, Seabridge Gold	Do commercial and non-commercial vehicles have different accident rates? Is there a threshold number of vehicles, above which, accidents increase?	Accident rates vary between commercial and non-commercial vehicles (see Table 3.1-3 and 3.1-4).
32.	Andrew Webber, Regional District of the Kitimat-Stikine	Elizabeth Miller, Seabridge Gold	In the section that describes collisions versus accidents, does this involve more than one vehicle?	Collision and accident are used interchangeably throughout the report. Both terms refer to a "crash incident" to be consistent with the ICBC data. The raw ICBC data counts "crash incidents" but does not specify the number of vehicles involved in each incident.
33.	Bob Bocking, LGL for NLG	Elizabeth Miller, Seabridge Gold	Is there accident data prior to 1996?	Seabridge is not aware of any accident data prior to 1996.
34.	Mike Demarchi, LGL for NLG	Elizabeth Miller, Seabridge Gold	What is the confidence interval of predicted accident numbers?	The final report figures for the Collision Prediction Model will include bands surrounding the predicted collision numbers, indicating the range of values encompassed by a 95% confidence level (Figures 3.2-1 through 3.2-3, and 8.3-1 through 8.3-3).
35.	Dwayne Day, THREAT	Elizabeth Miller, Seabridge Gold	Is there accident data available from other operating mines in the region?	Seabridge is not aware of accident data being available from operating mines.
36.	Mansell Griffin, NLG	Elizabeth Miller, Seabridge Gold	Does the collision data include information on whether or not an animal was involved in the incident?	The ICBC police collision data does not include information on whether or not an animal was involved in a 'crash incident'. Incidents involving wildlife fatalities are recorded in MoTI's "Wildlife Accident Reporting System" (WARS).

JULY 9, 2012 WORKING GROUP MEETING COMMENTS

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
37.	Mark Cleveland, GHCO	Elizabeth Miller, Seabridge Gold .	Do concentrate trucks have higher collision rates?	The ICBC police collision data distinguishes between commercial and non-commercial vehicles, but does not provide details on the types of commercial vehicles involved in incidents. In general, accidents rates are higher for non-commercial vehicles than for commercial vehicles (see tables 3.1-1 and 3.1-2) (ICBC 2011a, b).
38.	Mansell Griffin, NLG	Elizabeth Miller, Seabridge Gold	Would drivers be employed by the mine?	Drivers will be subcontractors or employees. Sub-contractors will be required to meet the same safety standards as mine drivers.
39.	Bob Bocking, LGL for NLG	Elizabeth Miller, Seabridge Gold	Was ICBC collision data or police collision data used?	Police collision data from ICBC was used in the report because it is more comprehensive than ICBC collision data.
40.	Dwayne Day, THREAT	Elizabeth Miller, Seabridge Gold .	Does accident near miss data exist?	Seabridge is not aware of near miss data existing for operating mines.
41.	Dwayne Day, THREAT	Elizabeth Miller, Seabridge Gold	Is there information regarding wildlife accidents vs. incidents not involving wildlife?	See response to comment #30.
42.	Chris Hamilton, EAO	Anne Currie, Rescan, Risk Assessment Presentation	How does the Working Group know that the mitigation being proposed by Seabridge is going to be enforced?	Proposed mitigation will be detailed in management plans to be presented in the EA Application. Enforcement measures are outside of a proponent's control (e.g., the number of RCMP patrolling highways 37 and 37A to enforce speed limits)

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
43.	Norm Maclean, LGL for NLG and Mansell Griffin, NLG	Anne Currie, Rescan	What is the context when looking at risk in relation to the local versus regional wildlife population levels? What is the definition of moderate? For example, a moderate risk may more severe in a local context, but would be diluted in a regional context because of the larger area. A small effect on a regional population has an impact on local populations. For example, moose populations in the Cranberry area are declining and this population is important locally.	The KSM project is committed to limiting any effects on moose, particularly due to direct mortality. The Project is limiting and quantifying its effects in three ways: 1. The KSM Project will not construct any new roads that are open to the public, hence no new areas will be open for hunters. 2. The KSM Project is not located in the Cranberry area - the sole effect on moose in NLG territory will be due to increased traffic - to levels below historic highs in the 1990s. 3. To understand the effects of increased traffic on moose KSM completed a quantitative assessment of the likely increase in moose mortality due to increased traffic. This analysis examines the sensitivity of the current moose population to this increased mortality. Rescan collaborated with and/or received data from Nass moose surveys, Nisga'a and Gitanyow hunting rates, Gitanyow road monitoring studies, and the results of non-resident hunting tags. This analysis provides a quantitative evaluation of the effects on the moose population. The information from this analysis is included in the final report as Appendix D.
44.	Mark Cleveland, GHCO	Anne Currie, Rescan Assessment	There is a risk to sockeye populations in Brown Bear Creek. A fuel spill should be rated as major or catastrophic as there is no barrier on the downstream side of Highway 37 at Bear Creek.	While all streams are considered important, the report (Figure 5.1-1a through I, Table 5.2-1 and Figure 5.2-1) highlights important fish-bearing streams identified by the working group (such as Brown Bear Creek). For the accidents risk assessment, the severity rating varies depending on the proximity of a spill to a watercourse, the volume of material spilled, how quickly spilled material is cleaned up, whether the spill is localized or not, etc. Potential risks from spills will be mitigated through actions described in the Spill Prevention and Emergency Response Plan, which provides specifications for preventing spills and controlling the release of spills during traffic accidents. The plan will minimize response time (e.g. by locating spill kits at strategic locations along the haul route) and maximize clean-up efficiency, preventing long-term or geographically extensive effects. As a result fuel spills are rated as moderate severity. Considering the range of potential events that could occur, the report will be revised to make a range of severity ratings clearer.

JULY 9, 2012 WORKING GROUP MEETING COMMENTS

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
45.	Bob Bocking, LGL for NLG	Anne Currie, Rescan	The report is too general with respect to potential risks to specific salmon populations. Interested in seeing more detail in the risk assessment. Suggest specific populations be assessed individually in a different chart where risk conclusions and mitigation are adjusted based on effects on local salmon species.	During the meeting, the Working Group identified the key salmon-bearing watercourses along the traffic route. The baseline section of the fish and aquatic habitat risk assessment section discusses these areas with particularly high fisheries values. The probability of a spill happening is low, and the probability of a spill happening at one a sensitive location during a sensitive time is even lower. Regardless, such an event in these areas may have a higher severity rating, because they're so important to the system. Risk conclusions and mitigation are made considering the most sensitive streams and local salmon species (see Table 5.2-1).
46.	Mark Cleveland, GHCO	Anne Currie, Rescan	Is additional mitigation such as guard rails at stream crossings being considered?	Sherrie Applegate (MoTI) noted that highway improvements including installation of new guard rails is dependent on the ministry's budget. She also noted that public safety needs to be assessed when considering installing new guard rails.
47.	Kevin Koch, GHCO	Anne Currie, Rescan	The time to respond to an accident or spill in the north is not the same as the south. Response time is limited by geography and available resources.	Seabridge is committed to installing spill response stations at strategic locations along the highways in order to reduce the time to respond to accidents or spills. The locating of spill kits will be done in consultation with First Nations, Nisga'a, MoTI, and MOE.
48.	Mike Demarchi, LGL for NLG	Anne Currie, Rescan	The method and conclusion seem to be based on qualitative information rather than quantitative information (e.g., population estimates) and there is no indication of a threshold value. The report looks at historical wildlife numbers and needs to consider the current status of wildlife populations along the traffic route.	To understand the effects of increased traffic on moose KSM completed a quantitative assessment of the likely increase in moose mortality due to increased traffic. This analysis examines the sensitivity of the current moose population to this increased mortality. Rescan collaborated with and/or received data from Nass moose surveys, Nisga'a and Gitanyow hunting rates, Gitanyow road monitoring studies, and the results of non-resident hunting tags. This analysis provides a quantitative evaluation of the effects on the moose population. The information from this analysis is included in the final report as Appendix D.
49.	Chris Schell, MOE	Anne Currie, Rescan	It would be best to provide funding to an existing program (Northwest Invasive Plant Council) which does invasive plant surveys and spraying along the highway. These techniques are more effective than washing trucks.	MoTI is responsible for controlling invasive plants on public highways. Seabridge will consider working with the Northwest Invasive Plant Council if invasive plants are unintentionally introduced on Seabridge controlled access roads.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
50.	Dwayne Day, THREAT	Anne Currie, Rescan	There are some areas where people (e.g., farmers) don't want spraying for invasive plants.	Sherrie Applegate (MoTI) noted that spraying is based on species. Weeds are pulled by hand within MoTI's right-of-way where farmers do not want any spraying.
51.	Mark Cleveland, GHCO	Anne Currie, Rescan	Concerned about accidents in areas where people park along the highway to access pine mushroom and berry sites. For example, in the fall, between Meziadin Junction and Kitwanga, there are mushroom pickers park in this area for six weeks.	Seabridge is interested in establishing a communication mechanism to work with the Gitanyow to identify mushroom and berry picking sites along Highway 37.
52.	Dwayne Day, THREAT	Anne Currie, Rescan	Will industrial vehicles be using pull-outs near points of interest?	Sherrie Applegate (MoTI) indicated the ministry is considering increasing the number of rest areas along the highway, in consultation with First Nations.
53.	Mark Cleveland and Kevin Koch, GHCO	Anne Currie, Rescan Presentation on Cumulative Effects	Why is cumulative effects information not included in the report? Will we need to review the whole EA Application to review the cumulative traffic effects assessment?	Cumulative effects of traffic are considered in the final report (see chapter 8 of the KSM Project highways 37 and 37A Traffic Effects Assessment).
54.	Mark Cleveland, GHCO	Anne Currie, Rescan	Is there any reason the report doesn't include potential forestry data in the slide showing cumulative traffic estimates? If the forest industry picks up this could have an effect.	The cumulative effects assessment in the EA Application will consider other projects and activities, including forestry.
55.	Kevin Koch, GHCO	Anne Currie, Rescan	We don't really have data or know what the wildlife impacts were when vehicle traffic was at historic highs. What definition of cumulative effects are you using? I don't think historical data provides any value because wildlife impact is not known.	Chapter 8 of the KSM Project Highways 37 and 37A Traffic Effects Assessment considers cumulative effects, including a description of the assumptions used to prepare the assessment.
56.	Bob Bocking, LGL for NLG	Anne Currie, Rescan	The risk assessment methodology seems to deviate from Section 10.9 of the approved Application Information Requirements.	The methodology used in the Highways 37 and 37A Traffic Effects Assessment Report used likelihood and severity indices.
57.	Mike Demarchi, LGL for NLG	Anne Currie, Rescan	Is the report a draft or final? Will the discussions today be incorporated into the report?	The Highways 37 and 37A Traffic Effects Assessment was a draft report at the time of July 9 Working Group meeting. The final report considers comments from the July 9 Working Group meeting, and the final report is submitted as an Appendix (22-C) of the EA Application.

JULY 9, 2012 WORKING GROUP MEETING COMMENTS

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
58.	Jennifer Wilson, EC	Anne Currie, Rescan	Is there an opportunity to comment on the report as part of Environmental Impact Statement (EIS)?	Yes as the final report will be included as an appendix of the EIS/EA Application (Appendix 22-C).
59.	Bob Bocking, LGL for NLG	Anne Currie, Rescan	In the Likelihood Scale, what is the distinction between the 'rare' and 'unlikely' categories? Maybe rare should be "nil" or zero or collapse the scale to four points.	The Likelihood scale is described in section 4.4.3 of the report The definitions of the 'rare' and 'unlikely' have been modified for clarity in final version of the Report.
60.	Chris Hamilton, EAO	Greg Sharam, Rescan Presentation on Wildlife	In terms of moose-vehicle collisions, do cows get hit more often than bulls?	In the winter the bulls tend to be at higher altitudes because they can handle deeper snow while the cows are lower in the valley where the highway is located. As a result, cows are hit more often. Gitanyow representatives noted that since January 1, 2012 environmental monitors reported six road kills of cows. Approximately 70% of the moose observed around the highway were cows.
61.	Mark Cleveland, GHCO	Greg Sharam, Rescan	WARS data is deficient and I am glad this has been highlighted.	Comment noted.
62.	Kevin Koch, GHCO	Greg Sharam, Rescan	The report says that there are no Ungulate Winter Ranges (UWR) in the Cranberry area. UWRs are identified in this area as they are included in the Gitanyow reconciliation agreement.	Chris Schell noted the UWRs in the Cranberry area have not been legally designated. Moose winter range has been identified near the Cranberry Junction and Cranberry River (BC ILMB 2011). This has been considered in the risk assessment and will be discussed in the EA Application.
63.	Mike Demarchi, LGL for NLG	Greg Sharam, Rescan	An agency needs to take the lead to harmonize the different wildlife-vehicle collision datasets (WARS, ICBC and RCMP). Maybe the population model can factor in harvest rates and predation rates. Is there a tipping point where road kill could influence the population?	The Working Group acknowledged there would be benefits to amalgamating the different datasets. A quantitative assessment of the increase in moose mortality due to increased traffic is included in the final report.
64.	Norm Maclean, THREAT	Greg Sharam, Rescan	There is varying information on different moose populations. The company and government should be thinking of ways to re-start survey work.	Comment noted. As part of the Project Seabridge will be undertaking appropriate wildlife surveys in the Mine and TMF areas. Rescan collaborated with and/or received data from Nass moose surveys, Nisga'a and Gitanyow hunting rates, Gitanyow road monitoring studies, and the results of non-resident hunting tags and part of the quantitative evaluation of the effects on the moose population.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Presentation	Comment	Seabridge Response
65.	Dwayne Day, THREAT	Greg Sharam, Rescan	One of my concerns is the long term effects of predators on access roads. These new rights-of-way will change the migration routes of these animals now that they have access to these roads. This will increase the number of predators. The reasons for these effects have not been captured in the report. New roads could destroy good moose habitat areas, and should be compensated somehow.	The report focuses on highways 37 and 37A. The potential effects of the proposed Coulter Creek and Treaty Creek access roads on wildlife will be considered in the EA Application.
66.	Chris Schell, MOE / Mansell Griffin, NLG	Greg Sharam, Rescan	It is better to mitigate/prevent moose from being killed first, rather than to start by considering compensation for moose kills.	Comment noted.
67.	Mark Cleveland, GHCO	Greg Sharam, Rescan	I have heard from the Conservation Officers past that truck convoys can reduce strikes	Comment noted.
68.	Kevin Koch, GHCO	Greg Sharam, Rescan	Suggested holding a focused meeting with experts to discuss mitigation that might work in the proposed Project area.	Comment noted.

September 14, 2012 GHCO Comments

No.	Commenter / Date Received	Report	Comment	Seabridge Response
69.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	Gitanyow would like to frame the following comments in the context of the <i>Gitanyow Huwilp Recognition and Reconciliation Agreement</i> , signed by the eight Gitanyow Chiefs and the BC Ministers of Aboriginal Relations and Forest, Lands and Natural Resource Operations on March 28, 2012. This agreement includes the <i>Gitanyow Lax'yip Land Use Plan</i> which provides detailed management objectives and land use zones for the entire Gitanyow Lax'yip (territory). This Agreement represents a partial accommodation of Gitanyow Aboriginal Rights, and as such it is expected that the KSM Project will uphold and adhere to the relevant management objectives therein. We have attached the appropriate maps for the affected Wilp for reference.	Comment noted.
70.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	While the KSM TEA adequately outlines the various Valued Components that are potentially impacted by the transportation of products and supplies related to the KSM Project, Gitanyow holds significant concern over the potential effects on wildlife (primarily moose) from vehicle collisions and about the potential negative effects on aquatic ecosystems and human safety in the event that a commercial vehicle is involved in an accident, and deleterious substances are released into the environment.	Comment noted.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
71.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	The transport route, throughout much of its length, parallels and crosses many small streams and rivers that support fisheries that Gitanyow rely upon for food security (see photo 5). Among some of the most important streams include the Kitwanga River, Cranberry River, Meziadin River, Nass River and Bell Irving River. Many other smaller streams and creeks are also very important producers of salmon and other fish species and they include Brown Bear Creek, Hanna Creek, Tintina Creek and numerous other unnamed but highly productive tributary streams. Many of the fish stocks in all these water bodies are protected under Canada's <i>Wild Salmon Policy</i> and listed for special management by the province of BC. Furthermore, the route parallels dozens of kilometers of wetlands, which also serve an extremely valuable function to the hydrology of the larger river systems. The combination of these wetlands, streams and rivers support some of the most productive aquatic and terrestrial ecosystems in British Columbia. These ecosystems have supported the Gitanyow culture and way of life for thousands of years. All these streams and rivers are found within Gitanyow Lax'yip (Traditional Territory) and provide the Gitanyow wilp with much of their food fishery. The Gitanyow have aboriginal rights to fish in all these watersheds and the watersheds are protected under the constitution of Canada.	Comment noted.

No.	Commenter / Date Received	Report	Comment	Seabridge Response
72.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	In addition to salmon, moose meat makes a significant contribution to Gitanyow food security and plays an important role in Gitanyow culture and ceremonial systems. As such, Gitanyow Wilp members hold an Aboriginal right to access, utilize, and manage the moose populations within the Lax'yip. Through conducting the Gitanyow Wilp-Based Socio-Cultural Needs Assessment, Marsden (2010) determined that, although 69% of Gitanyow Wilp members were satisfied with the amount of traditional food they had access to, moose meat was the one food that was considered difficult to access. One of the reasons behind this difficulty in accessing moose is the approximately 68% decline over the past 10 years in moose populations over a large portion of the Nass watershed. (Demarchi 2001, 2007, 2011). Gitanyow is extremely concerned that the moose population is at a 'tipping point', and that any additional impacts or stressors on the moose population will have significant and potentially irreversible consequences. In a study conducted over a two-year period where First Nations people in 21 B.C. communities were surveyed, Chan et al. (2011) concluded that: 1. 41% of B.C. First Nations people experience food insecurity.	Comment noted. Wildlife values have been addressed in the report.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
(72.)	(continued)		2. Overall, the nutritional value of food intake is below what is required for optimal health, however, that nutritional quality is improved when traditional food is eaten. Moose meat cannot be simply replaced with market foods. The nutritional value of moose meat is superior to domestic meat such as cattle. Not only does moose meat contain roughly 1.1% fat in the muscle, compared to 30% fat in the muscle of beef, but moose contains eicosapentaenoic acid: a natural antifreeze that aids bloodflow of moose in frigid weather, and when consumed by humans protects against heart attack, atherosclerosis (hardening of arteries) and certain forms of arthritis (Rowland, 1989). Considering dietary concerns leading to heart disease and obesity were found to be major health issues for First Nations people in B.C. (Chan et al., 2011), the importance of having access to moose cannot be overstated. The Gitanyow have a constitutionally protected aboriginal right to harvest moose from the Lax'yip. Currently, this right is already threatened because moose populations are so low, which was demonstrated in the results of a moose survey conducted by the GHCO in 2011/2012. This survey showed only one moose harvested from the Gitanyow Territory by a Gitanyow Wilp member, despite significant efforts. Another 15 moose were harvested by Gitxsan Wilp members (who currently reside in Gitanyow) and one by an unknown hunter (Koch 2012). These numbers prove two important points: 1) Gitanyow Wilp members are having difficulty harvesting moose from the Gitanyow Territory, and: 2) there is a significant amount of moose being harvested on Gitanyow Territory by non-Gitanyow Wilp members.	
73.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	Although the Gitanyow are taking significant action with limited resources to deal with unauthorized hunting of moose on Gitanyow Territory, this problem is complex and finding solutions will take time and additional resources. To further put the results from this study into perspective, the total harvest number of 17 is very low compared to an average harvest of 34 moose reported in previous surveys conducted during the 2000/2001 and the 2001/2002 hunting seasons (Hamelin 2002). Furthermore, decreasing harvest levels reported this fall and winter support the ongoing winter population estimates that indicate moose populations have significantly declined.	Comment noted. Wildlife values have been addressed in the report.

No.	Commenter / Date Received	Report	Comment	Seabridge Response
74.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	Because of the multiple stressors and impacts on the moose population, Gitanyow requests that any project proposed within the Lax'yip or adjacent to it undergo a rigorous and jointly-designed cumulative impacts/effects assessment process. It is concerning that within the KSM TEA there is no mention of cumulative impacts/effects. It is our position that cumulative impacts assessment will likely be the most important part of the KSM TEA.	A cumulative effects assessment will be included in the final report (see Chapter 8 of the KSM Project Highways 37 and 37A Traffic Effects Assessment).
75.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	Cumulative effects as defined by CEAA are “changes to the environment that are caused by an action in combination with other past, present and future human actions (Hegmann et al. 1999)”. An “action” is further defined as “any project or activity of human origin (Hegmann et al. 1999)”. With respect to moose, we know the population has declined by close to 70% from 2001 to 2011 (Demarchi 2011) and Demarchi (2007) concluded that the largest single contributing factor to the decline of the Nass moose population was the overharvest of cow moose. Therefore, moose harvesting, which is a human activity, should be considered an action within a properly conducted CEA. In conducting a thorough CEA, the proponent must consider all current impacts to moose and other Valued Components (VCs), in combination with potential effects from the KSM project, and other reasonably foreseeable projects. We believe this is necessary to place the potential effects of the KSM project into the proper context, and thus have a complete understanding of the potential impacts and consequently how best to mitigate or avoid them. To adequately address the concerns outlined above, and to begin to frame a CEA, Gitanyow poses the following questions to the proponent: 1. How might the increase in traffic from the KSM project, in combination with other projects in the region and in consideration of other impacts, combine to further reduce moose numbers? 2. Will these reductions in moose numbers prevent the moose population from rebuilding or slow that rebuilding process? 3. What can the proponent do to offset this reduction in moose numbers?	In response to comments received during the traffic study working group meetings in Terrace (July 9, 2012), a quantitative assessment of the likely increase in moose mortality due to increased traffic was completed. The model includes a sensitivity analysis to different levels of traffic and different hunting regimes. Rescan collaborated with and/or receiving data from Nass moose surveys, Nisga'a and Gitanyow hunting rates, Gitanyow road monitoring studies, and the results of non-resident hunting tags. This analysis provides a quantitative evaluation of the effects on the moose population, and is summarized in the report and included as Appendix D. A cumulative effects assessment is also included in the final report (see Chapter 8 of the KSM Project Highways 37 and 37A Traffic Effects Assessment).

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
76.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	A further concern with the KSM TEA relates to the use of traffic data. Throughout the document there are many references made to historical traffic volumes, and how the traffic volumes will not exceed historical levels as a result of the KSM project. We are requesting further clarification from the proponent on the relevance of this comparison. From the Gitanyow perspective, we are unaware of any scientific evaluation of the effects on the environment during the historical traffic volume peaks of the '80s and '90s. The records of wildlife mortalities during this time are of very limited value because as we know, the WARS database is extremely incomplete. The proponent appears to be comparing projected levels to historical peaks because it makes the projected levels seem less significant. We do not see the value in trying to create the illusion of lesser impact. In the future, if comparisons are going to be made to historical traffic volumes, the proponent should include some solid data on the environmental impacts that occurred at the time of those historical traffic volumes.	Historical peaks of traffic volumes in the 1980s and 1990s have contributed to the baseline conditions currently along highways 37 and 37A. As the risk assessment evaluates potential changes to baseline conditions, this comparison is used to provide the reader historical context. The limitations of the WARS database are acknowledged in the study.
77.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	Furthermore, until such time as there is additional data collection conducted on traffic volumes, we consider all the traffic volume data to be very suspect and limited. We expect the proponents to be collecting data on traffic volumes in order to conduct a rigorous traffic effects assessment. We are pleased that the BCEAO and the Ministry of Transportation and Infrastructure (MoTI) are starting to move in this direction.	Comment noted. Seabridge has used available data from the Ministry of Transportation (traffic data and WARS data) and Gitanyow data. Seabridge has agreed to consider participating in MOTI-led initiatives for Highway 37 and 37A. The limitations of the WARS database are acknowledged in the study.
78.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	Gitanyow also notes that the TEA does not accurately predict the potential increase in traffic volume that is indirectly related to the project. Any project of this magnitude will result in a significant increase in other traffic along the corridor in question. There will be more workers and people in the area than just those transporting materials, supplies, product and workers to and from the minesite. People who move to the area to work at the mine will likely use Highway 37 for recreation (including hunting, fishing, snowmobiling, etc.) and accessing service centers. Further to the abovementioned concerns regarding potential impacts to moose from all types of vehicle traffic, we feel it is incumbent on the proponent to accurately reflect all potential traffic increases along the transportation corridor.	Current and reasonably foreseeable future project traffic along highways 37 and 37A is considered, in addition to estimated baseline traffic, in the cumulative risk assessment of the report. Traffic estimates are based on publicly available information. The cumulative risk assessment assumes all reasonably foreseeable mine and hydro projects will become operational and that all projects will occur at the same time Due to the uncertainty of whether or not other projects will proceed, and if they will overlap in time scale, this estimate ensures a conservative approach.

No.	Commenter / Date Received	Report	Comment	Seabridge Response
79.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	We appreciated the inclusion of data on current mining related traffic through the corridor (Section 2.1.3.1) as it is important for us to have an idea of the current levels of ore-truck traffic. As well, the data provided on historical forestry traffic was of value (Section 2.1.3.2). However, it is not just ore trucks that can have negative effects on wildlife/humans along the road, as other mine related traffic is extremely important as well. From our experience, it is the light-duty pickups that travel at reckless speeds along Hwy 37. This was echoed at the recent Kitsault transportation working group meeting by Corporal Mario Cloutier of the RCMP who stated that his staff have documented pickup trucks going as fast as 200 km/hour down Highway 37. Current levels of all industrial traffic should be included as part of the baseline.	All KSM related traffic estimates are included in the effects assessment.
80.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment	The Gitanyow are hopeful that the KSM and other transportation working groups are going to determine and implement the appropriate mitigation strategies that will result in an improvement from the current situation with respect to negative transportation related impacts to human health and the environment. We realize the mining sector, although very significant, will not be the only industrial user of Highway 37 and that agreements with the forest industry and other sectors must be sought as well. The Gitanyow feel strongly that the solutions to transportation problems will occur through the engagement and participation of all active industrial partners, as well as various departments within the Provincial and Federal governments. Outside assistance from various researchers and other jurisdictions will prove valuable as well.	Comment noted. Seabridge would be willing to participate in a government-led, multi-stakeholder initiative with other highway users to discuss possible mitigation strategies for negative effects of traffic along the KSM haul route.
81.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/Pg ii, Fig 1/ Exec Summ	Requesting clarification - why are some topics (such as wildlife relating to project traffic) listed under 3 different severity ratings?	Severity ratings can differ by VC and by type of risk. For example, in the wildlife risk assessment for Project traffic (matrix in Table 5.3-5), it is noted that the severity of impact to moose from direct mortality would be moderate, the impact to bears from direct mortality would be minor.
82.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg iii/Para 1	Can the proponent confidently state that over the lifetime of this mine (55 years plus 100's of years of post-closure) that "[p]otential social and environmental risks from traffic accidents are expected to be rare and unlikely occurrences."? Given the magnitude and duration of the proposed project, this statement requires substantiation.	The final report will include figures for the Collision Prediction Model indicating the range of values encompassed by a 95% confidence level (see Figures 3.2-1 through 3.2-3).

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
83.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 2-1/Sect 2.1.1, para 2	Gitanyow proposes that the proponent has mischaracterized the winter driving conditions along Highway 37 throughout this report, starting in this section. In theory, Hwy 37 is sanded and plowed in the winter as it states here. In reality, Hwy 37 receives a very low amount of daily road maintenance in comparison to other regional highways such as Hwy 16. This is critically important because the weather conditions along this corridor are exceptional (high snowfalls, frequent winter rains, freeze-thaw) and create extremely challenging road conditions on an annual basis. Because of the poor level of road maintenance, this creates very dangerous driving conditions. Gitanyow would like the proponent to produce data on the resources and time spent on road maintenance on Hwy 37 in comparison to other regional highways over the last 2 decades for comparison.	BC MOTI was contacted regarding the availability of road maintenance data along Highway 37. MOTI's response follows: "Hwy 37 and Hwy 37A are both classified as Class B highways and receive maintenance based on Ministry of Transportation Class B highway maintenance specifications. Hwy 16 in the Hazeltons/Kitwanga area is also a Class B highway as a comparison. For reference, generally a Class A highway is a highway with traffic volumes of over 5,000 vehicles a day which Hwy 37 does not receive. As noted in the Gitanyow report, the weather conditions for Hwy 37 and Hwy 37A along this corridor are exceptional (high snowfalls, frequent winter rains, freeze-thaw) and this poses challenges for the Maintenance Contractors. The ministry takes its commitment to provide a safe, effective transportation network very seriously and the performance of our maintenance contractors is an integral part of our commitment and we hold them accountable for the services they deliver. Ministry staff routinely audit and evaluate our maintenance contractors on Hwy 37 and 37A. In regards to data on the resources and time spent on road maintenance on Hwy 37 in comparison to other regional highways over the last two decades for comparison, our district office does not have that data readily available if at all available. This data would have to be compiled through the cooperation of the Maintenance Contractors and would be a time consuming effort. What we can say is that Hwy 37 and 37A have a lot of resources spent on it. For example, the maintenance contractor spends significant amounts of time and resources in snowblowing, daylighting and using equipment like snowcats to remove and store the extreme amounts of snow that falls in certain areas of Hwy 37 and Hwy 37A. The Ministry and Maintenance Contractor also put a lot of resources into avalanche control on one of the most active avalanche areas in North America. These types of resources certainly differ from areas like the Lakes or Nechako Service Areas."

No.	Commenter / Date Received	Report	Comment	Seabridge Response
84.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 2-13/Sect 2.1.3.4	While the results of the BC MoTI (2006) study are useful, it did only include heavy commercial vehicles. Other mine related traffic is important as well, such as light duty pickups. Hwy 37 is known as a relatively high-speed highway for several reasons. 1) There are long straight stretches. 2) Level of enforcement by RCMP is low because of the remoteness of the highway. 3) Workers have long distances to travel, and tend to not follow posted speed limits.	Comment noted.
85.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 2-17/Fig 2.4-1	In this table and throughout the report it appears the proponent has only mentioned one-way trips. Including the number of two-way trips provides a clearer indication of the actual amount of traffic on the roads each day. Again, this appears to be a strategy to minimize the appearance of potential impacts.	Traffic counters along the highway measure one-way trips; the data has been presented in this way for the sake of consistency and not to minimize the appearance of potential effects. For example 44 one-way trips equals 22 return or two-way trips.
86.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 3-10/Sect 3.2.1	It is important when using models to discuss the weakness of the assumptions of the model. The effectiveness of any model is directly related to the quality of the data used in the model. In the case of the Collision Prediction Model (CPM) there are two key problems with the model inputs: 1) Although Hwy 37/37A are classified as RAU2, our collective experience is that the maintenance level is lower than that of neighboring RAU2 highways such as Hwy 16. 2) The AADT volumes are acknowledged to be based on very poor and limited data. This is not to say that the model shouldn't be used, but the proponent should acknowledge the limitations.	The limitations of the model are reported in Section 3.2.2 of the Highways 37 and 37A Traffic Effects Assessment.
87.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-21/Sect 5.1.1.2	Should say Gitanyow Lake, not Kitwancool Lake.	The official gazetted name of this lake, as it appears on maps of British Columbia, is Kitwancool Lake. Seabridge is using the official, legal name for all named places in the study area. Please refer to the following URL: http://apps.gov.bc.ca/pub/bcgnws/names/40670.html However, we have also noted in the report that this lake is also known as Gitanyow Lake.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
88.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-25/Table 5.1-7	In several areas of the report including this table, the proponent references that speed limits will be enforced. As we know the RCMP clearly say it is very difficult to effectively enforce speed limits along Hwy 37. Seabridge stated at the July 9th, 2012 meeting that trucks would be equipped with satellite tracking systems to monitor speeds travelled. Questions regarding reliance on this method include: 1. Is the accuracy of these units tested? 2. Will all mine employees and contractors be equipped with these units, including drivers of light-duty and heavy commercial trucks? 3. How exactly is speed monitored using these units (i.e. is the company alerted automatically if an employee/contractor is speeding?)? 4. What will be the consequences for an employee or a contractor who is found to be speeding? The proponent could improve on speed limit enforcement by financially contributing to creation of new RCMP positions dedicated to patrolling Hwy 37. Other mitigation measures that will be needed to ensure protection of Community Well Being include: 1. Increased road maintenance, including potential financial contribution by the proponent. 2. The construction of more roadside pull-outs or increasing the shoulder width of the highway. Currently the shoulders are very narrow on Hwy 37 and this leads to serious safety issues when people pull over for conducting food/medicine harvesting, firewood gathering, vehicle breakdowns, etc.	Seabridge will enforce speed limits on KSM Project access roads via radar and security personnel. Seabridge has not stated that satellite tracking systems will be installed in vehicles.
89.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-28/Sect 5.1.3.4	Under <u>Risk Characterization</u>: The report states that “higher traffic volumes generally result in a greater number of accidents”, but then it follows by saying “importantly, however, increases and decreases in the rate of traffic accidents have not and are not anticipated to be concurrent with any level increase or decrease in traffic”. This appears to be a conflicting statement. Please clarify.	Comment noted. The paragraph has been re-worded in the report to state that “Increases and decreases in the rate of traffic accidents have not and are not anticipated to be concurrent with any level increase or decrease in traffic.”

No.	Commenter / Date Received	Report	Comment	Seabridge Response
90.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-28/Sect 5.2.1	The proponent lists “Northern Rivers” as one of three major watersheds affected by project traffic. We have never heard of a watershed known as the “Northern Rivers” watershed. Please clarify. The proponent states that “the largest Skeena River sockeye runs are in watercourses along highways 37 and 37A”. This is incorrect, as the largest Skeena River sockeye runs are in the Babine River watershed. The proponent states that “Skeena coho do not have any particularly large, significant stocks in the Study Area”, however Kitwanga coho should be considered a significant coho stock within the Skeena watershed. Bull trout are located not only in the Kitwanga, but also in the Cranberry River and in Hanna and Tintina Creeks. Dolly Varden, also blue-listed, are found all along the transportation corridor. Also, Meziadin Lake should be mentioned in the baseline data section considering a spill into either Hanna or Tintina Creeks would immediately pollute Meziadin Lake, which at a minimum contains Chinook, coho, pink, sockeye and kokanee salmon, as well as blue listed Dolly Varden, mountain and round whitefish, rainbow trout, steelhead and bull trout (blue-listed).	“Northern Rivers” is a typo. It meant to say “North Coast Rivers (coastal rivers near Stewart e.g. Bear River)”. This has been corrected in the report. Seabridge acknowledges that the salmon runs in the Babine watershed are the largest on the Skeena River. The next draft will be corrected to say “The largest Skeena River sockeye runs are not along the proposed Project traffic routes.” The importance of Kitwanga coho, bull trout, and Meziadin Lake have been highlighted in the report.
91.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-33/Sect 5.2.3.1	<u>Risk Mitigation:</u> The proponent’s listed risk mitigation equates simply to status quo measures which we believe are not adequate. Gitanyow will need to see additional mitigation measures including: 1. Guard rails along certain watercourses including, at a minimum, Bell Irving River, Nass River, Hanna and Tintina Creeks, Cranberry River, Brown Bear Creek and the Kitwanga River. An assessment should be conducted on the transportation route to determine specific locations of risk to aquatic habitat, similar to that conducted by Gitanyow and Avanti for the Kitsault project (Cleveland and Koch, 2012). 2. Actions taken towards increasing the regional capacity for spill response. Compared to areas that are closer to major centres, there is an insufficient capacity for spill response in the northwest region (Pers. Comm., Norm Fallows, 2012). There is nothing listed under risk mitigation that relates to prevention of spills. Prevention should be the primary objective.	The prevention of spills is listed as the primary objective of the Spill Prevention and Emergency Response Plan. Guard rails along a provincial highway are not included as proponent-led initiatives. Seabridge has committed to strategically locate spill response stations along Highway 37.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
92.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-34/Sect 5.2.3.2	<u>Risk Mitigation</u> : Again, nothing about prevention is listed.	This section has been revised to include prevention as the first form of mitigation for spills.
93.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-35/Table 5.2-6	The proponent should explain how a spill of diesel or ore concentrate into watercourses such as Hanna or Tintina Creeks, or the Cranberry or Kitwanga Rivers would only constitute a moderate severity impact. During the spawning season for sockeye, Hanna and Tintina Creeks will hold the majority of sockeye that spawn in the Nass Watershed. These watersheds drain into Meziadin Lake where two year classes of sockeye fry rear into smolts, therefore sockeye are present year round in Meziadin Lake. From fall to spring each year, these creeks have hundreds of millions of sockeye eggs incubating. Hundreds of Gitanyow people rely heavily on sockeye from the Meziadin system for their food security and for economic gain. The severity of impact of a potential spill into this system would be more accurately portrayed as extreme, not moderate.	It is understood that severity will vary depending on the size, location, timing of the spill, and effectiveness mitigation, and all streams in the assessment are considered important. The general determination of moderate severity on a spill of concentrate is supported by the fact that a concentrate spill would be highly localized, concentrate would be nearly insoluble in water because of low moisture content, and could therefore be cleaned up with relative ease. The determination of moderate severity on a diesel spill is supported by the fact that a fuel spill would be highly localized, and spill kits would be provided on all trucks transporting fuel. BMPs relating to petroleum spills will be described in detail in the Spill Prevention and Emergency Response Plan. Adherence to the plan will minimize response time and maximize clean-up efficiency, preventing long-term or geographically extensive effects.
94.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-37/Sect 5.2.3.3	<u>Risk Mitigation</u> : Why is this the first time prevention has been mentioned under mitigation for traffic accidents?	Comment noted. This will be addressed in the next draft of the report.
95.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-39/Sect 5.3.1.1	The proponent states that “there are no approved UWR for moose along the highways 37 and 37A”. Gitanyow directs the proponent to the Gitanyow Lax’yip Land Use Plan, previously mentioned, to identify the UWR which was approved by the Gitanyow and the province of BC in March of 2012. Moreover, that Gitanyow has already legalized this land use zone within our Ayookxw (Gitanyow Law). As such, in order to avoid infringement of an Aboriginal right, it is imperative that the proponent acknowledge the UWR identified in the Gitanyow Lax’yip Land Use Plan.	The Cranberry area has been identified and recognized as high quality ungulate habitat.

SEPTEMBER 14, 2012 GHCO COMMENTS

No.	Commenter / Date Received	Report	Comment	Seabridge Response
96.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-39/Sect 5.3.1.2	The Kitwanga and Cranberry watersheds, along which the transportation route runs parallel for a significant distance, are both very high value areas for grizzly bears. During spring, both these valleys contain abundant early forage and during fall provide salmon for grizzlies. In and around the village of Gitanyow, grizzly bears are commonly observed from spring through to fall.	Comment noted.
97.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-41/Table 5.3-2	Under Moose and Bears, why does it only specify Wilp Wii Litsxw?	This has been modified in the report.
98.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-45/Sect 5.3.3	The proponent states that the assessment to wildlife populations is generally qualitative because “the geographic population boundaries for the local populations considered in this assessment are both unknown and dynamic”. Modelling of potential impacts to the moose population are required that takes into account the best available data for model inputs, in order to provide a quantitative assessment of impacts to moose populations.	In response to comments received during the traffic study working group meetings in Terrace (July 9, 2012), a quantitative assessment of the likely increase in moose mortality due to increased traffic was conducted. The model analyzes the sensitivity of the current moose population to this increased mortality. Seabridge’s consultant is collaborating with and/or receiving data from Nass moose surveys, Nisga’a and Gitanyow hunting rates, Gitanyow road monitoring studies, and the results of non-resident hunting tags. This analysis provides a quantitative evaluation of the effects on the moose population, and is included in Appendix D.
99.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-46/5.3.3.1	<u>Risk Mitigation:</u> Reference to future mitigation strategies, without specific detail of what those strategies entail does not allow for meaningful review by Gitanyow.	This statement is revised for clarity in the report. Details of mitigation, including BMPs, plans and strategies are included in the EA.
100.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-47/Table 5.3-5	For Moose under Description of Consequence of Realized Risk the proponent concludes that “even though traffic volumes will be increasing considerably, the number of animal collisions will not increase by an equal percentage.” How did the proponent arrive at this conclusion and where are the references for this?	A quantitative assessment of the likely increase in moose mortality due to increased traffic was conducted. The model analyzes the sensitivity of the current moose population to this increased mortality, and provides a quantitative evaluation of the effects on the moose population. The model assumes a linear response of mortality to traffic at the current (low) traffic levels. At higher levels (such as those expected if all projects go) we would expect a curvilinear response with less mortality per unit of traffic than the current scenario. References are provided in Appendix D.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
101.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Pg 5-51/5.3.3.2	<u>Risk Characterization:</u> The proponent has not fully characterized the potential for direct mortality of moose due to vehicle collisions. They estimate there could be an average of 20 moose per year (range of 17 to 23) based on the estimate that the WARS data actually accounts for 25-35% of moose collisions. Data from one year of roadkill and roadside wildlife monitoring showed that cow moose comprised at least 50% of the roadkill (it was likely higher but sex was not reported for all roadkill). Cow moose comprised 70% of all live moose observed beside the highway during the 2011/12 winter (Koch 2012). Cow moose are known to winter lower than bulls especially when they are with calves, because snow levels are less at lower elevations (Pers. Comm., Len Vanderstar, 2012). When cow moose are killed it has a disproportionately negative effect on the overall moose population. A further negative factor that is not considered is that if a cow that has a calf is killed during winter, the likelihood of the calf surviving the winter is very slim. Often calves will remain near the dead cow which increases its chances of getting hit or preyed upon by wolves which are attracted to the kill site (Pers. Comm., Gary Olson, 2012). The mortality levels of orphaned calves should be accounted for in any roadkill estimate. Another factor that should be considered is the increased levels of roadkill during extreme snowfall winters. In 2007/08 and again in 2011/12 there were extremely high snow levels. Climate change predictions are that we should expect more of these types of winters, in addition to more freezing rain events during winter. During winters of extreme snowfall there will need to be additional mitigation measures in place.	A quantitative assessment of the likely increase in moose mortality due to increased traffic was conducted. The model analyzes the sensitivity of the current moose population to this increased mortality, and provides a quantitative evaluation of the effects on the moose population. The traffic mortality submodel accounted for the current sex ratio and carried that forward to the future scenarios (Appendix D).

No.	Commenter / Date Received	Report	Comment	Seabridge Response
102.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies:	From the Gitanyow perspective, a threat to the moose population is a threat to Gitanyow food security, and a potential infringement of our constitutionally protected Aboriginal rights. Gitanyow refers the proponent to the following relevant sections of the Gitanyow Huwilp Recognition and Reconciliation Agreement (including the Gitanyow Lax'yip Land Use Plan) as guidance for protecting both the food security and Aboriginal rights of the Gitanyow: Plan Goals for Moose (Objective 2.0; Measure/Management Considerations) "Moose winter range management plans should be prepared by all non-forestry industries that plan developments within the plan area, prior to any development clearing or construction activities, as a condition to receiving a license or permit from the Province of BC to proceed with the project." (pg 47). Gitanyow proposes that a moose winter range management plan should be developed jointly with the proponent and Gitanyow to address the issues related to potential impacts on the moose population. Management Direction for the Area to be Protected [Hanna Tintina Conservancy] (Objective 1.0) "Maintain conservation, recreation, and cultural heritage values and features within the area to be protected identified as the Hanna-Tintina Area to be Protected in Schedule A Map 1." And "A comprehensive management plan shall define management objectives for the area as well as acceptable uses and levels of use, zoning and other strategies to minimize conflicts and help ensure the integrity of important protected-area values." As a portion of Highway 37 and adjacent area will soon become a conservancy, with a joint Management Plan developed and implemented by Gitanyow and the Province, Gitanyow proposes that the proponent pro-actively work with Gitanyow to address the aforementioned concerns regarding traffic and potential spills in the Hanna Tintina area to be protected (see attached map).	Comment noted. A quantitative assessment of the likely increase in moose mortality due to KSM traffic was conducted. Results of the moose population dynamics model and imbedded moose vehicle collision model indicated that the addition of traffic from the KSM project is projected to cause an additional <1% mortality to the moose population at the current population size, a mortality rate that does not predict a substantial decline from the base case scenario. Indirect effects of moose mortality on hunting and trapping are assessed in the Socio-economic and Land Use Section of the report (Section 5.1). While possible, hunting and trapping activities are not predicted to be at risk from a change in traffic volumes as a result of the Project. As such, the severity of the risk for hunting and trapping as a result of change in traffic is expected to be minor.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
(102.)	(continued)		To protect Gitanyow food security and Aboriginal rights, the following mitigations will be required: - Significantly increased levels of vegetation management along Highway 37. Although this is the responsibility of MoTI, all industrial users of the highway should be contributing to this. The current level of vegetation management allows vegetation to encroach to the point where shrubs are overhanging the road shoulders, therefore visibility is almost nil in many locations, and consequently cover and food for moose is excellent along much of the highway ROW (Photos 6 and 7). Longer term solutions are needed for vegetation management and these should include: - Brushing to widths that are shown by the best available research to be effective at reducing collisions. This includes a potential widening of the ROW. - Chipping of woody debris along the ROW to suppress vegetation growth. - Planting of plant species that are not palatable to moose. - Time brush cutting to reduce the palatability of the re-growing brush for moose. - Work with Gitanyow and DFO to develop vegetation management solutions along the many riparian areas alongside the highway. Although the abovementioned strategies will be costly in the short term, they will have long- term benefits that will benefit moose and other wildlife, as well as all users of the highway.	

No.	Commenter / Date Received	Report	Comment	Seabridge Response
103.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies:	Significantly improved road maintenance. Currently Hwy 37 receives much less plowing and sanding than other busier highways in this region. The southern part of Highway 37 passes through the Interior Cedar Hemlock and Coastal Western Hemlock Biogeoclimatic (BEC) Zones, and these BEC zones are known for extremely high moisture levels year round, with snow being the dominant precipitation type in winter. However, as our climate changes we are seeing numerous freezing rain events during winter and climate modelers expect we will see more of the same for decades to come for this region. These freezing rain events frequently occur over snow-packed roads leading to extremely dangerous driving conditions. Extreme rain or rain-on-snow events can cause flooding and washout roads, leading to vehicle accidents - evident in the case of the Maple Leaf Trucking accident which resulted in 49 tonnes of zinc ore entering Strohn Lake (Nov 2011 - on western boundary of Gitanyow Territory).	Road maintenance on provincial highways is the responsibility of BC MOTI. Please refer to response on comment number 83 regarding road maintenance information provided by MOTI..
104.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies	Prior to the project being constructed, conduct research into wildlife hotspots along the highway. This should be conducted year round for at least one year prior to the project commencing, and could consist of a weekly drive of the transport route from the Hwy 37/16 junction to where the transport route leaves Hwy 37, as well as Hwy 37A. This type of survey would also be useful for collecting roadkill data. As the project construction commences, continue with this research to refine the knowledge on hotspots using a proven methodology such as that developed by Hesse et al. 2010.	Comment noted. Mitigation and monitoring of effects on wildlife will be detailed in the Wildlife Management and Monitoring Plan, and the Traffic and Access Management Plan, and will require that Project personnel (including drivers) will communicate locations of observed wildlife to drivers; and locations of collisions between wildlife and vehicles will be documented. These plans will be included in the EA.
105.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies	Following the research into wildlife hotspots, place effective signage along key parts of the highway to alert drivers.	Highway signage is the responsibility of BC MOTI. Seabridge will place signage, as required on KSM access roads.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
106.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies	During winters of extreme snowfall, create diversionary trails parallel to the highway, and additional trails that lead away from the highway into areas where there is moose forage. In Alaska they have had success with supplementary feeding by placing bales of silage at the ends of these diversionary trails which keep the moose back away from the highway (Grauvogel 1990). In a Swedish study they concluded that “supplementary feeding can be used under certain conditions to redistribute moose in relation to browsing, or to traffic (Sahlsten et al. 2010). When moose are consistently near highways because of 1) abundant forage and 2) the highway allows for easy walking, they are in a dangerous situation of both high predation risk and high risk for vehicle collisions.	Mitigation regarding effects on wildlife due to disruption of movement or attractants will be included in the Wildlife Management and Monitoring Plan, which will be included in the EA. Refuge areas will be ploughed along the road during winter; gaps in snow banks on roads will be created at best spacing to allow an escape for wildlife.

No.	Commenter / Date Received	Report	Comment	Seabridge Response
107.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies	Work with Gitanyow, the Province, and other proponents that use Highway 37 to establish a Food Security Trust Fund that supports the following: 1. A budget for wildlife monitors to patrol the highway and other forestry roads, record roadkills and monitor hunting. The Gitanyow are leading the way in B.C. with our work in 2011/2012 in terms of conducting moose harvest surveys and developing a harvest permitting system (Koch 2012). Currently there is funding from B.C. for the 2012/13 season, however, for the program to continue additional funding will be needed. Small financial contributions from industrial partners would go a long way towards wildlife conservation and rebuilding of the moose populations. 2. In Alaska they have had great success with a moose salvage program. Volunteer groups are equipped with 4WD pickup trucks with flatbeds and winches. When there is a report of a moose kill on the highway, these groups are able to load the moose within 30 minutes of arriving on the scene. This greatly reduces the time spent by police or conservation officers, and is also a much safer option for those who salvage moose. A moose/wildlife salvage program goes hand in hand with overall wildlife/roadkill monitoring. Industrial partners could contribute by means of providing funding for capital costs (ie. work truck and winch). 3. Funds for a food processing facility including a cooler, freezer and butchering area. This would enable retrieval of road kill during the warm season where people cannot cool meat properly without taking it to butcher shops in Terrace or Smithers, which is not affordable for most Gitanyow people. Although projects such as the KSM will likely result in increased roadkilled moose, effects to overall food security could be partially mitigated by increasing the capacity of Gitanyow to retrieve and process moose that would otherwise be wasted on the highway	Comment noted. Seabridge acknowledges the concerns associated with moose harvest. Seabridge proposes to use a currently existing public Highway (highways 37 and 37A). Discussions on food security trusts are best directed at the provincial government as managers of the public highway.

PROPOSED KSM PROJECT - JULY 9, 2012 WORKING GROUP MEETING
KSM PROJECT HIGHWAY 37 AND 37A TRAFFIC EFFECTS ASSESSMENT REPORT:
RESPONSES TO QUESTIONS AND COMMENTS RAISED BY THE WORKING GROUP

No.	Commenter / Date Received	Report	Comment	Seabridge Response
108.	GHCO/ September 14, 2012	KSM Highway Traffic Effects Assessment/ Recommended Mitigation & Prevention Strategies	Development of a Cumulative Impacts/Effects Assessment for the KSM TEA. Involving Gitanyow, other proponents, and MoTI and other relevant ministries. In order to fully assess, prevent, and mitigate potential impacts from the traffic associated with the KSM project, a full-scale CEA is required. Gitanyow further requests direct involvement in the methodology design, baseline data collection, assessment, and drafting of final results.	A cumulative effects risk assessment is now included in the report (see Chapter 8 in the Highways 37 and 37A Traffic Effects Assessment).

References

ICBC. 2011a. *Corridor Crashes for Hwy 37 from Bob Quinn Camp to Hwy 16*. Insurance Corporation of British Columbia: North Vancouver, British Columbia.

ICBC. 2011b. *Corridor Crashes for Hwy 37A from Stewart to Meziadin Lake Junction, Meziadin*. Insurance Corporation of British Columbia: North Vancouver, British Columbia.