37 Cumulative Environmental Effects Assessment

37.1 Introduction

This chapter outlines the methodology overview of the cumulative effects assessment (CEA) for the KSM Project Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS), as well as summarizes the findings of the potential for residual effects (both adverse and beneficial) to act in combination with other known human actions to produce cumulative effects.

Summaries of the residual cumulative effects and significance determinations for each valued component (VC) are consolidated in this chapter to meet the requirements of the *Canadian Environmental Assessment Act* (1992) as directed by the Canadian Environmental Assessment Agency (CEA Agency). Full details of the assessments of cumulative effects for individual Valued Components (VCs), carried out to meet both the *Canadian Environmental Assessment Act* (1992) and the British Columbia (BC) *Environmental Assessment Act* (1996a) requirements, are provided in Chapters 6 to 25.

The CEA Agency has recently released a new Operational Policy Statement (OPS; CEA Agency 2013) that sets out the general requirements on how to consider cumulative effects under the new *Canadian Environmental Assessment Act* (2012). Environmental assessments initiated under the former *Canadian Environmental Assessment Act* (1992)—which is the case for the KSM Project Application/EIS—are still held under the old OPS (CEA Agency 2007). Under the 2007 OPS, detailed guidance for conducting cumulative effects assessments is provided in the Cumulative Effects Assessment Practitioners Guide (CEA Agency 1999), which has been followed for the Project CEA.

The CEA Agency defines cumulative effects as "changes to the environment that are caused by an action in combination with other past, present and future human actions". An **"action"** is defined as a project or activity (CEA Agency 1999). **"Projects"** are typically some form of commercial or industrial development that is planned, constructed, and operated (e.g., a mine or a resource access road); **"activities"** are the other actions of humans in an area, such as public highway traffic, hiking, and hunting. The cumulative effects of a project can be viewed as the total effects on a resource, ecosystem, or human community attributable to the project and all other human actions. Where a residual effect for a given project is not predicted to be affected by any other human actions, no cumulative effect is identified.

For the purposes of the following CEA the term **"environment"** includes both the natural and human environments, as defined under Paragraph 2 of the *Canadian Environmental Assessment Act* (1992).

For cumulative effects to occur, the action under review must have a residual effect on a VC, and that VC must also be affected by one or more other actions. Different actions may combine to affect VCs in the following three ways:

- **Additive:** for example, where a number of actions contribute to an increase in concentration of a particular pollutant;
- **Synergistic:** where the effects of two or more actions combine to result in an effect greater than the sum of the actions, for example, the effects on wildlife of different sources of disturbance being present simultaneously; and
- **Inducive:** where one activity facilitates others, for example, a new right-of-way providing public access to an area.

The concept of cumulative effects recognizes that while the effects of an individual action may be relatively small, the effects of two or more actions may combine to produce cumulative effects that could be considered significant.

Cumulative effects can occur in a number of ways as indicated by the CEA Agency (1999), including:

- **Physical-chemical transport**: where a physical or chemical constituent is transported away from the action under review and then interacts with another action (e.g., air emissions, waste water effluent, and sediment).
- **Nibbling loss**: the gradual disturbance and loss of land and habitat (e.g., clearing of land for a new mine development and roads into a forested area). The Cassiar Iskut-Stikine Land and Resource Management Plan (LRMP; BC ILBM 2000) and the Nass South Sustainable Resource Management Plan (SRMP; BC MFLNRO 2012) were reviewed for the area with respect to the assessment; however, government decides thresholds or limits of acceptable change with respect to how much development can occur in the area.
- **Spatial and temporal crowding**: where cumulative effects occur when there are too many activities within too small an area in too brief a period of time. A threshold may be exceeded and the environment may not be able to recover to pre-disturbance conditions. Effects can occur quickly or gradually over a long period of time before the consequences become apparent. Spatial crowding results in an overlap of effects among actions (e.g., noise from a highway adjacent to an industrial site, confluence of stack emission plumes, and close proximity of timber harvesting, wildlife habitat, and recreational use in a park). Temporal crowding may occur if effects from different actions overlap or occur before the VC has had time to recover.
- **Growth-inducing potential:** where each new action can induce further actions to occur. The effects of these "spin-off" actions (e.g., increased vehicle access into a previously relatively inaccessible area) may add to the cumulative effects already occurring near the proposed action, creating a "feedback" effect. Such actions may be considered as "reasonably foreseeable actions."

The LRMP (BC ILMB 2000) and SRMP (BC MFLNRO 2012) were both reviewed and information has been incorporated into relevant disciplines in the CEA as appropriate. The CEA conducted for the KSM Project establishes the potential for cumulative effects to occur, and assesses the significance of those effects.

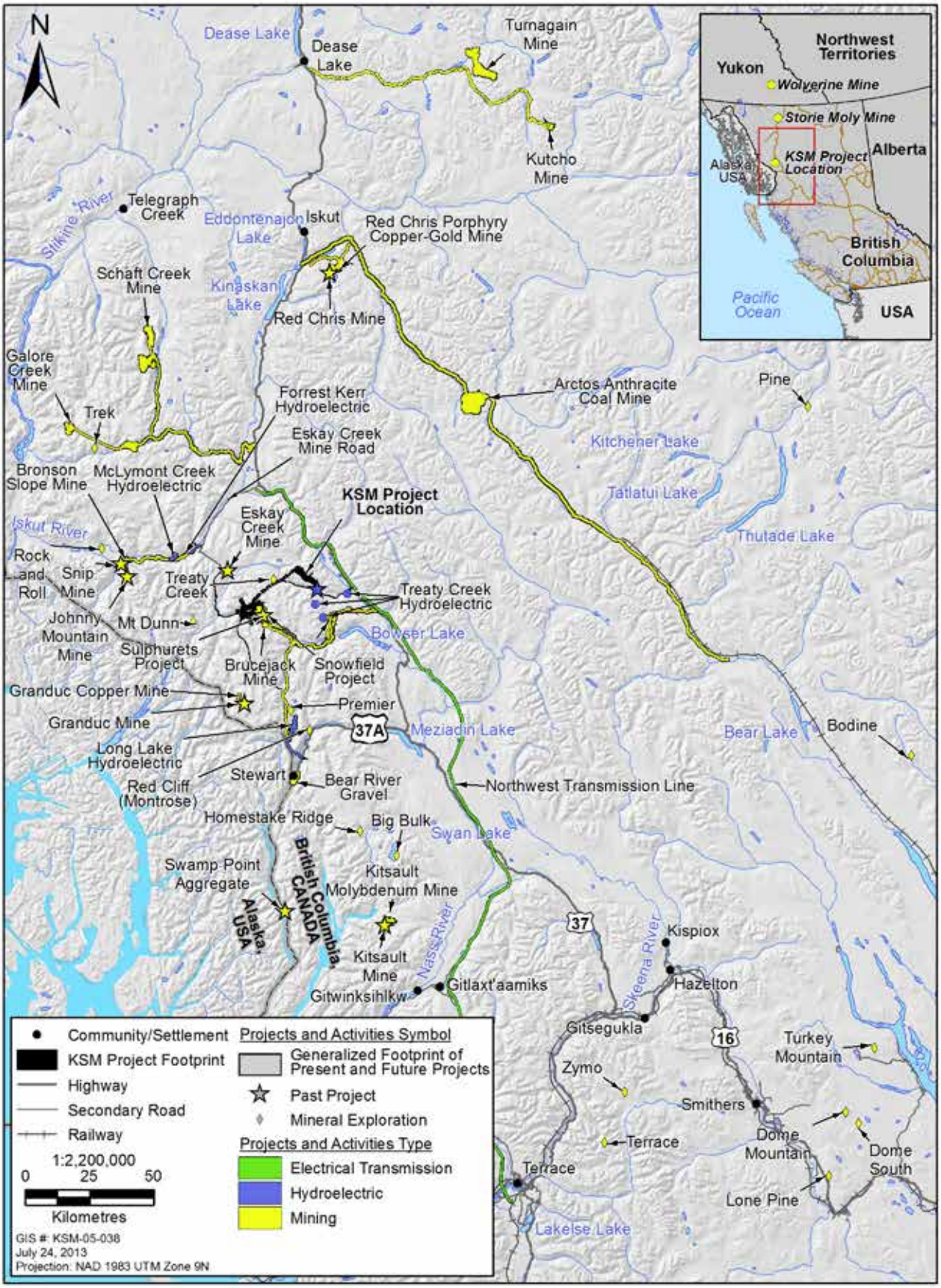
37.2 Regional Projects and Activities

The human actions considered in the CEA are categorized into environmental and socio-economic components. The environmental CEA includes human related projects (past, present, and future) as determined in consultation with the British Columbia Environmental Assessment Office (BC EAO) and the CEA Agency. The spatial extent considered in the socio-economic CEA encompasses all information in the environmental CEA, as well as:

- the communities of Stewart, Telegraph Creek, Dease Lake, Iskut, Hazelton, New Hazelton;
- Nisga'a Nation communities of Gitlaxt'aamiks, Gitwinksihlkw, Laxgalts'ap, and Kincolith;
- Bell II;
- Meziadin Junction;
- Bob Quinn Lake settlement;
- Smithers;
- Gitanyow; and
- Terrace.

The human actions considered in the CEA are categorized into past, present, and reasonably foreseeable future projects. These projects are presented in the next three sections and presented in Figures 37.2-1 and 37.2-2. The human actions also consider the following land use activities within the regional context:

- use of agricultural resources;
- fishing (commercial and recreational);
- guide outfitting;
- Aboriginal harvesting (fishing, hunting/ trapping, and plant harvest);
- resident trapping;
- mineral and energy resource exploration;
- recreation and tourism activities (parks and commercial tenures for heli-skiing, rafting, etc.);
- timber harvesting (forestry); and
- activities involving traffic and roads.



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KSM PROJECT

KSM Project Cumulative Effects Scoping: Projects and Activities Considered in the Biophysical Environmental Assessment

Figure 37.2-1

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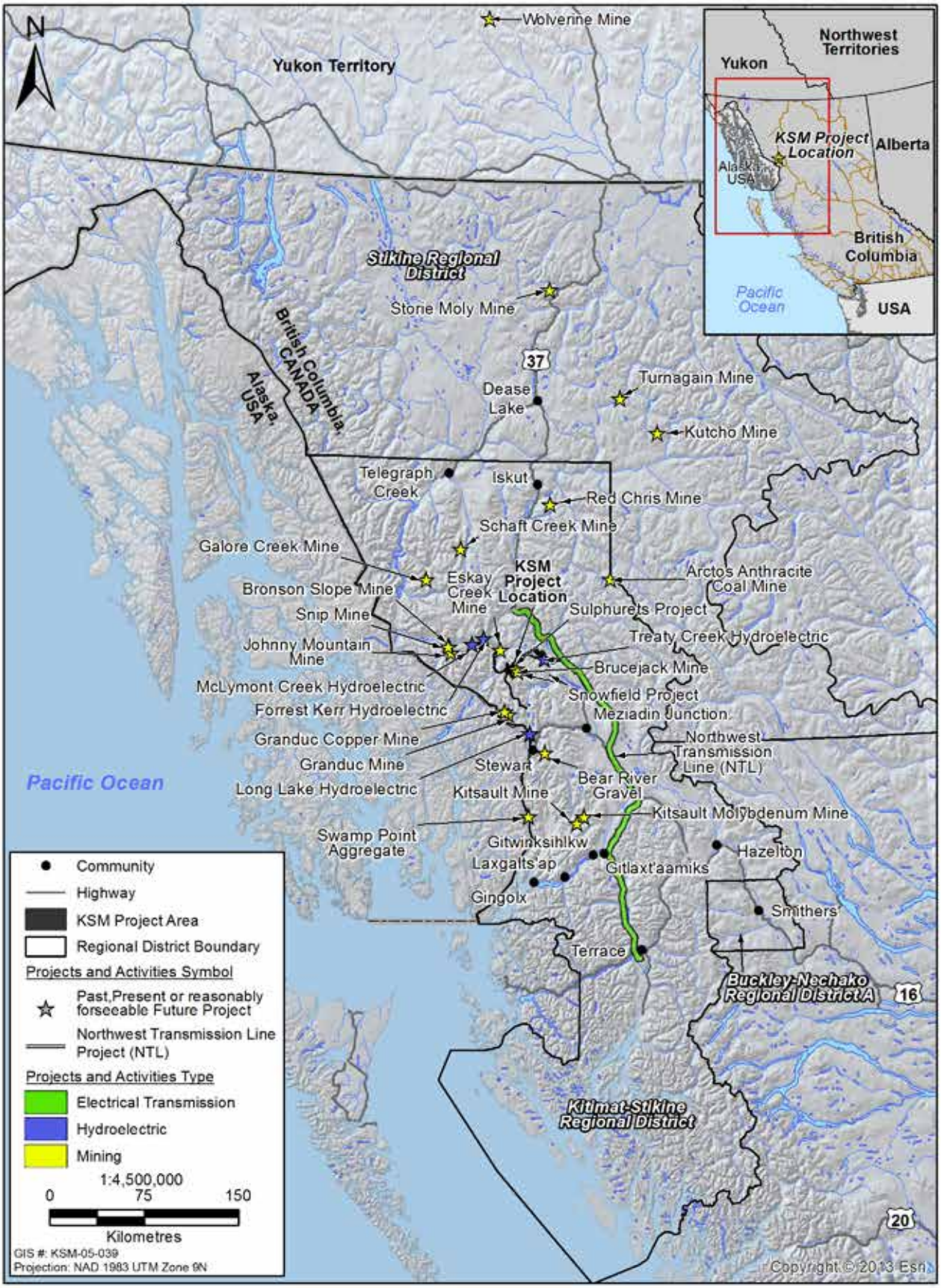

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KSM PROJECT

KSM Project Cumulative Effects Issue Scoping: Human Activities (Projects) and Areas Considered for Human Environmental Assessments

Figure 37.2-2

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37.2.1 Past Projects and Activities

Past industrial projects within the Project CEA study areas are confined to mining activities. Mining projects within the CEA study areas that have been active since 1964 (the past temporal boundary), but are now closed, are listed in Table 37.2-1. Details regarding past projects and activities are provided in Chapter 5 (Section 5.4.3) of the Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS).

Table 37.2-1. Summary of Past Mining Projects in the Cumulative Effects Assessment Study Areas

Mine	Coordinates	Owner	Commodities	Project Type	Operational Period
Eskay Creek Mine	56°39' N 130°27' W[4]	Barrick Gold Corporation[3]	Gold, silver, zinc, copper, lead[3]	Underground[3]	1995 to 2008[2]
Granduc Mine	56°12' N 130°20' W[6]	Newmont Mining Corporation Ltd. Esso Resources Canada[5]	Copper, gold, silver[5]	Underground[5]	1971 to 1978 1980 to 1984[6]
Johnny Mountain Mine	56°37' N 131°04' W[7]	International Skyline Gold Corporation[7]	Gold, silver, copper, zinc, lead[7]	Underground[8]	1988 to 1990[7] 1993[8]
Kitsault Mine (Past Producing)	55°25' N 129°25' W[10]	BC Molybdenum, a subsidiary of Kennco Exploration (Western) Ltd from 1963 to 1972; Climax Molybdenum Company of British Columbia (CMC) and affiliates from 1973 to 1998[11]	Mainly molybdenum; also silver, lead, zinc, copper, and tungsten[10]	Open pit mining[11]	1967 to 1972[9] 1981 to 1982[9]
Snip Mine	56°40' N 131°06' W[14]	Cominco Ltd.; Homestake Canada Inc. (beginning in 1996); and acquired by Barrick Gold Corp. in 2001.[15]	Gold, silver, copper, zinc, lead[14]	Underground	1991 to 1999[14]
Sulphurets Project	56°30' N 130°12' W[17]	Newhawk Gold Mines Ltd.	Gold, silver[16]	Advanced underground exploration and bulk sampling program[16]	1986 to 1990[16]
Swamp Point Aggregate Mine Project	55°28' N 130°02' W[7]	Ascot Resources Ltd.[1]	Sand and gravel aggregate quarry, and ship-loading facility[1]	Aggregate quarry	Construction and operation between 2006 and 2008, closed in 2011[18]

Data sources:
[1] BC EAO (2010); [2] Murphy and Napier (1996); [3] McGurk, Laundry, and MacGillvray (2005); [4] InfoMine (2010); [5] McGuigan and Harrison (2010); [6] MEMPR (1988); [7] MEMPR (2008); [8] Skyline Gold Corp. (2006b); [9] Avanti Mining Inc. (2009); [10] MEMPR (2010); [11] AMEC Earth & Environment (2010); [12] MEMPR (2007a); [13] Jayden Resources Inc. (2010); [14] MEMPR (2007b); [15] Sibbick and MacGillivray (2006); [16] Price (2005); [17] MEMPR (2012); and [18] Ascot Resources Ltd. (2012).

37.2.2 Present Projects and Activities

With the suspension of construction for the Galore Creek Mine project in late 2007, and closure of the Eskay Creek Mine in March 2008, there are currently no operating mine projects close to the Project (BC Stats 2010). However, the Red Chris Mine is currently under construction, and the Wolverine Mine project in the Yukon, approximately 490 km away from the Project, is currently engaged in operation phase activities. Wolverine Mine Project concentrate is trucked to the Port of Stewart for shipment to overseas smelters (Yukon Zinc Corp. 2012).

Currently there are a number of hydroelectric developments in the region. The Northwest Transmission Line (NTL), Long Lake Hydroelectric Power, and the Forrest Kerr Hydroelectric Power projects are engaged in construction activities. These existing projects are summarized in Table 37.2-2. Further details on current projects are provided in Chapter 5 (Section 5.4.4) of the Application/EIS.

Table 37.2-2. Summary of Present Projects within the Cumulative Effects Assessment Study Areas

Project	Coordinates	Owner	Project Type	Anticipated Construction Period	Anticipated Operational Period	Current Regulatory Status
Forrest Kerr Hydroelectric	56°44' N 130°39' W[1]	Coast Mountain Power Corp.	195 megawatt[3] hydroelectric power generation, and 188 km[1] transmission line.	48 months[12]	From mid-2014 for 60 years[2]	Certified as of July 2010, and site development began June 2010[2]
Long Lake Hydroelectric	56°6'N 129°59'W[7]	Regional Power/ Premier Power Corp[5]	31 megawatt hydroelectric project, and 10 km transmission line[6]	24 months[5]	From December 2012[6] for 80 years[8]	Construction began July 2010[6]
Northwest Transmission Line	Along Highway 37 from Terrace to Bob Quinn Lake[1]	BC Hydro	344 km 287 kV transmission line[9]	39 months	From Spring 2014[9] For 50+ years	Certified as of February 2011, and construction began January 2012[9]
Red Chris Mine	57°42' N 129°47' W[10]	Imperial Metals Corp.	Open Pit Mine: copper, gold, and silver[10]	22 months[10]	28.3 –year mine life[10]	Certified as of August 2005 and extended in 2010, and construction began May 2012[10]
Wolverine Mine Project	61°9' N 130°44' W	Yukon Zinc Corp.	Underground mine: copper, lead, zinc, and silver[4]	20 months[4]	From 2010 for 9.5-year mine life[11]	Construction completed as of 2010[11]

Data sources:
[1] BC EAO (2010); [2] JOC News Service (2010); [3] Simpson (2010); [4] Yukon Zinc Corp. (2006); [5] Northern Development Initiative Trust (2012b); [6] Regional Power (2012); [7] Wikimapia (2012); [8] CEA Agency (2012); [9] BC Hydro (2012); [10] Gillstrom, Anand, and Robertson (2012); [11] Yukon Zinc Corp. (2012); and [12] Northern Development Initiative Trust (2012a).

37.2.3 Reasonably Foreseeable Future Projects and Activities

Reasonably foreseeable future projects are those within the CEA that have entered or completed the BC Environmental Assessment (EA) process or are within close proximity to the Project and are anticipated to enter the BC EA process during the KSM review process or have been included at the direction of the BC EAO or the CEA Agency. Table 37.2-3 summarizes 14 projects that meet these criteria. Details regarding past projects and activities are provided in Chapter 5 (Section 5.4.5) of this assessment.

There is uncertainty around the prediction of potential effects from projects that are in the pre-application stage of the BC EA process. Potential effects and influences that can be predicted are based on publically available information and professional judgement. Where information is missing or lacking, assumptions are made with consideration for typical projects of similar size and type. Anticipated future project timelines for construction and operation are shown in Figure 37.2-3.

37.3 Cumulative Effects Assessment Framework

Tasks typically considered within the basic EA framework include scoping, analysis, mitigation, significance determination and follow-up (CEA Agency 1999). Following the completion of the Project effects assessments, the following steps were conducted for the CEA:

- VCs with residual effects determined as not significant (minor), not significant (moderate), or significant (major) were carried forward in the CEA;
- temporal and spatial boundaries were defined;
- past, present, and potential future projects and human activities considered in the CEA were identified and described;
- incremental effects associated with other projects/human activities were identified; and
- significance and likelihood after mitigation of residual cumulative effects were discussed.

37.4 Methods

The CEA followed, where applicable, the approach used for the Project-specific residual effects analysis and determination of significance presented in Chapter 5 guidelines and established in the *Cumulative Effects Assessment Practitioners Guide* (CEA Agency 1999). As an initial starting point, only the Project-specific residual effects were carried forward into the CEA.

The CEA approach was adapted from Senner et al.(2002) and included a number of steps within two main procedures of scoping and analysis of effects. Scoping included the identification of:

- residual effects and VCs to be included in the CEA;
- spatial and temporal boundaries; and
- human actions occurring within the spatial and temporal boundaries.

Table 37.2-3. Summary of Reasonably Foreseeable Future Projects within the Cumulative Effects Assessment Study Areas

Project	Coordinates	Owner	Project Type	Anticipated Construction Period	Anticipated Operational Period	Current Regulatory Status
Arctos Anthracite Coal Project	between 57°06'N and 57°23'N; and 128°37'W and 129°15'W[2]	Fortune Coal Ltd.[1]	Open pit: anthracite coal[1]	24 months	20 years[2]	Pre-application[1]
Bear River Gravel	55°56'00"N 129°38'30"W[3]	Glacier Aggregates Inc.[1]	Gravel extraction[1]	24 months[3]	25 years[3]	Pre-application[1]
Bronson Slope Mine	56°39' N 131°05' W[4]	Skyline Gold Corp[3]	Open pit mine: Gold, copper, silver, molybdenum[5], and magnetite[4]	36 months	20 years	Deferred, drafting Project Description
Brucejack Mine	56° 28' N 130° 11'W[6]	Pretium Resources Inc.	Underground: gold and silver[6]	12 months[6]	16 years[6]	Pre-application
Galore Creek Mine	57° 13' N 131° 26' W	Galore Creek Mining Corporation (NovaGold and Teck Resources)	Open pit mine: copper, gold and silver[1]	48 months[7]	18 years[7]	Certified in 2007[1], re-drafting Project Description
Granduc Copper Mine	56° 14' N 130° 20' W[8]	Castle Resources Inc.	Underground	24 months	10 years	Drafting Project Description
Kitsault Mine	55º25'19" N 129º25'10" W[9]	Avanti Kitsault Mining Inc.[1]	Open pit mine: molybdenum[1]	25 months[9]	15 years[9]	Approved March 18, 2013[1]
Kutcho Mine	58°12'N 128°22'W[11]	Capstone Mining Corp.[10]	Underground/open-pit (~4% of production) mine: copper, zinc, gold and silver[10]	18 months[10]	12 years[10]	Pre-application[1]
McLymont Creek Hydroelectric	56°41' N 130°47' W	AltaGas Renewable Energy Inc.	Hydropower	3 years[12]	40 years[12]	Certified[1]

(continued)

Table 37.2-3. Summary of Reasonably Foreseeable Future Projects within the Cumulative Effects Assessment Study Areas (completed)

Project	Coordinates	Owner	Project Type	Anticipated Construction Period	Anticipated Operational Period	Current Regulatory Status
Schaft Creek Mine	130°58'48.9" N 57°22'4.2" W [13]	Copper Fox Metals Inc.	Open pit mining: copper, gold, molybdenum, silver[13]	36 months[13]	15 years[13]	Pre-application[1]
Snowfield Project	56°29' N 130°12' W[14]	Pretium Resources Inc.	Open pit mine: gold, copper, molybdenum, and rhenium	36 months	27 years	Not yet in Pre-application
Storie Moly Mine	59°14'30"N 129°51'24"W[15]	Columbia Yukon Explorations	Open pit mine: molybdenum[16]	15 months	20 years[16]	Not yet in Pre-application Draft Project Description submitted for review
Treaty Creek Hydroelectric	Unknown	Northern Hydro Ltd.[17]	Hydropower	Unknown	Unknown	Not yet in Pre-application
Turnagain Mine	58°30' N 128°45' W [18]	Hard Creek Nickel Corp.	Open pit mine: nickel[18]	24 months[19]	28 years[20]	Not yet in Pre-application

Data sources: [1.] BC EAO (2013); [2.] Rescan (2004); [3.] Cambria Gordon Ltd.(2006); [4.] BC MEMPR (2010); [5.] Skyline Gold Corp. (2006a); [6.] Rescan (2013); [7.] NovaGold (2012); [8.] Cambria Geosciences Inc. (2010); [9.] Avanti Mining Inc. (2011); [10.] Capstone Mining Corp. (2011a); [11.] JDS Energy & Mining Inc. (2010); 1[2.] Government of BC (2012); [13.] Copper Fox Metals (2010); [14.] Armstrong, Brown, and Yassa (2009); [15.] Watts, Griffis, and McOuat Limited and Mintec Inc. (2009); [16.] Purcell and Wheeler (2008);[17.] HydroWatch (2012); [18.] Wardrop (2010b); [19.] AMEC (2008b); [20.] AMC Mining Consultants (2011).

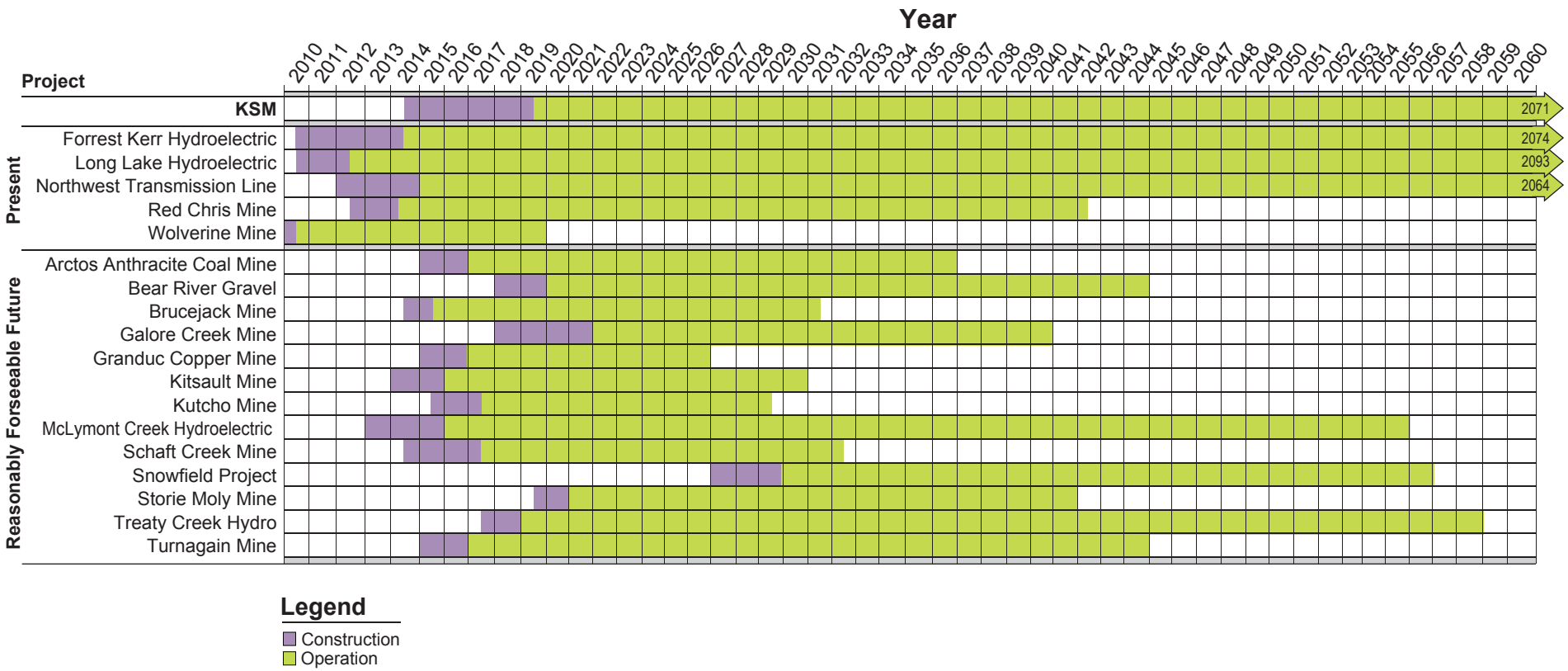

Figure 37.2-3

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Estimated Present and Future Project Timelines

Figure 37.2-3

Rescan
Engineers & Scientists

The analysis of effects included:

- identification of linkages to other actions;
- identification of the effects of past, existing, and future actions;
- assessment of cumulative effects;
- mitigation, monitoring, and adaptive management; and
- determination of the significance of residual cumulative effects.

The methodology provided the rationale in identifying other developments (past, current, and reasonably foreseeable future projects, and other human activities) that may temporally and spatially overlap with the residual effects of the Project (these projects are identified in Section 37.2 (Tables 37.2-1, 37.2-2, and 37.2-3).

Cumulative effects are assessed within Chapters 6 to 25 to address provincial requirements. A summary of these CEAs is provided in this chapter to address federal requirements.

37.4.1 Issue Scoping

The residual effects on each VC are described in their respective EA chapters. All residual effects identified in the individual EA chapters have been selected for the cumulative effects evaluation, as required under the Application for Information Requirements (AIR).

Human actions that could potentially interact with VCs are determined for each assessment topic. The list of projects and activities considered is described in each discipline's respective chapter.

Spatial overlap between the effects of the KSM Project and of other human actions has been evaluated by developing a "linkage map" for each assessment topic and associated VCs, illustrating the areas where effects of the Project on a VC can reasonably be expected to occur. The maps are then used to determine which of the other human actions could potentially overlap spatially with the area of assessment topic and VC-specific effects. Temporal overlap is evaluated by examining the expected timing and duration of the potential KSM Project effects and of other human actions. This process includes an assessment of whether past human actions affected the current condition of each VC. The specifics of these interactions are discussed within the assessment chapters following the initial determination of linkages to environmental topics due to spatial overlap. Unless there is a spatial overlap, temporal overlap is considered irrelevant, as activities are considered to be in accordance to existing LRMPs.

Linkage maps and tables for each assessment topic, where relevant, are presented in the respective EA chapters with summaries presented in this chapter.

37.4.2 Identification of Potential Cumulative Effects

Using a matrix approach, each potential residual effect of the KSM Project identified in the previous steps of the assessment has been considered in the context of the effects of the past, present, and future human actions. These are discussed in each discipline's chapter.

All the VCs from each chapter and potential residual effects are presented in Chapter 5. Only those VCs with residual effects are carried forward into the cumulative effects assessment. The human actions considered in this chapter are limited to those identified during the cumulative issue scoping exercise in each respective EA chapter. A summary table of those actions that could potentially interact with Project effects is provided for each assessment topic.

37.5 Boundaries

37.5.1 Spatial

Spatial boundaries consider the potential geographic or physical extent of change generated by the Project, as related to a specific assessment topic or VC.

For the KSM Project-specific effects assessments, distinct spatial boundaries are defined for each assessment topic. Spatial boundaries are determined based on the location and distribution of VCs and on the spatial extent of potential Project effects. The spatial scale may have been confined to the Project footprint, a local study area (LSA), or a regional study area (RSA). Beyond the spatial boundaries, the Project is expected to have negligible potential effects on the VCs. The rationale for selecting specific spatial boundaries is explicitly stated in each chapter.

The spatial overlap between the residual effects of the project and of other actions is evaluated by developing a "linkage map" for each VC, demonstrating the areas where residual effects of the Project on a VC could potentially occur. The maps are then used to determine which of the other human actions overlap spatially with the area of VC-specific residual effects. The initially scoped cumulative effects linkage maps are presented in their respective chapters, as well as in this chapter for all disciplines carried through the CEA.

37.5.2 Temporal

The potential effects of the Project will change over time, depending on the activities that occur during each phase of the Project life. Temporal boundaries are the time periods considered in the assessment, which take into account the phases of the KSM Project and the timelines of other human actions.

The phases of the KSM Project form the primary temporal boundaries for the Project-specific effects assessment and, combined with potential effects from other human actions and projects, the CEA. The four phases of the KSM Project are:

- **construction:** 5 years;
- **operation:** 51.5 years;
- **closure:** 3 years; and
- **post-closure:** 250 years.

Several factors were considered when selecting the length of the post-closure period (250 years). In general, this post-closure length chosen to be several times larger than that typically used for BC mining projects which are often about 50 years long (e.g., Teck's approved Line Creek Coal Phase II Project is reported to be estimated at about 37 years from 2038 to 2075 (Teck Coal Limited 2011b), and the NTL is reported as existing "indefinitely" for "50+" years (BC Transmission Corporation 2010). Two hundred-fifty years is also a similar time scale to that used for tailing dam design (e.g., design capacity of dams must be built to withstand 1 in 200 year flood events), plus an additional 50 years. By 250 years, many of the residual environmental effects of the Project should have stabilized, although some residual effects may still persist and require mitigation, which has been addressed for those applicable VCs as appropriate.

Chapter 5 (Section 5.3.2) defines temporal boundaries for use in the CEA as:

- **Past** (1964 to 2008): coinciding with the development of the Granduc Mine, which influenced the growth of the community of Stewart and other human activities in the area;
- **Present** (2008 to 2012): from the start of KSM baseline studies to the completion of the environmental effects assessment; and
- **Future:** boundaries are stated in each assessment chapter, and vary according to the time estimated for VCs to recover to baseline conditions (taking into account natural cycles of ecosystem change).

37.6 Cumulative Effects Assessment on Valued Components

37.6.1 Greenhouse Gas Emissions (Climate Change)

37.6.1.1 Summary of Project-specific Residual Effects on Greenhouse Gas Emissions

As stated in the guidance document for incorporating climate change considerations into EAs (CEA Agency 2003), unlike most other environmental effects on VCs, the contribution of an individual project to the effect of climate change as a whole cannot be measured due to the global scale, uncertainty, and complexity involved. Therefore, the only "effect" considered in the Chapter 6 greenhouse gas (GHG) assessment is the direct change in atmospheric GHG levels as a result of the Project, rather than secondary effects on climate change parameters. This effect is anticipated to be a net increase in atmospheric GHG levels about 165 kt carbon dioxide equivalent (CO_2e) per year on average over the life of the Project from facility-level GHG emissions alone, rising to 175 kt CO_2e per year when land-use change is added (Chapter 6, Section 6.7.3.1).

The residual effect of GHG emissions from the Project is assessed as **not significant** (**minor)** as shown in Table 37.6-1 due to dilution factors at the global scale involved, as well as based on an industry and jurisdictional comparisons at different scales. Against the metal mining sector, the Project GHG emission intensity (3.5 t CO_2e/kt ore to mill) falls in the low end of the industry profile (ranging from 2.2 to 29.6 t CO_2e/kt ore to mill, Section 6.7.4.2). The Project also represents about 0.28, 0.02, and 0.0005% of provincial, national and international recently reported GHG emissions inventories.

Table 37.6-1. Summary of Assessment of Project-specific Residual Effects for Greenhouse Gas Emissions

Description of Residual Effect	Project Components	Timing of Effect	Magnitude of Effect	Extent of Effect	Duration of Effect	Frequency	Reversibility	Context	Initial Significance Determination	Follow-up Monitoring
Rise in atmospheric GHG levels	All	Construction	Low	Beyond Regional	Far Future	Regular	Reversible Long-term	Neutral	Not Significant (Minor)	Not Required†
Rise in atmospheric GHG levels	All	Operation	Low	Beyond Regional	Far Future	Continuous	Reversible Long-term	Neutral	Not Significant (Minor)	Not Required†
Confidence in the Probability and Likelihood of Residual Effect										
High*										

Notes:
Section 6.8.2 defines the residual effect descriptors criteria.
GHG=greenhouse gas
*** Confidence and probability levels are both rated high for residual effect descriptors**
† Follow-up monitoring is ranked as "not required" per "not significant" rating; however, measuring/monitoring and reporting Project GHG emissions will still be required per BC and Canadian GHG reporting regulations as stated in Section 6.1.2 and the GHG Management Plan (26.12) in Chapter 26.

37.6.1.2 Cumulative Effects Assessment for Greenhouse Gas Emissions

Similar to how it is not possible to assess the direct effects of a single project on global climate change, it is not possible to conduct a cumulative effects assessment for this VC either. Instead, the proxy is used of a comparison of Project GHG emissions themselves to provincial, federal, and international GHG emission levels (as reported in Section 37.6.1.1). This comparative method is consistent with guidance by the CEA Agency (2003) and the majority of Canadian environmental effects assessments, which take the approach of comparing project GHG emission levels rather than looking at their cumulative climatic effects (Rescan 2006; Amec 2008a; Teck Coal Limited 2011a; Amec 2012).

37.6.1.3 Mitigation and Monitoring for Cumulative Effects for Greenhouse Gas Emissions

While cumulative effects of Project GHGs are not assessed as they are for other Project VCs, the impetus for incorporating GHG assessments in EAs in the first place is part of a larger initiative to measure and reduce anthropogenic GHG emissions in order to mitigate their cumulative global effects on climate change, such as reported on by the Intergovernmental Panel on Climate Change (CEA Agency 2003; IPCC 2007) and BC and Canadian annual GHG inventories (BC MOE 2012; Environment Canada 2012).

As reported on in Section 6.12, considerable provincial, national, and international legislation exists to measure, report on, and mitigate GHG emissions towards mitigating effects on climate change. The primary regulations applicable to GHG emissions from mining projects (and other industries) in BC at this time are the *BC Reporting Regulation* (BC Reg 272/2009) under the jurisdiction of the *Greenhouse Gas Reduction (Cap and Trade) Act* (2008) and the *Greenhouse Gas Emissions Reporting Program* (Environment Canada 2010). Under these regulations, based on its predicted residual GHG emissions, the Project will have to report its annual facility level emissions both provincially and federally, as will other projects that meet reporting thresholds.

In addition to measuring and reporting, there are many measures laid out to monitor and mitigate Project GHG emissions—which are similar to those implemented for similar projects in the Canadian context—including, in order of importance:

- minimizing Project fuel use (e.g., by equipment, vehicles, and generators) through implementing fuel efficiency/conservation measures;
- minimizing Project energy use (e.g., by facility and electrical equipment) through implementing energy efficiency/conservation measures; and
- minimizing planned land-use change clearing/burning and maximizing replanting/ sequestration where possible.

These measures entail the implementation of a GHG management hierarchy starting with avoidance, then reduction, replacement, enhancement, and finally potentially offsetting of GHG emissions, as described in more detail in Chapter 6, Section 6.72 and in the GHG Management Plan in Chapter 26.12. These include measures such as implementing driver training programs to reduce idling, maintaining equipment and vehicle engines to ensure optimal efficiency, and

procuring low emission level equipment and contractors to minimize emission from sources both upstream and downstream in the Project product cycle. Over the Project life, it is also anticipated that increased regulatory pressure, and improved technical means to enhance GHG emissions reductions for mining projects may also be implemented to reduce GHG emissions for extractive industries as a whole in BC, Canada, and internationally.

37.6.1.4 Summary of Residual Cumulative Effect for Greenhouse Gas Emissions

The issue of the global effect of cumulative anthropogenic GHG emissions on climate change is the impetus rather than the assessed effect at the EA level for individual projects, which makes this VC an exception for which cumulative effects on climate are not able to be assessed, though they will contribute incrementally to a residual 'effect' on atmospheric GHG levels. Project GHG emission levels quality it for provincial and federal reporting requirements, but it will have a negligible contribution to global atmospheric GHG levels overall.

37.6.2 Air Quality

37.6.2.1 Summary of Project-specific Residual Effects on Air Quality

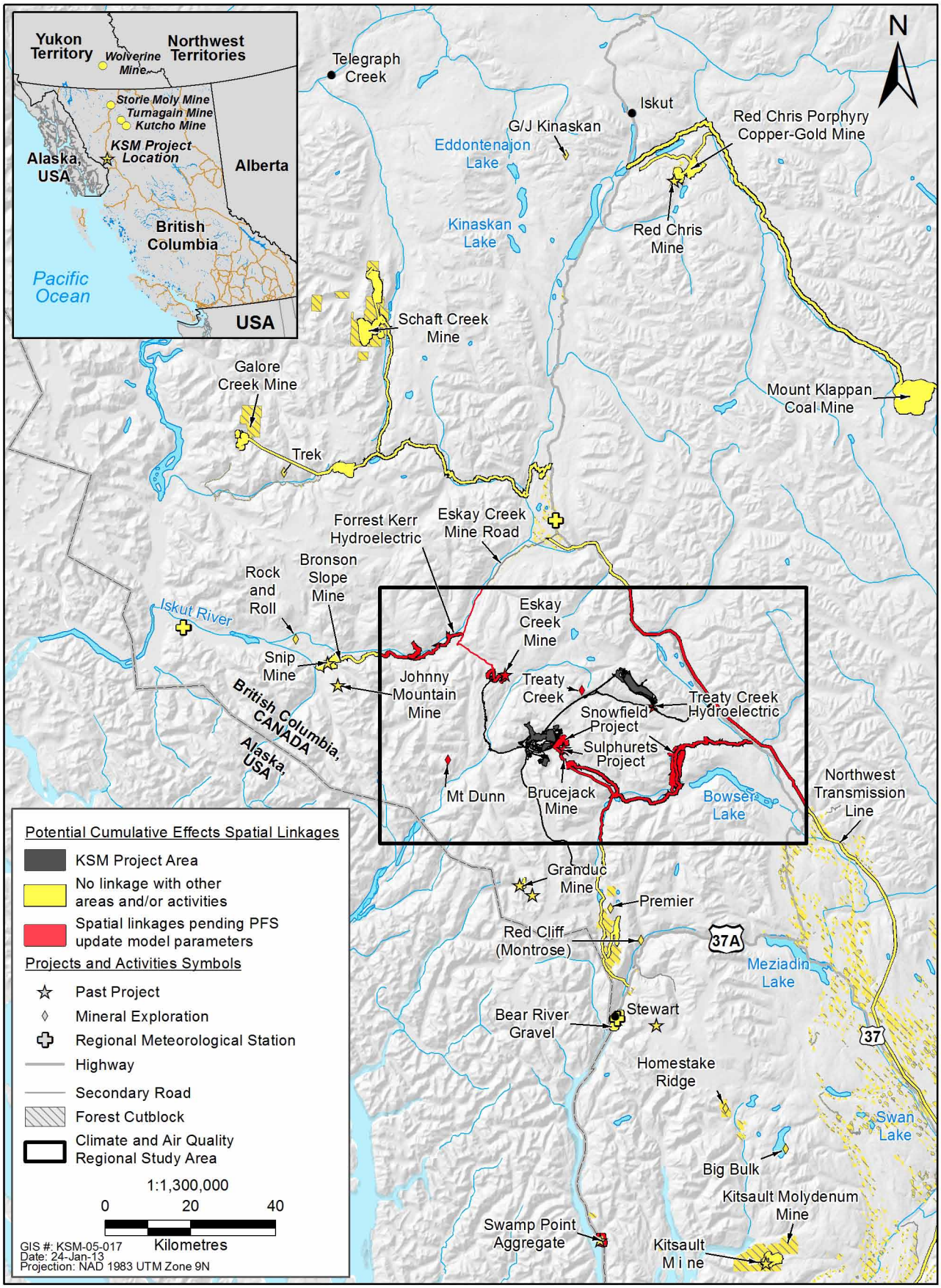
The KSM Project is predicted to have a residual effect resulting in a reduction of ambient air quality (Chapter 7). The overall magnitude of the Project's residual effect on air quality is low to medium, with landscape to regional extent, long duration, regular frequency, and reversible short-term effects. Since the Project area was previously disturbed, context is neutral. The probability of the effect occurring is high, and the confidence level of the residual effect is medium to high. The significance of the overall Project residual effect was considered **not significant (minor)**, with follow-up monitoring not required. Dustfall stations will be installed at various locations throughout the Project area to ensure compliance.

The residual effects on air quality are carried through the CEA where they are expected to have cumulative interactions with other human projects and activities.

37.6.2.2 Cumulative Effects Assessment Boundaries for Air Quality

Several projects have spatial linkages or temporal linkages with the KSM Project (Figure 37.6-1). Projects and human actions with a spatial overlap with the KSM Project's potential effects on air quality are:

- Eskay Creek Mine;
- Treaty Creek Hydroelectric;
- Forrest Kerr Hydroelectric;
- the NTL;
- the Snowfield Gold-Copper Project;
- the Brucejack Mine;
- mineral, oil, and gas exploration; and
- road access and traffic.



KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Air Quality

Figure 37.6-1

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Past, present, and reasonably foreseeable future projects and human activities with a temporal overlap with the KSM Project (construction is forecasted to start in 2014) include the:

- Construction of the Forrest Kerr Hydroelectric project and a portion of the NTL that may overlap temporally with the KSM Project. These projects will use Highway 37 and the Eskay Creek Mine road mainly during their construction periods, which may overlap with the KSM Project's construction phase.
- Construction phase of the Snowfield Project which is scheduled to start in 2027.
- Construction phase of the Brucejack Mine which has a similar construction schedule to KSM. The Brucejack Mine operation phase will start following two years of construction. The operation phase of the Brucejack Mine will overlap with the construction and operation phases of the KSM Project

Since the Eskay Creek Mine has ceased operation in 2008, there is no temporal linkage with the KSM Project except for maintenance vehicles that still operate on site to support ongoing monitoring. This maintenance activity is expected to be negligible compared to the level of activities during the KSM Project construction and operation phases. A cumulative effect interaction between the Eskay Creek Mine and the KSM Project is not expected.

The Treaty Creek Hydroelectric Power Project, and mineral and energy resource explorations (Mt Dunn and Treaty Creek exploration projects) are considered to have low activity levels compared to activities from the KSM Project; therefore, the interaction between the Treaty Creek Hydroelectric Power Project and the KSM Project is negligible. The roadway traffic is expected to have a small effect compared to other mining activities as shown in the isopleth results for construction and operation. Interaction between roadway traffic and the KSM Project is expected to be negligible. As a result, the Forest Kerr Hydroelectric Power Project, NTL, Snowfield Project, and the Brucejack Mine are assessed further in the next section.

37.6.2.3 Cumulative Effects Assessment for Air Quality

Table 37.6-2 lists the potential interactions between each of the projects and activities identified in the previous section as potentially having a cumulative effect with the KSM Project's predicted residual effects on air quality.

Table 37.6-2. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Air Quality

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities			
	Forrest Kerr Hydroelectric	Northwest Transmission Line	Snowfield Project	Brucejack Mine
Change in Ambient Air Quality	No Interaction	No Interaction	No Interaction	Possible Interaction

37.6.2.3.1 Forrest Kerr Hydroelectric Power Project

The Forrest Kerr hydroelectric project is a run-of-river hydroelectric power facility currently under construction until mid-2014. After mid-2014, the Forrest Kerr hydroelectric project is expected to be in operation. The construction phase of the Forrest Kerr project is not anticipated to spatially or temporally overlap with the KSM Project since Forrest Kerr begins construction prior to the KSM construction phase. During operation, physical activities associated with the Forrest Kerr project include some road traffic for inspection or maintenance purposes, and employee vehicle travel along highway 37 and the Eskay Creek Mine road. Although information related to predicted traffic levels is not readily available, provided that the activity level for the Forrest Kerr Project is low during operation (and because of atmospheric mixing that disperses contaminants quickly such that only short-term transient effects on air quality are experienced along roads), any interaction between the Forrest Kerr Project and the KSM Project is considered to be negligible, with no residual effect.

37.6.2.3.2 Northwest Transmission Line

The NTL, an approximately 344-km electricity transmission line, is currently under construction (since 2012), and is expected to be operational in 2014. When the NTL is in operation, no regular activities will be required other than periodic inspection or maintenance. Since the KSM Project construction phase is not expected to commence until 2014, there is *no* temporal linkage between the KSM Project, and hence, no potential for residual effects.

37.6.2.3.3 Snowfield Project

The Snowfield property, located within the Sulphurets District immediately adjacent to the KSM Project, is partially inside the KSM Project modeling fenceline. The Snowfield Project is currently in a dormant exploration stage with no immediate plans to initiate the project. No interaction between the Snowfield Project and the KSM Project is expected.

37.6.2.3.4 Brucejack Mine

The Brucejack Mine is located 65 km north-northwest of Stewart, 21 km south-southeast of the closed Eskay Creek Mine, and approximately 5.5 km east-southeast of the Sulphurets Deposit of the KSM Project. Temporal and spatial linkages between the Brucejack Mine and the KSM Project exist with the potential for cumulative effects on air quality. The Brucejack Mine has recently entered the BC *Environmental Assessment Act* (1996a) and *Canadian Environmental Assessment Act, 2012* (2012) EA processes. The Brucejack Mine is a proposed underground gold and silver mining operation with primary crushing of ROM ore underground before transport to surface facilities. Since Brucejack is an underground mine, threshold limit values in the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008) are expected to be met. Since the air quality in the underground mine will meet the threshold limit values, the emissions from the Brucejack underground mining operation are expected to be low and controlled. The primary crushed ore will be hauled to the mill, which consists of crushing, grinding, gravity concentration, and flotation processes. The ore stockpile, surface crusher, flotation plant, backfill paste plant, and concentration stockpile will be housed within a single building (Rescan 2012); this design reduces fugitive dust emissions from material handling and eliminates the potential of wind erosion of the stockpiles. With a proposed processing rate of up to 2,700 tpd for the Brucejack Mine (much less than the average ore production rate of

130,000 tpd for KSM), the effect on air quality from the Brucejack Mine that has the potential to interact at a regional scale with the KSM Project is expected to be minor. Although an interaction between the Brucejack Mine and the KSM Project exist, the magnitude of increase of the cumulative residual effect is expected to be minor. Although there is an interaction between the Brucejack Mine and the KSM Project, the magnitude increase of the cumulative residual effect is expected to be **not significant (minor**).

37.6.2.4 Mitigation and Monitoring for Cumulative Effects on Air Quality

Surface improvement controls on unpaved access roads include paving or adding gravel to dirt roads. Surface treatment controls for this Project include the application of water to the road surface. Baghouses will be installed on crushers to remove particulates out of air or gas released from industrial processes. Equipment and vehicles will be maintained on a regular basis to ensure their effectiveness. Regular inspections will be conducted and all parts showing signs of wear or damage will be promptly replaced. Generators and incinerators for the Project will be in compliance with the Tier 4 standards, and models with lower emission rates will be preferred. Incinerators will also have to comply with Canada-wide standards for dioxins and furans (CCME 2009) and Canada-wide standards for mercury emissions (CCME 2010).

Ore stockpiles will be covered and the processed ore stockpiles will be enclosed. Covering and enclosing ore stockpiles will provide control efficiency of approximately 80% for handling of the material (Air & Waste Management Association 2000).

The Mitchell-Treaty Twinned Tunnels (MTT) will be used not only to transport material, but also to transport personnel and equipment between the Mine Site and the Processing and Tailing Management Area (PTMA). Since workers are expected to be inside the tunnels, air quality inside the MTT needs to be in compliance with standards set in *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008). Baghouses or wet scrubbers will be used in the MTT to ensure concentrations of particulate matter meet the threshold limit values. Fans will also be used at the portals to ensure fresh air flows through the tunnels.

There are no specific mitigation or management measures explicitly identified from other projects or activities to address effects on ambient air quality. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project.

37.6.2.5 Summary of Residual Cumulative Effects of Change in Ambient Air Quality

Brucejack Mine emissions are expected to be much lower than that from the KSM Project. Adjusted for the cumulative contribution of the two projects, the magnitude of the cumulative residual effect is expected to be low to medium. The extent of a residual cumulative effect on air quality is landscape to regional during both the construction and operation phases, while the duration of the cumulative residual effect for construction is considered medium, and long for operation. The frequency of the cumulative residual effect is regular for both phases. The nature of air quality and the resilience of the area will not change due to the cumulative effect and the cumulative effect is reversible in the short-term, with a neutral context. The close proximity of

the Brucejack Mine to the KSM Project indicates the probability of a cumulative effect occurring is high. Since quantitative data is not available for the Brucejack Mine, the adjusted confidence level for the cumulative residual effect is considered low to medium. Given the rating of a moderate magnitude and landscape to regional geographic extent, as shown in Table 37.6-3, the significance of the overall cumulative effect is considered **not significant (minor)**. Follow-up monitoring is not deemed necessary for air quality effects.

37.6.3 Terrain, Surficial Geology, and Soils

37.6.3.1 Summary of Project-specific Residual Effects on Terrain, Surficial Geology, and Soils

Two VCs associated with terrain, surficial geology, and soils have been identified (Chapter 8): soil quantity and soil quality. Residual environmental effects associated with the development of the Project on these two VCs include:

Soil Quantity:

- Permanent loss of 2,554 ha of surface area under Project footprint infrastructure remaining after closure; and
- Loss of unknown amounts of soil due to erosion.

Soil Quality:

- Soil degradation resulting from a combination of soil contamination, soil compaction, and loss of soil fertility; permanent soil degradation is expected in up to 3,972 ha of buffers surrounding components retained after closure.

Residual effects on soil quantity and quality are all rated as **not significant (minor)**, except for soil loss from the TMF, which is expected to be **not significant (moderate)**.

37.6.3.2 Cumulative Assessment Boundaries for Terrain, Surficial Geology, and Soils

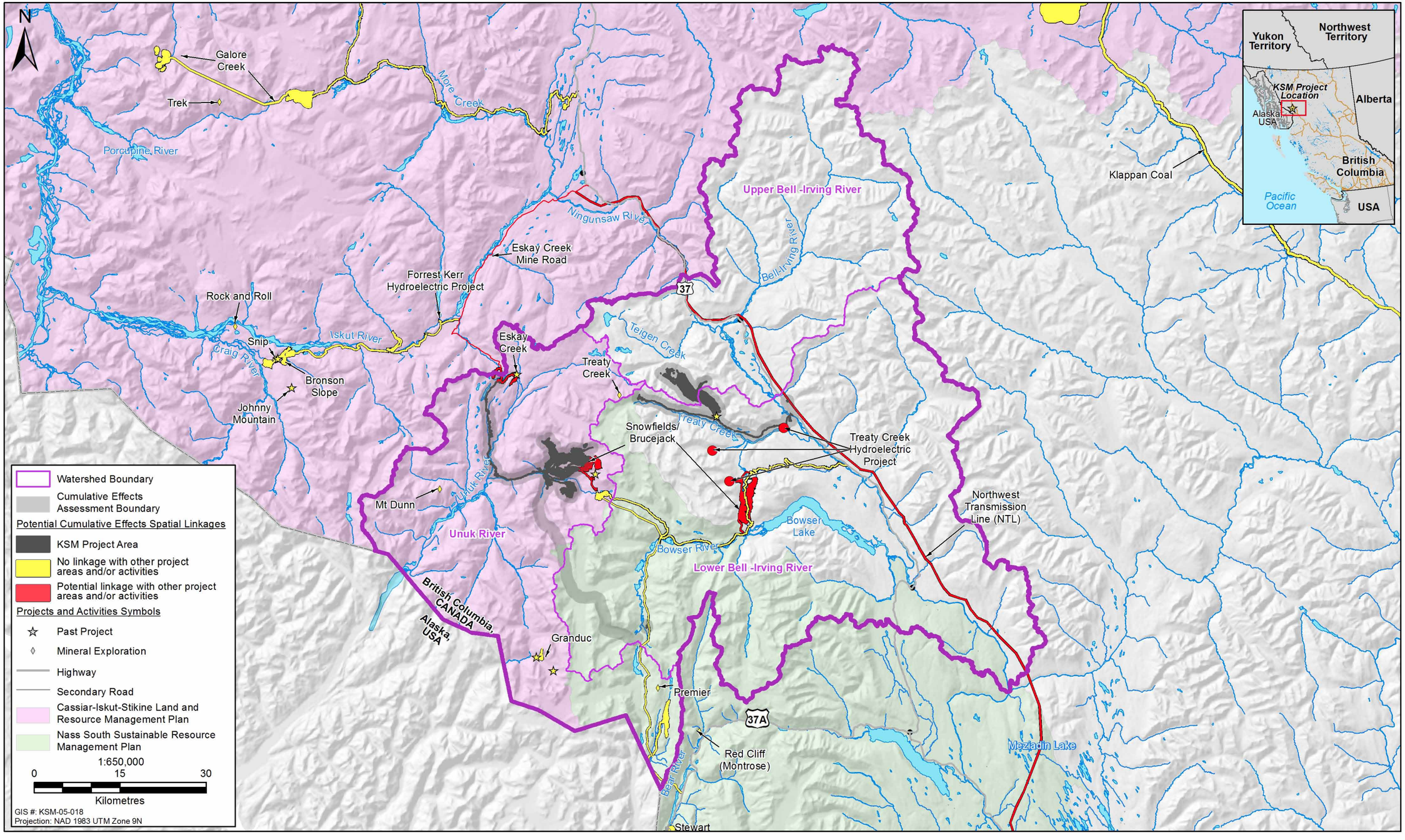
The KSM Project footprint extends into three watersheds (Unuk River, Upper Bell-Irving River, and Lower Bell-Irving River). The extent of these three watersheds has been used as the spatial boundary of the CEA Area and is shown in Figure 37.6-2. The Eskay Creek Mine and the Sulphurets Underground Development Project are the only past projects with a spatial linkage to potential effects on terrain and soils from the Project. Present and reasonably foreseeable future human actions with potential spatial Project linkages include:

- the NTL, which is currently under construction;
- the proposed development of the Snowfield Project;
- the proposed development of the Brucejack Mine; and
- the proposed development of Treaty Creek Hydroelectric Project.

Table 37.6-3. Summary of Residual Cumulative Effects on Air Quality

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Change in Ambient Air Quality	Brucejack Mine	Construction	Low to medium	Low to medium	Landscape to regional	Landscape to regional	Medium	Medium	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	Low to medium	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Not Required
	Brucejack Mine	Operation	Low to medium	Low to medium	Landscape to regional	Landscape to regional	Long	Long	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	Low to medium	Not Significant (minor)	Not Significant (minor)	Not Required	Not Required
Overall Effect	All	Construction and operation	Low to medium	Low to medium	Landscape to regional	Landscape to regional	Long	Long	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	Low to medium	Not Significant (minor)	Not Significant (minor)	Not Required	Not Required

Note:
CE = Cumulative Effect



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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Terrain, Surficial Geology, and Soils

Figure 37.6-2

A temporal linkage between the soil degradation events associated with different projects may be established when periods of reduced soil functionality (including 30-year recovery periods) overlap.

The Eskay Creek Mine is the only past project that has the potential to overlap temporally with the environmental effects to terrain and soils resulting from development of the Project. Future human actions with potential temporal linkages with the Project include: the proposed development of the Snowfield Project; the proposed development of the Brucejack Mine; and the proposed development of Treaty Creek Hydroelectric Project.

37.6.3.3 Cumulative Effects Assessment for Terrain, Surficial Geology, and Soils

The past, existing, and reasonably foreseeable future activities in Table 37.6-4 have the potential to overlap spatially and temporally with the loss of ecologically functional soil, primarily due to loss of land surface area and soil erosion associated with development of the KSM Project.

Table 37.6-4. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects

Description of Effect (by VC)	Potential for Cumulative Impact: Relevant Projects and Activities				
	Eskay Creek Mine	**Sulphurets Mine**	**Treaty Creek Hydroelectric Project**	**Brucejack Mine**	**Snowfield Project**
Soil Quality:					
Compaction	Potential spatial and temporal linkage between compacted areas	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkage between compacted areas	Potential spatial and temporal linkage between compacted areas	Potential spatial and temporal linkage between compacted areas
Contamination	Potential spatial and temporal linkage between contaminated areas	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkage between contaminated areas	Potential spatial and temporal linkage between contaminated areas	Potential spatial and temporal linkage between contaminated areas
Loss of Fertility	Potential spatial and temporal linkage between affected areas	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkage between affected areas	Potential spatial and temporal linkage between affected areas	Potential spatial and temporal linkage between affected areas
Soil Quantity:					
Loss of Land Surface Area	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkages between disturbed areas
Bulk Erosion	Potential spatial and temporal linkage with the CCAR	Potential spatial and temporal linkages between disturbed areas	Potential spatial and temporal linkage with TCAR	Potential spatial and temporal linkage between affected areas (e.g., mining pits)	Potential spatial and temporal linkage between affected areas (e.g., mining pits)

37.6.3.3.1 Soil Quantity

Permanent access roads and non-reclaimed, disturbed areas such as landings, laydown areas, and borrow pits contribute to a direct loss of soil quantity otherwise available to perform a number of ecological functions and constitute a fundamental change in land use (Bulmer et al. 2008). Landslides and other forms of soil erosion represent both losses of bulk soil and decreases in site productivity (Miles, Swanson, and Youngberg 1984; Smith, Commandeur, and Ryan 1986; Bulmer et al. 2008). It has been shown that high road densities (e.g., above 0.12 km of road per km^2 on slopes above 60% grade, or above 0.16 km/km^2 in riparian areas; Porter et al. 2012) are correlated with high soil erosion and high sediment transport to streams (USFS 1996; BC MOF 2001; Gustavson and Brown 2002), high landslide frequency (Porter et al. 2012), an increased risk of fire occurrence (USFS 1996; Arienti et al. 2009), and high tree mortality (USFS 1996).

Consequently, as the proportion of developed land under the footprint of various projects increases, the cumulative effect of this loss on soil ability to store carbon and nutrients and control groundwater movement is expected to gradually decrease.

37.6.3.3.2 Soil Quality

Soil degradation is caused by contamination, compaction, and loss of fertility attributable to changes in structure, hydrological patterns, erosion, transportation, and long-term storage. Contamination can result from aerial deposition of metals from mined minerals (e.g., dust; Zhi-Qing 1996) and from potential spills of fuels and other chemicals used by mining and power-generating industries. Some level of soil contamination can also be attributed to metal leaching from waste rock storage areas and from roads cut through acid generating rock. Soil compaction, typically caused by construction activities, reduces the ability of soil to support life and often leads to increased surface runoff and erosion (Noss 1995; Gunn 2009). Industrial development also leads to disruption of natural soil drainage patterns and necessarily involves soil disturbance through salvage, long-term storage, and redistribution. Landslides and other forms of soil erosion associated with roads decreases the productivity of surrounding areas (Smith, Commandeur, and Ryan 1986; Bulmer et al. 2008). Roads also increase the risk of fire occurrence (USFS 1996; Arienti et al. 2009) and tree mortality (USFS 1996).

Consequently, as the proportion of developed land increases, the cumulative spatial extent of soil degradation is expected to rise. Soil degradation associated with the three projects considered in this CEA is expected to spatially and temporally interact with soil degradation due to the development of the KSM Project.

37.6.3.4 Mitigation and Monitoring for Cumulative Effects on Soil Quantity and Soil Quality

No mitigation and management plans besides those in Chapter 26 are identified to mitigate cumulative effects on soil quantity, other than proactive and comprehensive regional planning among other projects that potentially contribute to the cumulative effects. Where feasible, resource sharing (e.g., highways, power lines, water, and fuel stations) will be considered.

For mitigation and management for the degradation effects on soil quality, the management plans outlined in Section 26.13 will also contribute to the minimization of cumulative effects, as will dust-abating technologies including windbreaks, fences, water sprays, and dust suppression fluids. The amount of human-generated waste (e.g., batteries, aerosol cans, and insecticides) that have the potential to contaminate soil will be minimized through reduction, reuse, recycling, and proper disposal of remaining material. A comprehensive monitoring program will be established at the beginning of mine construction to verify proper implementation and effectiveness of mitigation measures (Section 8.7.3.2).

It is expected that the best management practices (BMPs) will be followed during soil salvage, stockpiling, and reclamation and that modern erosion/sedimentation control, spill control, and environmental monitoring programs will be established at each of the existing and planned projects in the region.

Implementation of policies to minimize the area and duration of soil disturbance by each of the participating projects will constitute an important mitigation strategy. Development of comprehensive soil management plans and following BMPs for road construction, road maintenance, soil salvage, and stockpiling constitute vital aspects of this mitigation effort.

37.6.3.5 Summary of Residual Cumulative Environmental Effects on Terrain, Surficial Geology, and Soils

37.6.3.5.1 Soil Quantity

The cumulative loss of soil quantity is expected to extend spatially across multiple watersheds and its duration will extend into the far future. The loss of soil quantity will occur as a series of sporadic events and is considered irreversible as most of the excavated, buried, or eroded soil will be permanently lost. Due to the proposed employment of BMPs, modern monitoring, and mitigation methods, the magnitude of this effect is expected to be medium, and the resilience of the receiving environment is predicted to be neutral. The likelihood of soil losses is high but due to a number of unknown external variables, the confidence in the predicted outcome is medium (Table 37.6-5). Overall, the residual cumulative effect of permanent soil loss at the proposed projects in the region is expected to be **not significant (moderate)**.

37.6.3.5.2 Soil Quality

The cumulative degradation of soil quality resulting from the development of six interacting projects (Section 8.9.3.1) is expected to have regional spatial extent (three watersheds). Soil degradation will occur as a series of sporadic events, will extend into the far future, and is considered irreversible. Due to proposed employment of BMPs and monitoring and mitigation methods, the magnitude of this effect is expected to be low, and resilience of the receiving environment is predicted to be low. The likelihood of soil degradation is medium but due to a number of unknown external variables, the confidence in the predicted outcome is low (Table 37.6-6). The residual cumulative degradation of soil quality due to the proposed projects in the region is expected to be **not significant (minor)**.

37.6.4 Groundwater

37.6.4.1 Summary of Project-specific Residual Effects on Groundwater

37.6.4.1.1 Groundwater Quantity

Groundwater quantity will be affected by development of the Project but the effects are expected to be restricted within the local catchment basins containing mine components. The overall residual effect on the regional landscape receiving environment from all components by post-closure is assessed to be **not significant (moderate).**

Residual effects include the following:

- local changes in groundwater levels and flow patterns (directions and rates) due to mine de-watering and water level management during construction (not significant [moderate]) and operation (not significant [minor]);
- local water level mounding in the Mitchell and McTagg RSFs during operation and post-closure (not significant [minor]); and
- local and landscape changes in groundwater levels and flow patterns (directions and rates) due to creation of artificial ponds with seepage control mechanisms (i.e., the Water Storage Facility [WSF] and the Tailing Management Facility [TMF]) during construction and operation (not significant [moderate]).

Groundwater flow modelling has demonstrated that the KSM Project will affect groundwater quantity within the local mine footprints. Residual effects will occur due to dewatering of pits and block caves during operation, pit lake water level management during post-closure, water level mounding in the Mitchell and McTagg RSFs, and the development of artificial ponds with seepage control mechanisms (WSF and TMF). Groundwater management is planned into the far future in the Mitchell Pit and Mitchell Block Cave Mine, Sulphurets Pit and Backfill RSF, Kerr Pit, WSF, and TMF. Increase in ground elevation along the Mitchell and McTagg valleys due to placement of waste rocks will result in elevation of the water table.

Effects resulting from these components will be permanent, with the imposition of water levels and flow patterns that diverge substantially from baseline conditions. However, considering that groundwater is regionally abundant, and losses arising from Project activities will be negligible in relative terms in the regional scale, no residual effects are predicted for down-gradient watershed basins. Effects on groundwater quantity are expected to have no resultant effects on downstream surface water quantity (baseflow) or on the aquatic or riparian habitat and aquatic species that these streams support.

37.6.4.1.2 Groundwater Quality

Groundwater quality will be affected by development of the Project but the effects are expected to be confined to the immediately vicinity of the footprints of the TMF and Mitchell Valley mine components upstream of the WSF. No exceedances of provincial water quality guidelines have been forecast outside of the mine footprints, so residual effects in the regional downstream receiving environment are assessed to be insignificant or minor during operation and post-closure**.**

Table 37.6-5. Summary of Cumulative Residual Effects on Soil Quantity

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Soil Quantity: Loss of land Surface Area	Roads and other non-reclaimed areas retained after closure	Construction	Medium	Medium	Local	Regional	Far future	Far future	One-time	Sporadic	Irreversible	Irreversible	Neutral	High	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Not Required
Soil Quantity: Bulk Erosion.	Roads and other non-reclaimed areas retained after closure	Construction	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	High	High	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Moderate)	Not Required	Not Required
Overall Effect	All	Post-closure	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	High	High	High	Medium	Medium	Low	Not Significant (Minor)	Not Significant (Moderate)	Not Required	Not Required

Note:

CE = Cumulative Effect

For a complete list of Project components see Table 8.8-2.

Table 37.6-6. Summary of Cumulative Residual Effects on Soil Quality

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Decreased soil fertility in buffers surrounding components retained after closure.	Roads and other non-reclaimed areas retained after closure	Construction	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	High	High	Medium	Medium	Low	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Soil compaction in buffers surrounding components retained after closure.	Roads and other non-reclaimed areas retained after closure	Construction	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	High	High	Medium	Medium	Low	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Soil contamination in buffers surrounding components retained after closure.	Roads and other non-reclaimed areas retained after closure	Post-closure	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	High	High	Medium	Medium	Low	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

Notes:

CE = Cumulative Effect

Conservative groundwater flow and non-reactive solute transport modelling was conducted to assess potential residual effects on groundwater quality sourced in mines (Mitchell Pit and Block Cave Mine, Iron Cap Block Cave Mine, and the Sulphurets and Kerr pits), reservoirs that store contact water (TMF and WSF), the RSFs, and tunnels. Separate simulations were conducted for the Mine Site and PTMA LSAs and sensitivity simulations were carried out for parts of the Mine Site and PTMA models. With mine design and seepage mitigation control measures in the Mine Site, the plume from the Mitchell and McTagg RSFs is going to be captured in the downstream WSF, and plumes from the Water Storage Pond is going to be captured in the seepage recovery area by the seepage collection dam and tunnels. In the PTMA, the plume is also expected to be captured in the seepage recovery areas by the seepage collection dams. The predicted contact water plume concentrations have been incorporated in the surface water quality assessment.

Contact water seepage would occur for the duration of the mine life, and would continue for an uncertain amount of time following end of operation. The magnitude of degradation would be high, because elevated levels of certain metals would enter the groundwater environment, resulting in exceedances of guidelines for human consumption and the protection of freshwater aquatic life. Degradation of groundwater quality will be confined to the immediately vicinity of the footprints of the TMF and Mitchell Valley mine components upstream of the WSF. Mitigation measures included in infrastructure designs in these areas will minimize seepage of degraded water into the downstream groundwater environment. No exceedances of provincial water quality guidelines have been forecast outside of the mine footprints, in the regional downstream receiving groundwater environment. Overall, the residual effect on groundwater quality was determined to be **not significant (moderate**).

37.6.4.2 Cumulative Assessment Boundaries for Groundwater

The residual effects on groundwater are carried through the CEA where they are expected to have cumulative interactions with other human projects and activities.

The major groundwater divides used to delineate the LSAs are used to assess potential spatial overlap of groundwater effects arising from other projects. Modelling exercises have shown that extents of plumes emanating from project areas that interact with the groundwater environment will not surpass these boundaries. A 1-km buffer around the MTT and Coulter Creek access road footprints was also used to account for potential releases of industrial fluids along these corridors. Groundwater contamination can persist long after human activity at a site has ceased leading to overlap with past or future projects. The following projects and activities are considered to have a potential spatial and temporal overlap with effects on groundwater quantity and quality as (Figure 37.6-3):

- the proposed Brucejack Mine;
- the proposed Snowfield Project;
- the past Sulpherets Project;
- the NTL; and
- mineral and energy resource exploration.

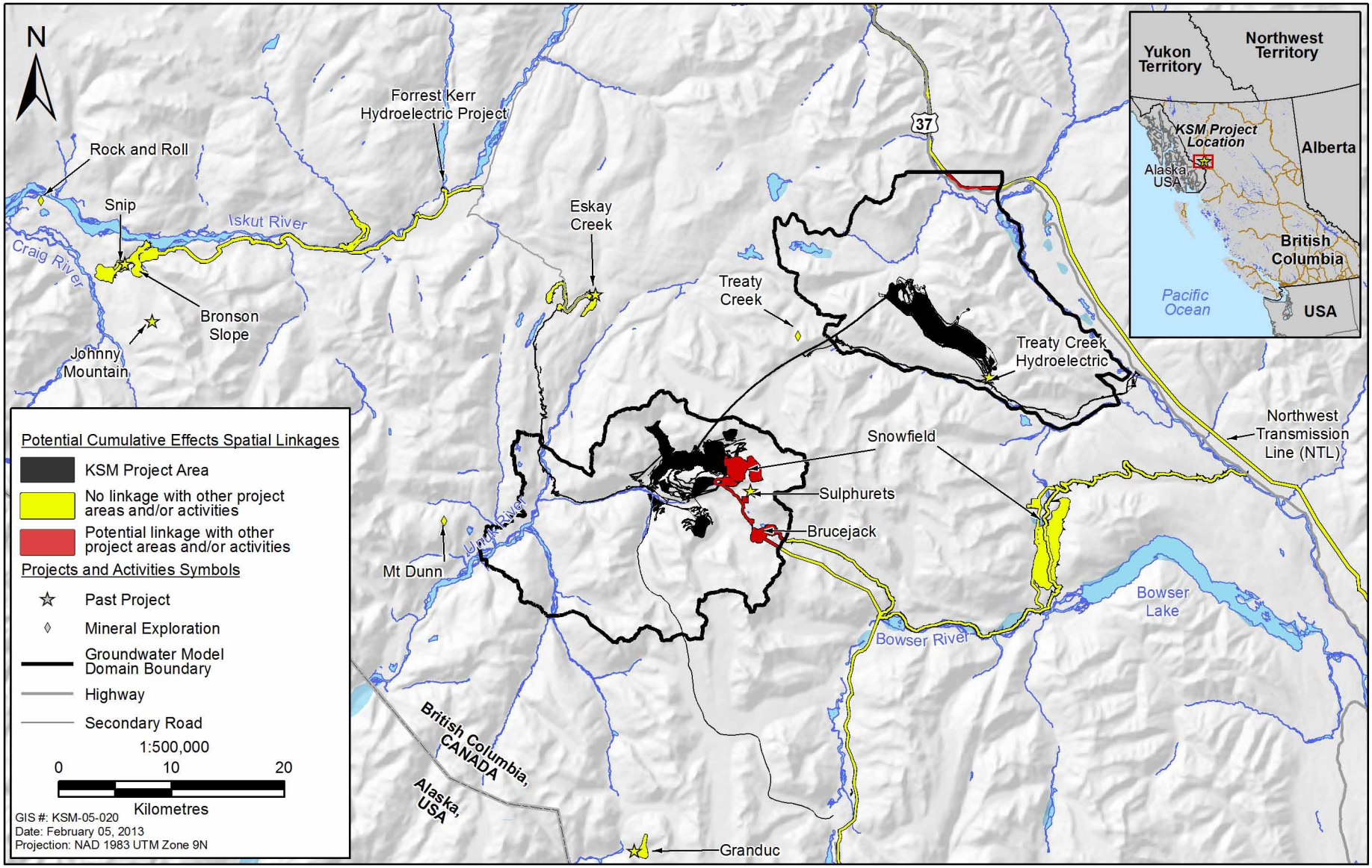

Figure 37.6-3

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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Groundwater

Figure 37.6-3

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37.6.4.3 Cumulative Effects Assessment for Groundwater

Table 37.6-7 provides a summary of the projects listed above identified to have potential to overlap with the KSM Project's potential residual effects on groundwater.

Table 37.6-7. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Groundwater Quantity and Quality

Description of KSM Project Residual Effects	Potential for Cumulative Effect: Relevant Projects and Activities				
	Snowfield Project	**Brucejack Mine**	**Sulphurets Project**	**Northwest Transmission Line**	**Mineral and Energy Resource Exploration**
Groundwater Quantity					
Mine de-watering and water level management	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Development of contact water ponds and implementation of associated seepage control mechanisms	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Tunnel drainage effects	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Development of preferential flow pathways due to submergence of excavated mine components	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Groundwater Quality					
Degradation arising from seepage of contact water	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Degradation arising from releases of industrial fluids	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

37.6.4.3.1 Groundwater Quantity

Effects on groundwater quantity associated with the KSM Project are predicted to be local to landscape in extent, thereby minimizing potential for interaction with projects that are not likely to be immediately adjacent to KSM Project components. The proximity of the planned Snowfield Pit to the planned Mitchell Pit is such that potential cumulative effects on groundwater quantity exist.

The Snowfield Project is in an early stage of exploration and has not yet entered the BC environmental assessment process. Therefore infrastructure plans are highly uncertain. The most recent infrastructure plans, detailed by Wardrop (2010a), identify an open pit and adjacent waste rock dumps in the Upper Mitchell Valley. At present, there are no plans for further exploration of the property or activities to define how the project could be developed. The last exploration conducted on the property occurred in 2011. Pretium Resources Inc. will not have to expend any funds on the project until 2022 (Pretium Resources Inc. 2012).

37.6.4.3.2 Groundwater Quality

The proximity of the planned Snowfield Pit to the planned Mitchell Pit is such that potential cumulative effects on groundwater quality also exist. As shown in Table 37.6-7, there are no other potential interactions. Effects on groundwater quality associated with the KSM Project are predicted to be local or landscape in extent, thereby minimizing potential for interaction with projects that are not in the immediate vicinity to KSM Project components.

Tailing disposal for the Snowfield Project was planned for the Scott Creek Watershed, which is several basins to the northeast. Snowfield Project infrastructure that would be located in the upper Mitchell Valley may generate effects on groundwater quality that interact with those arising from the KSM Project. As mentioned in Section 37.6.4.3.1 (and elaborated on in Chapter 5), Pretium Resources Inc. has no current plans to advance its development; therefore, the groundwater CEA with this project is conservative, and based on the Wardrop (2010a) assumptions (Chapter 5, Section 5.4.5.11) regarding potential project characteristics and interactions.

37.6.4.4 Mitigation and Monitoring for Cumulative Effects on Groundwater

37.6.4.4.1 Groundwater Quantity

As no effects assessment data exist for the Snowfield Project at the time of writing to evaluate cumulative residual effects with the KSM Project, the following assumptions have been made:

- infrastructure will be limited to an open pit, waste rock dumps, and a conveyor/transport tunnel in the Upper Mitchell Valley immediately west of the Mitchell Pit (Wardrop 2010a);
- decommissioning of the Snowfield pit will likely involve development of a pit lake, but what water level management in the pit will be sustained following operations is unknown; and
- all contact water will be transported off site for disposal and/or treatment, so no contact water storage facility will be created in the Upper Mitchell Valley.

The planned tunnel leaving the Mitchell Valley to the east is expected to interact with the groundwater environment. However, it is not expected to pose effects that interact with residual effects associated with the KSM Project. Effects on groundwater quantity in the local hydrogeologic setting have been shown to be localized. Therefore no interaction is expected due to tunnel drainage effects or the persistent preferential flow pathway that would exist following decommissioning to perpetuity.

No Project mitigation measures are planned to minimize cumulative effects on groundwater quantity arising from interactions with the planned Snowfield Project. The most recent Snowfield infrastructure plans, detailed by Wardrop (2010a), do not specify mitigation measures to minimize cumulative effects on groundwater quantity arising from interactions with the KSM Project either.

37.6.4.4.2 Groundwater Quality

As the Snowfield Project footprint is located in the Upper Mitchell Valley, it would be upstream of the KSM Project WSF. All seepage in this catchment basin is controlled, as discussed in Chapter 12. The KSM Project does not include plans for any mitigation measures specifically targeting cumulative effects on groundwater quality, and due to the early stage of the Snowfield Project, it has no specific mitigation measures developed yet to address seepage of contact water (Wardrop 2010a).

Dewatering would be required for extraction in the Snowfield pit that would create a groundwater sink, similar in nature to that predicted for the Mitchell, Sulphurets, and Kerr pits during the KSM Project operation phase. Whether decommissioning would involve management of the water level in the Snowfield pit remains uncertain.

37.6.4.5 Summary of Residual Cumulative Effects on Groundwater

37.6.4.5.1 Groundwater Quantity

Interaction of drawdown cones arising from mine dewatering is expected to occur for the Mitchell Pit, Mitchell Block Cave Mine, Iron Cap Block Cave, and Snowfield Pit during the operations. The cumulative effect does not augment any significance determination criteria relative to project-specific residual effects. The residual cumulative effects are determined to be **not significant (moderate),** and restricted to the local project footprints for mine components upstream of the WSF (Table 37.6-8).

37.6.4.5.2 Groundwater Quality

The KSM Project will affect groundwater quality. The past Sulphurets Advanced Exploration Project, the planned Brucejack Mine, and the planned Snowfield Project are also expected to affect (or have affected in the case of the Sulphurets Project) groundwater quality, and are located in the upper watersheds that contain the KSM Project Mine Site. The past Sulphurets Project and the planned Brucejack Mine are located in groundwater flow regimes that do not interact with water that is predicted to be affected by the KSM Project. Thus, potential interactions only exist for the Snowfield Project.

The Snowfield Project is in an early stage of exploration, and most recent infrastructure plans indicate that cumulative effects would be confined to the Upper Mitchell Valley. Mixing of plumes may increase contaminant loads in the groundwater environment. However, catchment isolation measures planned for this locality will contain any additive effects. Thus, cumulative effects remain local and **not significant (moderate**; Table 37.6-9**)**.

37.6.5 Surface Water

37.6.5.1 Summary of Project-specific Residual Effects on Surface Water

The effects assessment on surface water quantity is detailed in Chapter 13.

37.6.5.1.1 Surface Water Quantity

A combination of modelling techniques, which included a GoldSim water balance model and regional frequency analysis, are employed to assess the potential effects of the Project on surface water quantity. VCs are selected in order to isolate the potential effects on local and regional study areas from the two main Project footprints, the PTMA and the Mine Site. No significant residual effects are expected to be transmitted downstream into the regional study area, which included the Unuk River at the International Boundary and the Bell-Irving River downstream of the confluence with Treaty Creek. High magnitude effects on low order drainages (i.e., upper section of the watersheds) within both the PTMA and Mine Site LSAs are identified. However, these effects are not significant at the downstream boundaries of the LSAs, at Teigen Creek Treaty Creek, and Sulphurets Creek; all specific residual effects are assessed as **not significant (minor or moderate).**

37.6.5.1.2 Surface Water Quality

Residual effects of the KSM Project for surface water quality are predicted for the Coulter Creek and Treaty Creek access corridors, Sulphurets Creek, the Unuk River, and the Treaty and Teigen watersheds. The effects assessment on surface water quality is detailed in Chapter 14 and summarized below.

Degradation of Surface Water Quality due to Sedimentation and Erosion

While sediment and erosion control mitigation measures will be implemented, sedimentation of streams near the Project during the construction and operation phases is likely to occur at some point (Henley 2000). Implementation of sediment control measures will reverse the effect of sedimentation on surface water quality. The effect of sedimentation and erosion on surface water quality is assessed as **not significant (minor).**

Degradation of Surface Water Quality near Access Corridors

Metal leaching and acid rock drainage (ML/ARD) mitigation, explosives management, and sediment and erosion control will prevent significant degradation of surface water quality near access corridors. It is likely, however, that some water quality degradation in watercourses near the access corridors will occur at some point during the life of the Project given the potential for ML/ARD and sedimentation and erosion (Huckabee 1975; Forman and Alexander 1998; Henley 2000). Water quality responses to road run-off include increased concentrations of metals and salinity, but tend to be temporary and localized (Forman and Alexander 1998). The significance determination for the effect of degradation of water quality near access roads is assessed as **not significant (minor)**.

Degradation of Water Quality in Sulphurets Creek

Project design changes, ML/ARD mitigation, and water management have minimized degradation of surface water quality in Sulphurets Creek. Selenium concentrations, however, are predicted to be greater than both the background concentrations and water quality guidelines at times, indicating degradation of water quality in the operation, closure, and post-closure phases of the Project. The significance determination for the effect of degradation of water quality in Sulphurets Creek is assessed as **not significant (moderate)**.

Table 37.6-8. Summary of Residual Cumulative Effects on Groundwater Quantity

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Alteration of groundwater levels, flow rates and directions due to mine de-watering and water level management	Snowfield Project	Operation	High	High	Local	Local	Far future	Far future	Continuous	Continuous	Irreversible	Irreversible	Low	Low	High	High	High	High	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Not Required
Overall Effect	All	Post-closure	High	High	Local	Local	Far future	Far future	Continuous	Continuous	Irreversible	Irreversible	Low	Low	High	High	High	High	Not Significant (Moderate)	Not Significant (Moderate)	Required	Required

Note:
CE = Cumulative Effect

Table 37.6-9. Summary of Residual Cumulative Effects on Groundwater Quality

Description of Residual Effect	Other Project(s) Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Confidence Level Adjusted for CE				
Degradation of groundwater quality due to seepage of contact water	Snowfield Project	Construction	High	High	Local	Local	Far future	Far future	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	High	High	High	Not Significant (Moderate)	Not Significant (Moderate)	Required	Required
Overall Effect	All	Post-closure	High	High	Local	Local	Far future	Far future	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	High	High	High	Not Significant (Moderate)	Not Significant (Moderate)	Required	Required

Note:
CE = Cumulative Effect

Degradation of Water Quality in Unuk River

Project design changes, ML/ARD mitigation, and water management have minimized degradation of surface water quality in the Unuk River. Selenium concentrations, however, are predicted to be greater than both the background concentrations and water quality guidelines at times at site UR1 below the confluence with Sulphurets Creek, indicating degradation of water quality in the operation, closure, and post-closure phases of the Project. Selenium concentrations are predicted to be below water quality guidelines at site UR2 at the BC-Alaska border. The probability of the effect occurring is medium and the confidence in the effects assessment is medium. The significance determination for the effect of degradation of water quality in the Unuk River was assessed as **not significant (moderate)**.

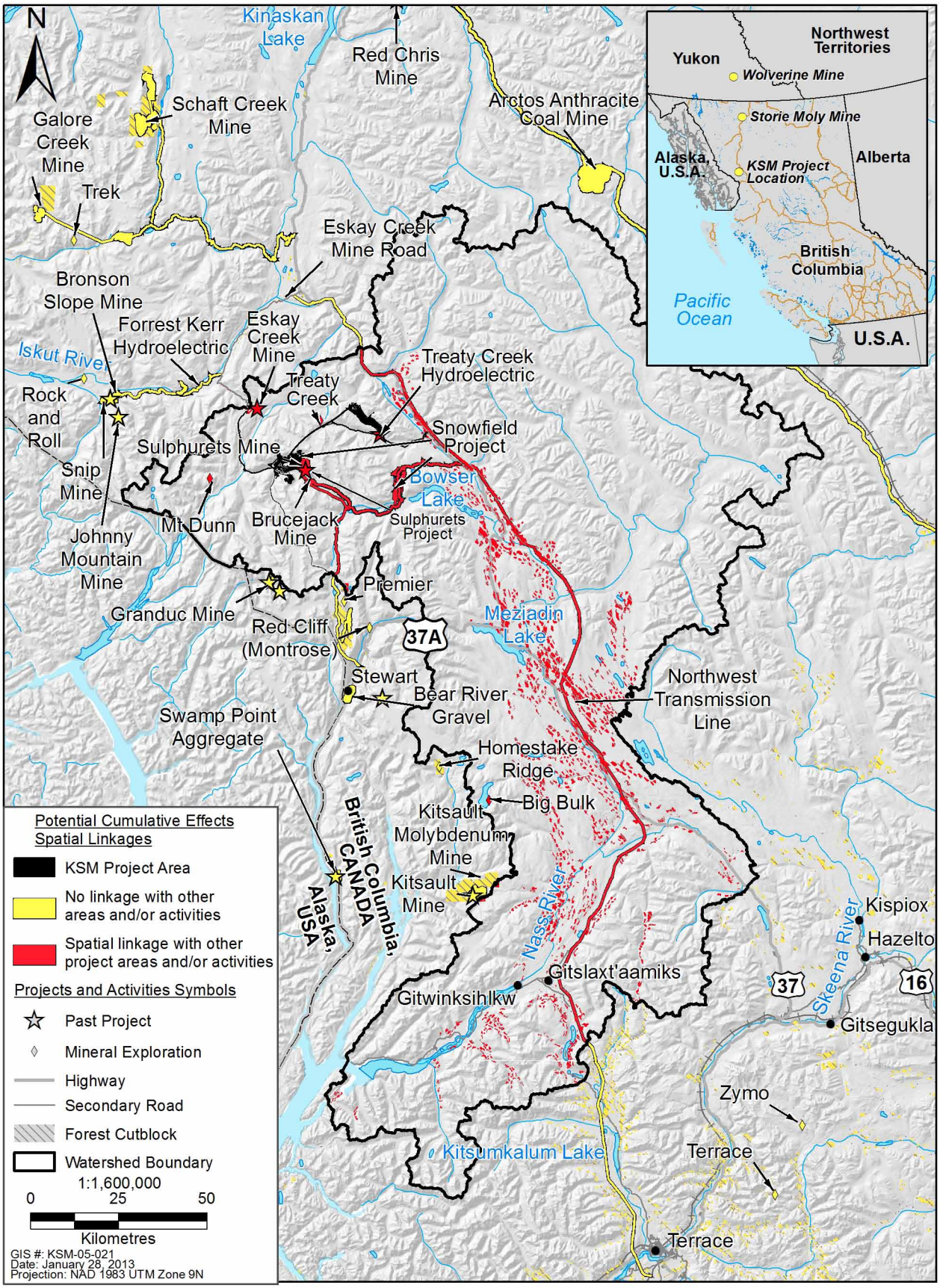
Degradation of Water Quality in Treaty and Teigen Watersheds

Water management designs and plans have minimized degradation of surface water quality in the Treaty watershed. Occasional hazard quotients greater than 1.0 are calculated for dissolved aluminum and dissolved iron; however, these are artifacts of a mass balance model that does not simulate mineral precipitation and analytical uncertainty for values close to the analytical detection limit. Nitrogen loading is predicted to occur above baseline nutrient concentrations and the effect on aquatic life is assessed in Chapter 15. The concentrations of various other parameters are predicted to be greater than baseline conditions, but below water quality guidelines. The significance determination for the effect of degradation of water quality in the Treaty and Teigen watersheds is assessed as **not significant (minor)**.

37.6.5.2 Cumulative Assessment Boundaries for Surface Water

The KSM Project Mine Site falls within the Sulphurets Creek watershed, and the PTMA is within the Teigen Creek and Treaty Creek watersheds. Water from the Mine Site flows into the Unuk River, while water from the PTMA flows to either Teigen Creek or Treaty Creek, then to the Bell-Irving River, and eventually to the Nass River. Appropriately, CEA boundaries include the Sulphurets Creek and Unuk River watersheds, as well as the Teigen Creek, Treaty Creek, and Bell-Irving River watersheds. Other projects and activities occurring within these watersheds are considered to have a spatial linkage with potential effects of the KSM Project (Figure 37.6-4). These include:

- the past-producing Eskay Creek Mine and Granduc Mine;
- the advanced exploration activity associated with the Sulphurets Project;
- the proposed Snowfield Project;
- the proposed Brucejack Mine;
- the proposed Treaty Creek Hydroelectric Project;
- the NTL; and
- past and future forestry activity.



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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Surface Water

Figure 37.6-4

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Cumulative effects from the closed Eskay Creek Mine, Granduc Mine, and the Sulphurets Project are included in the baseline conditions for the KSM Project. A spatial and temporal overlap with the KSM Project construction and operation phases and the Brucejack Mine is assumed. The scope of the Treaty Creek Hydroelectric Project is not determined at this stage and the NTL is not expected to have residual surface water quality effects. Thus, no cumulative effect with the Project is assessed for these two projects.

37.6.5.3 Cumulative Effects on Surface Water

Table 37.6-10 provides a summary of the spatial and temporal linkages between other projects and activities and the KSM Project that are considered in the surface water CEA.

Table 37.6-10. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Surface Water

Description of KSM Project Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	Granduc Mine	Sulphurets Project	NTL	Brucejack Mine	Snowfield Project
Degradation of Water Quality	Possible Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction
Change in Water Quantity	No Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction

37.6.5.3.1 Surface Water Quantity

Stream Flows within the Mine Site

Among the projects and activities that have potential linkage with the KSM Project (Table 37.6-10), the Brucejack Mine has potential to interact cumulatively with expected Project-related residual effects on streamflows within the Mine Site.

The Brucejack Mine and KSM Project have potential for residual cumulative effects with respect to annual flow volumes, monthly flow distribution, peak flows, and low flows. However, the water management plan and detailed design of the Brucejack Mine are not yet finalized. Therefore, assessment of cumulative effects and identification of mitigation measures are not possible at this stage. Adjusted descriptors in Table 37.6-11 are marked as "N/A" (not applicable).

37.6.5.3.2 Surface Water Quality

A residual effect on water quality in the Sulphurets-Unuk watershed due to increased selenium concentrations was predicted for the KSM Project. This residual effect is predicted to be not significant (moderate) with mitigation (Section 14.8.2). The magnitude of the residual effect in Sulphurets Creek and in the Unuk River is high, with a medium magnitude residual effect in the Unuk River at the BC-Alaska border. Increased selenium loading from the Brucejack Mine has the potential to increase concentrations of selenium in Sulphurets Creek and in the Unuk River, which could result in a cumulative effect of a greater magnitude in the Unuk River at the

BC-Alaska border. Estimations of water quality effects from the Brucejack Project Description (Rescan 2012) submitted to the BC EAO are used to quantify the additional selenium loading.

37.6.5.4 Mitigation and Monitoring for Cumulative Effects on Surface Water

37.6.5.4.1 Surface Water Quantity

Mitigation of potential water quantity effects by present and future projects is expected to occur though implementation of BMPs and proven mitigation strategies and cooperation with other users of the resource.

37.6.5.4.2 Surface Water Quality

Extensive mitigation to avoid degradation of surface water quality was included in the design for the proposed KSM Project. Mitigation includes measures to avoid, reduce, and monitor adverse effects to surface water quality, and specific mitigation measures are developed for the various pathways that Project components could potentially interact with surface water quality. Section 14.7.2 provides detail on KSM Project water quality mitigation. In summary, water quality effects for the KSM Project will be primarily mitigated through water management including diversion of non-contact water and collection and treatment of contact water. Effluent discharges from the WSF and the TMF will be staged to the natural hydrograph to minimize water quality effects.

Water quality monitoring and adaptive management are expected to minimize water quality effects throughout the construction, operation, closure, and post-closure phases.

Mitigation of water quality effects by present and future projects is expected to occur though implementation of BMPs and proven mitigation strategies. The Brucejack Mine is proposing a combination of subaqueous disposal and paste backfill to underground workings for waste rock and tailing material. A high-density sludge lime water treatment system is proposed as a contingency to address potential water quality effects in the Sulphurets/Unuk watershed (Rescan 2012).

37.6.5.5 Summary of Residual Cumulative Effects on Surface Water

37.6.5.5.1 Surface Water Quantity

There are no identified residual cumulative residual effects for surface water quantity (Table 37.6-11).

37.6.5.5.2 Surface Water Quality

The Brucejack Project Description identifies the potential for local, low magnitude effects on water quality (Rescan 2012). The cumulative effect on water quality from the Brucejack Mine will not influence the descriptors used in the assessment of Project-specific residual effects because concentrations of selenium in the Sulphurets/Unuk watershed are not expected to increase above the Project-specific predictions as a result of cumulative water quality effects. Therefore, there will be no residual cumulative effects. The significance determination of cumulative residual effects was assessed as **not applicable (N/A)** in Table 37.6-12.

No residual cumulative effects on surface water quality are predicted.

Table 37.6-11. Summary of Residual Cumulative Effects on Surface Water Quantity

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Potential increase/decrease in annual flow volumes	Brucejack Mine	Construction	High	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Operation	High	N/A	Local	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Closure	High	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Post-closure	High	N/A	Local	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Required	N/A
Potential sharpening/flattening of monthly flow distribution	Brucejack Mine	Construction	Medium	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Not Required	N/A
		Operation	Medium	N/A	Local	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Not Required	N/A
		Closure	Medium	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Not Required	N/A
		Post-closure	Medium	N/A	Local	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	High	N/A	Not Significant (Moderate)	N/A	Not Required	N/A
Potential increase/decrease of Peak Flows	Brucejack Mine	Construction	High	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Operation	High	N/A	Local	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Closure	High	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Post-closure	High	N/A	Local	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
Potential increase/decrease of Low Flows	Brucejack Mine	Construction	High	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Operation	High	N/A	Local	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Closure	High	N/A	Local	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
		Post-closure	High	N/A	Local	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A
Overall Effect	All	Post-closure	High	N/A	Local	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Low	N/A	High	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	N/A

Note: CE = Cumulative Effect.

Table 37.6-12. Summary of Residual Effects on Surface Water Quality

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
Degradation of water quality due to sedimentation	All	Construction	High	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality due to sedimentation	All	Operations	High	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Construction	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Operations	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Closure	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality (TSS, ML/ARD, nitrogen loading).	Access Corridors	Post-closure	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	High	High	Not Significant (Minor)	Not Required
Degradation of water quality in Sulphurets Creek (elevated selenium).	Mine Site	Operations	High	Landscape	Long	Continuous	Reversible long-term	Low	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Sulphurets Creek (elevated selenium).	Mine Site	Closure	High	Landscape	Medium	Continuous	Reversible long-term	Low	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Sulphurets Creek (elevated selenium).	Mine Site	Post-closure	High	Landscape	Far future	Continuous	Reversible long-term	Low	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR1; elevated selenium).	Mine Site	Operations	High	Landscape	Long	Continuous	Reversible long-term	Neutral	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR1; elevated selenium).	Mine Site	Closure	High	Landscape	Medium	Continuous	Reversible long-term	Neutral	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR1; elevated selenium).	Mine Site	Post-closure	High	Landscape	Far future	Continuous	Reversible long-term	Neutral	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR2; elevated selenium).	Mine Site	Operations	Medium	Regional	Long	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR2; elevated selenium).	Mine Site	Closure	Medium	Regional	Medium	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required
Degradation of water quality in Unuk River (UR2; elevated selenium).	Mine Site	Post-closure	Medium	Regional	Far future	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required

(continued)

Table 37.6-12. Summary of Residual Effects on Surface Water Quality (completed)

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	TMF	Operations	Medium	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	TMF	Closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Treaty watershed (North Treaty and Treaty creeks; nitrogen loading).	TMF	Post-closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	TMF	Operations	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	TMF	Closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Degradation of water quality in Teigen watershed (South Teigen and Teigen creeks; nitrogen loading).	TMF	Post-closure	Low	Landscape	Medium	Sporadic	Reversible short-term	High	Medium	Medium	Not Significant (Minor)	Required
Overall Residual Effect	All	Post-closure	Medium	Regional	Far future	Continuous	Reversible long-term	High	Medium	Medium	Not Significant (Moderate)	Required

37.6.6 Fish and Aquatic Habitat

37.6.6.1 Summary of Project-specific Residual Effects for Fish Valued Components (Bull Trout, Dolly Varden, Rainbow Trout/Steelhead, and Pacific Salmon)

Chapter 15 details the assessment of potential residual effects for the VC fish species. Several potential residual effects were identified that could affect fish in the LSA and RSA. These potential residual effects include:

- direct mortality;
- noise;
- erosion and sedimentation;
- water quality degradation; and
- habitat loss or alteration.

Residual effects for fish VCs are: direct mortality, noise, erosion and sedimentation, and water quality degradation leading to toxicity in fish. There is potential that Project-related increases in selenium concentrations downstream of the Mine Site WTP may lead to toxicity in fish residing downstream in lower Sulphurets Creek (below the cascades) or in the Unuk River. This potential residual effect is rated at **not significant (moderate)**. Otherwise, all other potential Project-related residual effects on fish VCs (i.e., Dolly Varden, bull trout, rainbow trout/steelhead, and Pacific salmon) are assessed as **not significant (minor)**, and are not likely to affect fish population viability.

37.6.6.2 Summary of Project-specific Residual Effects for Aquatic Habitat

Several potential residual effects were identified that could affect aquatic habitat (Chapter15). These potential residual effects include:

- erosion and sedimentation;
- water quality degradation; and
- habitat loss or alteration.

Residual effects for the aquatic habitat VC are erosion and sedimentation, water quality degradation, and habitat loss or alteration; all are assessed as **not significant (minor).** Overall, potential Project-related residual effects on the aquatic habitat VC are assessed as **not significant (minor)**.

37.6.6.3 Cumulative Assessment Boundaries for Fish Valued Components and Aquatic Habitat

The residual effects on fish and aquatic habitat are carried through the CEA where they are expected to have cumulative interactions with other human projects and activities. Watersheds with the potential to be affected by KSM Project activities include the Unuk River, Sulphurets Creek, Teigen Creek, Treaty Creek, and Bell-Irving River. Figure 37.6-5 illustrates the locations of other projects and activities with which the Project has been identified to potentially have past, present, or reasonably foreseeable interactions.

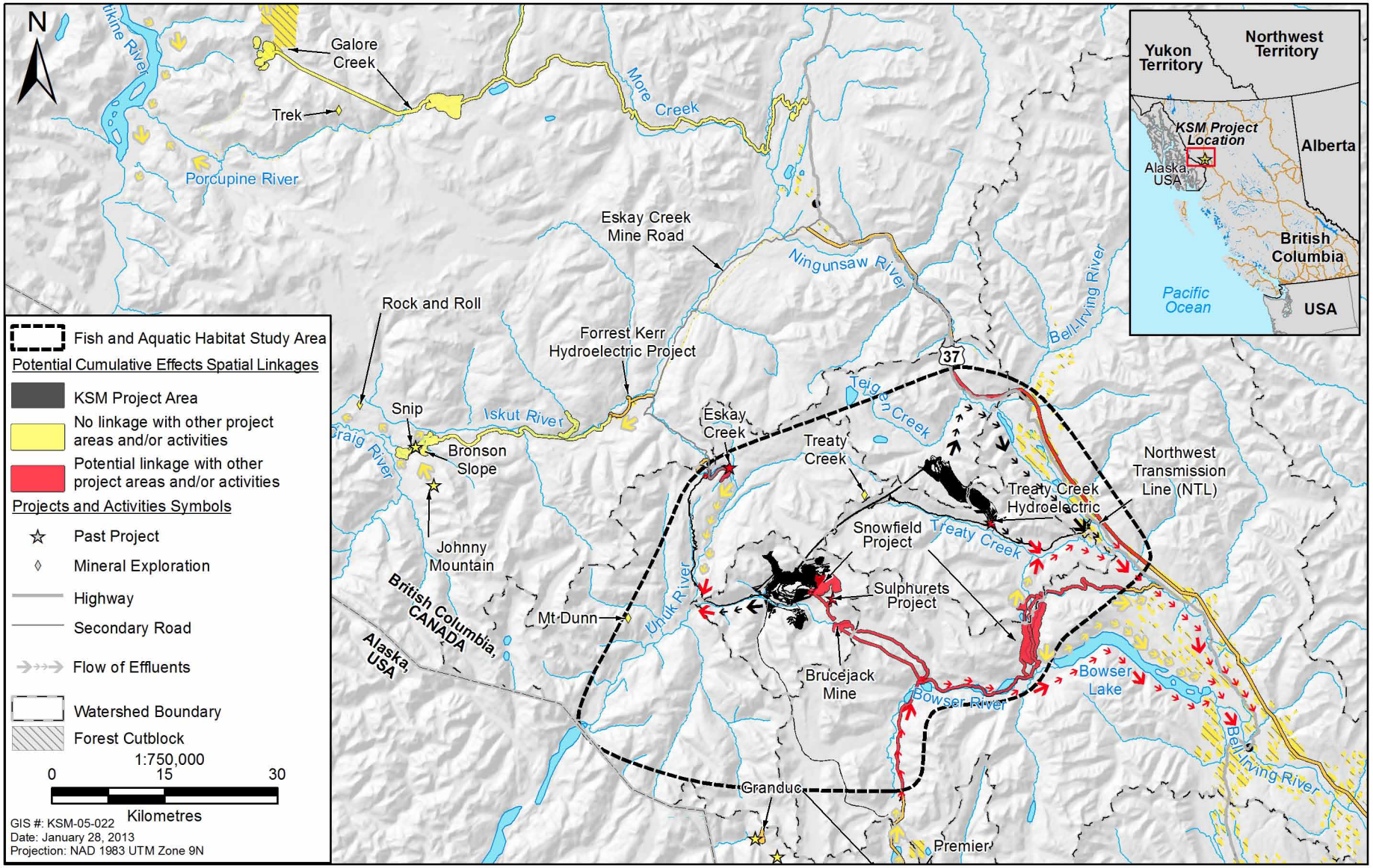

Figure 37.6-5

SEABRIDGE GOLD
KSM PROJECT

KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Fish and Aquatic Habitat

Figure 37.6-5

Rescan Engineers & Scientists

The past projects and human activities that may affect fish and aquatic habitat and that may spatially overlap potential effects from the KSM Project are:

- the past-producing Eskay Creek Mine;
- the past-producing Granduc Mine;
- Sulphurets Project;
- fishing; and
- past forestry activities in the Bell-Irving River watershed.

Present and future projects and human activities with potential effects to fish and aquatic habitat that overlap spatially with potential effects from the KSM Project include:

- the NTL;
- the Forest Kerr Hydroelectric Project;
- the Brucejack Mine;
- the Snowfield Project;
- Granduc Copper Mine;
- the Treaty Creek Hydroelectric Project;
- fishing;
- possible future mineral and energy resource exploration; and
- possible future forestry activities.

Effects to fish and aquatic habitat from past projects and human activities may temporally overlap with potential effects from the KSM Project if effluents from the activities persist in the aquatic environment or if habitat has not had sufficient time to recover from past effects. Past projects and human activities that may overlap temporally with the KSM Project are:

- the Eskay Creek Mine;
- the Granduc Mine;
- the Sulphurets Project;
- fishing;
- mineral exploration; and
- forestry activities.

37.6.6.4 Cumulative Effects Assessment for Fish Valued Components (Bull Trout, Dolly Varden, Rainbow Trout/Steelhead, and Pacific Salmon) and Aquatic Habitat

Table 37.6-13 summarizes the past, existing, and reasonably foreseeable future activities have the potential to overlap spatially and temporally with the KSM Project's potential effects on fish and aquatic habitat.

Table 37.6-13. Summary of Projects and Activities with Potential to Interact Cumulatively with Project-specific Residual Effects on Fish and Aquatic Habitat VCs

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Eskay Creek Mine	**Granduc Mine**	**Sulphurets Project**	**Forrest Kerr Hydroelectric**	**NTL (Northwest Transmission Line)**
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction
Noise	Possible Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction
Erosion and sedimentation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Water Quality Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Habitat Loss and Alteration	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Brucejack Mine	**Snowfield Project**	**Granduc Copper Mine**	**Treaty Creek Hydroelectric**	**Fishing**
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Noise	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction
Erosion and sedimentation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction
Water Quality Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction
Habitat Loss and Alteration	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities	
	Mineral and Energy Resource Exploration	**Timber Harvesting**
Direct Mortality	Possible Interaction	Possible Interaction
Noise	Possible Interaction	Possible Interaction
Erosion and sedimentation	Possible Interaction	Possible Interaction
Water Quality Degradation	Possible Interaction	Possible Interaction
Habitat Loss and Alteration	Possible Interaction	Possible Interaction

37.6.6.4.1 Direct Mortality

Fishing, and the use of heavy equipment in and around water, may affect fish in a cumulative manner if the activities were to drastically increase or spatially extend across a broad area. Increased fishing pressure on bull trout, rainbow trout/steelhead, and Pacific salmon may occur due to improved access to waterbodies near the LSA and RSA. Increased fishing pressure may occur because of all identified relevant projects and activities. The use of heavy equipment caused by the construction and maintenance of access roads or project related infrastructure may contribute cumulatively to direct mortality effects.

37.6.6.4.2 Noise

Noise effects stemming from the Project are expected to predominately occur within the construction phase. It will also be reasonable to assume that noise-related effects from other projects and activities will occur during their construction phases.

The majority of past, present, and future project may cumulatively increase noise on fish. The potential for increased noise is low because there are no fish present within most project infrastructure. Fish are not present within the Eskay Creek Mine, Granduc Mine, Sulphurets Project, Brucejack Mine, Snowfield Project, and Granduc Copper Mine infrastructure areas (existing or proposed). However, there are fish present within watercourses at past, present, and future access roads. Past or future projects have or will be constructed during separate temporal periods; therefore, the potential for cumulative effects from noise effects is unlikely.

37.6.6.4.3 Erosion and Sedimentation

The geographic scope of erosion and sedimentation can range from localized to far-reaching events depending on the amount and type (e.g., particle size) of sediment that is introduced into the aquatic environment. In addition, sedimentation effects can occur throughout the Project's construction, operation, and closure phases. These spatial and temporal properties of erosion and sedimentation are likely similar for other projects and activities that may act cumulatively with potential Project-related erosion and sedimentation effects.

The majority of past, present, and future projects may cumulatively affect fish from increased sedimentation. The potential for increased sedimentation is low because there are no fish present within most project infrastructure, and fish are located a considerable distance downstream from most project infrastructure. Fish are not present within the infrastructure areas (existing or proposed) of the Eskay Creek Mine, Granduc Mine, Sulphurets Project, Brucejack Mine, Snowfield Project, and Granduc Mine. The nearest watercourses downstream of these projects are the Unuk River (downstream of the Eskay Creek Mine, the Sulphurets Project, the Brucejack Mine, and the Snowfield Project) and the Bowser River (downstream of the Granduc Mine).

However, there are fish present within watercourses at past, present, and future access roads, in which erosion events could occur.

37.6.6.4.4 Water Quality Degradation

The majority of past, present, and future projects identified as having potential linkages for cumulative effects may contribute to toxicity in fish associated with water quality degradation

(metals, process chemicals, petroleum products, and nitrogenous compounds). Fish are not present within the footprints of Eskay Creek Mine, Granduc Mine, Sulphurets Project, Brucejack Mine, and Snowfield Project. The nearest fish-bearing watercourses downstream of other projects are: Eskay Creek – Coulter Creek and Unuk River, Granduc – Bowser River, Sulphurets – Sulphurets Creek and Unuk River, Brucejack – Sulphurets Creek and Unuk River, Snowfield – Sulphurets Creek and Unuk River, and Granduc Copper – Bowser River.

Metals may be introduced to the environment from two main sources. ML/ARD, with mobilization of metals in acidic leachate, can be generated from weathering of PAG rock that is exposed during construction of infrastructure or ongoing activities associated with mining. Point source discharges of effluent from mining infrastructure (such as tailing ponds) may also be a source of metals and process chemicals (such as cyanide, flocculants, etc.). Petroleum products may be introduced to aquatic environments due to work that occurs in and around waterways. Nitrogenous compounds, derived from either blasting residues/airborne particles or STP effluent, can also enter the aquatic environment and has the potential to cause toxicity in fish. Collectively, these chemical compounds can alter water quality and can individually or in mixtures lead to toxicity in fish. Toxicity in fish may be seen as impairments in reproduction, immune competence, olfaction, osmoregulatory balance, and behavioural changes.

There are fish present within watercourses near past/present/future access roads, where introduction of metals, petroleum products, and blasting residues (if blasting is required to construct the road) into the aquatic environment may occur from multiple projects. However, fish are generally located a considerable distance downstream from most of the main infrastructure associated with past, present or future project infrastructure (e.g., existing or potential mine pits, tailing ponds, processing facilities, etc.). Metals and other chemicals can still be a concern since they can be carried long distances dissolved in or carried by water. The potential for toxic effects will depend on the dilution capacity available with distance from the source since concentrations (and thus the probability of toxicity) will decrease with distance.

Inputs of metals from historical projects including the Eskay Creek Mine, Granduc Mine, and Sulphurets Project would have been measured during baseline studies since they contribute to background, existing concentrations and would have been incorporated into the water chemistry of the receiving environment. These baseline data were already captured in the predictive water quality modelling that was completed (Appendix 14-H). Provided that no new changes occur in the conditions at these historical mines, metal inputs should remain stable or decrease over time. No additional cumulative effects related to these Projects would be expected with development of the KSM Project beyond what was already included in the predicted concentrations of metals based on baseline studies.

There are a number of future projects that may have spatial or temporal overlaps with the KSM Project. The Snowfield Project is located immediately adjacent to the KSM Project, such that the Snowfield property may be influenced by KSM Project access plans for the area (Snowden 2012). The Snowfield deposit area drains downstream to Mitchell Creek (Wardrop 2010a) which is upstream of the proposed WSF for the KSM Project. A Preliminary Economic Assessment (PEA) was completed in 2010 that explored the value of combining the Brucejack and Snowfield Projects (Wardrop 2010a). The Snowfield Project proponent has no current plans to advance development;

therefore, since there is no potential temporal overlap, the Snowfield Project was considered to not have the potential for cumulative effects to water quality.

The reopened Granduc Copper Mine is located 40 km northwest of Stewart in northwestern British Columbia and previously produced between 1971 and 1984 (see Section 5.3.3.2). Castle Resources Inc. acquired the Granduc property from Bell Copper in July 2010, and began exploration drilling with the aim of redeveloping the mine (Marketwire 2010; Scales 2012). In 2011, Castle Resources Inc. had the 17 km tunnel rehabilitated, and plans to rehabilitate specific levels of the old underground mine to establish underground drill stations for exploration. Castle Resources Inc. is currently working on a Preliminary Economic Assessment that will evaluate mining methods, tailing impoundment, and a suitable milling process (Dickson 2012), indicating that a temporal overlap with the KSM Project is possible. It is expected that mine will use sub-level caving techniques (Dickson 2012; Scales 2012). The drainage from the Granduc Copper Mine is to the Bowser River, Bowser Lake, and ultimately to the Bell-Irving River. However, since residual water quality effects from activities in the PTMA of the KSM Project are not predicted to occur in Treaty or Teigen creeks (and therefore no effects are predicted in the Bell-Irving River), there is no spatial overlap in water quality effects from the projects and the Granduc Copper Mine was considered to not have the potential for cumulative effects to water quality.

Similarly, the Treaty Creek Hydroelectric project (on upper Treaty Creek) and the NTL project (in the Bell-Irving watershed) may have temporal overlap with the KSM Project. However, these projects are located in areas where they would not be expected to have a spatial overlap with the KSM Project since no water quality degradation effects are predicted in Treaty Creek or the Bell-Irving River for the KSM Project.

The proposed Brucejack Mine is located immediately east of the KSM Project and entered the BC Environmental Assessment process in 2012. The Brucejack Mine is an underground gold and silver mining operation targeting two deposits. The mine life is projected to be a minimum of 16 years, with anticipated commencement of operation in 2016 (Wardrop 2011), indicating that a temporal overlap with the KSM Project is possible. Approximately 5 Mt of waste rock will be produced throughout the mine life, with 2 Mt of waste rock stored sub-aqueously in the southwest corner of Brucejack Lake. An estimated 8 Mt of flotation tailing material will additionally be deposited in Brucejack Lake. Brucejack Lake drains west into the Sulphurets/Unuk watershed (Rescan 2012). Water quality effects from the Brucejack Mine have the potential to interact with residual effects from the KSM Project; therefore the Brucejack Mine was included in the fish and aquatic habitat CEA.

A residual effect on water quality in the Sulphurets-Unuk watershed due to increased selenium concentrations was predicted for the KSM Project. This residual effect is predicted to be not significant (moderate) with mitigation (Chapter 14) to water quality, and not significant (moderate) to fish (section 15.8.2.5.1). For fish, the magnitude of the residual effect in Sulphurets Creek and in the Unuk River is high. Increased selenium loading from the Brucejack Mine has the potential to increase concentrations of selenium in Sulphurets Creek and the Unuk River, which could result in a cumulative effect of a greater magnitude in the Unuk River at the

BC-Alaska border. Estimations of water quality effects from the Brucejack Project Description (Rescan 2012) submitted to the BC EAO are used to quantify the additional selenium loading.

37.6.6.4.5 Habitat Loss and Alteration

Cumulative effects associated with fish habitat loss and alteration are not expected to occur in the cumulative effects study area. There are no fish present within most Project infrastructure areas (existing or proposed) such as the Eskay Creek Mine, Granduc Mine, Sulphurets Project, Brucejack Mine, and Snowfield Project. The associated access roads of these projects as well as the NTL access roads have resulted, or will result, in fish habitat loss at watercourse crossings. The NTL Project has caused the loss of fish habitat through the removal of riparian habitat due to the installation of the transmission line alignment.

Lost and altered fish habitat will be compensated for as per the Project-specific Fish Habitat Compensation Plans. These compensation plans must be approved by Fisheries and Oceans Canada (DFO) and must achieve no net loss of fish habitat; therefore, cumulative effects associated with past, present, and future projects are minimal.

For the loss of non-fish bearing aquatic habitat within and downstream of the Mine Site due to KSM Project other foreseeable projects (e.g., Brucejack Mine and Snowfield Project) may also contribute to a one-time loss in the Sulphurets Creek watershed. While this has the potential to decrease sediment inputs and benthic drift to downstream aquatic environments, it is likely that the effect would be minor since the developments would occur significant distances upstream from waterways that would be affected by cumulative effects (e.g., Sulphurets Creek, Unuk River). Also, potentially affected areas for foreseeable mining development would likely be located in the glaciated headwaters of various creeks, which are typically low in nutrients and would likely have low productive capacity; thus a low magnitude for residual cumulative effects was assessed. Any residual effects would occur at a landscape level, since they would occur outside of the Project infrastructure. Any residual cumulative effect would likely be reversible in the long-term. However, there is uncertainty in this assessment since plans regarding future mine development in the cumulative effects study area are not currently available, which affects both the probability of effects occurring and the confidence level in the assessment. Overall, the residual cumulative effect for loss of non-fish bearing aquatic habitat was assessed to be **not significant – minor**.

37.6.6.5 Mitigation and Monitoring for Cumulative Effects on Fish Valued Components (Bull Trout, Dolly Varden, Rainbow Trout/Steelhead, and Pacific Salmon) and Aquatic Habitat

It is anticipated that other projects will adopt the same mitigation strategies as the KSM Project. Mitigation measures proposed for the KSM Project are standards stated in federal and provincial guidelines (e.g., *DFO Land Development Guidelines for the Protection of Aquatic Habitat* (DFO 1993), *MOE Standards and Best Practices for Instream Works* (BC MOE 2004), and DFO Pacific Region Operational Statements (DFO 2010)) to which all projects are subject. Adhering to the *DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky 1988) will help to mitigate effects of noise from blasting.

The *Fish-Stream Crossing Guidebook* (BC MOF 2002) and the sewage effluent permit requirements, among others, help to mitigate effects of erosion and sedimentation on fish and aquatic habit.

The Spill Containment and Emergency Response Plans, which all projects must have, will help prevent and minimize degradation of water quality from spills. It is also expected that other current or future projects that may discharge effluent to shared waterways will meet discharge criteria such that resultant downstream concentrations will not increase above the Project-specific predictions as a result of cumulative water quality effects.

Extensive mitigation to avoid degradation of surface water quality was included in the design for the proposed KSM Project. Mitigation includes measures to avoid, reduce, and monitor adverse effects to surface water quality and specific mitigation measures were developed for the various pathways that Project components can potentially interact with surface water quality. Water quality effects for the KSM Project will be primarily mitigated through water management including diversion of non-contact water and collection and treatment of contact water. Effluent discharges from the WSF and the TMF will be staged to the natural hydrograph to minimize water quality effects. Chapter 14 (Surface Water Quality Chapter) provides detail on KSM Project water quality mitigation.

Project-specific cumulative effect mitigations for protection of water quality are the same as previously mentioned in Chapter 15, and include:

- environmental monitoring;
- selection of road alignments that minimize areas with high potential for ML/ARD;
- orientation of the TMF so that discharges during the Project operation phase occur predominantly to Treaty Creek, rather than to South Teigen/Teigen creeks, which contain more sensitive fish habitat than Treaty Creek;
- collection of seepage from TMF and WSF/WTP and return of seepage to the TMF or WSF/WTP;
- careful control of discharges from the TMF and WSF/WTP to stage discharges with hydrological conditions, ensuring adequate assimilative capacity of receiving environments (i.e., implementation of the Water Management Plan);
- adhering to appropriate construction operating window for instream work;
- fuel stored in bermed and lined containment facilities to prevent seepage into the soil;
- spill kits;
- equipment maintenance;
- stream setback distances for construction;
- implementation of mitigation strategies for blasting residue as outlined various acts, regulations, and DFO Pacific Region Operational Statements;

- proper sewage treatment and disposal, as required by the Municipal Wastewater Regulation (BC Reg 87/2012) or the Sewerage System Regulation (BC Reg 326/2004);
- implementation of the ML/ARD Management Plan;
- implementation of the Erosion Control Plan;
- implementation of the Fish and Aquatic Habitat Protection and Mitigation Plan; and
- environmental monitoring under the Aquatic Effects Monitoring Plan.

Water quality monitoring and adaptive management are expected to minimize water quality effects throughout the construction, operation, closure, and post-closure phases.

A combination of sub-aqueous disposal and backfill to underground workings for waste rock and tailing material is proposed for the Brucejack Mine. A high-density sludge lime water treatment system is proposed as a contingency to address potential water quality effects in the Sulphurets/Unuk watershed (Rescan 2012).

It is also expected that other current or future projects that may discharge effluent to shared waterways will meet discharge criteria such that resultant downstream concentrations will not increase above the Project-specific predictions as a result of cumulative water quality effects.

Mitigation measures to prevent the loss and alteration of fish habitat will be implemented to minimize cumulative effects associated with habitat loss. Guidelines, BMPs, and DFO Operational Statements (DFO 2010) must be followed for each project and their activities to minimize the cumulative effect of habitat loss in the cumulative effects study area. Detailed and functional Fish Habitat Compensation Plans must also be developed and approved by DFO. Thus, additional mitigation to address potential cumulative effects is not required.

37.6.6.6 Summary of Residual Cumulative Effects on Fish Valued Components (Bull Trout, Dolly Varden, Rainbow Trout/Steelhead, and Pacific Salmon) and Aquatic Habitat

Key measures to reduce the potential for residual effects on fish and aquatic habitats as a result of KSM Project activities include a combination of management plans, mitigation plans, and monitoring programs, which are summarized in Section 37.6.6.5. It is expected that future projects will also include similar mitigation and management strategies**.**

Tables 37.6-14 to 37.6-18 summarize the residual cumulative effects on fish and aquatic habitat. The potential for residual cumulative effects on fish and aquatic habitat as a result of interaction between the KSM Project and other past, present, or future projects was assessed to be **not significant (minor)** for potential effects related to direct mortality, noise, erosion and sedimentation, and loss of habitat.

Table 37.6-14. Summary of Residual Cumulative Effects on Bull Trout

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Blunt tissue trauma causing mortality to all fish life stages	Treaty Creek Access Road	Construction	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Treaty Creek Access Road	Operations	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Treaty Creek Access Road	Closure	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	Treaty Creek Access Road	Construction	Negligible	Negligible	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Treaty Creek Access Road; North Cell Tailing Management Facility; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Operations	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility	Closure	Negligible	Negligible	Landscape	Landscape	Short	Short	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle	Operations	Medium	N/A	Landscape	N/A	Long	N/A	Sporadic	N/A	Reversible long-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle	Closure	Medium	N/A	Landscape	N/A	Medium	N/A	Sporadic	N/A	Reversible long-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle	Post-closure	Medium	N/A	Landscape	N/A	Long	N/A	Sporadic	N/A	Reversible long-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	Not Required
Overall Effect	All	Post-closure	Medium	Medium	Landscape	Landscape	Long	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Low	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-15. Summary of Residual Cumulative Effects on Dolly Varden

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects: Probability	Likelihood of Effects: Probability Adjusted for CE	Likelihood of Effects: Confidence Level	Likelihood of Effects: Conf. Level Adjusted for CE	Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Construction	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Closure	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Construction	Negligible	Negligible	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Negligible	Negligible	Local	Local	Short	Short	One-time	One-time	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Operations	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; East Catchment Diversion	Closure	Negligible	Negligible	Landscape	Landscape	Short	Short	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Operations	High	N/A	Regional	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required

(continued)

Table 37.6-15. Summary of Residual Cumulative Effects on Dolly Varden

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects: Probability	Likelihood of Effects: Probability Adjusted for CE	Likelihood of Effects: Confidence Level	Likelihood of Effects: Conf. Level Adjusted for CE	Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Construction	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Closure	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Construction	Negligible	Negligible	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Negligible	Negligible	Local	Local	Short	Short	One-time	One-time	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Operations	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; East Catchment Diversion	Closure	Negligible	Negligible	Landscape	Landscape	Short	Short	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Operations	High	N/A	Regional	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required

(continued)

Table 37.6-16. Summary of Residual Cumulative Effects on Rainbow Trout/Steelhead

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing	Construction	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing	Operations	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing	Closure	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing	Construction	Negligible	Negligible	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Negligible	Negligible	Local	Local	Short	Short	One-time	One-time	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37	Operations	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; East Catchment Diversion	Closure	Negligible	Negligible	Landscape	Landscape	Short	Short	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Operations	High	N/A	Regional	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required

(continued)

Table 37.6-16. Summary of Residual Cumulative Effects on Rainbow Trout/Steelhead (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Closure	High	N/A	Regional	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Post-closure	High	N/A	Regional	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required
Overall Effect	All	Post-closure	High	High	Regional	Regional	Far future	Far future	Continuous	Continuous	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-17. Summary of Residual Cumulative Effects on Pacific Salmon

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Construction	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Blunt tissue trauma causing mortality to all fish life stages	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Closure	Low	Low	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	Coulter Creek Access Corridor; Treaty Creek Access Road; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Construction	Negligible	Negligible	Local	Local	Short	Short	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise causing sub-lethal effects, decreased feeding efficiency and habitat avoidance	South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; North Cell Tailing Management Facility	Operations	Negligible	Negligible	Local	Local	Short	Short	One-time	One-time	Reversible short-term	Reversible short-term	Low	Low	Low	Low	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Operations	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of eggs, decreased feeding efficiency, habitat avoidance, smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; East Catchment Diversion	Closure	Negligible	Negligible	Landscape	Landscape	Short	Short	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Operations	High	N/A	Regional	N/A	Long	N/A	Regular	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required

(continued)

Table 37.6-17. Summary of Residual Cumulative Effects on Pacific Salmon (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Closure	High	N/A	Regional	N/A	Medium	N/A	Regular	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Post-closure	High	N/A	Regional	N/A	Far future	N/A	Regular	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Required	Not Required
Overall Effect	All	Post-closure	High	High	Regional	Regional	Far future	Far future	Regular	Regular	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-18. Summary of Residual Cumulative Effects on Aquatic Habitat

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Erosion and sedimentation causing smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; Centre Cell Tailing Management Facility; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction	Operations	Low	Low	Landscape	Landscape	Medium	Medium	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Erosion and sedimentation causing smothering of aquatic invertebrates, loss of productive habitat capacity	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; South Cell Tailing Management Facility; East Catchment Diversion	Closure	Negligible	Negligible	Landscape	Landscape	Short	Short	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to (non-fish) aquatic life	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Operations	High	N/A	Regional	N/A	Long	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	Not Required
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to (non-fish) aquatic life	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Closure	High	N/A	Regional	N/A	Medium	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	Not Required

(continued)

Table 37.6-18. Summary of Residual Cumulative Effects on Aquatic Habitat (continued)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Water quality degradation due to metals, process chemicals, petroleum products, or nitrogenous compounds resulting in toxicity to fish	Treaty OPC; Concentrate Storage and Loadout; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility; South Cell Tailing Management Facility; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle;Coulter Creek Access Corridor; Treaty Creek Access Road; Camp 11: Treaty Marshalling Yard; Camp 12: Highway 37 Construction; Camp 6: Treaty Saddle; Camp 7: Unuk North; Camp 8: Unuk South; Mitchell-Treaty Tunnel; Treaty Creek Access Road; East Catchment Diversion; Coulter Creek Access Corridor; McTagg Diversion Tunnel; McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit	Post-closure	High	N/A	Regional	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	Not Required
Loss of fish habitat and decrease in the productive capacity of aquatic habitat due to linear development (access roads and transmission line), and TMF development (dams and tailings) footprints	Coulter Creek Access Corridor; Treaty Creek Access Road; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility	Construction	Medium	Medium	Local	Local	Medium	Medium	One-time	One-time	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Loss of fish habitat and decrease in the productive capacity of aquatic habitat due to linear development (access roads and transmission line), and TMF development (dams and tailings) footprints	Coulter Creek Access Corridor; Treaty Creek Access Road; South Cell Tailing Management Facility	Operations	Medium	Medium	Local	Local	Long	Long	One-time	One-time	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Loss of fish habitat and decrease in the productive capacity of aquatic habitat due to water quanity reductions downstream of the TMF	North Cell Tailing Management Facility; Centre Cell Tailing Management Facility	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Required	Required
Loss of fish habitat and decrease in the productive capacity of aquatic habitat due to water quanity reductions downstream of the TMF	South Cell Tailing Management Facility; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility	Operations	Low	Low	Landscape	Landscape	Long	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Loss of fish habitat and decrease in the productive capacity of aquatic habitat due to water quanity reductions downstream of the TMF	South Cell Tailing Management Facility; North Cell Tailing Management Facility; Centre Cell Tailing Management Facility	Closure	Low	Low	Landscape	Landscape	Medium	Medium	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Loss of aquatic habitat productive capacity within McTagg, Mitchell, and non-fish bearing reaches of Sulphurets Creek due to infrastructure development (footprint) and diversion of water	McTagg Rock Storage Facililty; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit; McTagg Twinned Diversion Tunnels; diversion channels/ditches	Construction	Low	Low	Local	Local	Far future	Far future	One-time	One-time	Irreversible	Irreversible	Low	Low	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

(continued)

Table 37.6-18. Summary of Residual Cumulative Effects on Aquatic Habitat (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Loss of aquatic habitat productive capacity within McTagg, Mitchell, and non-fish bearing reaches of Sulphurets Creek due to infrastructure development (footprint) and diversion of water	McTagg Rock Storage Facility; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit; McTagg Twinned Diversion Tunnels; diversion channels/ditches	Operations	Low	Low	Local	Local	Far future	Far future	One-time	One-time	Irreversible	Irreversible	Low	Low	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Loss of fish habitat productive capacity within the fish bearing reach of Sulphurets Creek due to infrastructure development (footprint) and water management	McTagg Rock Storage Facility; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit; McTagg Twinned Diversion Tunnels; diversion channels/ditches	Construction	Low	Low	Landscape	Landscape	Medium	Medium	Continuous	Continuous	Reversible short-term	Reversible short-term	Low	Low	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Loss of fish habitat productive capacity within the fish bearing reach of Sulphurets Creek due to infrastructure development (footprint) and water management	McTagg Rock Storage Facility; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit; McTagg Twinned Diversion Tunnels; diversion channels/ditches	Operations	Low	Low	Landscape	Landscape	Long	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Low	Low	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Loss of fish habitat productive capacity within the fish bearing reach of Sulphurets Creek due to infrastructure development (footprint) and water management	McTagg Rock Storage Facility; Mitchell Rock Storage Facility; Mitchell Ore Preparation Complex; Mitchell Pit; Water Storage Facility; Water Treatment & Energy Recovery Area; Sludge Management Facilities; Sulphurets Laydown Area; Sulphurets-Mitchell Conveyor Tunnel; Sulphurets Pit; Kerr Pit; McTagg Twinned Diversion Tunnels; diversion channels/ditches	Closure	Low	Low	Landscape	Landscape	Long	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Low	Low	Medium	Medium	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Decrease in the productive capacity of aquatic habitat within non-fish bearing reaches of Gingras Creek due to water quantity changes (McTagg Creek diversion and hydropower plant development)	McTagg Power Plant, McTagg Twinned Diversion Tunnels; diversion channels/ditches	Construction	Low	Low	Landscape	Landscape	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Decrease in the productive capacity of aquatic habitat within non-fish bearing reaches of Gingras Creek due to water quantity changes (McTagg Creek diversion and hydropower plant development)	McTagg Power Plant, McTagg Twinned Diversion Tunnels; diversion channels/ditches	Operations	Low	Low	Landscape	Landscape	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Decrease in the productive capacity of aquatic habitat within non-fish bearing reaches of Gingras Creek due to water quantity changes (McTagg Creek diversion and hydropower plant development)	McTagg Power Plant, McTagg Twinned Diversion Tunnels; diversion channels/ditches	Closure	Low	Low	Landscape	Landscape	Medium	Medium	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Decrease in the productive capacity of aquatic habitat within non-fish bearing reaches of Gingras Creek due to water quantity changes (McTagg Creek diversion and hydropower plant development)	McTagg Power Plant, McTagg Twinned Diversion Tunnels; diversion channels/ditches	Post-closure	Low	Low	Landscape	Landscape	Far future	Far future	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	High	High	Regional	Regional	Far future	Far future	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Low	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required

Note: CE = Cumulative Effect.

The only project that has the potential to affect water quality that has both spatial and temporal overlaps with the KSM Project is the Brucejack Mine (see Chapter 15, Section 15.9.2.5.1). The Brucejack Project Description identified the potential for local, low magnitude effects on water quality (Rescan 2012). The cumulative effect on water quality from the Brucejack Mine will not influence the descriptors used in the assessment of Project-specific residual effects because concentrations of selenium in the Sulphurets-Unuk watershed are not expected to increase above the Project-specific predictions as a result of cumulative water quality effects. Therefore, there will be no residual cumulative effects, so the rating applied was **not applicable (N/A)**.

However, the overall residual cumulative effect was based on the Project residual effects for water quality degradation since this was the most significant potential effect for all VC fish species or aquatic habitat. Although cumulative effects for water quality degradation were rated as N/A in the CEA, for the purposes of an overall rating for each VC (final line of Tables 37.6-14 to 37.6-18), ratings equivalent to the Project residual effects were assigned for overall cumulative effects for each of the residual effect descriptors. Therefore, the overall cumulative effect is assessed as **not significant – minor** for bull trout and aquatic habitat and **not significant – moderate** for Dolly Varden, rainbow trout/steelhead, and Pacific salmon.

37.6.7 Wetlands

37.6.7.1 Summary of Project-specific Residual Effects to Wetlands

Potential residual effects on wetlands are identified in Chapter 16 and include:

- loss of wetland extent; and
- loss of wetland function.

Wetland extent and function will be affected by development of the Project; however, the majority of effects are not significant. Footprint analysis identified that 12% of the study area wetlands will be affected by the Project. However, when effects to wetlands are examined by Project area at the local scale it was determined that the loss of fen and swamp wetland area with the TMF was considered potentially significant. Thus a compensation plan was developed to mitigate the loss of local wetland extent function; effectively reducing the significance of lost extent and function to **not significant (moderate)**.

These residual effects are carried through the CEA process as potential cumulative effects where they are assessed to have cumulative interactions with other human actions.

37.6.7.2 Cumulative Assessment Boundaries for Wetlands

A wetland VC CEA boundary was determined to assess spatial linkages between KSM Project potential residual effects on wetland ecosystems with effects from other projects. To account for rare or endangered wetland communities, major watershed boundaries were used to define the wetland VC CEA boundary.

Considering the wetland VC boundary that encompasses the Unuk River and Bell-Irving River watersheds, the following projects and activities are considered to have a potential spatial overlap with loss of wetland functions and loss of wetland extent (Figure 37.6-6):

- the past-producing Eskay Creek Mine;
- the proposed NTL;
- the proposed Brucejack Mine;
- the proposed Kitsault Project;
- the proposed Arctos Anthracite Coal Project;
- the proposed Schaft Creek Project;
- forestry activity; and
- mineral and resource exploration activity.

Effects from past and present human actions and projects that have the potential to overlap temporally with effects to the extent and function of wetlands from the KSM Project are: mineral exploration, forestry activity, the past-producing Eskay Creek Mine, and the NTL.

Future human actions with temporal linkages with the KSM Project are:

- ongoing present and future mineral exploration;
- future forestry activity;
- construction of the NTL, which may overlap with the KSM construction and operation phases;
- the proposed Brucejack Mine's construction and operation, which are likely to overlap with the KSM Project's operation phase; and
- the proposed Arctos Anthracite Coal Project, and Schaft Creek Mine, which have the potential to reduce wetland extent, which translates into a reduction of wetland function within northwest BC.

37.6.7.3 Cumulative Effects Assessment for Wetlands

A summary of possible interactions for each past, present, and future human other projects and actions listed in the previous section and identified to have a spatial or temporal linkage with the Project-specific residual effects is presented in Table 37.6-19.

37.6.7.3.1 Loss of Wetland Extent

The KSM Project will affect wetlands, as will other projects in the region. The cumulative effects on wetland extent will be limited to projects within the vicinity of the KSM Project because effects on individual wetlands are local.

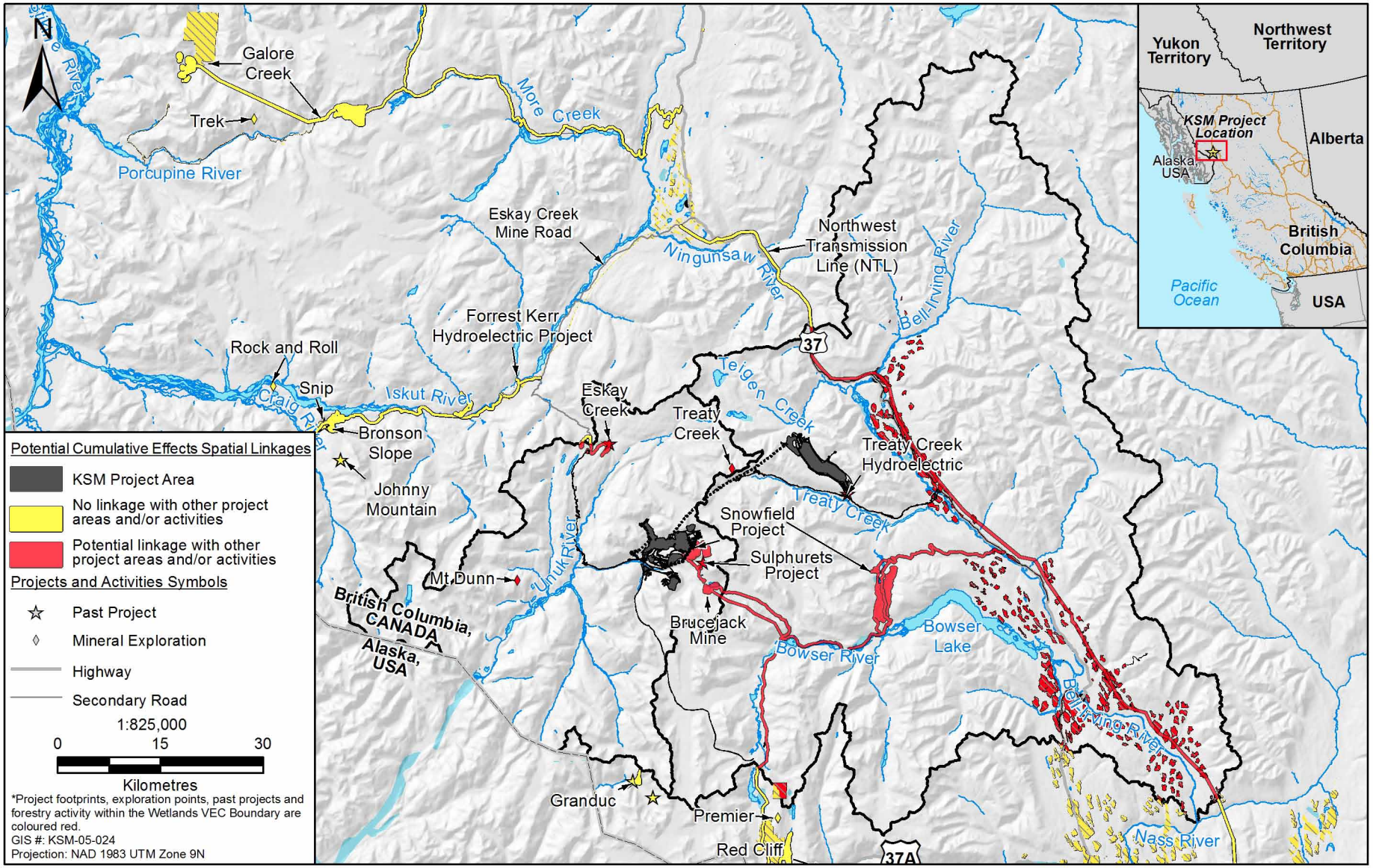

Figure 37.6-6

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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Weltands

Figure 37.6-6

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Table 37.6-19. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Wetlands

Description of KSM Project Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities							
	NTL	Brucejack Mine	Mineral and Energy Resource Exploration	Timber Harvesting	Kitsault Mine	Arctos Anthracite Coal Project	Schaft Creek Mine	Eskay Creek Mine
Loss of Wetland Extent	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction
Loss of Wetland Function	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

37.6.7.3.2 Loss of Wetland Function

The KSM Project will affect wetland function, as will other projects in the region. The cumulative effects on wetland function, which is a VC of regional importance, includes all identified projects where a loss of wetland extent is expected.

37.6.7.4 Mitigation and Monitoring for Cumulative Effects on Wetland Extent and Function

A Wetland Compensation Plan was developed for the KSM Project. The Wetland Compensation Plan and wetland reclamation in the TMF at closure will also mitigate cumulative effects on wetland extent. The Wetland Compensation Plan and reclamation at closure will result in 2.5 times as many wetlands at closure than were present at baseline. The Wetland Compensation Plan will also provide some degree of mitigation to cumulative effects on wetland function.

Compensation efforts will include the development of wetland features into three fish habitat compensation projects. This will improve the functioning condition of the fish habitat compensation and will promote the development of wetland functions similar to those lost by the project. In addition, a wetland near Smithers, BC, will be enhanced to restore wetland functions. This wetland is located close to a population center that will benefit from education, research, and recreation benefits not currently realized in many wetlands in northwest BC.

37.6.7.5 Summary of Residual Cumulative Effects on Wetland Extent and Function

The KSM Project will affect wetland extent and function, as have other mining and resource development projects within the region. However, by the post-closure phase of the KSM Project, approximately 2.5 times as many wetlands will exist in northwest BC. Reclamation in the TMF will create approximately 275 ha of wetlands and the Wetland Compensation Plan will see the development of 48 ha. Successional development of compensation and reclamation areas will have to be continually checked and monitored to make sure that similar communities to those lost will be created.

Table 37.6-20 provides a summary of all potential residual cumulative effects considered in the assessment of Project effects and cumulative effects on wetland extent and function. The residual cumulative effect on the loss of wetland extent is expected to be **not significant (minor)** because of the compensation and reclamation activities planned.

Wetlands will also be a reclamation endpoint in the TMF at closure. Although the communities will be different than those present at baseline, the reclaimed wetlands will provide functions such as habitat function for migratory birds and moose, hydrological functions such as water storage, and ecological functions such as complex ecosystems. Wetland compensation, reclamation, and wetland values will make the residual cumulative effect to wetland function **not significant (minor)**.

37.6.8 Terrestrial Ecosystems

37.6.8.1 Summary of Project-specific Residual Effects to Terrestrial Ecosystems

The KSM Project may result in residual effects of vegetation loss and vegetation degradation (Chapter 17). Direct loss of terrestrial ecosystems will result from vegetation clearing during the construction, operation, and in a few instances, closure phases. The majority of losses are expected within the Mine Site, PTMA, and access road corridors.

Degradation of terrestrial ecosystems is expected to occur within but not evenly throughout a degradation zone around some Project components. For instance, degradation can result from the accumulation of dust from traffic on unpaved roads or from nearby blasting and ore processing facilities. Potential degradation effects also include the introduction and spread of invasive plant species and windthrow adjacent to new clearings in forested ecosystems. Degradation effects that alter the structure and function of ecosystems may result from changes to natural hydrology patterns, especially for riparian and floodplain ecosystems; the potential effects resulting from hydrologic changes are assessed within the Fish and Aquatic Habitat Effects Assessment (Chapter 15).

Potential losses and degradation resulting from development of the proposed KSM Project are expected within each of the terrestrial ecosystem VCs:

- potential pine mushroom habitat;
- avalanche track ecosystems;
- listed ecosystems;
- riparian and floodplain ecosystems;
- alpine and parkland ecosystems;
- old forest ecosystems;
- other terrestrial ecosystems.

These residual effects are rated as not significant (minor and moderate) in Chapter 17 and are carried through the CEA process as potential cumulative effects where they are assessed to have cumulative interactions with other human actions.

37.6.8.2 Cumulative Assessment Boundaries for Terrestrial Ecosystems

The terrestrial ecosystems CEA boundary developed to identify past, present, and reasonably foreseeable future projects and activities with potential spatial and/or temporal linkage with the KSM Project is shown in Figure 37.6-7. Watersheds that overlap any Project infrastructure or roads required to access the infrastructure (such as the Eskay Creek Mine road), are included in the CEA boundary. The watersheds comprising the CEA boundary include the Upper Bell-Irving River, Lower Bell-Irving River, Iskut River, Lower Iskut River, and the Unuk River. This 1,300,000 ha CEA boundary outlines a sustainable area of terrestrial ecosystems in which the proposed KSM Project is situated.

The following past, present, and reasonably foreseeable future projects and land use activities are identified (Chapter 17, Table 17.9-1) as having the potential to influence terrestrial ecosystem-based VCs by either direct disturbance or by indirect effects mainly from the use of the Eskay Creek Mine road:

- the past-producing Eskay Creek Mine;
- the Granduc Mine (past-producing and future);
- the past-producing Johnny Mountain Mine;
- the past-producing Snip Mine;
- the past-producing Sulphurets Project;
- the Forrest Kerr Hydroelectric Project;
- the Long Lake Hydroelectric Project;
- the NTL;
- the future Bronson Slope Mine;
- the future Brucejack Mine;
- the future Galore Creek Mine;
- the future McLymont Creek Hydroelectric Project;
- the future Treaty Creek Hydroelectric Project;
- the future Snowfield Project;
- mineral and energy resource exploration;
- traffic and roads; and
- timber harvesting (forestry).

Residual effects of vegetation loss and degradation associated with each of these projects and activities have the potential to interact with residual effects expected from KSM Project.

Table 37.6-20. Summary of Residual Cumulative Effects on Wetland Extent and Function

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Loss of wetland extent (Treat Creek Access Rd, Coulter Creek Access Road, Camp 7, and Treaty OPC	NTL, Brucejack Mine, Resource Exploration, and Timber Harvest	Construction	Low	Negligible	Local	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Minor)	Not Significant (Minor)	Required	not required
Loss of wetland extent (Camp 3, Sulphurest Laydown Area, Kerr Pit	NTL, Brucejack Mine, Resource Exploration, and Timber Harvest	Construction	Negligible	Negligible	Local	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Minor)	Not Significant (Minor)	Required	not required
Loss of wetland extent (North Cell South Cell, and Centre Cell)	NTL, Brucejack Mine, Resource Exploration, and Timber Harvest	Construction	High	Low	Local	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Moderate)	Not Significant (Minor)	Required	not required
Loss of wetland function (Treat Creek Access Rd, Coulter Creek Access Road, Camp 3, Camp 7, Treaty OPC, Sulphurest Laydown Area, and Kerr Pit)	NTL, Brucejack Mine, Resource Exploration, and Timber Harvest	Construction	Negligible	Negligible	Regional	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Minor)	Not Significant (Minor)	Required	not required
Loss of wetland function (North Cell South Cell, and Centre Cell)	NTL, Brucejack Mine, Resource Exploration, and Timber Harvest	Construction	Medium	Negligible	Regional	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Moderate)	Not Significant (Minor)	Required	not required
Loss of wetland function (Treat Creek Access Rd, Coulter Creek Access Road, Camp 3, Camp 7, Treaty OPC, Sulphurest Laydown Area, and Kerr Pit)	Kitsault mine (closed), Arctos Anthracite Coal Mine, Schaft Creek Mine, Eskay Creek Mine	Construction	Negligible	Negligible	Regional	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Minor)	Not Significant (Minor)	Required	not required
Loss of wetland function (North Cell South Cell, and Centre Cell)	Kitsault mine (closed), Arctos Anthracite Coal Mine, Schaft Creek Mine, Eskay Creek Mine	Construction	Medium	Negligible	Regional	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Moderate)	Not Significant (Minor)	Required	not required
Overall Effect	All	Post-closure	Low	Low	Regional	Regional	Far future	Far future	Sporadic	One-time	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Intermediate	Not Significant (Minor)	Not Significant (Minor)	Required	Optional

CE = Cumulative Effect.

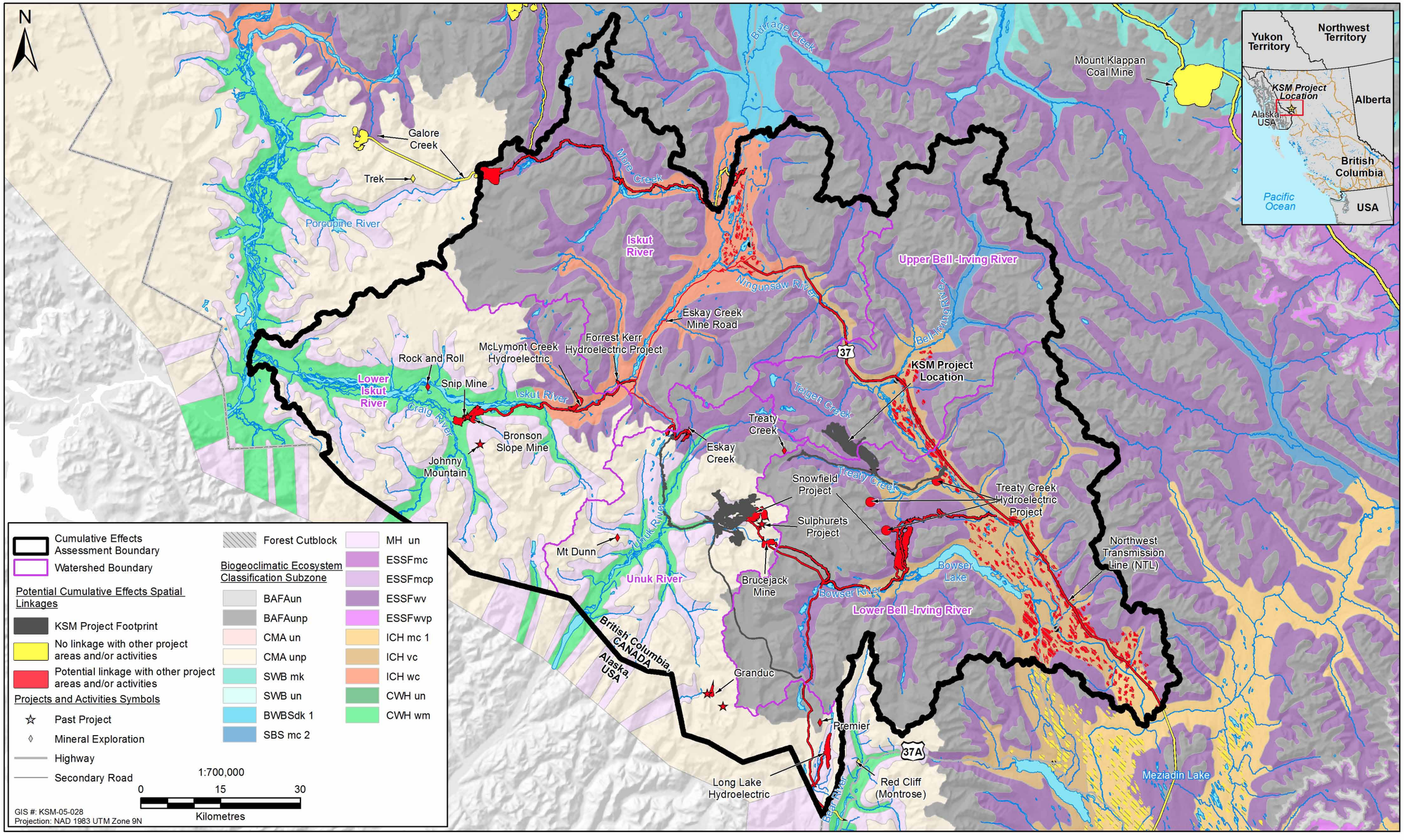

Figure 37.6-7

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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Terrestrial Ecosystems

37.6.8.3 Cumulative Effects Assessment for Terrestrial Ecosystems

Seven terrestrial ecosystem VCs were scoped into the CEA: potential pine mushroom habitat, avalanche track ecosystems, British Columbia Conservation Data Centre blue- and red-listed ecosystems (listed ecosystems), riparian and floodplain ecosystems, alpine and parkland ecosystems, old forest ecosystems, and other terrestrial ecosystems. The VCs, identified based on their cultural or ecological importance, represent ecosystems or habitats that represent preservation or conservation priorities. Residual effects of vegetation loss are possible for each of the VCs due to vegetation clearing during the construction and operation phases of the KSM Project.

For each of the seven VCs, Tables 37.6-21 through 37.6-27 identify the respective projects and activities with potential to interact cumulatively with the residual loss and degradation effect estimates from the KSM Project.

37.6.8.3.1 Potential Pine Mushroom Habitat

Direct loss and degradation of pine mushroom habitat could have resulted from clearing during construction of Highway 37 and from past timber harvesting at low elevations near the highway. Given the preponderance of glacial fluvial deposits with high coarse fragment content along Highway 37, it is possible that areas of high quality pine mushroom habitat were lost and degraded. However, the extent cannot be quantified as mapping of historic mushroom habitat is unavailable.

In addition to the potential loss and degradation from the KSM Project, further cumulative effects on potential pine mushroom habitat may result from development of the NTL and future McLymont Creek Hydroelectric projects. Each project estimated a low magnitude residual effect on potential mushroom habitat, with neither expected to appreciably increase the magnitude of the potential effect expected from the KSM Project. Most of the potential for direct habitat loss is associated with the NTL Project, to the south of and beyond, the CEA boundary. Potential effects from other projects and land use activities, including timber harvesting within the low elevation ICH BEC units, were not assessed within the available EA application documents.

As prime pine mushroom habitat and harvesting potential occurs outside of the CEA boundary, and given that the present and proposed developments each identified small areas of potential habitat, estimated nil to low magnitude effects, and incorporated design changes to accommodate known habitat and areas of use, the cumulative overall effect, summarized in Table 37.6-28, is expected to be **not significant (minor)**.

37.6.8.3.2 Avalanche Track Ecosystems

Information regarding potential effects on avalanche ecosystems is unavailable for the closed Johnny Mountain and Snip mines, each of which were fly-in/fly-out operations located within the Iskut River drainage, approximately 50 km northwest of the Eskay Creek Mine road. Similarly, no information is available for the closed Eskay Creek Mine and Sulphurets Project, the present Long Lake Hydroelectric Project, and proposed Granduc Copper Mine. Although no information is available, past road construction (including Highway 37) and timber harvesting activities, largely concentrated at low elevations within the Bell-Irving River watershed, are unlikely to have resulted in loss or degradation of avalanche track ecosystems.

Table 37.6-21. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Potential Pine Mushroom Habitat

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Timber Harvesting – Forestry	**Traffic and Roads**	**Eskay Creek Mine**	**Forrest Kerr Hydroelectric**	**Northwest Transmission Line**	**Brucejack Mine**
Vegetation Loss	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Snowfield Project	**McLymont Creek Hydroelectric**	**Treaty Creek Hydroelectric**	**Galore Creek Mine**	**Bronson Slope Mine**
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-22. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Avalanche Track Ecosystems

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Snip Mine	Eskay Creek Mine	Sulphurets Project	Long Lake Hydroelectric	Granduc Copper Mine
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Galore Creek Mine	Snowfield Project	Brucejack Mine	Treaty Creek Hydroelectric	Bronson Slope Mine
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-23. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Listed Ecosystems

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Timber Harvesting - Forestry	Traffic and Roads	Snip Mine	Eskay Creek Mine	Long Lake Hydroelectric
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Galore Creek Mine	Snowfield Project	Brucejack Mine	Treaty Creek Hydroelectric	Bronson Slope Mine
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-24. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Riparian and Floodplain Ecosystems

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities								
	Timber Harvesting – Forestry	Traffic and Roads	Eskay Creek Mine	Granduc Mine	Johnny Mountain Mine	Snip Mine	Sulphurets Project	Forrest Kerr Hydroelectric	Long Lake Hydroelectric
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities								
	Long Lake Hydroelectric	Northwest Transmission Line	Bronson Slope Mine	Brucejack Mine	Galore Creek Mine	Granduc Copper Mine	McLymont Creek Hydroelectric	Snowfield Project	Treaty Creek Hydroelectric
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-25. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Alpine and Parkland Ecosystems

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Eskay Creek Mine	Long Lake Hydroelectric	Galore Creek Mine	Snowfield Project	Brucejack Mine	Granduc Copper Mine	Bronson Slope Mine
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-26. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Old Forest Ecosystems

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Timber Harvesting – Forestry	Northwest Transmission Line	Long Lake Hydroelectric	Brucejack Mine	Snowfield Project	Bronson Slope Mine	Galore Creek Mine
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-27. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Other Terrestrial Ecosystems

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities								
	Timber Harvesting – Forestry	Traffic and Roads	Eskay Creek Mine	Granduc Mine	Johnny Mountain Mine	Snip Mine	Sulphurets Project	Forrest Kerr Hydroelectric	Long Lake Hydroelectric
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities							
	Northwest Transmission Line	Bronson Slope Mine	Brucejack Mine	Galore Creek Mine	Granduc Copper Mine	McLymont Creek Hydroelectric	Snowfield Project	Treaty Creek Hydroelectric
Vegetation Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Vegetation Degradation	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

None of the projects with a present linkage assessed potential effects on avalanche track ecosystems, suggesting that effects could be of nil to low magnitude. The Forrest Kerr Hydroelectric Project facilities and associated access road are situated at low elevations within the Iskut River drainage and, although the transmission line proposed between the Forrest Kerr powerhouse and Meziadin Junction may cross areas of avalanche terrain between Bob Quinn Lake and the Meziadin substation, no potential effects were identified. Similarly, the NTL Project EA Application neither identified nor assessed effects on avalanche track ecosystems.

Future projects within the CEA boundary have potential to result in additional degradation where infrastructure is developed or operated within or adjacent to avalanche track ecosystems. As the projects are in early planning phases, the assessment was completed using pre-feasibility footprint information. Within the Galore Creek Mine EA Application, avalanches were identified as a geohazard and snow avalanche hazard was estimated along 22.9 km of the proposed access road, 17.8% of its total length. Although mine site facilities are proposed in areas subject to avalanche activity, avalanche ecosystems were not assessed as a valued component. Further cumulative loss of 183 ha may result from the development of the future Snowfield and Brucejack mines. The cumulative loss of 853 ha is equivalent to 2.2% of the 38,800 ha of avalanche track ecosystems mapped within the KSM Project RSA. Although it cannot be quantified without ecosystem mapping information, the total area of avalanche ecosystems is likely far greater within the wider CEA boundary.

The overall cumulative effect, summarized in Table 37.6-29, is expected to be **not significant (minor).** No further loss or degradation is expected within the Sulphurets Creek watershed, deemed most sensitive to cumulative effects given the concentration of Project-related effects.

37.6.8.3.3 Listed Ecosystems

In addition to the potential loss and degradation from the KSM Project, largely associated with proposed development of access corridors within the low elevation (CWH and ICH) BEC zones, further cumulative effects may result from development of the present and future projects. A lack of information on effects from past projects or land use activities, including previously-closed mines within the Iskut River drainage, timber harvesting, and development of Highway 37, prohibits a quantitative assessment of potential effects. Where the present assessed projects listed ecosystems as a VC, including the NTL and McLymont Creek Hydroelectric projects, little to no residual effects were estimated. The highest potential for cumulative effects is likely associated with development of the proposed Brucejack Mine, Snowfield Project, and Treaty Creek Hydroelectric Project, which have infrastructure proposed within similar BEC units and topography.

Given that present and proposed developments have identified small areas of vegetation loss, estimated nil to low magnitude effects, and incorporated mitigations such as identifying known locations on the ground and construction maps, the cumulative overall effect, summarized in Table 37.6-30, is expected to be **not significant (minor)**.

Table 37.6-28. Summary of Residual Cumulative Effects on Pine Mushroom Habitat

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Confidence Adjusted for CE				
Vegetation Loss	Eskay Creek Mine Forrest Kerr Hydroelectric Northwest Transmission Line Brucejack Mine Snowfield Project McLymont Creek Hydroelectric Treaty Creek Hydroelectric Galore Creek Mine Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Low	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Vegetation Degradation	Eskay Creek Mine Forrest Kerr Hydroelectric Northwest Transmission Line Brucejack Mine Snowfield Project McLymont Creek Hydroelectric Treaty Creek Hydroelectric Galore Creek Mine Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Medium	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Low	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

Note:

CE = Cumulative Effect

Table 37.6-29. Summary of Residual Cumulative Effects on Avalanche Track Ecosystems

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Confidence Adjusted for CE				
Vegetation Loss	Snip Mine Eskay Creek Mine Sulphurets Project Long Lake Hydroelectric Granduc Copper Mine Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine	Construction	Medium	Medium	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Moderate)	Not Significant (Minor)	Not Required	Not Required
Vegetation Degradation	Snip Mine Eskay Creek Mine Sulphurets Project Long Lake Hydroelectric Granduc Copper Mine Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Medium	Medium	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Moderate)	Not Significant (Minor)	Not Required	Not Required

Note:

CE = Cumulative Effect

Table 37.6-30. Summary of Residual Cumulative Effects on Listed Ecosystems

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Confidence Adjusted for CE				
Vegetation Loss	Snip Mine Eskay Creek Mine Long Lake Hydroelectric Granduc Copper Mine Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Low	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Irreversible	Irreversible	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Vegetation Degradation	Snip Mine Eskay Creek Mine Long Lake Hydroelectric Granduc Copper Mine Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Medium	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

Note:

CE = Cumulative Effect

37.6.8.3.4 Riparian and Floodplain Ecosystems

Although some loss and degradation of riparian and floodplain ecosystems has likely resulted from vegetation clearing during construction of Highway 37 and from previous timber harvesting activities at low elevations near the highway, it cannot be quantified. Similarly, no information on potential effects is available for the closed Johnny Mountain or Snip mines, which were fly-in/fly-out operations within the Iskut River drainage.

In addition to potential loss and degradation from the KSM Project, further effects have resulted from projects identified as a present linkage, all of which are under development. The NTL Project EA Application assessed riparian areas and floodplain forests as valued ecosystem components and habitat alteration from rights-of-way and one-time clearing areas was estimated. The potential effect was considered medium magnitude but not significant (Rescan 2010). The Forrest Kerr Hydroelectric Project EA Application, which addressed the residual cumulative effects of forest clearing, did not assess riparian ecosystems as a valued component. The potential effect on riparian areas, primarily cottonwood habitat along creeks and rivers, was considered very minor and assumed to be largely mitigated through compliance with provincial and federal regulations.

Each future project has potential to result in incremental loss of riparian and floodplain ecosystems. Those with greatest potential to result in incremental loss of riparian and floodplain ecosystems include the Brucejack Mine and the Treaty Creek Hydroelectric facilities. As proposed, each would result in loss of riparian, floodplain, and wetland ecosystems along Treaty Creek, Todedada Creek, Scott Creek, Bowser River, and at high elevations in the headwaters of Sulphurets Creek. Given the similarity in ecosystems and topography to the KSM Project, the access roads and facilities proposed for the Brucejack Mine, Snowfield Project and Treaty Creek Hydroelectric Project could also result in low magnitude residual effects. Potential effects from additional development within the Sulphurets and Treaty Creek watersheds may add to the effects on riparian and floodplain ecosystems estimated from the KSM Project.

Given that present and proposed developments have identified small areas of potential vegetation loss and degradation, and estimated nil to low magnitude effects, the cumulative overall effect, summarized in Table 37.6-31, is expected to be **not significant (minor)**.

37.6.8.3.5 Alpine and Parkland Ecosystems

Previous loss and degradation of alpine and parkland ecosystems is not expected from past low elevation developments and land use activities, including the Snip Mine, Highway 37, and timber harvesting, most of which has occurred within the ICH BEC zone near the Bell-Irving River. Although their elevations suggest potential overlap, no information is available regarding the extent of effect resulting from the Granduc or Johnny Mountain mines, which closed in 1984 and 1993, respectively.

Based on an overlay with the 2008 BC MOFR BEC lines, future projects with greatest potential to result in cumulative effects include the Snowfield Project, Galore Creek Mine, and Brucejack Mine, with smaller effects estimated for the Granduc Copper Mine and Long Lake Hydroelectric

Project. In addition to the potential loss and degradation within the Sulphurets Creek watershed from the KSM Project, development of the proposed Brucejack Mine and Snowfield Project could result in further effects within this watershed, resulting in a localized medium magnitude effect.

The cumulative overall effect, summarized in Table 37.6-32, expected to be medium magnitude within the Sulphurets Creek watershed and low magnitude within the remainder of the CEA boundary, is considered **not significant (minor)**.

37.6.8.3.6 Old Forest Ecosystems

Although direct loss and degradation of old forest ecosystems may have resulted from vegetation clearing during construction of Highway 37 and from previous timber harvesting activities at low elevations near the highway, the effects cannot be quantified. It is assumed, however, that much of the logged area was previously old forest. No information regarding potential effects on old forest ecosystems is available for the closed Johnny Mountain or Snip mines, which were fly-in/fly-out operations within the Iskut River drainage. At present, logged areas comprise approximately 16,200 ha of the CEA boundary, primarily within the low elevation ICHwc and ICHvc BEC subzones in the Bell-Irving and Upper Iskut River watersheds.

Based on current provincial inventory data, 1,340 ha (12% of baseline distribution) of loss may result from the KSM Project, primarily from development of infrastructure proposed within the Sulphurets and Teigen Creek watersheds. Further loss may result from each of the projects identified as a present linkage, each of which is in development. The NTL Project EA Application assessed old forests as a sensitive valued ecosystem component and estimated a maximum alteration of 863 ha due to clearing of rights-of-way and one-time clearing areas. Estimated losses were highest within proposed transmission line segments 10, 12, and 14. Within segments 12 through 15 (the segments overlapping the CEA boundary), the estimated 352 ha loss was considered medium magnitude, given the ecological importance of old forests and their importance to local communities. As sustainability of old forest ecosystems was not considered threatened, this loss was considered not significant. Potential degradation effects from invasive species, increased fire risk, and edge effects were considered low magnitude and not significant.

The Forrest Kerr Hydroelectric Project infrastructure does not overlap areas of old forest in the current provincial inventory data. Each identified future project has potential to lose additional areas of old forest. The McLymont Creek Hydroelectric Project EA Application did not assess old forest as a specific valued component. However, the at-risk (listed) ecosystems were identified as being primarily old forest ecosystems, which were not considered limiting (Hemmera 2011). The McLymont Creek Hydroelectric Project overlaps approximately 31 ha of old forest.

Table 37.6-31. Summary of Residual Cumulative Effects on Riparian and Floodplain Ecosystems

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects: Probability	Likelihood of Effects: Probability Adjusted for CE	Likelihood of Effects: Confidence Level	Likelihood of Effects: Confidence Adjusted for CE	Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted for CE
Vegetation Loss	Snip Mine Eskay Creek Mine Granduc Mine Johnny Mountain Mine Sulphurets Project Forrest Kerr Hydroelectric Northwest Transmission Long Lake Hydroelectric Granduc Copper Mine McLymont Creek Hydroelectric Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Low	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Low	Low	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Vegetation Degradation	Snip Mine Eskay Creek Mine Granduc Mine Johnny Mountain Mine Sulphurets Project Forrest Kerr Hydroelectric Northwest Transmission Line Long Lake Hydroelectric Granduc Copper Mine McLymont Creek Hydroelectric Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Medium	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

Note:

CE = Cumulative Effect

Table 37.6-32. Summary of Residual Cumulative Effects on Alpine and Parkland Ecosystems

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Confidence Adjusted for CE				
Vegetation Loss	Eskay Creek Mine Long Lake Hydroelectric Granduc Copper Mine Galore Creek Mine Brucejack Mine Snowfield Project														High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Vegetation Degradation	Eskay Creek Mine Long Lake Hydroelectric Granduc Copper Mine Galore Creek Mine Brucejack Mine Snowfield Project														Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All														High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

Note:

CE = Cumulative Effect

Other future projects with potential to result in incremental loss of old forest ecosystems include the Snowfield Project, Bronson Slope Mine, Brucejack Mine, and Galore Creek Mine. It is assumed that development plans for future timber harvesting, potentially a large contributor to future old forest loss, will proceed in accordance with the regional- and landscape-level objectives established within the respective land and sustainable resource management plans. Given the extent of old forest mapped within the CEA boundary (193,500 ha) in the provincial database, the estimated total cumulative loss (1.6% of existing baseline) is considered low magnitude. Cumulative losses, expected to be greatest within the Unuk River, Upper Bell-Irving, and Lower Bell-Irving watersheds, represent a very small percentage of current baseline distributions, which range from 34,000 to 60,000 ha. Including the previously harvested cutblocks (16,200 ha), the cumulative loss of 19,200 ha represents approximately 10% of the old forest within the provincial inventory data.

Considering potential for cumulative loss and degradation effects on old forest ecosystems against the current availability within the CEA boundary, the cumulative overall effect, summarized in Table 37.6-33, is expected to be **not significant** (**minor**; Rescan 2010).

37.6.8.3.7 Other Terrestrial Ecosystems

In addition to the potential loss and degradation from the KSM Project, the majority within the Teigen, Treaty and Sulphurets watersheds, further effects would result from development of the present and future projects. Within the CEA boundary, an estimated 430 ha of loss would result from the NTL Project, an effect considered of medium magnitude given the irreversible nature of alteration and lack of specific mitigation. Potential degradation from invasive species, increased fire risk, and edge effects were considered low magnitude and not significant for the NTL Project.

The amount of clearing for the Forrest Kerr Project was deemed insignificant relative to the extent of plant communities in the general area, although local high magnitude cumulative effects for vegetation were identified for past, on-going, and future projects, including actions related to local development of Nisga'a villages and logging activity. Despite a moderate ranking for the sum of cumulative effects, the incremental effect from the Forrest Kerr Hydroelectric Project was considered low magnitude.

Further incremental effects would result from developing the proposed mines and hydroelectric facilities. Proposed infrastructure overlapping the CEA boundary includes linear access and transmission line corridors, mine sites, and tailing management facilities. Given the similarity in ecosystems and topography to the KSM Project, the access roads and facilities proposed for the Brucejack and Snowfield projects could result in a low magnitude residual effect, similar to the potential effects estimated from the KSM Project.

The total area subject to cumulative effects, largely concentrated within the Upper Bell-Irving, Lower Bell-Irving, Iskut, and Lower Iskut River watersheds, represents a very small percentage of current distributions of other terrestrial ecosystems throughout the CEA boundary. The cumulative overall effect, summarized in Table 37.6-34, is expected to be low magnitude and **not significant (minor)**.

37.6.8.4 Mitigation and Monitoring for Cumulative Effects on Terrestrial Ecosystems

For each VC, the sections below briefly summarize the mitigation proposed by the Project and other present and future projects to minimize the cumulative effect of incremental vegetation loss and/or degradation. General management measures detailed within the Terrestrial Ecosystems Management and Monitoring Plan (Section 26.20), applicable to most terrestrial ecosystem VCs, will minimize potential for cumulative loss and degradation. Measures include minimizing all clearing dimensions and preferentially retaining areas of mature and old forest where an option exists to remove younger stands. Other measures include adopting management and monitoring programs to minimize erosion and windthrow effects and promptly re-vegetating or re-seeding after clearing to minimize potential for introduction and spread of invasive plants.

Other present and future projects outline similar mitigations to minimize effects of vegetation loss and degradation due to disturbance and other secondary effects. These range from broad statements such as limiting the extent of clearing, to detailed plans to minimize disturbance and other secondary effects, including disturbance from invasive plant species and windthrow. Specific examples of management include implementing rehabilitation measures to limit habitat suitability for invasive plants and monitoring for effects of windthrow, including hazard trees, and invasive plants.

It is expected that future developments will continue to adopt or develop appropriate management and monitoring strategies to minimize potential for loss and degradation and, where applicable, will proceed in accordance with regional- and landscape-level objectives established within overarching resource management plans.

37.6.8.4.1 Potential Pine Mushroom Habitat

Although no Project-specific mitigation has been developed to minimize loss and degradation of potential pine mushroom habitat, general management measures outlined within the Terrestrial Ecosystems Management and Monitoring Plan in Chapter 26 will minimize the loss of vegetated ecosystems, including potential pine mushroom habitat. Specific measures include minimizing clearing dimensions and preferentially retaining areas of mature and old forest that have higher potential to support pine mushrooms.

However, given the high importance to the culture and economies of the local Aboriginal groups and other residents, it is assumed that future projects proposed within pine mushroom habitat will make appropriate efforts to identify the location of known resources and harvesting sites early in the planning phases.

37.6.8.4.2 Avalanche Track Ecosystems

No Project-specific mitigation has been developed to minimize loss and degradation of avalanche track ecosystems. The general management measures provided within the Terrestrial Ecosystems Management and Monitoring Plan in Chapter 26, such as minimizing all clearing dimensions, will minimize effects on avalanche tracks.

Table 37.6-33. Summary of Residual Cumulative Effects on Old Forest Ecosystems

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Confidence Adjusted for CE				
Vegetation Loss	Northwest Transmission Long Lake Hydroelectric Brucejack Mine Snowfield Project Bronson Slope Mine Galore Creek Mine Timber Harvesting - Forestry Traffic and Roads	Construction	High	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Irreversible	Irreversible	Low	Low	High	Medium	High	Medium	Not Significant (Moderate)	Not Significant (Minor)	Not Required	Not Required
Vegetation Degradation	Northwest Transmission Long Lake Hydroelectric Brucejack Mine Snowfield Project Bronson Slope Mine Galore Creek Mine Timber Harvesting - Forestry Traffic and Roads	Construction	High	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Low	Low	High	Medium	High	Medium	Not Significant (Moderate)	Not Significant (Minor)	Not Required	Not Required

Note:
CE = Cumulative Effect

Table 37.6-34. Summary of Residual Cumulative Effects on Other Terrestrial Ecosystems

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Vegetation Loss	Snip Mine Eskay Creek Mine Granduc Mine Johnny Mountain Mine Sulphurets Project Forrest Kerr Hydroelectric Northwest Transmission Line Long Lake Hydroelectric Granduc Copper Mine McLymont Creek Hydroelectric Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Low	Low	Local	Regional	Far future	Far future	One-time	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

(continued)

Table 37.6-34. Summary of Residual Cumulative Effects on Other Terrestrial Ecosystems (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects: Probability	Likelihood of Effects: Probability Adjusted for CE	Likelihood of Effects: Confidence Level	Likelihood of Effects: Conf. Level Adjusted for CE	Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
Vegetation Degradation	Snip Mine Eskay Creek Mine Granduc Mine Johnny Mountain Mine Sulphurets Project Forrest Kerr Hydroelectric Northwest Transmission Line Long Lake Hydroelectric Granduc Copper Mine McLymont Creek Hydroelectric Galore Creek Mine Brucejack Mine Snowfield Project Treaty Creek Hydroelectric Bronson Slope Mine Timber Harvesting - Forestry Traffic and Roads	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

Note: CE = Cumulative Effect.

Given the regional importance of avalanche ecosystems as wildlife habitat, especially as food and shelter for grizzly bears, and as habitat providing plant species valued by local Aboriginal groups, it is expected that future projects in similar terrain will also include avalanche ecosystems as a valued component and will adopt or develop appropriate management and monitoring strategies to minimize potential loss and degradation.

37.6.8.4.3 Listed Ecosystems

The design of the Project was changed to avoid several areas mapped as potentially sensitive or listed ecosystems. No further mitigation specific to listed ecosystems is proposed, as general management measures provided within the Terrestrial Ecosystems Management and Monitoring Plan in Chapter 26 will minimize loss and degradation. They include minimizing all clearing dimensions and preferentially retaining areas of mature and old forest (most likely to support listed plant communities), where the option exists to remove younger forests. Similarly, specific mitigations described within other projects include flagging of known boundaries on construction maps and on the ground to prevent accidental encroachment.

Provincial land and resource management plans, and other land development guidelines or best management practices, recognize the importance of maintaining listed ecosystems in achieving regional scale biodiversity objectives. It is expected that EAs for future projects with potential to remove or degrade listed ecosystems will assess them as a valued component and adopt or develop appropriate management and monitoring strategies to minimize potential effects.

37.6.8.4.4 Riparian and Floodplain Ecosystems

The Project design was changed, including the Coulter Creek and Treaty Creek access roads, was revised during infrastructure design to avoid potentially sensitive riparian and wetland ecosystems. General mitigation measures to minimize the loss and degradation of riparian and floodplain ecosystems include ensuring riparian setbacks and work practices proceed in accordance with legislated reserve and/or management zone widths. The creation of riparian and wetland habitat under the Fish and Wetland Habitat Compensation Plans (Appendices 15-R and 16-B, respectively) further mitigates some of the vegetation loss resulting from the Project.

Other projects outline a variety of mitigation activities to address and minimize the effects of loss and degradation. These range from general statements, such as “limiting the extent of clearing,” to detailed management plans for working in and around watercourses. For example, the Forrest Kerr Project references the Riparian Assessment and Prescription Procedures – Field Guide (McLennan and Johnson 1997) and provides management recommendations for in-stream work, many directly related to riparian vegetation.

As most provincial land and resource management plans, and other land development guidelines or best management practices, recognize the importance of maintaining riparian and floodplain ecosystems in achieving biodiversity and fish and wildlife habitat objectives, EAs for all future projects with potential to result in such ecosystem loss are expected to assess these ecosystems as valued components and adopt or develop appropriate management and monitoring strategies.

37.6.8.4.5 Alpine and Parkland Ecosystems

Loss and degradation of alpine and parkland ecosystems will be minimized by ensuring clearing of vegetation occurs only where necessary. No further mitigation has been developed specific to alpine and parkland ecosystems, as the general management measures provided within the Terrestrial Ecosystems Management and Monitoring Plan in Chapter 26 will minimize potential effects. Similarly, no mitigations specific to alpine and parkland ecosystems are provided in publically available sources for other projects, although each of the present projects outlines general mitigation activities to address and minimize the effects of loss and degradation.

As provincial land and resource management plans, and other land development guidelines or best management practices, recognize the importance of maintaining alpine and parkland ecosystems in achieving biodiversity and wildlife habitat objectives, it is expected that EAs for future projects will assess them as valued components and adopt or develop appropriate management and monitoring strategies.

37.6.8.4.6 Old Forest Ecosystems

Loss of old forest ecosystems will be minimized by ensuring clearing of vegetation occurs only where necessary and, where the option exists, retaining patches of old forest in lieu of younger stands. No further mitigation measures have been developed to minimize loss and degradation of old forest ecosystems, as the general management measures provided within the Terrestrial Ecosystems Management and Monitoring Plan (Chapter 26) will minimize effects.

As most provincial land and resource management plans, and other land development guidelines or best management practices, recognize the importance of maintaining old forest ecosystems in achieving biodiversity objectives, it is expected that EAs for all future projects with potential to result in loss and degradation will assess them as a valued component and adopt or develop appropriate management and monitoring strategies.

37.6.8.4.7 Other Terrestrial Ecosystems

Loss of other terrestrial ecosystems will be minimized by ensuring clearing of vegetation occurs only where necessary. The general management measures provided within the Terrestrial Ecosystems Management and Monitoring Plan in Chapter 26 will minimize loss and degradation.

Each of the present projects outlines general mitigation activities to address and minimize the effects of vegetation loss and degradation. Most provincial land and resource management plans and other land development guidelines or best management practices recognize the importance of maintaining ecosystem biodiversity.

37.6.8.5 Summary of Residual Cumulative Effects on Terrestrial Ecosystems

The assessment of cumulative effects on terrestrial ecosystems adopted a watershed-based study boundary, albeit using higher-order watersheds (i.e., Lower Iskut River and Upper Iskut River) than were used for the residual effects assessment within the LSA. The other projects and activities with the highest potential to interact cumulatively with the KSM Project residual effects are those resulting in additive vegetation loss or degradation within the same local watersheds (i.e., Treaty Creek and Sulphurets Creek) as the KSM Project. The projects with proposed

infrastructure immediately adjacent to, or affecting the same local watersheds, are the proposed Snowfield Project, Brucejack Mine, and the Treaty Creek Hydroelectric Project. However, within the Sulphurets Creek watershed, no additional loss of avalanche track or old forest ecosystems (the VCs with potential for medium and high magnitude residual effects) is expected.

Where similar VCs are assessed within other available Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS) documents (NTL Project, Forrest-Kerr Hydroelectric Project, and McLymont Creek Hydroelectric Project), low to medium magnitude effects are typically estimated, with respective results of not significant. The potential losses of avalanche track and old forest ecosystems, the largest potential effects from the KSM Project, are considered medium and low magnitude within the CEA, respectively, with low magnitude cumulative losses expected from other projects and activities, relative to their availability within the CEA boundary.

All cumulative effects on terrestrial ecosystem VCs are assessed as **not significant (minor).**

37.6.9 Wildlife and Wildlife Habitat

37.6.9.1 Summary of Project-specific Residual Effects on Wildlife Valued Components

The Project-specific effects were considered in detail in Chapter 18 for 11 wildlife VCs: moose, mountain goat, grizzly bear, black bear, American marten, hoary marmots, bats, raptors, wetland birds, forest and alpine birds, and western toads. Potential residual effects on wildlife identified and assessed include: 1) habitat loss and alteration; 2) disruption of movement; 3) sensory disturbance; 4) direct mortality; 5) indirect mortality; 6) attractants; and 7) chemical hazards.

As a result of design changes and the planned implementation of mitigation and monitoring, no residual wildlife effects are assessed as significant associated with the KSM Project. **Not significant (medium)** residual effects for moose (overall), mountain goats (overall), grizzly bears (overall), and wetland birds (chemical hazards) are predicted. **Not significant (minor)** residual effects are predicted for black bears (overall), American marten (overall), hoary marmots (overall), bats (chemical hazards), wetland birds (overall), raptors (habitat loss), forest and alpine birds (habitat loss), and western toads (direct mortality).

37.6.9.2 Cumulative Assessment Boundaries for Wildlife and Wildlife Habitat

Spatial boundaries were chosen to evaluate the effects on: 1) individual animals, and 2) populations of animals. The effects on individual animals of wide-ranging species (i.e., moose, mountain goat, grizzly bear, and black bear) were examined by calculating a Movement Area (MA), defined as the distance away from the KSM Project that an average animal of particular species may travel in a year (maximum home range size). The assessment within the MAs looks at the other projects that an individual animal could foreseeably interact with.

Effects on populations of VCs were evaluated over a larger area (CEA Area) than for an individual animal, using wildlife management units or natural boundaries. Four main spatial scales were selected to evaluate effects on wildlife populations for use in the CEA:

1. the grizzly bear population unit boundaries (the outer periphery of the three grizzly bear population units that converge at the KSM Project, which are used for grizzly bears and black bears);
2. the wildlife management area, used for moose and mountain goat, which consisted of three wildlife management units that converge at the KSM Project (wildlife management units 6-16, 6-17, and 6-21);
3. the adjusted RSA based on the RSA used in the wildlife effects assessment, with species-specific adjustments to the RSA boundary based on home range size (used for American marten and western toad, which can move slightly farther than the original RSA boundary); and
4. the RSA (used for all remaining VCs whose movement from the Project should not extend beyond the RSA boundary).

Additional information on the rational for the spatial boundaries and maximum range size calculations for each wildlife VC are outlined in Chapter 18. Figures 37.6-8 to 37.6-13 display the MAs used for examining effects on individual animals (moose, mountain goat, grizzly bear, and black bear) and the CEA Area, used for examining effects on populations.

The following time spans were used to define past, present and future effects:

- **Past:** 1964 to 2008; coinciding with the development of the Granduc mine, which influenced the growth of the community of Stewart and other human activities in the area (StewartBC.com 2004);
- **Present:** 2008 to 2013; the start of KSM Project baseline studies to the completion of the environmental effects assessment; and
- **Future:** 2013 to 2167; the time period over which all wildlife VCs are expected to recover to baseline conditions following the completion of the 51.5 year mine life of the KSM Project.

All spatially linked projects that clearly overlap the construction and operation phases of the KSM Project were considered to be temporally linked in the CEA. Some past projects were still considered to be linked to the present (and sometimes future) conditions of certain VCs due to remaining infrastructure (e.g., roads), learned responses from wildlife (e.g., food attractants), or permanent/long lasting habitat alterations (e.g., cleared areas).

For assessments involving the effect of traffic volumes on wildlife, Yukon Zinc's Wolverine Mine was included after requests from working group meetings to include traffic from this mine. This additional project falls outside of the CEA areas, but was included because it adds vehicles to major thoroughfares (i.e., highways 37 and 37A) that pass through CEA areas (See Chapter 5 for all projects included in traffic calculations).

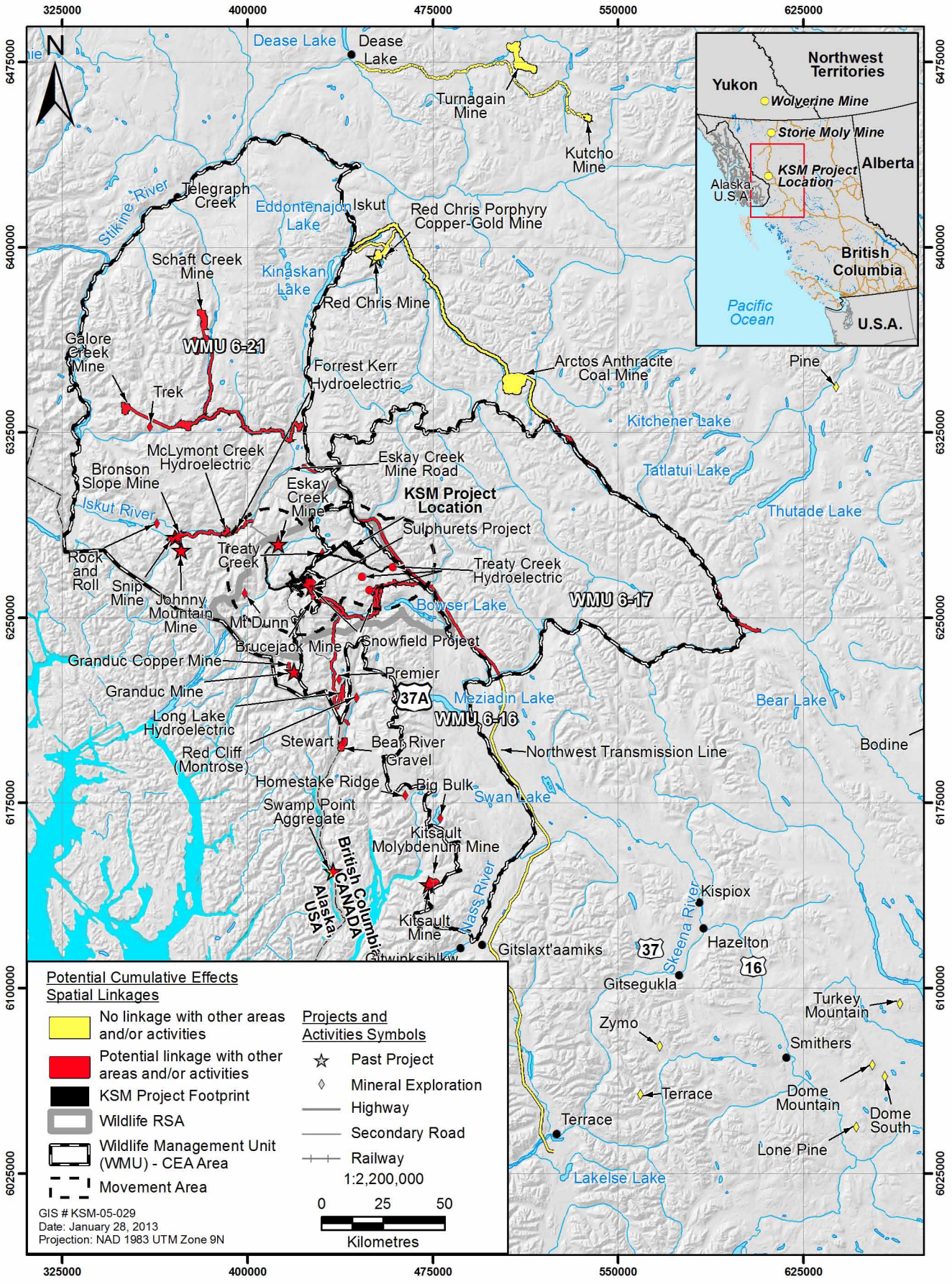


Figure 37.6-8

Moose Cumulative Effects Assessment Area and Movement Area

SEABRIDGE GOLD
KSM PROJECT

Rescan
Engineers & Scientists

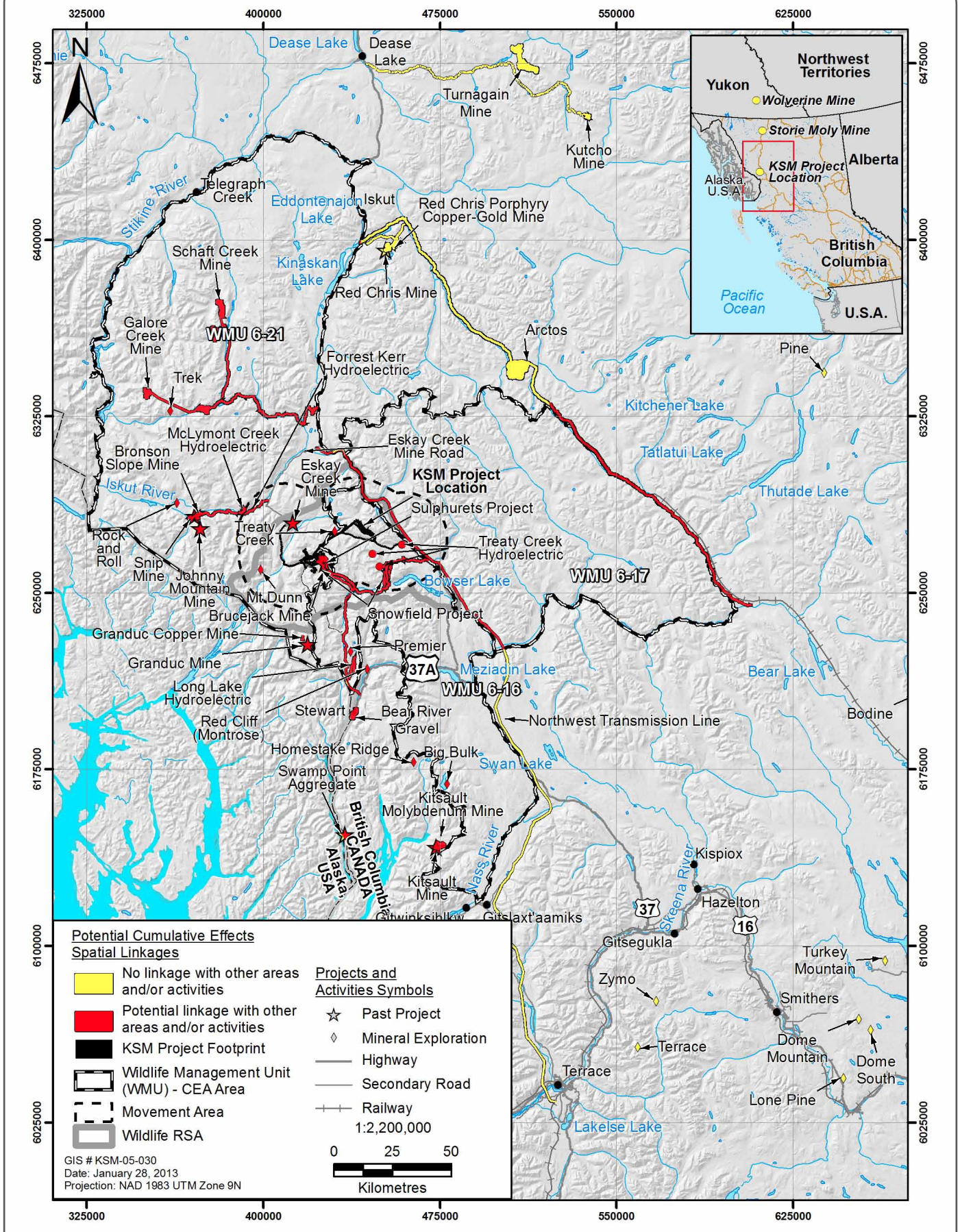


Figure 37.6-9

Mountain Goat Cumulative Effects Assessment Area and Movement Area

SEABRIDGE GOLD
KSM PROJECT

Rescan
Engineers & Scientists

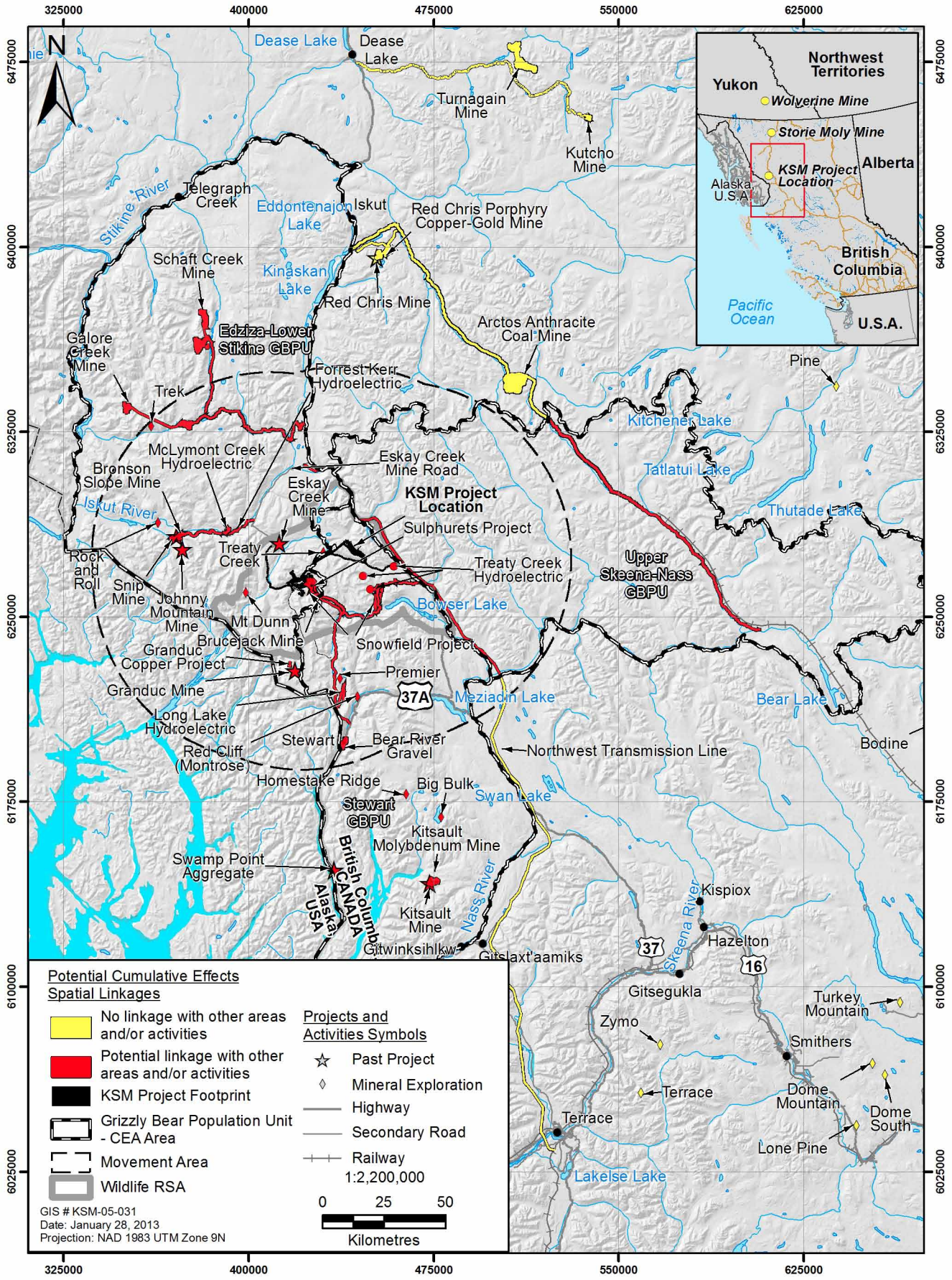


Figure 37.6-10

Grizzly Bear and Black Bear Cumulative Effects Assessment Area and Movement Area

SEABRIDGE GOLD KSM PROJECT

Rescan Engineers & Scientists

PROJECT # 868-022-45 GIS No. KSM-05-033 February 5, 2013

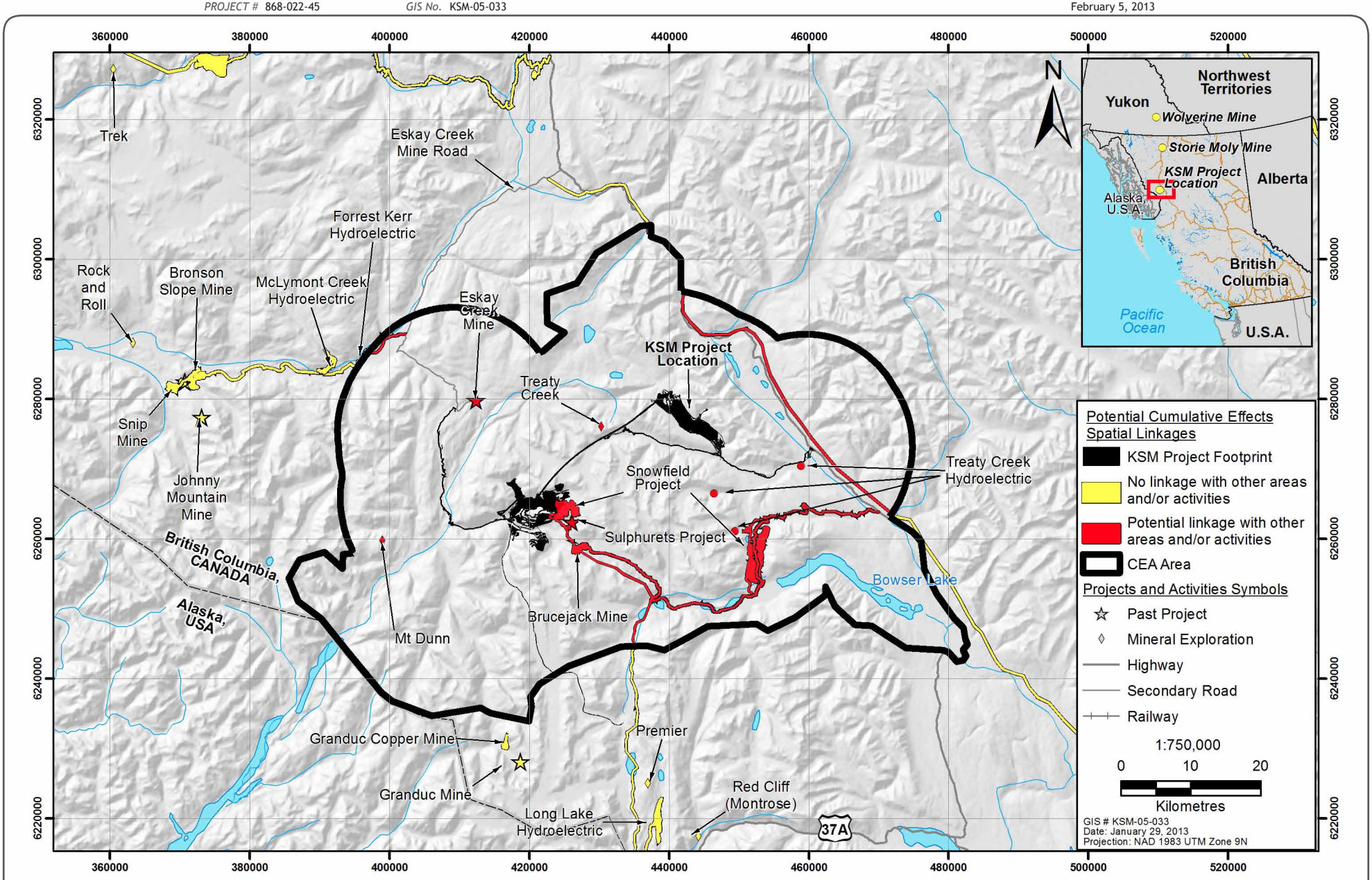


Figure 37.6-11

SEABRIDGE GOLD
KSM PROJECT

American Marten Cumulative Effects Assessment Area

Figure 37.6-11

Rescan
Engineers & Scientists

PROJECT # 868-022-20 GIS No. KSM-05-034 Febraury 5, 2013

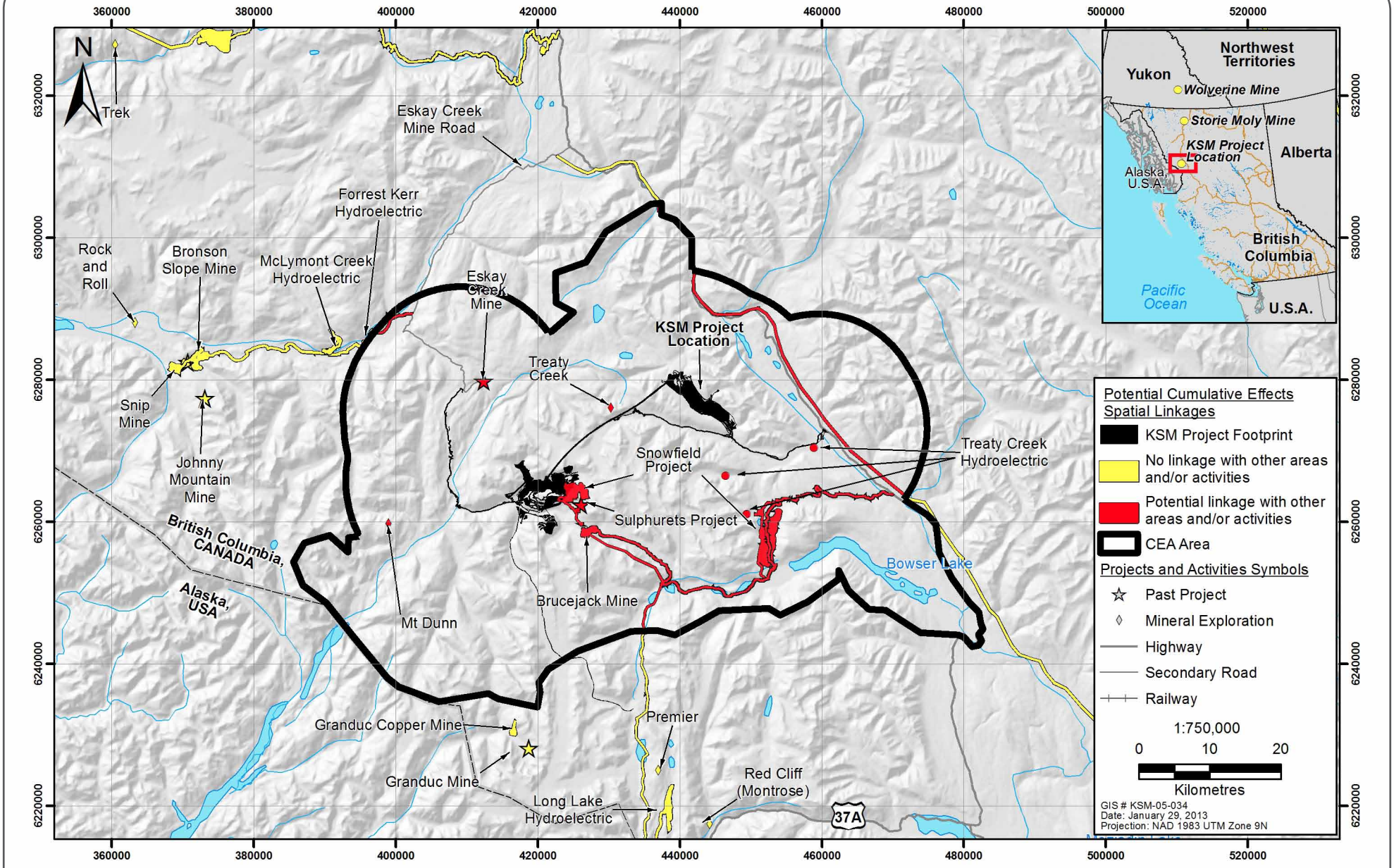


Figure 37.6-12

SEABRIDGE GOLD
KSM PROJECT

Western Toad Cumulative Effects Assessment Area

Figure 37.6-12

Rescan
Engineers & Scientists

PROJECT # 868-022-45 GIS No. KSM-05-035 Febraury 5, 2013

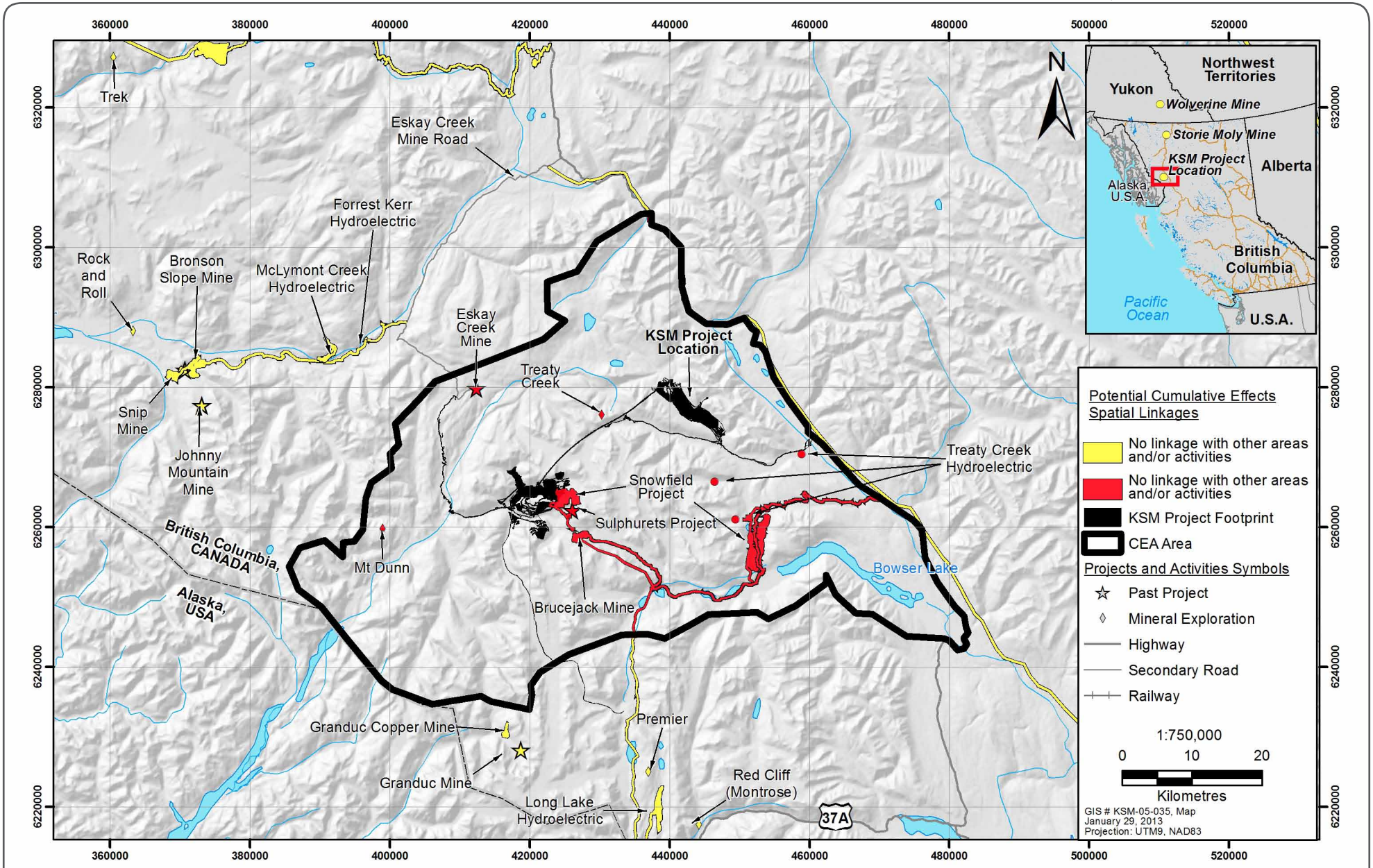


Figure 37.6-13

SEABRIDGE GOLD
KSM PROJECT

Cumulative Effects Assessment Area for Hoary Marmots, Birds and Bats

Figure 37.6-13

Rescan
Engineers & Scientists

37.6.9.3 Cumulative Effects on Wildlife and Wildlife Habitat

For each of the 11 wildlife VCs considered in the Application/EIS (Chapter 18), at least one residual effect was predicted. The residual effects marked with a "Y" in Table 37.6-35 were carried forward into the CEA, where other projects that may interact with these effects for VCs on a larger spatial scale are considered.

Table 37.6-35. Residual Effects Predicted from the Wildlife Application for an Environmental Assessment Certificate / Environmental Impact Statement

Effect / Valued Component	Habitat Loss/ Alteration	Disruption of Movement	Sensory Disturbance	Direct Mortality	Indirect Mortality	Attractants	Chemical Hazards
Moose	Y	Y	N	Y	Y	N	Y
Mountain goat	**Y**	Y	**Y**	Y	Y	N	Y
Grizzly bear	Y	Y	N	Y	Y	Y	N
Black bear	Y	Y	N	Y	Y	Y	N
American marten	Y	N	N	Y	N	N	N
Hoary marmot	Y	N	N	Y	N	N	N
Bats	N	N	N	N	N	N	**Y**
Raptors	Y	N	N	N	N	N	N
Wetland birds	Y	N	N	N	N	N	**Y**
Forest and alpine birds	Y	N	N	N	N	N	N
Western toad	N	N	N	Y	N	N	Y

Note: All effects identified begin during the construction phase and continue into post-closure. The presence of a residual effect is marked with a "Y" while those effects not expected to result in a residual are marked with an "N". All residual effects (marked with a "Y") are considered in this CEA.

Tables 37.6-36 to 37.6-46 list the potential interactions between the other past, present and reasonably foreseeable projects and activities identified in Section 37.6.9.2 as potentially having a cumulative effect with the KSM Project's predicted residual effects on the 11 wildlife VCs carried into the CEA.

37.6.9.3.1 Moose

Table 37.6-36 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on moose.

Table 37.6-36. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Moose

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Eskay Creek Mine	Granduc Mine	Snip Mine	Forest Kerr Mine	NTL	Long Lake Hydroelectric Project	Bronson Slope Mine
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Chemical Hazards	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Brucejack Mine	Galore Creek Mine	Arctos Anthracite Coal Mine	Schaft Creek Mine	Snowfield Project	Treaty Creek Hydroelectric	McLymont Creek Hydroelectric
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Chemical Hazards	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Residential and Aboriginal Harvest	Mineral and Energy Exploration	Fishing	Recreation and Tourism	Timber Harvest	Traffic and Roads	Guide Outfitting
Habitat Loss	No Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Chemical Hazards	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

Table 37.6-37. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Mountain Goats

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Eskay Creek Mine	**Granduc Mine**	**Johnny Mountain Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	No Interaction
Sensory	No Interaction	No Interaction	No Interaction
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	No Interaction
Chemical	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Snip Mine	**Sulphurets Project**	**Forest Kerr Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction
Movement	No Interaction	No Interaction	Possible Interaction
Sensory	No Interaction	No Interaction	Possible Interaction
Direct Mortality	No Interaction	No Interaction	Possible Interaction
Indirect Mortality	No Interaction	No Interaction	Possible Interaction
Chemical	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	NTL	**Long Lake Hydroelectric**	**Bronson Slope Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction
Sensory	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Chemical	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Brucejack Mine	**Galore Creek Mine**	**Arctos Antrocite Coal Transport**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction
Sensory	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Chemical	Possible Interaction	No Interaction	No Interaction

(continued)

Table 37.6-37. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Mountain Goats (completed)

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Schaft Creek Mine	**Snowfield Project**	**Treaty Creek Hydroelectric Project**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction
Sensory	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Chemical	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	McLymont Creek Hydroelectric	**Residential and Aboriginal Harvest**	**Mineral and Energy Exploration**
Habitat Loss	Possible Interaction	No Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction
Sensory	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	No Interaction	Possible Interaction
Chemical	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Fishing	**Recreation and Tourism**	**Timber Harvest**
Habitat Loss	No Interaction	No Interaction	Possible Interaction
Movement	No Interaction	Possible Interaction	Possible Interaction
Sensory	No Interaction	Possible Interaction	Possible Interaction
Direct Mortality	No Interaction	No Interaction	No Interaction
Indirect Mortality	No Interaction	No Interaction	Possible Interaction
Chemical	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities	
	Traffic and Roads	**Guide Outfitting**
Habitat Loss	Possible Interaction	No Interaction
Movement	Possible Interaction	Possible Interaction
Sensory	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	No Interaction
Chemical	No Interaction	No Interaction

Table 37.6-38. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Grizzly Bears

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	**Granduc Mine**	**Johnny Mountain Mine**	**Kitsault Mine (Closed)**	**Snip Mine**	**Swamp Point Aggregate Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction
Attractants	No Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Forest Kerr Mine	**NTL**	**Long Lake Hydroelectric**	**Bear River Gravel**	**Bronson Slope Mine**	**Brucejack Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Galore Creek Mine	**Kitsault Mine**	**Arctos Anthracite Coal Mine**	**Schaft Creek Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

(continued)

Table 37.6-38. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Grizzly Bears (completed)

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Fishing	**Guide Outfitting**	**Residential and Aboriginal Harvest**	**Mineral and Energy Exploration**	**Recreation and Tourism**	**Timber Harvest**
Habitat Loss	No Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction
Indirect Mortality	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities	
	Traffic and Roads	**McLymont Creek Hydroelectric**
Habitat Loss	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	Possible Interaction

Table 37.6-39. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Black Bears

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	**Granduc Mine**	**Johnny Mountain Mine**	**Kitsault Mine (Closed)**	**Snip Mine**	**Swamp Point Aggregate Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction
Attractants	No Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Forest Kerr Mine	**NTL**	**Long Lake Hydroelectric**	**Bear River Gravel**	**Bronson Slope Mine**	**Brucejack Mine**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Galore Creek Mine	**Kitsault Mine**	**Arctos Anthracite Coal Mine**	**Schaft Creek Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric Project**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction
Indirect Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction

(continued)

Table 37.6-39. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Black Bears (completed)

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Fishing	**Guide Outfitting**	**Residential and Aboriginal Harvest**	**Mineral and Energy Exploration**	**Recreation and Tourism**	**Timber Harvest**
Habitat Loss	No Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction
Movement	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	No Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction
Indirect Mortality	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Attractants	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-40. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on American Marten

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	**Forest Kerr Hydroelectric**	**NTL**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Resident and Aboriginal Harvest	**Mineral and Energy Exploration**	**Fishing**	**Recreation and Tourism**	**Timber Harvest**	**Traffic and Roads**
Habitat Loss	No Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction

Table 37.6-41. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Hoary Marmots

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek	**Sulphurets Project**	**NTL**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Residential and Aboriginal Harvest	**Fishing**	**Recreation and Tourism**	**Mineral and Energy Exploration**	**Timber Harvest**	**Traffic and Roads**
Habitat Loss	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Direct Mortality	Possible Interaction			Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-42. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Bats

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities				
	Eskay Creek Mine	NTL	Brucejack Mine	Snowfield Project	Treaty Creek Hydroelectric
Chemical	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Mineral and Energy Exploration	Timber Harvest	Traffic and Roads
Chemical	No Interaction	No Interaction	No Interaction

Table 37.6-43. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Raptors

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	NTL	Brucejack Mine	Snowfield Project	Treaty Creek Hydroelectric	Mineral and Energy Exploration
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities	
	Timber Harvest	Traffic and Roads
Habitat Loss	Possible Interaction	Possible Interaction

Table 37.6-44. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Wetland Birds

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	**NTL**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**	**Residential and Aboriginal Harvest**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction
Chemical	No Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction	No Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities		
	Mineral and Energy Exploration	**Timber Harvest**	**Traffic and Roads**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction
Chemical	No Interaction	No Interaction	No Interaction

Table 37.6-45. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Forest and Alpine Birds

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities								
	Eskay Creek Mine	**NTL**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**	**Residential and Aboriginal Harvest**	**Mineral and Energy Exploration**	**Timber Harvest**	**Traffic and Roads**
Habitat Loss	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Table 37.6-46. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Western Toads

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities					
	Eskay Creek Mine	**NTL**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**	**Recreation and Tourism**
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities			
	Aboriginal and Residential Harvest (traffic)	**Mineral and Energy Exploration**	**Timber Harvest**	**Traffic and Roads**
Direct Mortality	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

The individual cumulative effects on moose in regards to habitat loss, disruption of movement, and direct and indirect mortality are all determined to be **not significant** (minor or moderate). However, the overall cumulative effect on moose is rated based on the knowledge that these effects may interact and create additive or synergistic effects that would have a different nature or greater effect on local populations as a whole, potentially affecting the survival rates and reproductive success of individual animals.

The level of future industrial development along the Highway 37 corridor is uncertain. It is unlikely that all currently proposed mine projects will be developed at the same time. Therefore, two possible future scenarios were evaluated for potential overall cumulative effects on moose, primarily driven by increased mortality from traffic accidents: 1) an "Unlikely Development Scenario" where all or most projects go ahead as planned leading to relatively high traffic levels and wildlife collisions, and 2) a "Likely Development Scenario,",= with only one to three mining projects being concurrently in production, and correspondingly less traffic and wildlife collisions.

The overall cumulative effect under both scenarios is considered to have a medium magnitude, to extend into the far-future, to be regular in frequency, and (largely, but not wholly) reversible in the long-term. The context of the population is high, as moose in the area are declining.

The "Unlikely Development Scenario," with all or most projects proceeding, has a low confidence rating (Table 37.6-47) due to the difficulty in knowing how many proposed projects will go forward and the precise timing of each project. The overall cumulative effect on moose under the unlikely scenario of high development is predicted to result in a significant (major) effect on the moose population due to increased mortality due to traffic accidents. However, this assessment has relatively low certainty because the likelihood of all proposed projects occurring simultaneously is low and the model structure causes it to be overly sensitive to small reductions in survival.

The "Likely Development Scenario" has a medium probability of occurring and a medium confidence, as it is more likely that one to three projects occur, rather than all projects considered in the cumulative effects assessment. The overall cumulative effect on moose under the likely development scenario is **not significant (moderate**; Table 37.6- 47).

37.6.9.3.2 Mountain Goat

Table 37.6-37 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on mountain goat.

The individual cumulative effects on mountain goat in regards to habitat loss, sensory disturbance, disruption of movement, and direct and indirect mortality are determined to be **not significant** (**minor or moderate**). The overall cumulative effect is considered to have a medium magnitude, to extend into the far-future, to be regular in frequency, and (largely) reversible in the long-term. The context of the population is high because mountain goat will not be as resilient to a combination of effects occurring together as they are to individual effects. The effect has a medium probability of occurring and an intermediate confidence due to the difficulty in knowing how many proposed projects will go forward and the precise timing of each project. The cumulative overall effect on mountain goats is assessed as **not significant (moderate**; Table 37.6-48) if all other projects go through.

Table 37.6-47. Summary of Cumulative Residual Effects on Moose

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Habitat Loss	All	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	High	High	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Moderate)	Required	Not Required
Disruption of Movement	TMF, TCAR	Construction	Low	Low	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Direct Mortality	TCAR, CCAR	Construction	Low	Medium	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Moderate)	Required	Not Required
Indirect Mortality	TCAR, CCAR	Construction	Low	Low	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Chemical Hazards	TMF	Post-closure	Low	N/A	Local	N/A	Far future	N/A	Regular	N/A	Reversible long-term	N/A	High	N/A	Medium	N/A	Medium	N/A	Not Significant (Minor)	N/A	Required	N/A
Overall Effect - Likely Development Scenario	All	Construction	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Regular	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Not Required
Overall Effect - Unlikely Development Scenario	All	Construction	N/A	Medium	N/A	Regional	N/A	Far future	N/A	Regular	N/A	Reversible long-term	N/A	High	N/A	Low	N/A	Low	N/A	Significant (Major)	N/A	Not Required

CE = Cumulative Effect

Table 37.6-48. Summary of Cumulative Residual Effects on Mountain Goats

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Habitat Loss	Mine Site	Construction	Medium	Medium	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Neutral	Neutral	High	High	High	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Required	Not Required
Disruption of Movement	Mine Site	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Sensory Disturbance	Mine Site	Construction	Medium	Medium	Landscape	Regional	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Low	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Required	Not Required
Direct Mortality	Controlled avalanche	Construction	Neglibible	Low	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Indirect Mortality	Project Roads	Closure	Low	Low	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Chemical Hazards	Mine Site	Construction	Low	N/A	Landscape	N/A	Far future	N/A	Continuous	N/A	Reversible long-term	N/A	Neutral	N/A	Medium	N/A	Low	N/A	Not Significant (Minor)	N/A	Required	N/A
Overall Effect	All	Construction	Medium	Medium	Landscape	Regional	Far future	Far future	Sporadic	Regular	Reversible long-term	Reversible long-term	Neutral	High	Medium	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Not Required

CE = Cumulative Effect

37.6.9.3.3 Grizzly Bear

Table 37.6-38 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on grizzly bear.

The individual cumulative effects on grizzly bear in regards to habitat loss, disruption of movement, direct and indirect mortality, and attractants are determined to be **not significant** (**minor or moderate**). The overall cumulative effect is considered to have a medium magnitude, to extend into the far-future, to be sporadic in frequency, and (largely, but not wholly) reversible in the long-term. The context of the population is high because the resilience of the grizzly bear population will decrease with multiple effects impacting survival and reproductive rates. The effect has a medium probability of occurring and an intermediate confidence due to the difficulty in knowing how many proposed projects will go forward and the precise timing of each project. The cumulative overall effect on grizzly bears is assessed as **not significant (moderate**; Table 37.6-49).

37.6.9.3.4 Black Bear

Table 37.6-39 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on black bear.

The individual cumulative effects on black bear in regards to habitat loss, disruption of movement, direct and indirect mortality, and attractants are all determined to be **not significant** (**minor**). The overall cumulative effect on black bears is considered to have a low magnitude, extend into the far-future, to be sporadic, and reversible in the long-term. The context of the population is low, and the effect has a medium probability of occurring and an intermediate confidence due to the difficulty in knowing how many proposed projects will go forward and the precise timing of each project. The overall cumulative effect on black bears is assessed as **not significant (minor**; Table 37.6-50)**.**

37.6.9.3.5 American Marten

Table 37.6-40 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on American marten.

The residual effects predicted for American marten are habitat loss and direct mortality, and both are assessed as **not significant (minor**). These two effects may interact, creating additive or synergistic effects that would have a different extent for local American marten populations. Considering the two residual effects on marten, the amount of high quality habitat in the CEA area, existing human disturbance and activity (i.e., forestry, roads, and hunting), and mitigation to prevent residual effects, the overall potential residual cumulative effect is not predicted to affect the overall American marten population (low magnitude). The geographic extent of the overall effect will be regional, and the duration will be far-future. The frequency of the two effects is sporadic. The overall effect is largely reversible in the long-term because the removal of habitat will not be reversible, but road-based effects of direct mortality will be reversible at closure when traffic drops to lower levels. The context of the American marten

population is neutral, and the probability of habitat loss and direct mortality acting synergistically on the American marten population is medium, with an intermediate confidence. The overall cumulative effect on American marten is assessed as **not significant (minor**; Table 37.6-51).

37.6.9.3.6 Hoary Marmot

Table 37.6-41 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on hoary marmot.

The residual effects predicted for hoary marmots are habitat loss and direct mortality, and both are assessed as **not significant (minor**). Considering the two residual effects on hoary marmots, an overall potential residual effect is not predicted to affect the larger hoary marmot population in the CEA area, and the magnitude is predicted to be low. The geographic extent of the overall effect is landscape, as each project is expected to affect only a small portion of the overall population (i.e., only effects of individuals within small populations of a meta-population are expected). The duration will be far-future. The frequency of the two effects is sporadic, and will be reversible in the long-term. The context of the hoary marmot population is low, and the probability of an overall effect on the hoary marmot population is medium, with an intermediate confidence. The overall effect on hoary marmot is assessed as **not significant (minor**; Table 37.6-52)**.**

37.6.9.3.7 Bats

Table 37.6-42 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on bats.

The effect of chemical hazards on bats is the only residual effect identified for bat attributable to the KSM Project. This effect will not interact with any other project or activity in the bat CEA area. Therefore, no CEA was conducted for bats.

37.6.9.3.8 Birds

Table 37.6-43 to 37.6-45 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on raptor, wetland bird, and forest and alpine bird groups.

Some habitat loss and alteration for all birds is expected, with the loss of small numbers of nesting structures or nesting habitat during land clearing posing the greatest risk to these groups. The cumulative residual effect of habitat loss on raptors, wetland birds, and forest and alpine birds is assessed as **not significant (minor**; Tables 37.6-53 to 37.6-55).

A low magnitude residual cumulative effect of chemical hazards on wetland birds from Project activities is rated as **not significant (minor).**

Table 37.6-49 Summary of Cumulative Residual Effects on Grizzly Bears

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Habitat Loss	All	Construction	Low	Low	Local	Regional	Far Future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Disruption of Movement	All	Construction	Low	Medium	Landscape	Regional	Far Future	Far future	Sporadic	Regular	Reversible long Term	Reversible long-term	Neutral	Neutral	Medium	High	Low	Medium	Not Significant (Minor)	Not Significant (Moderate)	Required	Not Required
Direct Mortality	TCAR, CCAR	Construction	Negligible	Low	Landscape	Regional	Far Future	Far future	Sporadic	Sporadic	Reversible long Term	Reversible long-term	Neutral	Neutral	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Indirect Mortality	TCAR, CCAR	Construction	Low	Low	Landscape	Regional	Far Future	Far future	Sporadic	Sporadic	Reversible long Term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Attractants	Camps, Project roads	Construction	Low	Low	Local	Regional	Far Future	Far Future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Overall Effect	All	Contruction	Low	Medium	Local	Regional	Far Future	Far Future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	High	Medium	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Not Required

CE = Cumulative Effect

Table 37.6-50. Summary of Cumulative Residual Effects on Black Bears

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow-up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Habitat Loss	All	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Low	Low	High	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Disruption of Movement	All	Construction	Low	Low	Landscape	Regional	Far future	Far Future	Sporadic	Regular	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Direct Mortality	TCAR, CCAR	Construction	Negligible	Low	Landscape	Regional	Long	Far Future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Indirect Mortality	TCAR, CCAR	Construction	Low	Low	Landscape	Regional	Far future	Far Future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Attractants	Camps, Project roads	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	High	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Overall Effect	All	Construction	Low	Low	Landscape	Regional	Far future	Far Future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

CE = Cumulative Effect

Table 37.6-51. Summary of Cumulative Residual Effects on American Marten

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow-up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Adjusted by CE				
Habitat Loss	All	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Neutral	Neutral	High	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Direct Mortality	TCAR, CCAR, PTMA	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Overall Effect	All	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

CE = Cumulative Effect

Table 37.6-52. Summary of Cumulative Residual Effects on Hoary Marmots

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Habitat Loss	Mine Site	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Low	Low	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Direct Mortality	Mine Site	Construction	Low	Low	Local	Regional	Long	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
Overall Effect	Mine Site	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

CE = Cumulative Effect

Table 37.6-53. Summary of Cumulative Residual Effects on Raptors

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Habitat Loss	All	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

CE = Cumulative Effect

Table 37.6-54. Summary of Cumulative Residual Effects on Wetland Birds

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Habitat Loss	All	Construction	Low	Medium	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Chemical Hazards	TMF, WSF, receiving waters of Unuk River	Operation	Medium	Low	Landscape	Regional	Far future	Far future	Continuous	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Low	Low	Low	Not Significant (Moderate)	Not Significant (Minor)	Required	Not Required
Overall Effect	All	Construction	Low	Low	Landscape	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Low	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

CE = Cumulative Effect

Table 37.6-55. Summary of Cumulative Residual Effects on Forest and Alpine Birds

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Habitat Loss	All	Construction	Low	Low	Local	Regional	Far future	Far future	Sporadic	Sporadic	Irreversible	Irreversible	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required

CE = Cumulative Effect

Wetland birds are the only avian VC that may experience more than one residual effect. The residual effects predicted for wetland birds are habitat loss and alteration, and chemical hazards. Considering the two residual effects on wetland birds, an overall potential residual effect is not predicted to affect the larger wetland bird population, and the magnitude is predicted to be low. The geographic extent of the overall effect is regional, the duration will be far-future, the frequency of the two effects is sporadic, and the effects will be reversible in the long term. The context of the wetland bird population is neutral, and the probability of an overall effect on wetland birds is medium, with an intermediate confidence. The overall cumulative effect on wetland birds is assessed as **not significant (minor).**

37.6.9.3.9 Western Toads

Table 37.6-46 lists the potential interactions between past, present and reasonably foreseeable future projects identified as potentially having a cumulative effect with the KSM Project's predicted residual effects on western toads.

For western toads there is one predicted cumulative effect: direct mortality. This effect is considered to be of low magnitude because the likelihood that direct mortality attributable to vehicle collisions and vegetation clearing could affect population sizes beyond levels of natural variation is considered limited with mitigation. The extent of the effect is regional, and the duration is far-future because mortality will continue following closure of the KSM Project and beyond. The frequency is sporadic, and the effect is reversible in the long-term. The context of the population is high because western toads are listed on Schedule 1 of the *Species at Risk Act* (2002b), although the local population in BC is considered healthy (blue-listed in the province). There is a medium probability of the effect occurring and an intermediate confidence. The cumulative residual effect direct mortality on western toads is assessed as **not significant (minor**; Table 37.6-56).

37.6.9.4 Mitigation and Monitoring for Cumulative Effects on Wildlife and Wildlife Habitat

37.6.9.4.1 Moose

Other projects contributing to habitat loss and alteration for moose are expected to follow relevant BMPs and avoid high-quality moose winter habitat, especially proposed Ungulate Winter Range (UWR), wherever possible. Avoidance of mineral licks, rutting areas, and wetland foraging sites is also expected to occur wherever possible. In the case that any legally designated moose UWR is removed, compensation to offset the loss is expected. Other proponents are expected to design projects such that they attempt to meet the objectives of the Cassiar Iskut-Stikine LRMP (BC ILMB 2000) and the Nass South SRMP (BC MFLNRO 2012).

Forest harvesting on the regional scale is expected to follow general provincial forest harvesting principles to maintain functional habitat, including designing and locating cutblocks to provide connectivity of appropriate seral stage forests, and linking moose habitats at the landscape, sub-regional, and regional scales.

It is expected that other proponents will try to minimize their traffic volumes and will follow all relevant acts, regulations, and BMPs for the activities that they carry out. It is also expected that proponents will avoid placing infrastructure across or within moose travel networks where doing so can be avoided. Where winter use of roads is required and snow clearing activity is going to occur, it is assumed that proponents will create escape gaps in snow banks at frequent intervals to allow moose to cross and clear roads. Other proponents are also expected to attempt to design projects such that they meet the objectives of the Cassiar Iskut-Stikine LRMP (BC ILMB 2000) and the Nass South SRMP (BC MFLNRO 2012).

All other projects are expected to include similar mitigation measures to those adopted by the KSM Project and to follow all relevant acts, 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, in particular related to heavy industrial traffic, 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 with other stakeholders.

It is expected that all other industrial projects will include mitigation measures similar to those adopted by the KSM Project to minimize the effects of new road creation on indirect mortality rates for moose, and that each project will follow relevant acts, regulations, and BMPs for the activities that they carry out. It is expected that all industry roads will have controlled access, and that only forestry roads would potentially result in increased access.

37.6.9.4.2 Mountain Goat

Other projects contributing to habitat loss and alteration for mountain goat are expected to follow relevant BMPs and acts and to avoid high quality habitat (e.g., UWRs) where possible. Avoidance of mineral licks is also expected wherever possible. In the case that any legally designated mountain goat habitat is removed, compensation to offset the loss may be required by the British Columbia Ministry of Forests, Lands, and Natural Resource Operations (BC MFLNRO). Proponents are expected to design projects such that they attempt to meet the objectives of the Cassiar Iskut-Stikine LRMP and the Nass South SRMP and to follow the *General Wildlife Measures* under the *Forest and Range Practices Act* (2002a) for approved mountain goat UWRs.

Other projects contributing to the disruption of movements for mountain goat are expected to follow relevant BMPs and acts. Other proponents are expected to design projects such that they attempt to meet the objectives of the Cassiar Iskut-Stikine LRMP (BC ILMB 2000) and the Nass South SRMP (BC MFLNRO 2012).

Table 37.6-56. Summary of Cumulative Residual Effects on Western Toads

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance	Significance Adjusted for CE	Follow up Monitoring	Follow up Monitoring Adjusted by CE
															Probability	Probability Adjusted by CE	Confidence Level	Confidence Level Adjusted by CE				
Direct Mortality	PTMA, CCAR, TCAR	Construction	Low	Low	Local	Regional	Long	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required

CE = Cumulative Effect

Other projects contributing to sensory disturbance for mountain goats are expected to follow relevant BMPs and acts and to avoid high quality habitat, UWR, and mineral licks. Projects operating within 500 m of a UWR or occupied goat range are expected to mitigate their development activities seasonally, following the *General Wildlife Measures* under the *Forest and Range Practices Act* (2002). Helicopters flying over UWR or occupied mountain goat habitat are expected to adhere to a 2,000 m horizontal distance and a 400 m vertical distance setback, as set out in the Management Plan for Mountain Goats in BC (BC MOE 2010).

It is expected that all other projects will include mitigation measures similar to those adopted by the KSM Project and will follow all relevant acts, regulations, and BMPs for the activities that they carry out. Projects operating within 500 m of UWR or occupied goat range will be managed through the *General Wildlife Measures* under the *Forest and Range Practices Act* (2002), which imposes restrictions on activities around these areas. Where specific habitat protections are not afforded but mountain goats are suspected to occasionally use an area in the winter, adaptive mitigation such as mitigation of avalanche blasting is expected. To effectively address cumulative effects of direct mortality on mountain goats, the proponent is willing to participate in a regional initiative with other stakeholders, assuming the initiative is coordinated and managed by the appropriate government agency.

It is expected that all other industrial projects will include mitigation measures similar to those adopted by the KSM Project to minimize the effects of new road creation on indirect mortality rates for mountain goat, and that they will follow all relevant acts, regulations, and BMPs for the activities that they carry out.

37.6.9.4.3 Grizzly Bear and Black Bear

Other projects are expected to avoid high quality grizzly bear habitat wherever possible, and to follow all relevant acts, regulations, and BMPs for the activities that they carry out. Other proponents are also expected to design projects with careful consideration of the objectives of the Cassiar Iskut-Stikine LRMP (BC ILBM 2000) and the Nass South SRMP (BC MFLNRO 2012).

The CEA highlights the potential for the majority of habitat loss and alteration for grizzly bears to occur in the ESSF and ICH BEC units (largely by forestry), which are important for grizzly bears. Management of forest practices and other industrial activities must be coordinated on a regional scale to maintain a diverse habitat matrix distributed across a large elevational gradient to ensure persistence of grizzly bears.

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, 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 all other industrial projects within the CEA Area assessed in this report will include similar mitigation measures to those adopted by the KSM Project for attractant management to minimize the effects of increased attraction of grizzly bears to human-use sites,

and that they will follow all relevant acts, regulations, and BMPs for the activities that they carry out. Reporting of failures associated with project attractant management programs, including the KSM Project's, will be important; if grizzly bears are conditioned due to human errors in these programs, failures could increase risks at neighbouring sites.

37.6.9.4.4 American Marten and Hoary Marmot

It is expected that all other industrial projects will include mitigation measures similar to those adopted by the KSM Project to minimize the effects of habitat loss and alteration to these species. Further, other proponents are expected to follow all relevant acts, regulations, and BMPs for the activities that they carry out.

It is expected that all other industrial projects will include similar mitigation measures as adopted by the KSM Project to minimize the effects of new road creation and additional traffic, along with vegetation clearing activities, on direct mortality of American marten and Hoary Marmot. Other proponents are also expected to follow all relevant acts, regulations, and BMPs for the activities that they carry out.

37.6.9.4.5 Birds

It is expected that all other industrial projects will include mitigation measures similar to those adopted by the KSM Project to minimize the effects of habitat loss and alteration to avian VCs. Further, other proponents are expected to follow all relevant acts, regulations, and BMPs for the activities that they carry out.

It is noted in the Cassiar Iskut-Stikine LRMP (BC ILMB 2000) that, where nests are identified for forest-dependent raptors, harvesting at the landscape scale should be planned such that it provides contiguous canopy closure appropriate to raptor habitat requirements. This strategy will require the coordination of information collection (projects planned, project footprints, nest survey monitoring data, etc.) from various proponents by a regulating body.

It is expected that all other industrial projects will include mitigation measures similar to those adopted by the KSM Project to minimize the effects of chemical hazards on wetland birds. Further, other proponents are expected to follow all relevant acts, regulations, and BMPs for the activities that they carry out, and to adaptively mitigate if monitoring activities suggest chemical levels may be unsafe for wetland birds.

37.6.9.4.6 Western Toads

It is expected that all other industrial projects will include mitigation measures as similar to those adopted by the KSM Project to minimize the effects of direct mortality attributable to new road creation. Further, other proponents are expected to follow all relevant Acts, regulations, and BMPs for the activities that they carry out.

37.6.9.5 Summary of Residual Cumulative Effects on Wildlife Valued Components

The assessment of cumulative effects evaluated the effects of the KSM Project in addition to other mining projects, hydroelectric projects, forestry, and other land use activities in the CEA Area. A scoping process identified which wildlife VCs, additional projects, and potential effects were evaluated. All 11 of the wildlife VCs were evaluated. Of these, only moose in the "Unlikely Development Scenario" (where all or most projects go ahead as planned) was rated with a **significant** residual cumulative effect. Considering the "Likely Development Scenario," with less development and associated traffic-induced mortality, the overall cumulative effect on moose was rate **not significant (moderate**). All other residual cumulative effects for wildlife VCs were assessed as **not significant (minor or moderate)** as shown in Tables 37.6-48 to 37.6-56.

37.6.10 Noise

37.6.10.1 Summary of Project-specific Residual Effects on Noise

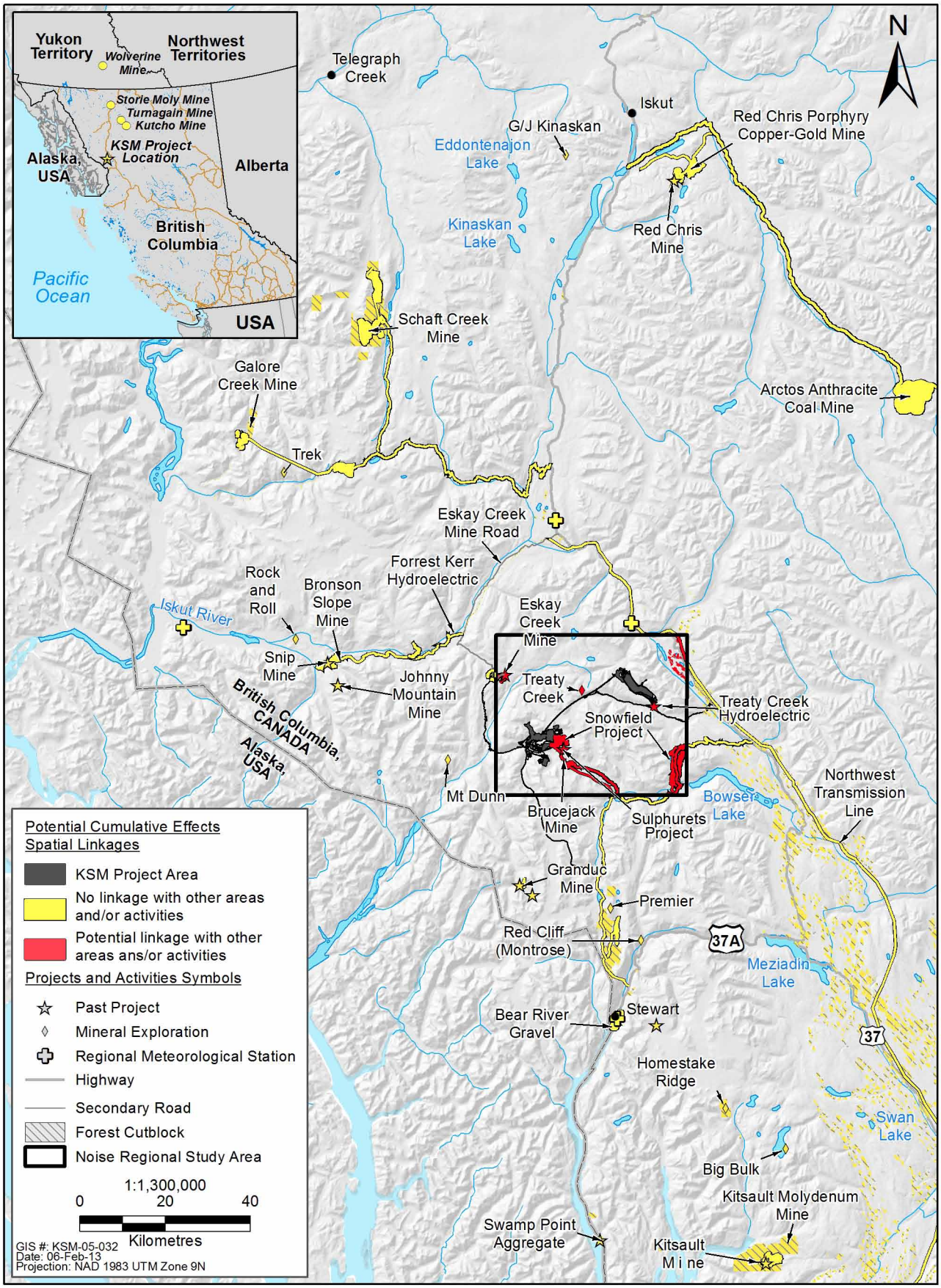
Noise from Project activities was assessed in Chapter 19 for the following potentially resultant residual effects: wildlife habitat, sleep disturbance, interference with speech communication, complaints, high annoyance, and rattling induced by low frequency noise. During construction and operation, the significance determination for these residual effects was determined to be **not significant (moderate).** Noise during construction is unavoidable, but levels should be mitigated by BMPs; consequently all the residual effects during construction are considered **not significant (minor).** Similarly, for operation, the noise modelling results predict **not significant (minor)** residual effects at worker camps, with the exception of potential sleep disturbance which is rated as **not significant (moderate)**.

Also during operation, mainly due to the effects of noise from blasting, but also from helicopter, and other continuous engine and activity noise expected to occur, loss of effective wildlife habitat due to noise is predicted to be a **not significant (moderate)** residual effect during this phase. This effect is discussed in greater detail in Chapter 18, Wildlife and Wildlife Habitat.

37.6.10.2 Cumulative Assessment Boundaries and Determination for Noise

Noise effects generally diminish with distance from a source. Since most human-generated noise has been found to be undetectable within 5 km for a large industrial source, a 10 km range from Project activities is expected to conservatively encompass all potential acoustic effects. Other noise-generating projects and activities within this boundary have the potential to act cumulatively with noise generated from the KSM Project (Figure 37.6-14). These projects and activities are considered to have a spatial linkage, and include:

- past-producing Eskay Creek Mine;
- Snowfield/Brucejack Mine Project;
- NTL and Forest Kerr Hydroelectric construction; and
- traffic using the Eskay Creek Mine road and Highway 37.



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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Noise

Figure 37.6-14

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37.6.10.3 Cumulative Effects Assessment for Noise

Table 37.6-57 lists the potential interactions between each of the projects and activities identified in the previous section as potentially having a cumulative effect with the KSM Project and each of the identified potential residual effects that Project noise levels will have.

With the exception of a possible interaction between the KSM and the Snowfield Project with regard to wildlife habitat loss and sleep disturbance, none of the other projects or activities are anticipated to have any noticeable interaction with the Project. This is mainly because noise effects are very localized as noise levels reduce at a significant rate with respect to distance from the source. According to the model results presented in Appendix 19-A, all sources of noise, with the exception of blasting, reach background levels a significant distance away from other potential sources of noise. Additionally, each of these sources of noise are, or will be, significantly smaller than those from the KSM Project. The potential of cumulative effects relating to noise are limited to those receivers within approximately 1 km of the area where the KSM Project and Snowfield Project are immediately adjacent to each other, as are sections of Highway 37, where Project-related traffic is likely to overlap. Due to distance from the KSM Project, the Treaty Creek Hydroelectric, the NTL, and the Forrest Kerr Projects are not expected to have any appreciable cumulative effect on noise levels.

37.6.10.4 Mitigation and Monitoring for Cumulative Effects on Noise

No additional mitigation beyond what was outlined in Chapter 19 for Project-specific effects is expected to be required to address cumulative effects. It is expected that each project with a potential spatial or temporal interaction will implement similar mitigation measures as those used in the KSM Project.

37.6.10.5 Summary of Residual Cumulative Effects on Noise

Noise effects are very localized. The distance to other projects that could be potential sources of noise in the area is great enough for there to be no noticeable cumulative effect, with the exception of noise from blasting, which may affect wildlife habitat and sleep disturbance as shown in Table 37.6-58. Wildlife habitat loss and sleep disturbance cumulative residual effects during the operation are both deemed to be **not significant (moderate**).

37.6.11 Economics

37.6.11.1 Summary of Project-specific Residual Effects for Economics

Four kinds of residual economic effects associated with the development of the Project are identified (Chapter 20): change in employment; change in income and value-added; change in business activity; and, change in economy. The first two of these residual effects are predicted for employment and income, and the last two are predicted for business opportunities and economic development. These effects are described in more detail in Chapter 20, Section 20.8.

Table 37.6-57. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects of Noise

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Snowfield Project	Brucejack Mine	Treaty Creek Hydroelectric	Eskay Creek Mine	Northwest Transmission Line Construction	Forest Kerr Construction	Road Traffic on Highway 37
Sleep Disturbance - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Sleep Disturbance - operation	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Interference With Speech Communication - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Interference With Speech Communication - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Complaints - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Complaints - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
High Annoyance - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
High Annoyance - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Noise Induced Rattling - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Noise Induced Rattling - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Loss of Wildlife Habitat - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Loss of Wildlife Habitat - operation	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

Table 37.6-58. Summary of Residual Cumulative Effects on Noise

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Ajusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Loss of Wildlife Habitat	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	High	High	Local	Regional	Medium	Medium	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Moderate)	Refer to Chapter 18, Wildlife	
Loss of Wildlife Habitat	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	High	High	Local	Regional	Long	Long	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Refer to Chapter 18, Wildlife	
Sleep Disturbance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	High	High	Local	Local	Medium	Medium	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	N/A	N/A
Sleep Disturbance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	High	High	Local	Local	Medium	Medium	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	Low	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	N/A	N/A
Interference With Speech Communication	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Interference With Speech Communication	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Complaints	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Complaints	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A

(continued)

Table 37.6-58. Summary of Residual Cumulative Effects on Noise (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Ajusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
High Annoyance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
High Annoyance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Noise Induced Rattling	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Noise Induced Rattling	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	Reversible short-term	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Overall Effect	All	Construction	High	High	Local	Regional	Medium	Medium	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	N/A	N/A
Overall Effect	All	Operations	High	High	Local	Regional	Medium	Medium	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	N/A	N/A

Note: CE = Cumulative Effect.

For the change in employment, the Project is predicted to have a beneficial **not significant (moderate)** effect on direct, indirect, and induced employment during construction and operation. This is expected to include employment of Aboriginal peoples and residents from the LSA communities. The change in business activity is also expected to alter the employment profiles of the RSA and LSA communities during construction and operation. For construction, the effect is assessed as being low in magnitude, regional in extent, of medium duration, continuous and of medium confidence with high probability; during operation the effect will be of longer duration and continuous. The effect of Project-related change in business activity on change in employment is predicted to be **not significant (moderate).**

Regarding effects on income and value added, the Project is predicted to have a beneficial **not significant (moderate)** effect on direct, indirect, and induced personal income, Gross Domestic Product (GDP), and government tax revenues during construction and operation. This is expected to include income to Aboriginal peoples and residents of the LSA communities. The change in business activity is also expected to alter the income profiles of the RSA and the LSA communities during construction and operation. The effect of Project-related change in business activity on change in income and value-added is predicted to be not **significant (moderate)**.

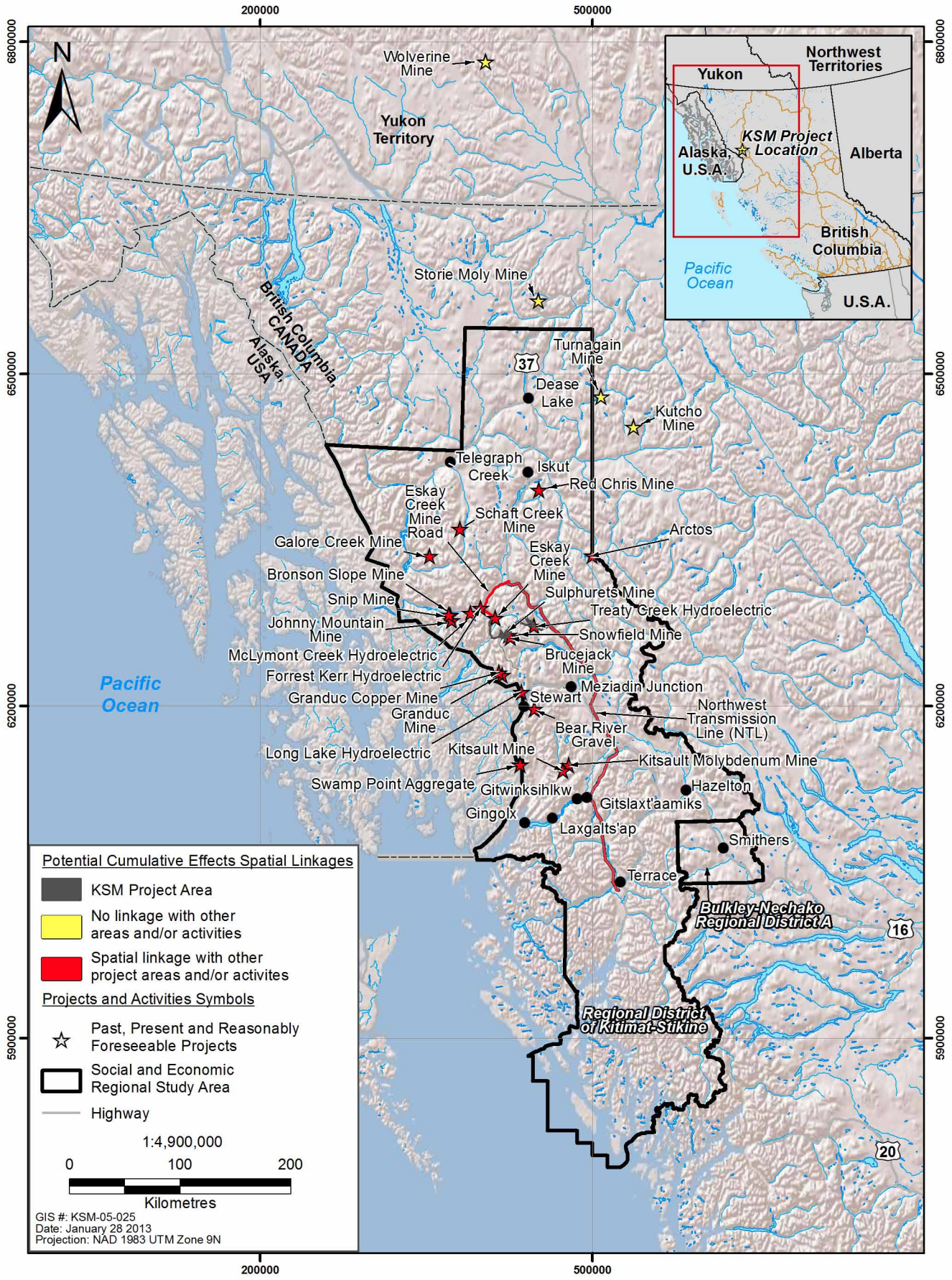
Not significant (moderate) beneficial effects of the Project on business opportunities are also predicted, relating to economic growth, investments, and development of local businesses during construction and operation. The change in employment and income is also expected to have beneficial effects on businesses selling goods and services to workers spending their incomes during construction and operation. The effect of Project-related change in employment and income on change in business activity was predicted to be **not significant (moderate)**.

Regarding economic development, the Project is predicted to contribute to RSA and LSA community development and broadening of the economic base during construction and operation. The beneficial effect of the Project on change in the economy was predicted to be **not significant (moderate).**

37.6.11.2 Cumulative Assessment Boundaries on Economics

There are a relatively large number of past and present and reasonably foreseeable projects (mainly mines) in northwestern BC that have provided, or could potentially provide, additional employment and expenditures in the region, as well as other income-generating land use activities. These projects and activities may interact spatially with the KSM Project effects on the economies of local communities and the region. Projects and activities considered to have a spatial linkage with the KSM Project fall within the RSA (Figure 37.6-15) and include:

- the Eskay Creek Mine;
- the Granduc Mine;
- the Johnny Mountain Mine;
- the Kitsault Mine (closed);
- the Snip Mine;
- the Sulphurets Project;



KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Economic and Social Effects

Figure 37.6-15

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- the Swamp Point Aggregate Mine;
- the Forrest Kerr Hydroelectric;
- the Long Lake Hydroelectric;
- the NTL;
- the Red Chris Mine;
- Bear River Gravel;
- the Bronson Slope Mine;
- the Brucejack Mine;
- the Galore Creek Mine;
- the Granduc Copper Mine;
- the Kitsault Mine;
- the McLymont Creek Hydroelectric Project;
- the Arctos Anthracite Mine;
- the Schaft Creek Mine;
- the Snowfield Project;
- the Treaty Creek Hydroelectric Project;
- fishing;
- guide outfitting;
- resident and aboriginal harvest;
- mineral and energy resource exploration;
- recreation and tourism; and
- timber harvesting.

Present projects (i.e., NTL and Red Chris Mine), future mine and hydroelectric projects, and commercial land use activities (i.e., fishing, guide outfitting, mineral and energy resource exploration, recreation and tourism, and timber harvesting) have a temporal linkage for economics, such that these current and future projects and activities may cause similar economic changes to the KSM Project at a similar time. All past projects and activities are assessed as not having a temporal linkage with economics because there are no longer any substantial employment and expenditures associated with these past projects and activities.

37.6.11.3 Cumulative Effects Assessment for Economics

37.6.11.3.1 Employment and Income

The predicted residual effects of the KSM Project include: beneficial effects on direct, indirect, and induced employment (including employment of Aboriginal peoples and LSA residents);

beneficial effects on direct, indirect, and induced personal incomes, GDP, and government tax revenues; and alteration of the current employment and income profiles of the RSA and LSA communities. With respect to other projects and activities, the Red Chris Mine, a number of other future mine and hydroelectric projects, and commercial land use activities (i.e., fishing, guide outfitting, mineral and energy resource exploration, recreation and tourism, and timber harvesting) have the potential to interact cumulatively with the residual effects of the KSM Project due to the employment, personal income, GDP, and government tax revenues generated by these other projects and activities (Table 37.6-59). The NTL Project is not expected to act cumulatively with the KSM Project on employment because construction of the NTL will be complete prior to the KSM Project beginning construction; in addition, during operation, the NTL Project will employ a small number of workers.

Table 37.6-59. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Employment and Income

Description of KSM Project Residual Effect	Northwest Transmission Line	Red Chris Mine	Future Mine and Hydroelectric Projects	Commercial Land Use Activities
The Project will have beneficial effects on direct, indirect, and induced employment, including employment of Aboriginal peoples and LSA residents	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
The Project will have beneficial effects on direct, indirect, and induced personal incomes, GDP, and government tax revenues, including income to Aboriginal peoples and LSA residents	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
The change in business activity is expected to alter the employment and income profile of the RSA and LSA communities	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction

37.6.11.3.2 Business Opportunities and Economic Development

The predicted residual effects of the KSM Project include: the economic growth, investment, and development of local businesses; beneficial effects on businesses selling goods and services to workers spending their incomes; and the growth, diversification, and overall advancement of economic development in the region. These residual effects are predicted to occur during the construction and operation phases of the KSM Project. With respect to other projects and activities, the Red Chris Mine, a number of other future mine and hydroelectric projects, and commercial land use activities (i.e., fishing, guide outfitting, mineral and energy resource exploration, recreation and tourism, and timber harvesting) have the potential to interact cumulatively with each of these effects (Table 37.6-60). The NTL Project is also expected to interact cumulatively because the power transmission infrastructure that it provides to the region will facilitate further economic development.

Table 37.6-60. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Business Opportunities and Economic Development

Description of KSM Project Residual Effect	Northwest Transmission Line	Red Chris Mine	Future Mine and Hydroelectric Projects	Commercial Land Use Activities
The Project will have beneficial effects on businesses selling goods and services to workers spending their incomes	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
The Project is expected to contribute to economic growth, investments, and the development of local businesses	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
The Project is expected to contribute to LSA and RSA development and broadening of the economic base	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

37.6.11.4 Mitigation and Monitoring for Cumulative Effects on Economics

37.6.11.4.1 Employment and Income

As described in Chapter 20, management practices, monitoring, and adaptive management will be implemented to mitigate and enhance the potential Project effects on employment, income, and value-added. These measures will include a Labour Recruitment and Retention Strategy, a Procurement Strategy, a Workforce Training Strategy, and a Workforce Transition Program.

There are no specific mitigation or management measures explicitly identified from other projects or activities to address effects on employment or income. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project (Section 20.7.2.1).

37.6.11.4.2 Business Opportunities and Economic Development

As described in Section 20.7.3.1, management practices, monitoring, and adaptive management will be implemented to mitigate and enhance the potential Project effects on business activity and change in the economy. These measures will include a Labour Recruitment and Retention Strategy, Procurement Strategy, and a Workforce Training Strategy that, collectively, are predicted to enhance local benefits and development of economies within the RSA and LSA communities.

There are no specific mitigation or management measures expected from other projects or activities to address effects on businesses supplying to projects and selling goods and services to residents and other businesses, or to address economic growth. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project (Section 20.7.2.1).

37.6.11.5 Summary of Residual Cumulative Effects on Economics

37.6.11.5.1 Employment and Income

Overall, as described in Chapter 20, beneficial cumulative effects on employment and income (Table 37.6-61) re predicted as a result of the interaction of the Project with other projects and activities. These effects are expected to include employment and income to LSA residents in Nisga'a Nation, First Nations, and non-Aboriginal communities. The overall cumulative effect is assessed as being medium in magnitude, beyond regional in extent, of long duration, and continuous through the duration of construction and operation. The effect is predicted to have a high probability of occurrence, with a high level of confidence in the assessment. The overall cumulative residual effect on employment and income by post-closure is predicted to be **significant (major)**. This significant rating applies to all cumulative residual effects assessed, except for the change in business activity that may beneficially alter the employment and income profile of the RSA and LSA in construction and operation, which has been rated as **not significant (moderate)**.

37.6.11.5.2 Business Opportunities and Economic Development

Overall, as described in Chapter 20, a positive cumulative effect on business opportunities and economic development (Table 37.6-62) is predicted, such as to businesses supplying the Project, economic growth, the development of local businesses, and broadening the economic base. The total cumulative residual effects are generally assessed as being medium in magnitude, regional in extent, of long duration, and being continuous through the duration of construction and operation. The effects are predicted to have a high probability of occurrence, with a medium to high level of confidence in the assessment. The cumulative residual effects on business opportunities and economic development are all predicted to be **not significant (moderate)**.

37.6.12 Heritage

37.6.12.1 Summary of Project-specific Residual Effects on Heritage

37.6.12.1.1 Disturbance of Known Archaeological Sites

The magnitude of change to known sites is assessed to be low, as only seven small lithic scatters of the 37 known sites within the RSA will be potentially affected. The five lithic scatters potentially directly affected by the Project are all small, non-stratified sites; mitigation through data recovery and/or monitoring will acceptably offset any potential loss of archaeological data. The geographic extent of the effect is determined to be local because the disturbance of an archaeological site has no effect on other archaeological sites in the area. As shown in Table 37.6-63, the residual effects attributed to disturbance of known archaeological sites are determined to be **not significant (minor).**

Table 37.6-61. Summary of Residual Cumulative Effects on Employment and Income

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
The Project will have beneficial effects on direct, indirect and induced employment, including employment of LSA residents in Aboriginal and non-Aboriginal communities.	Employment; Procurement of Goods and Services	Construction	Low	Beyond Regional	Medium	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required
	Employment; Procurement of Goods and Services	Operation	Low	Beyond Regional	Long	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required
The Project will have beneficial effects on direct, indirect and induced personal incomes, GDP, and government tax revenues, including income to LSA residents in Aboriginal and non-Aboriginal communities.	Employment; Procurement of Goods and Services	Construction	Low	Beyond Regional	Medium	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required
	Employment; Procurement of Goods and Services	Operation	Low	Beyond Regional	Long	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required
The change in business activity is expected to alter the employment and income profile of the RSA and LSA communities.	Employment; Procurement of Goods and Services	Construction	Low	Regional	Medium	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required
	Employment; Procurement of Goods and Services	Operation	Low	Regional	Long	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required
Overall Residual Effect	All		Low	Beyond Regional	Long	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required

Table 37.6-62. Summary of Residual Cumulative Effects on Business Opportunities and Economic Development

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
The Project will have beneficial effects on businesses supplying the Project and selling goods and services to residents and businesses.	Employment; Procurement of Goods and Services	Construction	Low	Regional	Medium	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required
		Operation	Low	Regional	Long	Continuous	Reversible short-term	Neutral	High	High	Not Significant (Moderate)	Not Required
The Project is expected to contribute to economic growth, investments, and the development of local businesses.	Employment; Procurement of Goods and Services	Construction	Low	Regional	Medium	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required
		Operation	Low	Regional	Long	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required
The Project is expected to contribute to LAA and RSA development and broadening of the economic base.	Employment; Procurement of Goods and Services	Construction	Low	Regional	Medium	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required
		Operation	Low	Regional	Long	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required
Overall Residual Effect	All		Low	Regional	Long	Continuous	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required

Table 37.6-63. Summary of Assessment of Project-specific Residual Effects for Heritage

Description of Residual Effect	Project Component(s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
Disturbance of known archaeological sites	Coulter Creek Access Road, Mitchell Pit, Water Treatment and Energy Recovery Area, and Treaty Creek Access Road	Construction	Low	Local	Far future	One-time	Irreversible	Neutral	Low	High	Not Significant (Minor)	Not required
		Operation	Low	Local	Far future	One-time	Irreversible	Neutral	Low	High	Not Significant (Minor)	Not required
Disturbance of unknown archaeological sites	All	Construction	Low	Local	Far future	One-time	Irreversible	Neutral	Low	High	Not Significant (Minor)	Not required
		Operation	Low	Local	Far future	One-time	Irreversible	Neutral	Low	High	Not Significant (Minor)	Not required

37.6.12.1.2 Disturbance of Unknown Archaeological Sites

The magnitude of change to unknown sites is assessed to be low as the Archaeological Impact Assessments conducted for the Project covered the moderate to high potential areas within the Project footprint, and any currently unknown sites, if present, in direct conflict the Project are expected to be small low density lithic scatters in unstratified deposits. The processes outlined in a Chance Find Procedure, including mitigation, will acceptably offset any potential loss of archaeological data. The probability of disturbance to unknown archaeological sites is low as AIAs were conducted; however, there is always a possibility that currently unrecorded archaeological sites may be discovered during ground altering activity. However, as the effort expended during the AIAs for the Project met the expectations of the Archaeology Branch of the British Columbia Government's Ministry of Forests Lands and Natural Resource Operations, there is a high level of confidence that there is low probability of any disturbance to unknown archaeological sites. By committing to site avoidance or mitigation through data recovery and/or monitoring, the archaeological sites for which effects are anticipated will be avoided or adequately curated. Residual effects of the Project on heritage VCs (Table 37.6-63) are anticipated to be **not significant (minor)**.

37.6.12.2 Cumulative Effects Assessment for Heritage

The development of additional projects, both present and future, and other human land use that involves ground disturbance has the potential to disturb or destroy additional archaeological sites. Present projects include: the Forrest-Kerr Hydroelectric Project, the Long Lake Hydroelectric Project, the NTL Project, the Red Chris Mine, and the Wolverine Mine. Reasonably foreseeable future projects include: the Arctos Anthracite Coal Mine, the Bear River Gravel Project, the Bronson Slope Mine, the Brucejack Mine, the Galore Creek Mine, the Granduc Copper Mine, the Kitsault Mine, the Kutcho Mine, the McLymont Creek Hydroelectric Project, the Schaft Creek Mine, the Snowfield Project, the Storie Moly Mine, the Treaty Creek Hydroelectric Project, and the Turnagain Mine (see Chapter 5 for detailed descriptions of these projects and activities). Current land use activities considered include mineral and energy resource exploration, timber harvesting, and resource access roads.

However, disturbance of small lithic scatter archaeological sites that will be affected by the Project are a spatially localized event that will not result in a negative effect on the condition of other archaeological sites. Further, due to the legal requirements of the *Heritage Conservation Act* (1996b), it is assumed that residual effects from other projects in the area will also be reduced to **not significant** through appropriated mitigation measures. Mitigation measures developed in consultation with the Archaeology Branch of the British Columbia Government's Ministry of Forests Lands and Natural Resource Operations and Aboriginal groups are designed to offset the disturbance of the archaeological site through the recovery of scientific data that may not otherwise have been gathered. Therefore, **no cumulative effects** are anticipated due to disturbance of the VC archaeological sites by the Project or others in the area.

37.6.12.3 Summary of Residual Cumulative Effects on Heritage

Assuming all other projects and activities adhere to the *Heritage Conservation Act* (1996b), no residual cumulative effects are anticipated on known or unknown archaeological sites.

37.6.13 Social

37.6.13.1 Summary of Project-specific Residual Effects for Social Valued Components

The following three residual social effects associated with the development of the Project were identified and assessed in Chapter 22: 1) community demographics, infrastructure, and services; 2) education, skills development, and training; and 3) community well-being (CWB).

Three residual effects on community demographics, infrastructure and services are predicted for the Project due to the effects of change in population and change in tax base. These three effects include: 1) altered community demographics due to population growth (beneficial and/or adverse depending on point of view); 2) demand on community infrastructure and services that may outpace small LSA communities' capacity in the short term due to population growth (adverse); and 3) an increase in government revenue available to fund infrastructure and services in the long term (beneficial). Largely due to the low magnitude, community-level extent, reversibility, and low context of the effects, the significance of each of these residual effects is determined to be not significant (minor), with a resulting overall rating of **not significant (minor)**.

The Project is predicted to lead to three beneficial effects on education, skills, and training that include: 1) an increase in educational profile of the local, regional, and provincial workforce through Project-related training, work experience, 2) improvement in the educational profile of LSA and RSA communities due to in-migration of skilled workers, and 3) improvement in the capacity educational institutions due to population-fueled demand. Overall, the effects of the Project on education, skills, and training are expected to be low in magnitude, regional in extent, long in duration, continuous in frequency, reversible in the long term, and neutral in context; the likelihood of the overall residual effect is expected to be high in probability with a high level of confidence. Thus, all residual effects and the overall effect are expected to be **not significant (minor)**.

Predicted beneficial residual effects of the Project on CWB include an increased sense of community worth, and increased financial independence and access to goods and services. Predicted adverse residual effects on CWB include increased family stress, increased substance misuse, and increased social and mental health issues. However, none of these effects are predicted to be significant. Overall, the effects of the Project on CWB are expected to be low in magnitude, community in extent, long in duration, continuous in frequency, reversible in the long term, and low in context. The likelihood of the overall residual effect is expected to be medium in probability with a medium level of confidence. Particularly given the low magnitude of all predicted effects, the overall predicted effect of the Project on CWB is **not significant (minor)**.

37.6.13.2 Cumulative Assessment Boundaries for Social Valued Components

The spatial boundaries for the social CEA is based on the RSA used for the social effects assessment (Figure 22.1-1). The RSA contains a large number of past, present, and reasonably foreseeable future projects (mainly mines) that have created, do create, or will create changes in employment, income and value-added, population, demand, tax base, noise, air quality, and transportation patterns. These projects and activities may interact spatially with the KSM Project effects on the social conditions of local communities and the region.

Projects and activities considered to have a spatial linkage with the KSM Project fall within the RSA (Figure 37.6-15), and include:

- the Eskay Creek Mine;
- the Granduc Mine;
- the Johnny Mountain Mine;
- the Kitsault Mine (past producing);
- the Snip Mine;
- the Sulphurets Project;
- the Swamp Point Aggregate Mine Project;
- the Forrest Kerr Hydroelectric Project;
- the Long Lake Hydroelectric Project;
- the NTL ;
- the Red Chris Mine;
- the Bear River Gravel;
- the Bronson Slope Mine;
- the Brucejack Mine;
- the Galore Creek Mine;
- the Granduc Copper Mine;
- the Kitsault Mine;
- the McLymont Creek Hydroelectric Project;
- the Arctos Anthracite Coal Project;
- the Schaft Creek Mine;
- the Snowfield Project;
- the Treaty Creek Hydroelectric Project;
- agricultural resources;
- fishing (commercial and recreational);
- guide outfitting;
- Aboriginal harvest (fishing, hunting/ trapping, and plant harvest);
- resident trapping;
- mineral and energy resource exploration;
- recreation and tourism (parks and commercial tenures for heli-skiing, rafting, etc.);
- timber harvesting (forestry); and
- traffic and roads.

Present mine and hydroelectric projects (i.e., the NTL Project and the Red Chris Mine), future mine and hydroelectric projects, and commercial land use activities (i.e., fishing, guide outfitting, mineral and energy resource exploration, recreation and tourism, and timber harvesting) may cause social changes that are similar to the KSM Project and that occur at a similar time. Past projects and activities are not considered to be temporally linked to the Project, as they no longer produce any social effects.

37.6.13.3 Cumulative Effects Assessment for Social Valued Components

37.6.13.3.1 Community Demographics, Infrastructure, and Services

The Project is predicted to result in beneficial and adverse residual effects to community demographics, infrastructure, and services. Beneficial effects include demographic change (depending on personal opinion of such change) and government revenue available to fund infrastructure and services. Adverse effects include demographic change (depending on personal opinion of such change) and increased demand on community infrastructure and services. The current Red Chris Mine, future mines and hydroelectric projects, and commercial land use activities (i.e., fishing, guide outfitting, mineral and energy resource exploration, recreation and tourism, and timber harvesting) have the potential to interact cumulatively with these effects due to the population growth and government tax revenues generated by these projects and activities (Table 37.6-64). The NTL is not expected to act cumulatively with the KSM Project on community demographics, infrastructure and services because construction of the NTL will be complete prior to the beginning of KSM Project construction; in addition, during operation, the NTL will employ a small number of workers.

Table 37.6-64. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Community Demographics, Infrastructure and Services

Description of KSM Residual Effect	NTL	Red Chris Mine	Future Mine and Hydroelectric Projects	Commercial Land Use Activities
Altering of community demographics due to population growth (beneficial and/or adverse, depending on personal opinion)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Demand on community infrastructure may outpace small LSA communities' capacity in the short term due to population growth (adverse)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in government revenues to fund infrastructure and services due to increased tax base (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction

37.6.13.3.2 Education, Skills, and Training

The Project is predicted to result in beneficial residual effects to education, skills, and training. The educational profile of RSA and LSA communities is expected to be improved due to employment-related training and work experience, in-migration of skilled workers, and improved

educational facilities. The Red Chris Mine, future mine and hydroelectric projects, and some commercial land use activities (primarily mineral and energy resource exploration) have the potential to interact cumulatively in a similar manner due to their employment and procurement of goods and services (Table 37.6-65).

Table 37.6-65. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Education, Skills, and Training

Description of KSM Residual Effect	NTL	Red Chris Mine	Future Mine and Hydroelectric Projects	Commercial Land Use Activities
Increase in the educational profile of the local, regional, and provincial workforce due to employment-related training and work experience (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Improvement in the educational profile of LSA and RSA communities due to in-migration of skilled workers (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Improvement in the capacity of educational institutions due to population-fueled demand (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction

37.6.13.3.3 Community Well-being

The Project is predicted to result in both beneficial and adverse residual effects on CWB. Beneficial residual effects include: 1) increase in individual esteem and community pride due to employment; 2) increase in financial independence and access to goods and services due to increased income; and 3) increase in community pride due to reversal in population decline. Adverse residual effects include: 1) increased family stress on families due to employment rotation schedules, and increase in substance misuse due to employment-related stress; 2) increase in substance misuse due to increase in income; 3) increased social and mental health and community safety issues in the short term as community capacity is outpaced by population change; 4) increase in emissions (noise, exhaust) due to increased traffic volume in Stewart; and 5) increase in vehicle accidents due to increased traffic volume in Stewart.

The Red Chris Mine, future mine and hydroelectric projects, and some commercial land use activities (i.e., guide outfitting, mineral and energy resource exploration, recreation and tourism, and timber harvesting) have the potential to interact cumulatively with these effects (Table 37.6-66).

37.6.13.4 Mitigation and Monitoring for Cumulative Effects on Social Valued Components

37.6.13.4.1 Community Demographics, Infrastructure, and Services

Management practices, monitoring, and adaptive management will be implemented to mitigate and enhance the potential Project effects on community demographics, infrastructure and services. This includes the Labour Recruitment and Retention Strategy, the Workforce training Strategy, timely Project updates to communities,, and the Employee Assistance Program.

Table 37.6-66. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Community Well-being

Description of KSM Residual Effect	NTL	Red Chris Mine	Future Mine and Hydroelectric Projects	Commercial Land Use Activities
Increase in financial independence and access to goods and services due to increased income (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in individual esteem and community pride due to employment (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in community pride due to reversal in population decline (beneficial)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in stress on families due to employment rotation schedules, and increase in substance misuse due to employment-related stress (adverse)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in substance misuse due to increase in income (adverse)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in social, mental health, and community safety issues in the short term as community support capacity is outpaced due to population change (adverse)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in emissions due to increased traffic volume in Stewart (adverse)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Increase in vehicle accidents due to increased traffic volume in Stewart (adverse)	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction

Changes in the tax base are predetermined by existing municipal, regional, and provincial regulatory frameworks; as such no specific mitigation is proposed. However, the Workforce Transition Program (Section 20.7.1.1) will assist in the transition of Project employees into new positions, helping to maintain the tax base due to income and consumer spending at Project closure.

There are no specific mitigation or management measures explicitly identified from other projects or activities to address effect on community demographics, infrastructure and services. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project.

There are no specific mitigation or management measures identified or expected from other projects or activities to address the effect of increased government revenues available to fund infrastructure and services.

37.6.13.4.2 Education, Skills, and Training

Management practices, monitoring, and adaptive management will be implemented to enhance the potential Project effects on education, skills, and training. This includes a Labour Recruitment and Retention Strategy, a Procurement Strategy, a Workforce Training Strategy, and timely updates to communities related to Project activities.

Management practices, monitoring, and adaptive management will be implemented to mitigate potential effects on community infrastructure and services, including education. On the basis of this information and increased tax revenue, local municipal governments and local educational institutions will be enabled to plan educational services and infrastructure to meet demand.

There are no specific mitigation or management measures explicitly identified from other projects or activities to address effects on education, skills, and training, including effects on educational facilities. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project.

37.6.13.4.3 Community Well-being

Management practices, monitoring, and adaptive management will be implemented to enhance potential effects on CWB due to employment and population change, work rotation schedules, and increases in income. This will include the Labour Recruitment and Retention Strategy, a Procurement Strategy, a Workforce Training Strategy, and providing timely Project updates to communities. This will also include financial management and general life skills training, a zero tolerance drug and alcohol policy, and an Employee Assistance Program.

As noted in Chapter 22, a number of measures will be put into place to mitigate the effects of traffic noise, air pollution, and traffic in Stewart. Project-related transport haulage load and dimensions will conform to prescribed limits and to all bulletins on seasonal axle weight restrictions. Appropriate traffic control measures will be implemented according to BC's Occupational Health and Safety Regulation (BC Reg. 296/97). Project vehicles will be required to adhere to the Traffic and Access Management Plan.

It is expected that other large resource development projects would adopt mitigation and management measures similar to those of the Project; however, no specific mitigation or management measures are identified from other projects or activities to address effects:

- due to change in population, effects on family stress, social and mental health, and substance misuse due to a change in employment;
- on financial independence, access to goods and services, or changes in income; or
- on the quality of the natural environment in Stewart due to a change in traffic, or effects on traffic safety in Stewart.

37.6.13.5 Summary of Residual Cumulative Effects on Social Valued Components

37.6.13.5.1 Community Demographics and Infrastructure

Overall, a positive cumulative residual effect is predicted for community demographics, infrastructure, and services (Table 37.6-67). The total cumulative effect is assessed as being low in magnitude, regional in extent, long in duration, continuous in frequency, reversible in the short term, and neutral in context. The likelihood of the effect is assessed as high in probability and medium in confidence level. Consequently, the overall cumulative effect of the Project on community demographics, infrastructure and services is predicted to be **not significant (minor)**.

37.6.13.5.2 Education, Skills, and Training

Overall, beneficial cumulative residual effects are predicted for education, skills, and training (Table 37.6-68). The total cumulative effect is assessed as being low in magnitude, regional in extent, long in duration, continuous in frequency, reversible in the long term, and neutral in context. The likelihood of the effect is assessed as high in probability and medium in confidence level. Consequently, the overall cumulative effect of the Project on education, skills, and training is predicted to be **not significant (minor)**.

37.6.13.5.3 Community Well-being

In the cumulative effects assessment for CWB, as shown in Table 37.6-69, the predicted cumulative residual effects are deemed to be **not significant (minor)**, except regarding residual cumulative effects predicted due to a change in traffic through Stewart that was assessed for two development scenarios as the level of future industrial development relying on the port of Stewart is uncertain.

It is unlikely that all currently proposed mine projects will be developed at the same time. Therefore, two possible future scenarios were evaluated for potential overall cumulative effects on traffic safety in Stewart: 1) a "likely development" scenario, with one to three mining projects being concurrently in production, and 2) an "unlikely development" scenario where all or most projects go ahead as planned.

Under the unlikely development scenario, the Red Chris Mine and other foreseeable mining projects are expected to interact with the KSM Project to produce a cumulative impact on the quality of the environment by increasing vehicle emissions in Stewart. The increase in traffic volume is predicted to increase the magnitude of the effect from low to medium. All other significance ratings will remain the same, except for the confidence level which reduces somewhat, due to lack of information on the other projects and uncertainty regarding when projects will proceed. Due to the increased magnitude of the effect, the cumulative effect on quality of the natural environment is predicted to be **significant (major)**. Under the likely development scenario, the magnitude of the effect is expected to remain low. Consequently, the cumulative effect on the quality of the natural environment is predicted to be **not significant (moderate)**. Similarly, considering the increased magnitude of the effect in combination with existing road and traffic safety designs within the community, the cumulative effect on traffic safety in Stewart is predicted to be **not significant (moderate).** Under the likely development scenario, the magnitude of the effect is expected to remain low. Consequently, the cumulative effect on the quality of the natural environment is predicted to be **not significant (minor)**.

Table 37.6-67. Summary of Cumulative Residual Effects on Community Demographics, Infrastructure, and Services

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Altering of community demographics due to population growth (beneficial and/or adverse, depending on personal opinion)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Low	Low	High	High	High	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Demand on community infrastructure and services may outpace small LSA communities' capacity in the short term due to population growth (adverse)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Regional	Regional	Medium	Medium	Continuous	Continuous	Reversible short-term	Reversible short-term	Low	Low	High	High	High	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in government revenues to fund infrastructure and services due to Increased tax base (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Medium	Regional	Regional	Long	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	High	High	Not significant (minor)	Not signifcant (minor)	Not Required	Not Required
Overall Effect	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Regional	Regional	Long	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Low	Neutral	High	High	High	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-68. Summary of Cumulative Residual Effects on Education, Skills, and Training

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Increase in the educational profile of the local, regional and provincial workforce due to employment-related training and work experience (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities		Low	Low	Regional	Regional	Long	Long	Continuous	Continuous	Reversible short-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Improvement in the educational profile of LSA and RSA communities due to in-migration of skilled workers (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Improvement in the capacity of educational institutions due to population-fuelled demand (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Medium	Regional	Regional	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	Low	Low	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Overall Effect	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities		Low	Low	Regional	Regional	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-69. Summary of Cumulative Residual Effects on Community Well-being

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Increase in individual esteem and community pride due to employment (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in financial independence and access to goods and services due to increased income (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Regional	Regional	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	High	High	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in stress on families due to employment rotation schedules, and increase in substance misuse due to employment-related stress (adverse)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	Medium	Low	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in substance misuse due to increase in income (adverse)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Neutral	Neutral	High	High	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in community pride due to reversal in population decline (beneficial)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Low	Low	Low	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in social, mental health, and community safety issues in the short term as community support capacity is outpaced by population change (adverse)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Regional	Regional	Medium	Medium	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in emissions due to increased traffic volume in Stewart (adverse) (likely)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Low	Low	High	High	High	Medium	Not significant (minor)	Not significant (moderate)	Not Required	Not Required
Increase in emissions due to increased traffic volume in Stewart (adverse) (unlikely)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Medium	Community	Community	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Low	Low	High	High	High	Low	Not significant (minor)	Signficant (major)	Not Required	Required
Increase in vehicle accidents due to increased traffic volume in Stewart (adverse) (likely)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Increase in vehicle accidents due to increased traffic volume in Stewart (adverse) (unlikely)	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Medium	Community	Community	Long	Long	Regular	Regular	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Medium	Low	Not significant (minor)	Not significant (moderate)	Not Required	Required
Overall Effect	Red Chris Mine; future mine and hydroelectric projects; commecial land use activities	Operations	Low	Low	Community	Community	Long	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Low	Neutral	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required

37.6.14 Land Use

37.6.14.1 Summary of Project-specific Residual Effects on Land Use

Residual land use effects associated with the development of the Project were predicted in Chapter 22 on the following VCs: commercial recreation, guide outfitting and trapping; recreational hunting and fishing; and subsistence. Residual effects for all other land use VCs are not anticipated, except for on navigation which is assessed separately in Chapter 31, Navigable Waters (summarized in Section 37.6.17).

Three residual effects of the Project are predicted for commercial recreation, guide outfitting, and trapping. The first is restriction on access to land and resources to four commercial recreation licence holders (Last Frontier Heliskiing and guide outfitters) from Project development, infrastructure, fencing and access restrictions. Access restrictions are predicted to be **not significant (minor)** for all phases, applying throughout the LSA for all Project activities. During closure and post-closure, the effect is predicted to be restricted to the Treaty Creek access road and PTMA. The second residual effects is changes in sensory disturbances (expected to affect commercial recreation stakeholders, including The Explorer's League, Bear Mountaineering, and Last Frontier Heliskiing, as well as guide outfitter #61006), that are predicted to be **not-significant (minor)** for all Project phases. The third residual effect is a change in the amount of resources, specifically of wildlife resources to guide outfitter #601066, predicted to be **not significant (minor)** for construction and operation, and **not significant (minor)** during closure.

One residual effect is predicted for recreational hunting and fishing involving a change in the amount of resources (e.g., moose, black bears and grizzly bears in the LSA and RSA) for resident hunters; this effect is predicted to be **not significant (minor)** for construction and operation, and **not significant (minor)** during closure.

Two residual effects are anticipated for subsistence. The first is a **not significant (minor)** effect due to access restrictions for subsistence harvesters in the LSA during all Project phases. The second is a result of a change in resources available to Aboriginal and non-Aboriginal hunters as a result of the Project. Based on limited historical and current use of the Project area by subsistence harvesters, and that healthy wildlife populations in the regional area exist that provide alternate subsistence opportunities, the adverse effect of the Project on subsistence harvesters is predicted to be **not significant (minor)** for construction and operation, and **not significant (minor)** during closure.

37.6.14.2 Cumulative Assessment Boundaries for Land Use

The spatial boundary for the land use CEA is based on the RSA used for the Project-specific land use effects assessment (Figure 37.6-16). A number of projects and activities may interact spatially with the KSM Project on land use. The past projects and activities that may affect land users and that may spatially overlap with residual effects from the KSM Project are: the Eskay Creek Mine; the Granduc Mine; Snip Mine; Johnny Mountain Mine; the Sulphurets Project; fishing, traffic, and roads; and past forestry activities.

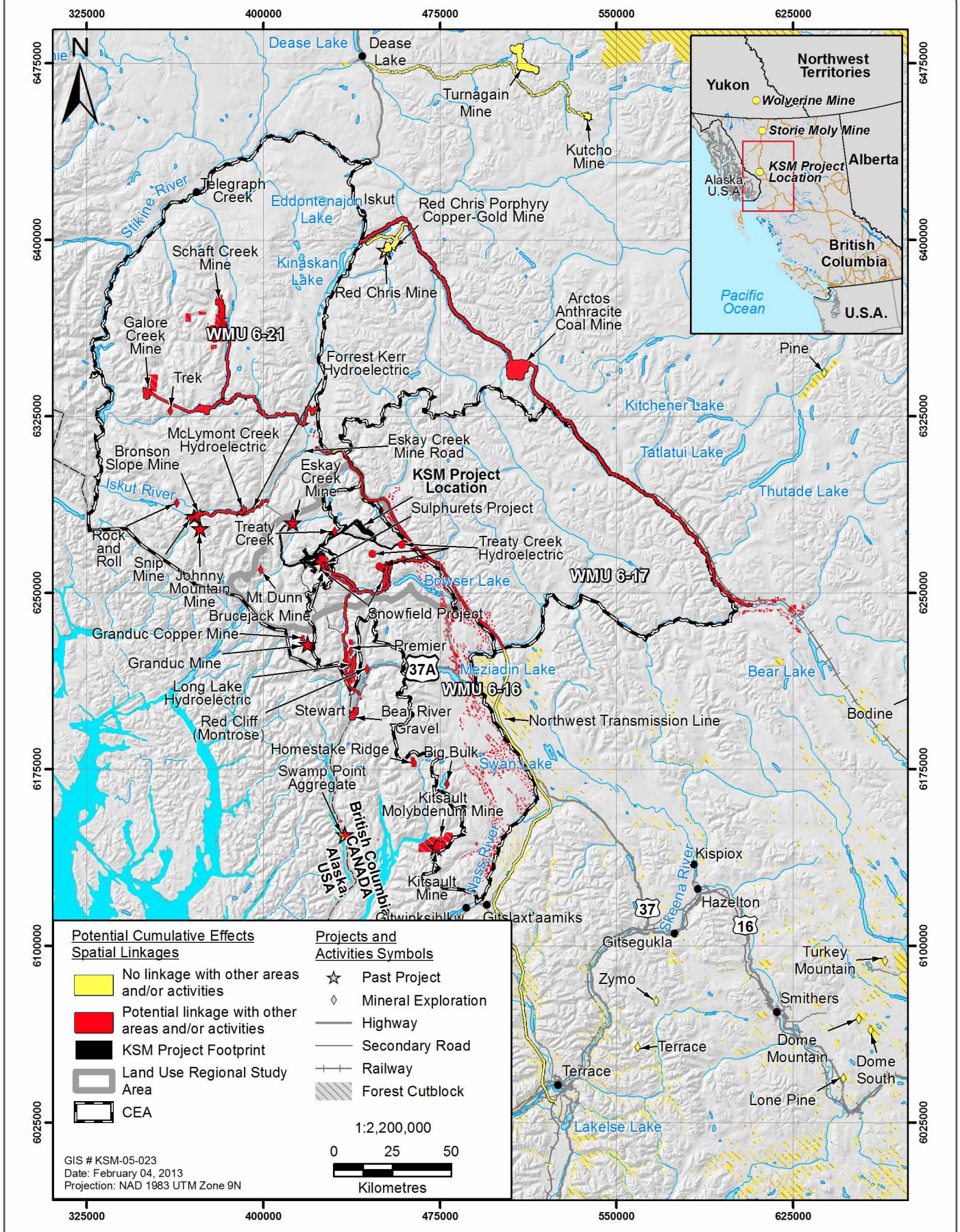

Figure 37.6-16

KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Land Use

SEABRIDGE GOLD
KSM PROJECT

Rescan
Engineers & Scientists

Present and future projects and human activities with potential effects to land users that overlap spatially with residual effects from the KSM Project include:

- the NTL (access corridor overlaps);
- the Forest Kerr Hydroelectric (access corridor overlaps);
- the Arctos Anthracite Coal Project;
- Schaft Creek Mine;
- Galore Creek Mine;
- Bronson Slope Mine;
- the Brucejack Mine (access corridor overlaps);
- the Snowfield Project (access corridor overlaps);
- the Granduc Copper Mine (access corridor overlaps);
- the McClymont Creek Hydroelectric (access corridor overlaps);
- the Treaty Creek Hydroelectric (access corridor overlaps);
- Long Lake Hydroelectric;
- fishing;
- guide outfitting;
- resident and aboriginal harvest;
- possible future mineral and energy resource exploration;
- possible future forestry activities; and
- traffic and roads.

Effects to land users from past projects and human activities may temporally overlap with residual effects from the KSM Project changes if the activities persist in the land use environment or if habitat has not had sufficient time to recover from past effects. Past projects and human activities that may overlap temporally with KSM Project are:

- the Eskay Creek Mine;
- the Granduc Mine;
- the Sulphurets Project;
- Snip Mine;
- Johnny Mountain Mine;
- fishing;
- guide outfitting;
- resident and aboriginal harvest;
- mineral exploration;
- traffic and roads; and
- forestry activities.

37.6.14.3 Cumulative Effects Assessment for Land Use

Present and future projects and human activities with potential effects to land users that could overlap temporally with residual effects from the KSM Project are previously listed above. Table 37.6-70 summarizes projects and activities with the potential to interact cumulatively with expected Project-specific residual effects on land use.

37.6.14.3.1 Commercial Recreation, Guide Outfitting and Trapping

The Project is predicted to have non-significant residual effects on commercial recreation, guide outfitting and trapping during all Project phases. Past mining projects, future mine and hydroelectric projects, and commercial land use activities such as energy and mineral resource exploration and timber harvesting, have the potential to interact cumulatively with this effect due to the additional restrictions on access to land and resources, as well as additional noise, traffic and infrastructure disturbances and change in the amount of harvested resources. Activities such as fishing, guide outfitting and resident/Aboriginal harvest are also expected to act cumulatively with the KSM Project due to the associated use of harvested resources. Altered or restricted access, sensory disturbance and change in resources are all predicted to lead to cumulative effects on altered or restricted access, assessed for all Project phases.

37.6.14.3.2 Recreational Hunting and Fishing

Recreational hunting within the RSA is predicted to have a number of residual effects for resident hunters during all Project phases due to a change in the amount of resources. Past mining projects, present and future mine and hydroelectric projects, and commercial land use activities, such as mineral and energy resource exploration and timber harvesting, have the potential to interact cumulatively with this effect due to additional loss of habitat, wildlife mortality and opening up of resources to increased pressures. Activities such as fishing, guide outfitting and resident/Aboriginal harvest are also expected to act cumulatively with the KSM Project.

37.6.14.3.3 Subsistence

The Project is predicted to have a number of non-significant residual effects on subsistence harvest users, notably Skii km Lax Ha and potentially Tahltan members, during all Project phases. Past mining projects, future mine and hydroelectric projects, and commercial land use activities such as energy and mineral resource exploration and timber harvesting, have the potential to interact cumulatively with this effect due to the additional restrictions on access to subsistence users, as well as additional changes in the amount of harvested resources due to habitat loss, wildlife mortality and disruption of movement. Activities such as fishing, guide outfitting and resident harvest are also expected to act cumulatively with the KSM Project due to the associated use of harvested resources.

Table 37.6-70. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Commercial Recreation, Guide Outfitting and Trapping; Recreational Hunting and Fishing; and Subsistence

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities												
	Eskay Creek Mine	Granduc Mine	Johnny Mountain Mine	Snip Mine	Kitsault Mine (Closed)	Sulphurets Project	Fishing	Guide Outfitting	Resident/ Aboriginal Harvest	NTL	Forest Kerr Hydroelectric	Schaft Creek Mine	Galore Creek Mine
Restricted access to commercial land user licence areas.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Restricted access to subsistence harvest for certain land users.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Noise, traffic and observation of project-related infrastructure in the landscape could alter practice areas and/or reduce economic opportunities for commercial licence holders due to a perceived reduction in the quality of the land user experience.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Wildlife resources diminished for guide outfitters due to habitat loss and increased strain on harvest resources.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Wildlife resources diminished for resident hunters due to habitat loss and increased strain on harvest resources.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Wildlife resources diminished for subsistence users due to habitat loss and increased strain on harvest resources.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

(continued)

Table 37.6-70. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Commercial Recreation, Guide Outfitting and Trapping; Recreational Hunting and Fishing; and Subsistence (completed)

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities (cont'd)										
	Bronson Slope Mine	**Brucejack Mine**	**Snowfield Project**	**Arctos Anthracite Coal Project**	**Granduc Copper Mine**	**McClymont Creek Hydroelectric**	**Treaty Creek Hydroelectric**	**Long Lake Hydroelectric**	**Mineral and Resource Exploitation**	**Traffic and Roads**	**Timber Harvesting**
Access to commercial land user licence areas will remain restricted.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction
Access to subsistence harvest areas will remain restricted for certain land users.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction
Noise, traffic and observation of project-related infrastructure in the landscape could alter practice areas and/or reduce economic opportunities for commercial licence holders due to a perceived reduction in the quality of the land user experience.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Wildlife resources diminished for guide outfitters due to habitat loss and increased strain on harvest resources.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Wildlife resources diminished for resident hunters due to habitat loss and increased strain on harvest resources.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction
Wildlife resources diminished for subsistence users due to habitat loss and increased strain on harvest resources.	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction	Possible Interaction

37.6.14.4 Mitigation and Monitoring for Cumulative Effects on Land Use

37.6.14.4.1 Restrictions on Access to Land and Resources

Access restrictions will be limited to access corridors and the Project footprint. Negotiated agreements designed to offset potential economic or subsistence-related losses from reduced access to the land and resources due to the Project may be pursued on a case-by-case basis with identified adversely impacted land users. There are no specific mitigation or management measures expected from other projects or activities to address the effect of altered or restricted access; however, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the Project.

37.6.14.4.2 Sensory Disturbances

Management plans, monitoring and adaptive management will be implemented to mitigate sensory disturbances, including a (Section 26.22), Traffic and Access Management Plan (Section 26.25), and visual quality mitigation.

The objective of the Noise Management Plan is to ensure that noise levels during all phases of the Project are acceptably low for human and wildlife receptors and receptors of concern in the vicinity of the project, as per human health guidelines (Health Canada 2011a). Details regarding mitigation with respect to the Traffic and Access Management Plan are provided in Chapter 26, Section 26.25.

A number of visual quality mitigation measures will be implemented as part of direct Project effects, including:

- design of roads will reduce effects on appearance of natural landscape wherever practical;
- tree buffers will be maintained on the side of access roads, where possible;
- tree buffers will be maintained around major infrastructure when infrastructure is potentially in view of land use areas where possible; and
- during closure, non-essential roads and infrastructure will be reclaimed and re-vegetated.

No additional mitigation measures are anticipated for cumulative effects. There are also no specific mitigation or management measures expected from other projects or activities to address the effects of sensory disturbances. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project. It is also expected that all other projects will comply with relevant government legislation with respect to noise and other emissions.

37.6.14.4.3 Change in the Amount of Resources

As part of Project effects mitigation, management plans related to sensory disturbances and their effects on resource quantity include: a Noise Management Plan, a Traffic and Access Management Plan, and mitigation of aesthetic disturbances. Potential effects from Project development and traffic on wildlife, fish and aquatic resources will be mitigated through the Wildlife and Wildlife Habitat Management Plan, as well as the Fish and Aquatic Habitat

Management Plan (and the Vegetation Clearing Management Plan. Added pressures on harvest resources (fish, vegetative and wildlife) due to potentially increased access to the study areas will be mitigated primarily through the Traffic and Access Management Plan. Monitoring and adaptive management will also be implemented to determine if additional measures are required for cumulative effects.

There are no specific mitigation or management measures expected from other projects or activities to address quantity of resources. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project. It is also expected that all other projects will comply with relevant government legislation with respect noise, wildlife, and fish and fish habitat, among others.

37.6.14.5 Summary of Residual Cumulative Effects on Land Use

37.6.14.5.1 Commercial Recreation, Guide Outfitting and Trapping

Restrictions on Access to Land and Resources

With the additional effects of past projects, future mine and hydroelectric projects, and commercial land use activities, the magnitude is predicted to remain medium as access restrictions will affect different land users to varying degree depending on the extent of their tenure area, though could potentially increase from negligible to low for post-closure. The extent and duration of the effect of restricted access is predicted to increase for all project phases, while all other residual effects ratings will remain the same (Table 37.6-71). The cumulative adverse effect of the Project on altered or restricted access is predicted to be **not significant (minor)** during all Project phases due to the small footprint of Projects in the broader region and the limited number of commercial recreation licence holders potentially affected.

Sensory Disturbances

With the additional effects of past projects, future mine and hydroelectric projects, and commercial land use activities, the magnitude and duration of the effect of sensory disturbance is predicted to increase, while all other residual effects ratings are predicted to remain the same (Table 37.6-71). The cumulative effect of sensory disturbance is assessed as **not significant (minor)** for all Project phases.

Change in the Amount of Resources

With the additional effects of past projects, future mine and hydroelectric projects, and commercial land use activities, as well as resident/Aboriginal harvest and guide outfitting, the magnitude and duration of the effect on quantity of resources for resident hunters is predicted to increase, while all other residual effects ratings are predicted to remain the same (Table 37.6-71). The cumulative effect of change in the amount of resources from the Project in conjunction with the corresponding effects of other projects and activities is assessed as **not significant (moderate)** for all Project phases.

Table 37.6-71. Summary of Residual Cumulative Effects on Commercial Recreation, Guide Outfitting and Trapping

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Access to certain areas within commercial licence tenures will remain restricted	Past mining projects; present and foreseeable future mining and hydroelectric projects; commercial land use activities	Construction	Medium	Medium	Local	Landscape	Medium	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Operations	Medium	Medium	Local	Landscape	Long	Long	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Closure	Medium	Medium	Local	Landscape	Medium	Long	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Post-closure	Negligible	Low	Local	Landscape	Far future	Far future	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Noise, traffic and observation of project-related infrastructure in the landscape could alter practice areas and/or reduce economic opportunities for commercial licence holders due to a perceived reduction in the quality of the land user experience.	Past mining projects; present and foreseeable future mining and hydroelectric projects; commercial land use activities	Construction	Medium	High	Regional	Regional	Medium	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Operations	Medium	High	Regional	Regional	Long	Far future	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Closure	Medium	High	Landscape	Landscape	Medium	Long	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Post-closure	Negligible	Low	Local	Landscape	Far future	Far future	Sporadic	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	Low	Low	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Wildlife resources diminished for guide outfitters and trappers due to habitat loss and increased strain on harvest resources.	Past mining projects; present and foreseeable future mining and hydroelectric projects; commercial land use activities; resident/Aboriginal harvest; guide outfitting activities	Construction	Medium	Medium	Regional	Regional	Medium	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	Medium	Not Significant (Moderate)	Not significant (Moderate)	Not Required	Not Required
		Operations	Medium	Medium	Regional	Regional	Long	Far future	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	Medium	Not Significant (Moderate)	Not significant (Moderate)	Not Required	Not Required
		Closure	Low	Low	Landscape	Regional	Medium	Long	Regular	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Medium	High	Medium	Not Significant (Minor)	Not significant (Moderate)	Not Required	Not Required

Note: CE = Cumulative Effect.
*** Cumulative residual effects on navigation are listed in Chapter 31 – Navigation in Table 31.9-2.**

37.6.14.5.2 Recreational Hunting and Fishing

Change in the Amount of Resources

With the additional effects of past projects, future mine and hydroelectric projects, and commercial land use activities, as well as resident/Aboriginal harvest and guide outfitting, the duration of the effect on the amount of resources is predicted to increase, while all other residual effects ratings are predicted to remain the same (Table 37.6-72). Magnitude is also predicted to remain the same due to the limited number of commercial recreation holders affected. The cumulative effect of change in the amount of resources is assessed as **not significant (moderate)** for all Project phases.

37.6.14.5.3 Subsistence

Restrictions on Access to Land and Resources

With the additional effects of past projects, future mine and hydroelectric projects, and commercial land use activities, the magnitude, extent and duration is predicted to increase for all phases, while all other residual effects ratings will remain the same (Table 37.6-73). However, the cumulative adverse effect of the Project on altered or restricted access is predicted to remain **not significant (minor)** during all Project phases as effects are predicted to be limited to accessing traplines 617T015 and 617T011 (i.e., restricted access is not predicted to act cumulatively on other subsistence uses).

Change in the Amount of Resources

With the additional effects of past projects, future mine and hydroelectric projects, and commercial land use activities, as well as resident/Aboriginal harvest and guide outfitting, the magnitude and duration of the effect on the amount of resources is predicted to increase for construction, operation and closure, while all other residual effects ratings are predicted to remain the same (Table 37.6-73). The cumulative effect of change in the amount of resources to subsistence users is assessed as **not significant (moderate)** for all Project phases.

37.6.15 Visual and Aesthetic Resources

37.6.15.1 Summary of Project-specific Residual Effects to Visual and Aesthetic Resources

In general, effects to visual and aesthetic resources can result from Project activities like stripping and clearing, and foundation preparation for proposed mine infrastructure (Chapter 24). The alteration of land cover begins in the Project construction phase and may persist into the operation phase due to the ongoing presence of the cleared areas. During closure, potential long-term effects may be reduced through reclamation re-vegetation.

Potential residual effects on visual and aesthetic resources were assessed for six VCs: visual quality for river rafting tours; visual quality for heli-skiing tours; visual quality for guided backcountry expeditions; visual quality for guided angling trips; visual quality for visitors to the Treaty Creek Site (*Nisga'a Final Agreement Act* [2000]); and visual quality for Highway 37 users. Of these five were predicted to have residual effects (to all but visitors to the Treaty Creek Site).

CCAR (built during construction) is predicted to have a residual effect on river rafting tours on the Unuk River As this will only affect a small portion of the river (and be decommissioned and reclaimed in post-closure), this residual effect is determined to be **not significant (minor)**. Similarly, TCAR is predicted to have a **not significant (minor)** residual effect on heli-skiing tours. In the Mine Site, the mine pits also have the potential to cause a residual effect with medium magnitude on heli-skiing tours during construction and operation, leading to a **not significant (minor)** rating for the assessed heli-skiing runs.

The TMF could create a residual effect on visual quality for guided backcountry expeditions (dependent on the height of the nearby surrounding trees), which is deemed to be **not significant (minor)**. In the Mine Site, the mine pits could also have a residual effect on guided backcountry expeditions, particularly on the extreme northwest section of the top of the Knipple Glacier; this effect is rated as **not significant (minor)**.

The Bell-Irving River Bridge along TCAR (built during construction) could have a residual effect on angling trips on the Bell-Irving River for no more than a 1 km stretch of the river where the bridge might be seen, leading to a residual effect determined to be **not significant (minor)**. TCAR, the transmission line, and Camp 12 (Highway 37 Construction Camp) could also create a residual effect on visual quality for users of Highway 37, depending on the height of the nearby surrounding trees; this potential residual effect is deemed as **not significant (minor)**.

37.6.15.2 Cumulative Assessment Boundaries for Visual and Aesthetic Resources

A viewshed analysis was performed using infrastructure from projects with potential spatial linkages. Each project viewshed analysis result was then compared to the baseline KSM Project infrastructure viewshed to identify overlap where the KSM Project and other projects and activities that may be seen from the same position. The cumulative viewshed analysis identified several other projects and activities that may be visible at locations within the visual quality study area where KSM Project infrastructure is also visible (Figure 37.6-17).

Six projects/activities and Highway 37 may be visible from locations when KSM Project infrastructure is also visible:

- the proposed Brucejack Mine;
- the Eskay Creek Mine;
- the Treaty Creek Hydroelectric Project;
- the NTL;
- past timber harvesting;
- the Snowfield Project; and
- Highway 37 (traffic from variety of projects and activities).

Views of all of the six projects and Highway 37 will overlap temporally with the KSM Project. Each project will have the potential to be seen at the same time as the KSM Project at some point at each phase of the KSM Project.

Table 37.6-72. Summary of Residual Cumulative Effects on Recreational Hunting and Fishing

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Wildlife resources diminished for resident hunters due to habitat loss and increased strain on harvest resources.	Past mining projects; present and foreseeable future mining and hydroelectric projects; commercial land use activities; resident/Aboriginal harvest; guide outfitting activities	Construction	Medium	High	Regional	Regional	Medium	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	Medium	Not Significant (Moderate)	Not significant (Moderate)	Not Required	Not Required
		Operation	Medium	High	Regional	Regional	Long	Far future	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	Medium	Not Significant (Moderate)	Not significant (Moderate)	Not Required	Not Required
		Closure	Low	Medium	Landscape	Regional	Medium	Long	Regular	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Medium	High	Medium	Not Significant (Minor)	Not significant (Moderate)	Not Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-73. Summary of Residual Cumulative Effects on Subsistence

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Access to subsistence areas, including trapline 617T015 and 617T011, will remain restricted for certain land users.	Past mining projects; present and foreseeable future mining and hydroelectric projects; commercial land use activities	Construction	Low	Medium	Local	Landscape	Medium	Long	Continuous	Continuous	Reversible short-term	Reversible short-term	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Required	Not Required
		Operations	Low	Medium	Local	Landscape	Long	Long	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	Medium	High	Medium	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Closure	Low	Medium	Local	Landscape	Medium	Medium	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	Medium	Medium	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
		Post-closure	Low	Medium	Local	Landscape	Far future	Far future	Continuous	Continuous	Irreversible	Irreversible	Neutral	Neutral	High	Medium	Medium	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Wildlife resources diminished for subsistence harvesters due to habitat loss and increased strain on harvest resources.	Past mining projects; present and foreseeable future mining and hydroelectric projects; commercial land use activities	Construction	Medium	High	Regional	Regional	Medium	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Required
		Operations	Medium	High	Regional	Regional	Long	Far future	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Medium	Medium	High	High	Not Significant (Moderate)	Not Significant (Moderate)	Not Required	Required
		Closure	Low	Medium	Landscape	Landscape	Medium	Long	Continuous	Continuous	Reversible long-term	Reversible long-term	Neutral	Neutral	Low	Medium	High	Medium	Not Significant (Minor)	Not Significant (Moderate)	Not Required	Required

Note: CE = Cumulative Effect.

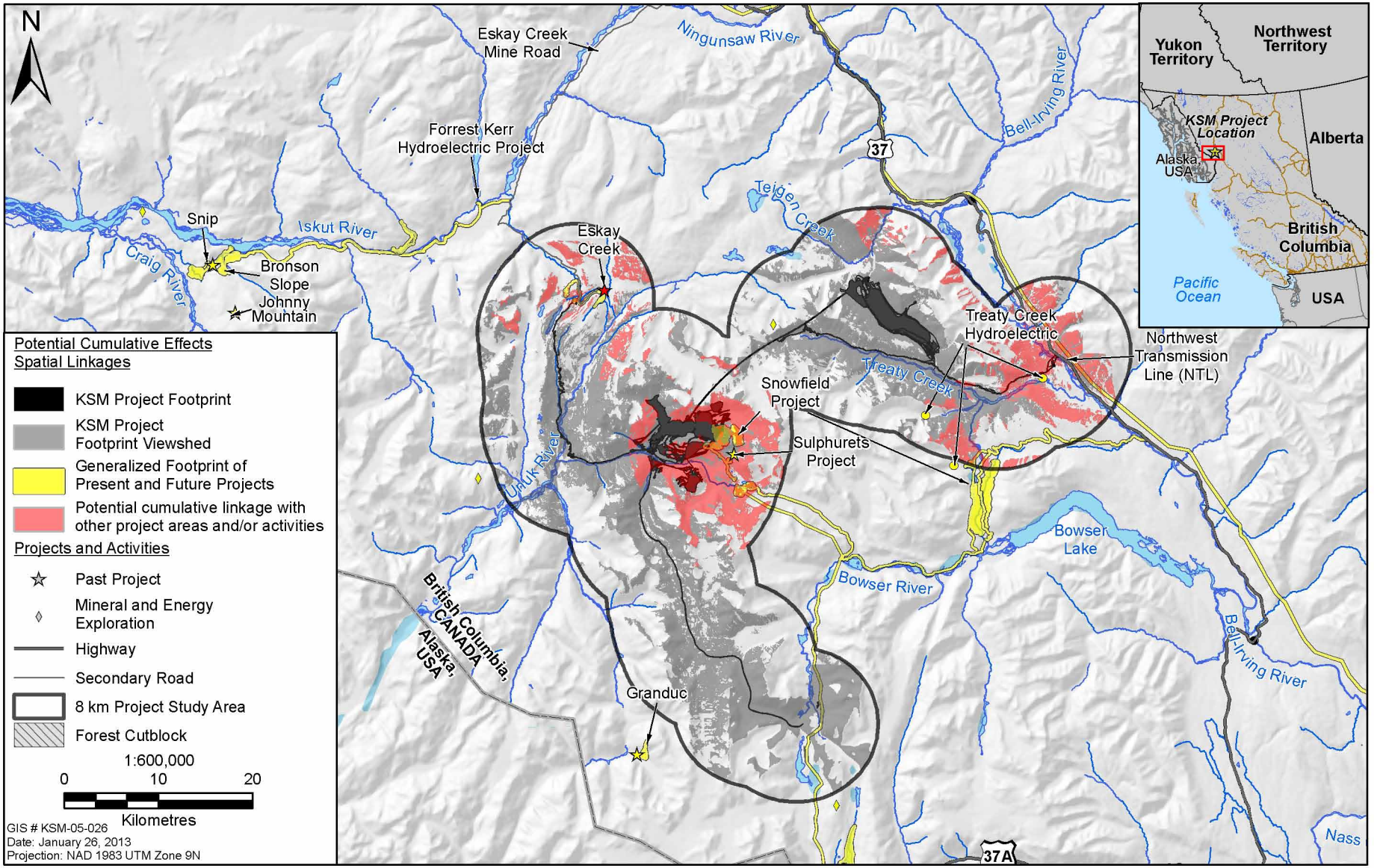

Figure 37.6-17

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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Visual and Aesthetic Resources

Figure 37.6-17

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37.6.15.3 Cumulative Effects Assessment for Visual and Aesthetic Resources

Of past, present and reasonably foreseeable future projects and activities identified that might interact with the KSM Project components and activities, the seven identified in the previous section were assessed for how the interact with the Project to produce residual cumulative effects as discussed below.

37.6.15.3.1 River Rafting Tours

The cumulative viewshed areas where the KSM Project CCAR components (i.e., Unuk River bridge) and other projects could potentially be seen at the same time were compared to the locations where river rafting tours travel. The comparison showed that other projects will not have an influence on rafters within the study area, so no residual cumulative effects are predicted on river rafting tours.

37.6.15.3.2 Heli-skiing Tours

The cumulative viewshed areas where the KSM Project and other projects could potentially be seen at the same time were compared to the locations where heli-skiing tours travel. The comparison showed that the proposed Brucejack Mine could have an influence on the cumulative effects on visual quality for heli-skiing tours in the study area. The result (Table 37.6-74) is a cumulative residual effect of a low level of alteration deemed to be **not significant (minor)**.

37.6.15.3.3 Guided Backcountry Tours

The cumulative viewshed areas where the KSM Project and other projects could potentially be seen at the same time were compared to the locations where guided backcountry expeditions travel. The comparison showed that the proposed Brucejack Mine and the NTL Project could have an influence on the cumulative effects of visual quality for guided backcountry expeditions in the study area. The result (Table 37.6-75) is a cumulative residual effect of a low level of alteration deemed to be **not significant (minor)**.

37.6.15.3.4 Guided Angling Trips

The cumulative viewshed areas where the KSM Project and other projects could potentially be seen at the same time were compared to the locations where guided angling trips travel. The comparison summarized in Table 37.6-76 showed that past timber harvesting will not create significant cumulative residual effect with the KSM Project at any of the assessed viewpoints, so this effect is assessed as **not significant (minor)**.

37.6.15.3.5 Users of Highway 37

No other projects are planned in areas where they could be viewed at the same time as the Project infrastructure by users of Highway 37, so there are no cumulative residual effects predicted.

Table 37.6-74. Summary of Residual Cumulative Effects on Alteration of Visual Quality for Heli-Skiing Tours

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
													Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
TMF could create adverse effect for skiers	Brucejack Mine	Construction	Low	Low	Regional	Regional	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	High	High	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Treaty Creek Access Road and transmission line could have an effect on visual quality for skiers		Construction	Low	Low	Landscape	Landscape	Long	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Pits could have an effect on visual quality for skiers	Brucejack Mine	Construction	Low	Low	Landscape	Landscape	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Low	Low	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Overall Effect	All	Construction	Low	Low	Landscape	Landscape	Far future	Far future	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-75. Summary of Residual Cumulative Effects on Alteration of Visual Quality for Guided Backcountry Expeditions

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
													Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
TMF could create adverse effect for guided backcountry expeditions	NTL Project	Construction	Low	Low	Landscape	Landscape	Far future	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Pits could have an effect on visual quality for guided backcountry expedition	Brucejack Mine	Construction	Low	Low	Landscape	Landscape	Far future	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	High	High	High	High	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Low	Low	Landscape	Landscape	Far future	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Medium	Medium	Medium	Medium	Not significant (minor)	Not significant (minor)	Not Required	Not Required

Note: CE = Cumulative Effect.

Table 37.6-76. Summary of Residual Cumulative Effects on Alteration of Visual Quality for Anglers

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
													Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Treaty Creek Access Road and bridge could create adverse effect for guided angling trips	Timber Harvesting	Construction	Medium	Medium	Local	Local	Long	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Medium	Medium	Low	Low	Not significant (minor)	Not significant (minor)	Not Required	Not Required
Overall Effect	All	Post-closure	Medium	Medium	Local	Local	Long	Long	Sporadic	Sporadic	Reversible long-term	Reversible long-term	Medium	Medium	Low	Low	Not significant (minor)	Not significant (minor)	Not Required	Not Required

Note: CE = Cumulative Effect.

37.6.15.4 Mitigation and Monitoring for Cumulative Effects on Visual and Aesthetic Resources

No additional mitigation will be used to reduce the potential cumulative effects of the proposed KSM Project on visual quality, apart from those already described in Section 24.7.

It is expected that other projects will adhere to the same regulations and conform to mitigation methods similar to those of the KSM Project.

37.6.15.5 Summary of Residual Cumulative Effects on Visual and Aesthetic Resources

There are three VCs that may experience residual cumulative effects on visual quality: heli-skiing tours, guided backcountry expeditions, and angling tours. All other visual quality VCs are not expected to experience residual cumulative effects.

The proposed Brucejack Mine could influence the visual quality of the viewpoint also affected by alteration of the landscape by the pits**.** The cumulative effect on the visual quality for heli-skiing tours (Table 37.6-60) will be **not significant (minor)** because the combined effect of the KSM Project and the Brucejack Mine will have a low level of alteration.

The cumulative effect on the visual quality for guided backcountry expeditions will be not significant as the combined effect of the KSM Project and the Brucejack Mine will have a low level of alteration and was assessed as **not significant (minor**; Table 37.6-75).

Past timber harvesting could increase the magnitude, extent, and duration of the effect on visual quality for angling trips, but does not change the intensity of effect and was assessed as **not significant (minor**; Table 37.6-76).

37.6.16 Human Health

37.6.16.1 Summary of Project-specific Residual Effects on Human Health

As described in Chapter 25, potential residual human health effects have been assessed based on is assessed based on nine descriptors (timing, magnitude, geographic extent, duration, frequency, reversibility, context, probability, and confidence). Residual effects are predicted on drinking water, air quality, quality of country foods, and noise as a result of the Project.

The assessment concluded that risks to human health from the ingestion of surface water are **not significant (minor)**. BC's ambient water quality guidelines for drinking water are not predicted to be exceeded during the operation, closure, and post-closure phases.

The Project is likely to have residual effects on human health from changes in air quality (in particular to incremental lifetime cancer risk (ILCR) and excess mortality due to an increase in concentration of $PM_{2.5}$) during construction and operation. However, these effects were assessed as **not significant (minor)**, because the air quality model (Chapter 7) indicated that no criteria air contaminant (CAC) levels were higher than BC air quality objectives and standards (BC MOE 2009). Due to some uncertainty in these predictions, follow-up monitoring of air quality parameters is required.

Residual effects on human health from the consumption of country foods at the PTMA and the Mine Site due to Project activities are predicted to be negligible during operation and closure. Human health effects from the ingestion of country foods have been assessed for operation, closure, and post-closure phases, and rated as **not significant (minor)**. During post-closure, upon cessation of Project activities, access by country food harvesters to the area may increase. Predicting the quality of country foods during post-closure has very high uncertainty associated with it. Therefore, should metal concentrations in water or soil be found at levels higher than applicable BC guidelines, a country foods risk assessment may be required to assess health risks at that time.

Noise effects only occur during Project activities during construction, operation, and closure, and residual effects are only expected for off-duty workers residing on-site in Camp 5 (Treaty Plant Camp), Camp 6 (Treaty Saddle Camp), and Treaty Operating Camp. Residual effects were not predicted for temporary and seasonal land users near the Project. Sleep disturbance for off-duty workers has been characterized as **not significant (minor)** during the construction phase and **not-significant (moderate)** during the operation phase at on-site locations.

37.6.16.2 Cumulative Assessment Boundaries for Human Health

Potential effects on humans could result from increased noise levels, changes in air quality and drinking water quality, and altered quality of country foods. Projects and human actions with a spatial overlap with the KSM Project's potential effects on surface water quality and air quality are shown in Figure 37.6-4 and 37.6-1, respectively. Potential noise effects from projects and human activities that may overlap with the KSM Project's potential effect on noise are shown on Figure 37.6-14. Potential country foods effects from projects and human activities that may overlap with the KSM Project's potential effect on country foods are shown in Figure 37.6-18.

Projects with potential cumulative effects include:

- Past Projects:
  - Eskay Creek Mine;
  - Granduc Mine; and
  - Sulphurets Project.
- Present Projects:
  - Forrest Kerr Hydroelectric; and
  - NTL.
- Reasonably Foreseeable Future Projects:
  - Brucejack Mine;
  - Snowfield Project; and
  - Treaty Creek Hydroelectric.
- Land Use Activities:
  - Roadway traffic.

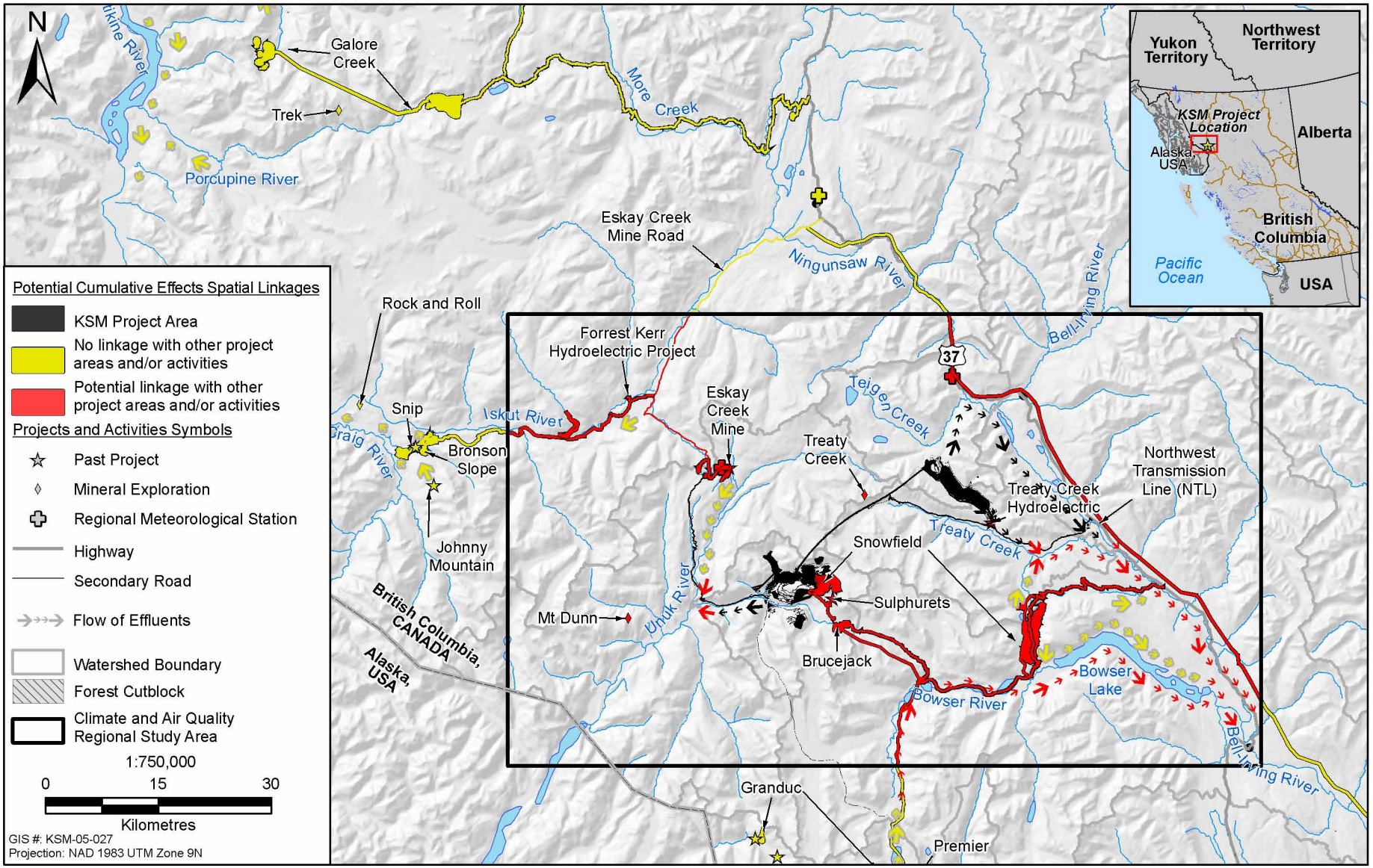

Figure 37.6-18

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KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Country Foods

Figure 37.6-18

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The following periods are evaluated as part of the CEAs:

1. **Past:** 1964 to 2008, coinciding with the development of the Granduc copper-gold mine, which influenced the growth of the community of Stewart and other human activities in the area (StewartBC.com 2004):
   - Past vehicle exhaust, particulates and tailing drainage from Eskay Creek Mine; previous dusting along the Eskay Creek Mine road and exposure of wildlife,
   - Past tailing drainage into Bowser River from Granduc Mine,
   - Past Tailing drainage into Sulphurets Creek from Sulphurets Mine,
   - Past land use activities that have affected the quantity of country foods available for harvest and consumption (fishing, guide-outfitting, resident- and aboriginal harvest), and
   - Past traffic dust and exhaust.
2. **Present:** 2008 to 2012, from the start of Project baseline studies to the completion of the environmental effects assessment:
   - Present air quality effects from maintenance vehicles at Eskay Creek Mine,
   - Present air quality from the construction of Forrest Kerr Hydroelectric and the NTL, should construction overlap with construction of the Project,
   - Noise from the construction of Forrest Kerr Hydroelectric and of the NTL if construction overlaps with construction of the Project.
   - Current land use activities that can affect the quantity of country foods available for harvest and consumption (fishing, guide-outfitting, resident- and aboriginal harvest, use of newly build access roads for increased harvesting), and
   - Present traffic dust and exhaust.
3. **Future:** 2013 until water quality recovers to baseline conditions (taking into account natural cycles of ecosystem change):
   - Air quality, noise and water quality effects from the construction and operation of Brucejack Mine, and exposure of wildlife,
   - Air quality, noise and water quality effects from the construction and operation of Snowfield Deposit, and exposure of wildlife,
   - Noise, dusting and water quality effects from the construction of Treaty Creek Hydroelectric.
   - Future land use activities that will affect the quantity of country foods available for harvest and consumption (fishing, guide-outfitting, resident- and aboriginal harvest, use of newly built access roads for increased harvesting), and
   - Future traffic dust and exhaust.

Possible interactions between projects due to spatial and temporal linkages are summarized in Table 37.6-77.

Table 37.6-77. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Human Health

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities														
	Eskay Creek Mine	**Granduc Mine**	**Johnny Mountain Mine**	**Snip Mine**	**Sulphurets Project**	**Forrest Kerr Hydroelectric Project**	**NTL (Northwest Transmission Line)**	**Bronson Slope Mine**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric Project**	**Fishing**	**Guide-outfitting**	**Resident and Aboriginal Harvest**	**Traffic and Roads**
Human health effects due to ingestion of metals from untreated **surface water** downstream of the Project	Possible Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Health effects from emissions of NO_2, SO_2, CO, TSP, $PM_{2.5}$, and PM_{10} related to Project rising above background, but below guidelines	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction
Increase in HQ for Metal Inhalation	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction
Increase in ILCR due to an increase in concentration of metals and $PM_{2.5}$	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction
Increase in risk of excess mortality due to increase in concentrations of $PM_{2.5}$	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction
Human health effects due to metal toxicity from ingestion of country foods	Possible Interaction	Possible Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction
Sleep Disturbance at Camps	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction	Possible Interaction	No Interaction	Possible Interaction	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	Possible Interaction

37.6.16.2.1 Drinking Water Quality

The residual effect to human health from drinking water was based on assessing temporal linkages and on an assessment of watershed boundaries and potential Project effects. For instance, if watersheds of other projects did not overlap with the watersheds downstream of the KSM Project (i.e., for the Sulphurets, Unuk, Teigen, Treaty, or Bell-Irving watersheds), then human health effects due to cumulative effects on drinking water are not likely to occur. As a result of comparing temporal and spatial linkages between the Project and other projects and activities listed in the previous section (as reported in detail in Chapter 25), no cumulative effects are predicted from interaction with the Eskay Creek Mine, Granduc Mine, Sulphurets Project, NTL, Brucejack Mine, Snowfield Project, or the Treaty Creek Hydroelectric Project as detailed below.

Since the Eskay Creek Mine, Granduc Mine, and the Sulphurets Project have ceased operation, effects to water quality have been assessed as part of the baseline water quality for the Project (2008 to 2013). Therefore, cumulative effects between the KSM Project and the Eskay Creek Mine, Granduc Mine, or Sulphurets Project are not expected.

There are no residual water quality effects from the KSM Project in the Bell-Irving River. Additionally, successful implementation of sedimentation and erosion control BMPs during construction of the NTL will minimize water quality effects (siltation) to the Bell-Irving River, so no cumulative effects on human health from drinking water are expected with the NTL.

For the Brucejack Mine, water quality effects will also be local in nature due to the underground design of the Project and back-up water treatment options (Section 14.9). Therefore, cumulative effects to drinking water between Brucejack Mine and the KSM Project are not expected.

The Snowfields Project is located upstream of the proposed water management structures (i.e., the WSF and WTP) for the KSM Project. At present, there are no plans for further exploration of the Snowfields property or activities to define how the project could be developed (Chapter 5). Therefore, cumulative effects to water quality-related human health were not assessed. No information is currently available on potential effects to water quality from the construction of Treaty Creek Hydroelectric either. No toxicological effects to drinking water and human health are expected from the construction of Treaty Creek Hydroelectric Project.

37.6.16.2.2 Cumulative Effects on Air Quality

Each of the projects with potential cumulative effects to air quality with spatial or temporal linkage with the KSM Project are discussed in Chapter 7 and reviewed in Chapter 25 regarding human health effects. The residual effects to human health from changes in air quality were not determined to have an interaction with effects from the closed Granduc Mine, Johnny Mountain Mine, Snip Mine, Bronson Slope Mine, and the Sulphurets Project as these four mines are located outside the air quality boundary.

Cumulative effects to human health between the KSM Project and the Eskay Creek Mine or the NTL are not expected as there are no temporal linkages between these projects. Regarding traffic and roads, exhaust from vehicles used to continue monitoring at the Eskay Creek Mine and construct and monitor other projects is also considered negligible compared to traffic from the KSM Project, therefore not leading to cumulative effects.

The construction phase of the Forrest Kerr Hydroelectric project will end before construction of KSM begins; therefore, there is no temporal linkage to cumulative effects. During operation of the hydroelectric power facility, expected activities include some vehicle travel for inspection, maintenance, and employee travel. Provided that the activity level for the Forrest Kerr project is low during operation, there will be no cumulative effect to human health due to air quality.

The Snowfield property is located within the Sulphurets District immediately adjacent to the KSM Project, and partially inside the KSM Project fence line. The proponent of the project has indicated that the exploration and development of the Snowfield deposit has stopped (Chapter 5), therefore, there is no temporal overlap with the KSM Project and cumulative effects are not expected.

Temporal and spatial linkages between the Brucejack Mine and the KSM Project exist and potentially have cumulative effects on air quality and human health. Emissions from the Brucejack underground mining operation are expected to be low and controlled. Project design will minimize fugitive dust emissions (Rescan 2012). Due to the Brucejack Mine's relatively small size compared to KSM, the effect on air quality from Brucejack is expected to be much less than that from KSM. The KSM residual air quality effect is likely to be similar to the cumulative effect from the two projects combined. Although the cumulative effect in air quality between the Brucejack and KSM projects is likely, the magnitude increase of the residual effect to human health is expected to be minor.

The Treaty Creek Hydroelectric Project is in the very early planning stages and it is assumed for the purposes of the CEA that this project would not be constructed until 2017. Therefore, the construction of this small run-of-the-river project would overlap with the construction of KSM. At this time, it is not possible to provide a cumulative effect assessment for human health. Given the small size of the project and provided that the maintenance activity level for the operation of the Treaty Creek Hydroelectric Project is low, any potential increase to residual effects to human health due to changes in air quality is expected to be minor.

37.6.16.2.3 Cumulative Effects on Country Foods

The residual effect to human health from changes in the quality of country food was not expected to have an interaction with Johnny Mountain Mine, Snip Mine, and Bronson Slope Mine. Potential country foods effects at these mines are unlikely to have spatial linkage with the KSM Project due to a lack of overlap for effects to air quality and water quality.

Cumulative effects on human health from country foods were assessed by considering the following components:

- the potential for cumulative effects on water quality;
- the potential for cumulative increases in dust and metals deposition onto plants and soils; and
- cumulative effects on wildlife quality.

Based on an assessment of cumulative effects to water quality, air quality, and wildlife, no cumulative effects to human health from the consumption of country food were identified, as outlined below.

Regarding water quality, cumulative effects from past projects (Eskay Creek Mine, Granduc Mine, and Sulphurets Project) are included in the baseline assessment for country foods and no additional future cumulative effects are expected. No interactions are expected for the Brucejack Mine, since water quality effects for that project will be local. There is no information available currently on other projects in the foreseeable future (Snowfield Project and Treaty Creek Hydroelectric). Therefore, cumulative effects on country foods quality due to changes in water quality are not expected.

Regarding cumulative dusting and metal deposition, the Brucejack Mine project and the construction of Treaty Creek Hydroelectric Project were the only projects in the reasonably foreseeable future that will have cumulative effects on air quality. There is no information available currently for the Snowfield Project. Since the increase in the maximum 30-day dust deposition rate due to the KSM Project is only 0.07% from background, dust deposition is highly localized, and the Brucejack Mine Project will use an underground mining and milling process with minimal dust, it is expected that there will be no cumulative effects from dust deposition on soils and vegetation in areas suitable for human harvest or for wildlife consumption.

Regarding cumulative effects on wildlife quality, wildlife with large home ranges or migratory wildlife may be exposed to effects from chemical hazards from several projects even if there is no spatial linkage for water and air quality effects, as long as these projects are located within the animal's home range. Commonly harvested wildlife that were assessed for Project residual effects included moose, snowshoe hare, grouse, and non-migratory Dolly Varden. Except for moose, none of the assessed animals are migratory and home ranges are smaller than the Project footprint. Therefore, snowshoe hare, grouse, and non-migratory Dolly Varden are not expected to be exposed to cumulative effects from other projects. Most moose are not migratory and remain within one watershed in low elevation forested habitat. Any cumulative toxicological effects on moose from the KSM Project and from the Eskay Creek Mine have been included in the baseline country foods assessment and will not contribute to future cumulative effects. Because there are no cumulative effects on water quality or air quality (dust) in moose habitat (Section 18.9), no cumulative toxicological effects are expected for moose.

37.6.16.2.4 Noise

The residual effect to human health from elevated noise levels were not determined to have an interaction with either past projects or projects that are at a distance from the KSM Project. Noise effects generally diminish with distance from a source. Since most human-generated noise has been found to be undetectable within 5 km for a large industrial source, a 10-km range from Project activities is expected to conservatively encompass all potential acoustic effects of the proposed Project. Land use activities (fishing, guide-outfitting, resident and aboriginal harvest) are not expected to generate cumulative noise effects. Acoustic effects may lead to human health effects at residential receptors (construction and mining camps). Table 25.9-2 lists the potential

interactions between each of the projects and activities identified in the previous section as potentially having a cumulative effect with the KSM Project.

A detailed description of cumulative human health effects is provided in Sections 19.9.2.1 and 25.9.2.5. None of the other projects or activities are anticipated to have any interaction with the KSM Project. According to the model results presented in Appendix 19-A, all sources of noise, except blasting, reach background levels a distance away from other potential sources of noise. Additionally, each of these sources of noise are or will be significantly smaller than those from the KSM Project. The potential for non-significant cumulative effects relating to noise are limited to those receivers within approximately 1 km of the area where the KSM Project and Snowfield Project/Brucejack Mine are immediately adjacent to each other.

Assuming the Snowfield Project/Brucejack Mine produces an equivalent amount of noise to the KSM Project (which is a very conservative assumption given the relative size of the two planned projects), receivers in this vicinity will experience a maximum 3 dB cumulative effect. Noise, at exploration Camp 1, the current closest receiver, will still be below the limit and therefore no significant cumulative effects to human health are anticipated from the Snowfield Project/Brucejack Mine.

Cumulative effects from traffic-related noise at the closest residential receivers along the sections of highways 37 and 37A that are used by the KSM Project, Forest Kerr Hydroelectric Project, and Snowfield Project/Brucejack Mine are assessed in Chapter 22, Appendix 22-C.

37.6.16.3 Additional Mitigation and Monitoring for Cumulative Effects on Human Health

37.6.16.3.1 Drinking Water Quality

No cumulative effects to human health from drinking water have been identified with respect to the Project; therefore, it is not necessary to identify further mitigation, monitoring, and management strategies. The Project has been designed with the goal to minimize adverse effects on water quality downstream of the Project area. Mitigation measures that are additional to those outlined in other sections of the Application/EIS are not anticipated to be required.

Requirements for other projects to monitor water quality and provide wastewater treatment, if necessary, will prevent cumulative effects to human health from surface drinking water, provided that the water is boiled as recommended by Health Canada (2011b).

37.6.16.3.2 Air Quality

Project-specific mitigation and monitoring measures for air quality are described in Section 7.8.1. Monitoring and adaptive mitigation for air quality effects, as described in Section 26.11, Air Quality Management Plan, and summarized in Section 25.7.2, will be implemented by the Proponent. These will include emissions and dust monitoring, and best management practices for vehicle maintenance, road maintenance, incineration, emissions control equipment, and transport and storage of tailing and concentrate. Any mitigation that results in an improvement to air quality will also reduce effects to human health.

It is expected that the Brucejack Mine Project will implement similar monitoring and adaptive management plans as the KSM Project to minimize potential cumulative effects on human health. Provided that mitigation for air quality at other projects is comparable to mitigation at the KSM Project, increases in residual effects to human health are expected to be minor. Air quality monitoring during construction of the projects will indicate whether BC air quality guidelines are met, and whether further mitigation and monitoring will be required.

37.6.16.3.3 Country Foods

No cumulative effects to human health from country foods have been identified; therefore, it is not necessary to identify further Project mitigation, monitoring, and management strategies. A monitoring and adaptive management plan is proposed to ensure that the wetlands and aquatic invertebrates in the TMF do not accumulate metals to levels that may result in accumulation in wildlife species that consume them, and therefore may lead to human health effects.

No cumulative effects to human health from country foods have been identified; therefore, it is not necessary to identify further mitigation, monitoring, and management strategies.

37.6.16.3.4 Noise

No significant cumulative effects were identified for human health from noise at the PTMA and Mine Site. Therefore, it is not necessary to identify further mitigation, monitoring, and management strategies.

Assuming that other projects will apply the same mitigation strategies as the KSM Project, no significant cumulative effects to human health from noise are expected.

37.6.16.4 Summary of Residual Cumulative effects on Human Health

As outlined below and in Table 37.6-78, no residual cumulative effects were identified on human health except potentially relating to air quality. Follow-up monitoring was not deemed to be required for any of the residual effects.

37.6.16.4.1 Drinking Water Quality

No potential for residual cumulative human health effects and significance were identified for drinking water.

37.6.16.4.2 Air Quality

The only projects that can have the potential for cumulative health effects with the KSM Project based on air quality in the foreseeable future are the Brucejack Mine and the construction of the Treaty Creek Hydroelectric Project. The residual effect on air quality from Brucejack Mine is expected to be much lower than that from the KSM Project. Since the increase in residual cumulative air quality effect from the Project residual air quality effect is expected to be minor, the magnitude adjusted for cumulative effect for human health related to increases of NO_2, SO_2, CO, TSP, PM_{10}, and $PM_{2.5}$ above baseline, but below guideline, is low. The cumulative magnitude of the HQ for metal inhalation also likely remains low. Therefore, these potential cumulative effects have been rated as **not significant (minor)**.

Since there is no threshold for health effects from small particulates, the minor cumulative increase in $PM_{2.5}$ may lead to a medium cumulative magnitude for ILCR and excess death endpoints. The extent for cumulative human health effects becomes landscape-wide. Qualifiers for human health effects due to degradation of air quality from both projects are considered similar to qualifiers for health effects from the KSM Project alone, because health outcomes are similar: far-future duration, regular frequency, and reversible long term (Section 25.7.2). Health is highly valued by people. Due to the smaller sizes and designs of other Projects compared to the KSM Project, the probability of a cumulative effect actually occurring is low. Since an emission inventory has not yet been developed, and dispersion and risk models have not been conducted for the Brucejack Mine, the adjusted confidence level for cumulative effect is low. The cumulative effect on ILCR and excess death due to potential cumulative increases in $PM_{2.5}$ is considered **not significant (moderate**; Table 37.6-78**).**

37.6.16.4.3 Country Foods

No residual cumulative effects to human health from country foods have been identified (Table 37.6-78).

37.6.16.4.4 Noise

No residual cumulative effects are expected for human health from noise (Table 37.6-78).

37.6.17 Navigable Waters

37.6.17.1 Summary of Project-specific Residual Effects on Navigable Waters

The KSM Project was assessed for two main potential indirect residual effects involving reductions in safe navigation and access to navigable waters (Chapter 31).

Six potential residual adverse effects on navigation are identified with the Project: two relate to temporary reduced navigation safety at bridge crossings for the Unuk and Bell-Irving rivers during specific Project phases, two relate to temporary access restrictions to navigable waters for these same waterways, and two relate to potentially reduced navigation safety from intake pipes to support Fish Habitat Compensation sites throughout all Project phases for Taft and Glacier Creeks if deemed navigable by Transport Canada.

The residual effects from the Unuk and Bell-Irving river bridges are anticipated to be local in extent, short in duration (during construction for both bridges, and during the dismantling and reclamation of the Unuk River bridge during post-closure), sporadic in frequency (due to the brief temporal nature of bridge construction), reversible in the short term, of neutral context, and of high probability and confidence levels. As a result of the characterization of these four residual access and safety effects, their significance is determined to **be not significant (minor)** for both bridges.

The other two effects are anticipated from the potential development of two water intake pipes that may be needed to support fish habitat compensation plans; these pipes would likely be in-stream where they may impede safe navigation in Taft and Glacier creeks (although it remains with Transport Canada to determine whether these creeks are navigable). The residual effects from these pipes are anticipated to be: during all Project phases, of negligible magnitude, local in extent, enduring to the far-future, continuous, reversible, of neutral context, and of high probability and confidence level. For these reasons, the significance of the residual effects of the intake pipes is determined to be not **significant (minor)**.

Table 36.6-78. Summary of Residual Cumulative Effects on Human Health

Description of KSM Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Adjusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Human health effects due to ingestion of metals from untreated surface water from the TMF and downstream of Mine site	NTL, Brucejack Mine, Snowfields Project, Treaty Creek Hydroelectric Project	Operation	Negligible	N/A	Individual/ Household	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Low	N/A	Medium	N/A	Not Significant (minor)	N/A	Not Required	N/A
	NTL, Brucejack Mine, Snowfields Project, Treaty Creek Hydroelectric Project	Closure	Negligible	N/A	Individual/ Household	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Low	N/A	Medium	N/A	Not Significant (minor)	N/A	Not Required	N/A
	NTL, Brucejack Mine, Snowfields Project, Treaty Creek Hydroelectric Project	Post-closure	Low	N/A	Individual/ Household	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Low	N/A	Low	N/A	Not Significant (minor)	N/A	Not Required	N/A
Health effects from emissions of NO_2, SO_2, CO, TSP, $PM_{2.5}$, and PM_{10} related to Project rising above background, but below guidelines	Brucejack Mine, Treaty Creek Hydroelectric Project	Operation	Low	Low	Community	Landscape	Far future	Far future	Regular	Regular	Reversible long-term	Reversible long-term	High	High	Low	Low	Medium	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Increase in HQ for Metal Inhalation	Brucejack Mine, Treaty Creek Hydroelectric Project	Operation	Low	Low	Community	Landscape	Far future	Far future	Regular	Regular	Reversible long-term	Reversible long-term	High	High	Low	Low	Medium	Low	Not Significant (Minor)	Not Significant (Minor)	Not Required	Not Required
Increase in ILCR due to an increase in concentration of metals and $PM_{2.5}$	Brucejack Mine, Treaty Creek Hydroelectric Project	Construction	Low	Medium	Community	Landscape	Far future	Far future	Regular	Regular	Reversible long-term	Reversible long-term	High	High	Low	Low	Medium	Low	Not Significant (Minor)	Not Significant (Moderate)	Not Required	Not Required
	Brucejack Mine, Treaty Creek Hydroelectric Project	Operation	Low	Medium	Community	Landscape	Far future	Far future	Regular	Regular	Reversible long-term	Reversible long-term	High	High	Low	Low	Medium	Low	Not Significant (Minor)	Not Significant (Moderate)	Not Required	Not Required
Human health effects due to metal toxicity from ingestion of country foods	NTL, Brucejack Mine, Snowfields Project, Treaty Creek Hydroelectric Project	Operation	Negligible	N/A	Regional/ Aboriginal Peoples	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	High	Low	N/A	High	N/A	Not Significant (minor)	N/A	Not Required	N/A
	NTL, Brucejack Mine, Snowfields Project, Treaty Creek Hydroelectric Project	Closure	Negligible	N/A	Regional/ Aboriginal Peoples	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	High	Low	N/A	High	N/A	Not Significant (minor)	N/A	Not Required	N/A
	NTL, Brucejack Mine, Snowfields Project, Treaty Creek Hydroelectric Project	Post-closure	Low	N/A	Regional/ Aboriginal Peoples	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	High	Low	N/A	Low	N/A	Not Significant (Minor)	N/A	Not Required	N/A
Human health effects due to Noise: Sleep disturbance on site	Eskay Creek Mine, Brucejack Mine, NTL, Forest Kerr Hydroelectric Project, Traffic and Roads	Construction	High	N/A	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Medium	N/A	Medium	N/A	Not Significant (Minor)	N/A	Not Required	N/A
	Eskay Creek Mine, Brucejack Mine, Forest Kerr Hydroelectric Project, Traffic and Roads	Operation	High	N/A	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Moderate)	N/A	Not Required	N/A
Overall Effect	All	Post-closure	Low	N/A	Regional/ Aboriginal Peoples	N/A	Short	N/A	Sporadic	N/A	Reversible short-term	N/A	High	N/A	Low	N/A	Low	N/A	Not Significant (Minor)	N/A	Not Required	N/A

Note: CE = Cumulative Effect

37.6.17.2 Cumulative Effects Assessment Boundaries for Navigable Waters

Projects that have spatial linkages or temporal linkages with the KSM Project are shown in Figure 37.6-19). Past projects that are likely to spatially interact with potential effects of the Project on navigable waters are the Eskay Creek Mine, and the Sulphurets Project. Reasonably foreseeable future projects which are likely to interact with the KSM Project include the Brucejack Mine, the Snowfield Project, and Treaty Creek Hydroelectric. Current land use activities which are likely to interact with the KSM Project include: fishing; guide outfitting; harvesting by locals and Aboriginals; and recreation and tourism.

37.6.17.3 Cumulative Effects Assessment for Navigable Waters

The areas where Project-related residual effects and the residual effects from other projects could potentially interact with regards to navigable waters were examined. The comparison showed that other projects will not produce residual effects on safety or access regarding navigation in the study area (Table 37.6-79).

37.6.17.3.1 Cumulative Effects on Safe Navigation on the Unuk River

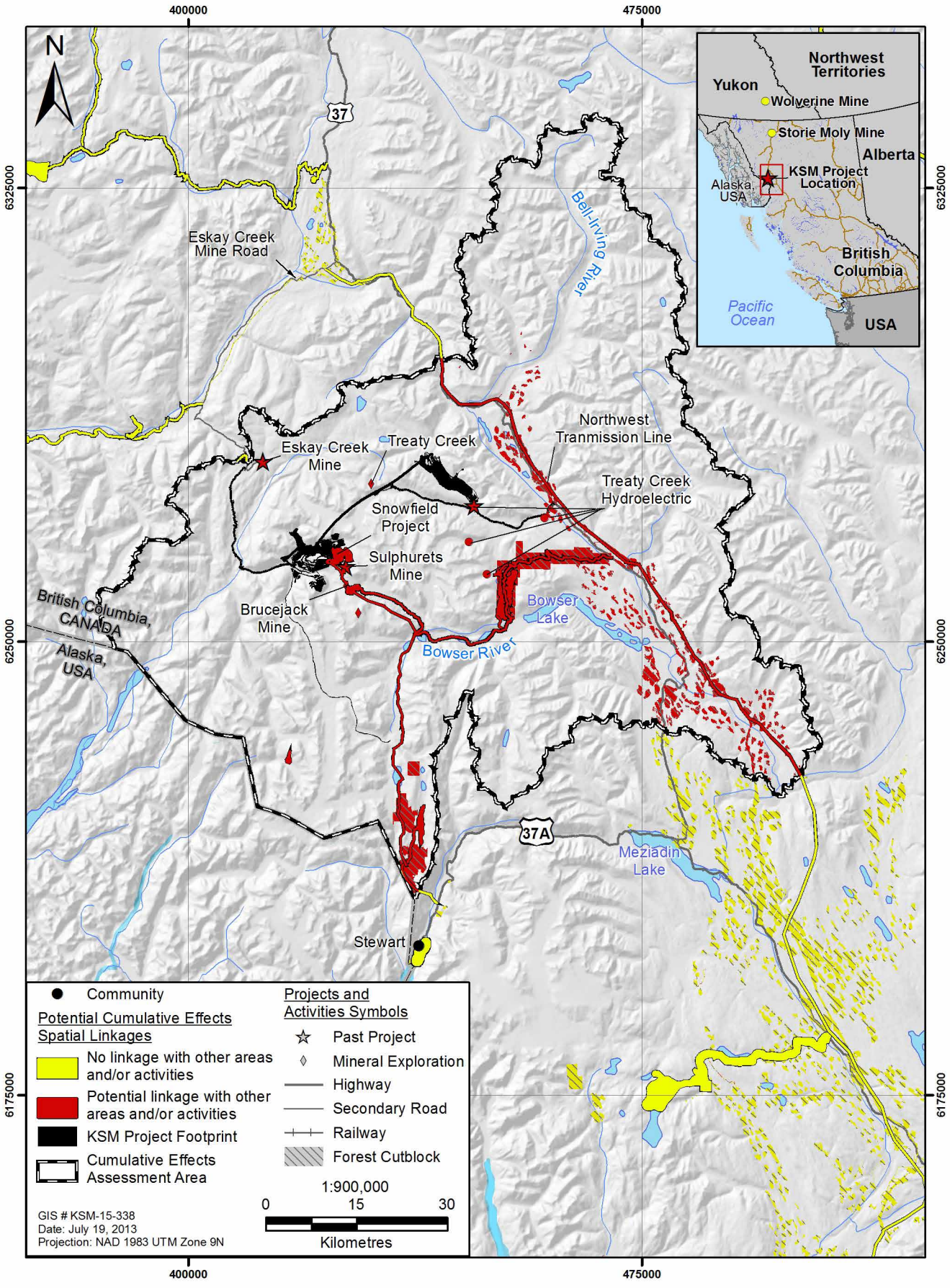
None of the considered projects involve infrastructure or components (such as towers or bridges) which could be developed on or near the Unuk River. While fishing, guide outfitting, local and Aboriginal harvest, and recreation and tourism occur on or in the vicinity of the Unuk River, none of these activities directly affect safe navigation. Consequently, **no cumulative effects** to safe navigation on the Unuk River are expected due to the lack of spatial overlap.

37.6.17.3.2 Cumulative Effects on Safe Navigation on the Bell-Irving River

Of the projects considered, the Eskay Creek Mine, Sulphurets Project, the NTL, Brucejack Mine, Snowfield Project, and Treaty Creek Hydroelectric hold the potential to interact with the Bell-Irving River (Table 31.9-2). However, four of these projects are unlikely to create effects to safe navigation. Roads associated with the Eskay Creek Mine and Sulphurets Project are already in place. The NTL crossing will be at a height sufficient to avoid interaction. Treaty Creek Hydroelectric will likely use the same bridge as the KSM Project due to its proximity with the proposed road and bridge crossing.

The Brucejack Mine and the Snowfield Project could interact cumulatively, as these proposed developments would likely require road and bridge access from Highway 37 which would cross over the Bell-Irving River. However, construction of this bridge would not overlap temporally with the bridge-building activities of the KSM Project.

Fishing, guide outfitting, harvesting by locals and Aboriginals, and recreation and tourism occur on or in the vicinity of the Bell-Irving River and use the river for navigation, but none of these activities adversely affect safe navigation. Consequently, **no cumulative effects** on safe navigation on the Bell-Irving River are expected.



KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Navigable Waters

Figure 37.6-19

SEABRIDGE GOLD
KSM PROJECT

Rescan
Engineers & Scientists

Table 37.6-79. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Navigable Waters

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities									
	Eskay Creek Mine	**Sulpherets Project**	**NTL**	**Brucejack Mine**	**Snowfield Project**	**Treaty Creek Hydroelectric**	**Fishing**	**Guide Outfitting**	**Local and Aboriginal Harvest**	**Recreation and Tourism**
Safety	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Accessibility	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

37.6.17.3.3 Cumulative Effects on Safe Navigation on Glacier Creek

No other project will interact with Glacier Creek. While fishing, guide outfitting, harvesting by locals and Aboriginals, and recreation and tourism might occur on or in the vicinity of Glacier Creek, none of these activities would directly affect safe navigation. Consequently, **no cumulative effects** on safe navigation on Glacier Creek are anticipated.

37.6.17.3.4 Cumulative Effects on Safe Navigation on Taft Creek

No other projects will interact with Taft Creek. While fishing, guide outfitting, local and Aboriginal harvest, and recreation and tourism might occur on or in the vicinity of Taft Creek, none of these activities would directly affect safe navigation. Consequently, **no cumulative effects** on safe navigation on Taft Creek are anticipated.

37.6.17.4 Cumulative Effects on Accessibility on the Unuk River

Of Project works considered, only the Unuk River Bridge interacts with the Unuk River. This three-span bridge will not normally affect accessibility (only potentially during brief construction and decommissioning activities), as it will be of sufficient height to allow for continued navigation. Fishing, guide outfitting, harvesting by locals and Aboriginals, and recreation and tourism occur on or in the vicinity of the Unuk River. However, none of these activities are likely to impede navigational access along the river. Consequently, **no cumulative effects** on accessibility for the Unuk River are anticipated.

37.6.17.5 Cumulative Effects on Accessibility to the Bell-Irving River

Of the projects considered, the Eskay Creek Mine, Sulphurets Project, NTL, Brucejack Mine, Snowfield Project, and Treaty Creek Hydroelectric hold the potential to interact with the Project's bridge across the Bell-Irving River (Table 31.9-2). An existing bridge and road associated with the Eskay Creek Mine and Sulphurets Project facilitates access to the river, which is considered a beneficial effect on access. The proposed Brucejack Mine road and bridge would also facilitate access should this project be developed. While construction of the latter bridge could temporarily hinder navigation along the river crossing, this would not overlap temporally with the KSM Project.

Fishing, guide outfitting, harvesting by locals and Aboriginals, and recreation and tourism rely on seasonal access to the Bell-Irving River and do not create direct access effects on navigation. Consequently, **no cumulative effects** on the Bell-Irving River are anticipated.

37.6.17.6 Overall Cumulative Effect on Navigable Waters

No cumulative effects for safety and access to navigable waters for the Unuk and Bell-Irving rivers or Glacier and Taft creeks are expected. Consequently, no overall cumulative effects are anticipated for navigable waters.

37.7 Summary

Table 37.7-1 summarizes the assessment of residual cumulative effects by discipline/VC.

Table 37.7-1. Significance of All Residual Cumulative Effects due to the KSM Project and other Past, Present, and Reasonably Foreseeable Future Projects and Activities

Discipline	Valued Component	Residual Cumulative Effect	CE Significance Rating
Air Quality	Air Quality	Change in ambient air quality	Not significant (moderate; construction); Not significant (minor; operation)
Air Quality	Air Quality	Overall change in ambient air quality	Not significant (minor)
Terrain, Surficial Geology, and Soils	Soil Quantity	Loss of land surface area under component footprint	Not significant (moderate)
Terrain, Surficial Geology, and Soils	Soil Quantity	Bulk erosion	Not significant (moderate)
Terrain, Surficial Geology, and Soils	Soil Quality	Decreased soil fertility in buffers surrounding components retained after closure	Not significant (minor)
Terrain, Surficial Geology, and Soils	Soil Quality	Soil compaction in buffers surrounding components retained after closure	Not significant (minor)
Terrain, Surficial Geology, and Soils	Soil Quality	Soil contamination in buffers surrounding components retained after closure	Not significant (minor)
Groundwater Quantity	Groundwater Quantity	Alteration of groundwater levels, flow rates and directions due to mine dewatering and water level management	Not significant (moderate)
Groundwater Quality	Groundwater Quality	Degradation of groundwater quality due to seepage of contact water	Not significant (moderate)
Fish and Aquatic Habitat	Bull Trout	Overall (direct mortality, noise, erosion and sedimentation, water quality degradation)	Not significant (minor)
Fish and Aquatic Habitat	Dolly Varden	Overall (direct mortality, noise, erosion and sedimentation, water quality degradation)	Not significant (moderate)
Fish and Aquatic Habitat	Rainbow Trout/Steelhead	Overall (direct mortality, noise, erosion and sedimentation, water quality degradation)	Not significant (moderate)

(continued)

Table 37.7-1. Significance of All Residual Cumulative Effects due to the KSM Project and other Past, Present, and Reasonably Foreseeable Future Projects and Activities (continued)

Discipline	Valued Component	Residual Cumulative Effect	CE Significance Rating
Fish and Aquatic Habitat	Pacific Salmon	Overall (direct mortality, noise, erosion and sedimentation, water quality degradation)	Not significant (moderate)
Fish and Aquatic Habitat	Aquatic Habitat	Overall (erosion and sedimentation, water quality degradation, habitat loss and alteration)	Not significant (minor)
Wetlands	Wetland Extend and Function	Loss of Wetland Extent and Function	Not significant (minor)
Terrestrial Ecosystems	Potential Pine Mushroom Habitat	Loss and degradation	Not significant (minor)
Terrestrial Ecosystems	Avalanche Track Ecosystems	Loss and degradation	Not significant (minor)
Terrestrial Ecosystems	Listed Ecosystems	Loss and degradation	Not significant (minor)
Terrestrial Ecosystems	Riparian and Floodplain Ecosystems	Loss and degradation	Not significant (minor)
Terrestrial Ecosystems	Alpine and Parkland Ecosystems	Loss and degradation	Not significant (minor)
Terrestrial Ecosystems	Old Forest Ecosystems	Loss and degradation	Not significant (minor)
Terrestrial Ecosystems	Other Terrestrial Ecosystems	Loss and degradation	Not significant (minor)
Wildlife	Moose	Overall (habitat loss, disruption of movement, and direct and indirect mortality)	Significant (major) for "unlikely development scenario"; Not significant (moderate) for "likely development scenario"
Wildlife	Mountain Goat	Overall (habitat loss, sensory disturbance, disruption of movement, and direct and indirect mortality)	Not Significant (moderate)
Wildlife	Grizzly Bears	Overall (habitat loss, disruption of movement, direct and indirect mortality, and attractants)	Not significant (moderate)

(continued)

Table 37.7-1. Significance of All Residual Cumulative Effects due to the KSM Project and other Past, Present, and Reasonably Foreseeable Future Projects and Activities (continued)

Discipline	Valued Component	Residual Cumulative Effect	CE Significance Rating
Wildlife	Black Bear	Overall (habitat loss, disruption of movement, direct and indirect mortality, and attractants)	Not significant (minor)
Wildlife	American Marten	Overall (habitat loss and direct mortality)	Not significant (minor)
Wildlife	Hoary Marmot	Overall (habitat loss and direct mortality)	Not significant (minor)
Wildlife	Raptors	Habitat Loss	Not significant (minor)
Wildlife	Wetland Birds	Overall (habitat loss and alteration)	Not significant (minor)
Wildlife	Forest and Alpine Birds	Habitat Loss	Not significant (minor)
Wildlife	Western Toads	Direct Mortality	Not significant (minor)
Noise	Noise	Sleep Disturbance	Not significant (moderate)
Noise	Noise	Interference with Speech Communication	Not significant (minor)
Noise	Noise	Complaints	Not significant (minor)
Noise	Noise	High Annoyance	Not significant (minor)
Noise	Noise	Noise-induced Rattling	Not significant (minor)
Noise	Noise	Loss of Wildlife Habitat	Not significant (moderate)
Economic	Employment and Income	Overall (direct, indirect and induced beneficial effects from Project and change in business activity)	Significant (major; beneficial)
Economic	Business Opportunities and Economic Development	Overall (beneficial effects on: business supplying Project and selling goods and services; to economic growth, investments and development of local business; and LSA and RSA development)	Not significant (moderate; beneficial)
Social	Community Demographics and Infrastructure	Overall (altering community demographics due to population growth; demand on community infrastructure; and increase in government revenues to fund infrastructure and services)	Not significant (minor; beneficial)

(continued)

Table 37.7-1. Significance of All Residual Cumulative Effects due to the KSM Project and other Past, Present, and Reasonably Foreseeable Future Projects and Activities (continued)

Discipline	Valued Component	Residual Cumulative Effect	CE Significance Rating
Social	Education, Skills, and Training	Overall (increase educational profile due to employment-related training and experience, due to in-migration of skilled workers, and improvement in capacity of educational institutions due to population-fueled demand)	Not significant (minor; beneficial)
Social	Community Well-being	Increase in individual esteem and community pride and financial independence.	Not significant (minor; beneficial)
Social	Community Well-being	Increase in stress on families, substance misuse, social/mental health, and community safety.	Not significant (minor)
Social	Community Well-Being	Vehicle emissions (increase in emissions like noise and exhaust due to increased traffic volume in Stewart)	Significant (major) for unlikely development scenario; Not significant (moderate) for likely development scenario
Social	Community Well-Being	Traffic safety (increase in vehicle accidents due to increased traffic volume in Stewart)	Not significant (moderate) for unlikely development scenario; Not significant (minor) for likely development scenario
Land Use	Commercial Recreation, Guide Outfitting and Trapping	Restriction of Access	Not significant (minor)
Land Use	Commercial Recreation, Guide Outfitting, and Trapping	Sensory Disturbance	Not significant (minor)
Land Use	Commercial Recreation, Guide Outfitting, and Trapping	Change in Amount of Resources for guide outfitters	Not significant (moderate)
Land Use	Recreational Hunting and Fishing	Change in Amount of Resources for resident hunters	Not significant (moderate)

(continued)

Table 37.7-1. Significance of All Residual Cumulative Effects due to the KSM Project and other Past, Present, and Reasonably Foreseeable Future Projects and Activities (completed)

Discipline	Valued Component	Residual Cumulative Effect	CE Significance Rating
Land Use	Subsistence	Restriction of Access	Not significant (minor)
Land Use	Subsistence	Change in Amount of Resources for substistence harvesters	Not significant (moderate)
Visual and Aesthetic Resources	Heli-skiing Tours	Overall from TMF, TCAR, transmission line and pit interactions	Not significant (minor)
Visual and Aesthetic Resources	Backcountry Expeditions	Overall from TMF and pit interactions	Not significant (minor)
Visual and Aesthetic Resources	Angling	Overall from TCAR and Bell-Irving River bridge interactions	Not significant (minor)
Human Health	Air Quality	Increase in risk of excess mortality or ILCR due to increase in emissions of metals and $PM_{2.5}$	Not significant (moderate)
Human Health	Air Quality	Health effects from air quality emissions rising above background but below guidelines; increase in HQ for metal inhalation	Not significant (minor)

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