fieldwork to assist in determining fish and fish habitat presence/absence at proposed Project watercourse crossings. The Fisheries Data Information System (FDIS) was the primary source of relevant existing and historical fish and fish habitat data. FDIS is a geo-referenced Geographical Information System (GIS) database of fish and fish habitat data overseen by Fisheries and Oceans Canada (DFO) and the BC Ministry of Environment (BC MOE). A number of baseline inventories and assessments were completed near the Project corridor, which were used for field assessments. These baseline inventories included:

- *Reconnaissance Level Stream Inventory of the Bell-Irving/Bowser Watershed: Watershed Code: 560 Volumes 1 – 3* (SKR 1998); and
- *Highway 37 Fish and Fish Habitat Inventory: Bell – Irving* (FINS 2004).

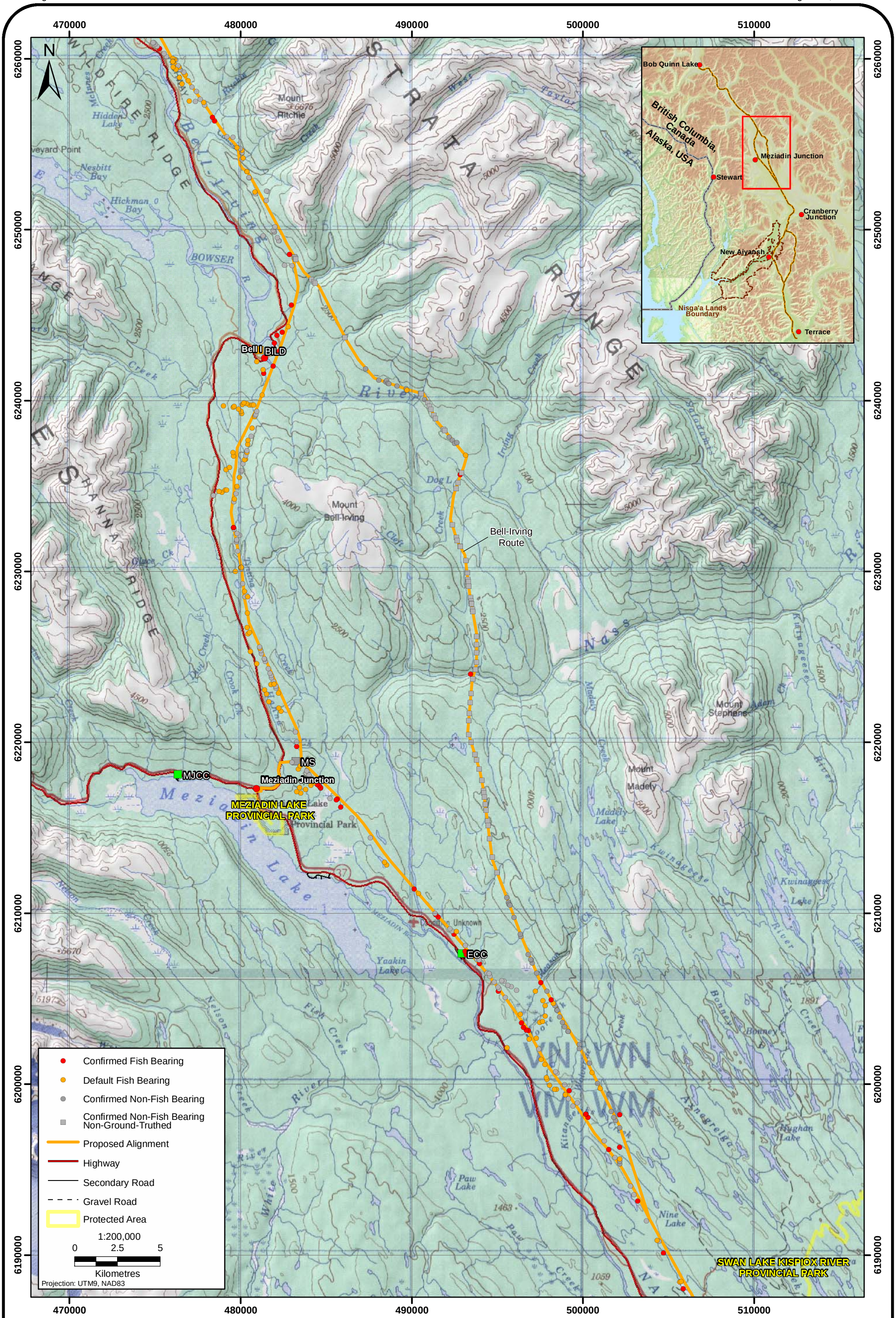
Subsequently, field crews ground-truthed the proposed route for locations of streams. The objectives of the stream assessments were to confirm fish presence, describe existing fish habitat, rank fish habitat suitability, and rank riparian habitat function in a standardized approach. For streams, fish habitat was assessed using methods based on the *Reconnaissance 1:20,000 Fish and Fish Habitat Inventory: Standards and Procedures* (RIC 1997b), *Watershed Technical Circular No.6: Riparian Assessment and Prescription Procedures* (BC MOE 1999), and the *Reconnaissance 1:20,000 Fish and Fish Habitat Inventory: Site Card Field Guide* (RIC 1999b).

Stream fish communities were sampled using backpack electrofishers and/or minnow traps according to *RISC Fish Collection Methods and Standards* (RIC 1997a), *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures* (RIC 2001), and the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Fish Collection Field Guide* (RIC 1999a). Fish sampling was not conducted at all transmission line stream crossings because of terrain limitations and availability of existing fisheries data. Rather, a defensible, systematic approach was adopted to classify the fish-bearing status of stream crossings (presented in Appendix 7.6-1 of the EAC Application). Streams were classified as either confirmed or default fish-bearing (i.e., Classes S1, S2, S3, S4) or non-fish-bearing (i.e., S5, S6) according to the *Fish Forest Practices Code Fish-stream Identification Guidebook* (BC MOF 1998).

6.2.1.2 Stream Habitat

The locations of assessed stream crossings are shown in Figure 6.2-1. Because of terrain, available existing fisheries data, non-fish bearing status, and time constraints, not all streams on the Bell-Irving route were ground-truthed and assessed. Overall, 57 crossings were assessed in the field of which 21 (37%) were defined as “streams” according to (BC MOF 1998). The assessed remainder, non-classified drainages (NCDs), were relatively abundant (36, or 63% were identified) along the proposed Project alignments. No fisheries sensitive zones were identified along the proposed Bell-Irving route. In addition, the 62 stream crossings that were not ground-truthed were identified as non fish-bearing during a desktop exercise.

Table 6.2-1 summarizes the number of stream classifications (i.e., S1 to S6) for ground truthed sites along the Bell-Irving route. Channel gradient and width, fish presence data, and fish accessibility were used to classify streams as S1 to S6. Sixteen (76%) streams were classified as fish-bearing (S1 to S4) and 5 (24%) as non-fish-bearing (S5 and S6) along the Bell-Irving route. Data broken into watersheds only include those portions of the Bell-Irving and Nass watersheds that overlap the Bell-Irving route.



Proposed Northwest Transmission Line
Fish Bearing Classification for Ground-Truthed and Non-Ground-Truthed Sites, 2010 - Bell Irving Route

FIGURE 6.2-1

Table 6.2-1. Summary of Stream Classifications and Habitat Evaluations for all Ground-Truthed Streams by Watershed

Watershed	Number of Crossings	Non-Classified Drainages	Stream Classification						Confirmed-Default Classification			Overall Habitat Evaluation		
			Fish-Bearing				Non-Fish-Bearing		Fish-Bearing		Non-Fish-Bearing			
			S1	S2	S3	S4	S5	S6	Confirmed	Default		Critical	Important	Marginal
Bell-Irving	16	9	1	0	4	2	0	0	1	6	0	1	4	2
Nass	41	27	1	1	6	1	3	2	2	7	5	0	2	9
All Watersheds	57	36	2	1	10	3	3	2	3	13	5	1	6	11

Dashes indicate data not applicable.

Data by watershed only includes sites along the Bell-Irving route, sites within these watersheds along the main Project route are presented in the EAC application.

Tables 6.2-1 and 6.2-2 summarize the number of "confirmed" or "default" fish-bearing streams (S1 to S4) along the Bell-Irving route for either ground-truthed or not ground-truthed streams. The methodology used to assign confirmed or default fish-bearing status of a stream, is identified in Appendix 6.2-2. Streams were confirmed through reviewing existing fish presence information and field fish sampling data. The majority of fish-bearing streams (83%) were confirmed through existing/historical fish presence data and map gradient information. A number of streams were confirmed as fish-bearing through field visual observation (17%), which was the least intensive sampling method. No streams were confirmed from sampling effort.

Table 6.2-2. Summary of Fish-bearing Status for all Non-ground-truthed Streams

Watershed	Total Number of Non-fish-bearing Stream Crossings
Bell-Irving	18
Nass	44
All Watersheds	62

Data by watershed only include sites along the Bell-Irving route, sites within these watersheds along the main Project route are presented in the EAC application.

For areas that were not ground-truthed, a defensible, systematic desktop approach was adopted to classify the fish-bearing status of proposed stream crossings. This approach is presented in Appendix 7.6-1 of the EAC Application. The desktop approach used 2010 fisheries baseline data, 2007 fisheries baseline data, a review of relevant historical data available on fish and fish habitat distribution, and Terrain Resource Information Management (TRIM) gradients along the Bell-Irving route. Watercourse crossings were potentially classified as one of three classes: default fish-bearing, confirmed fish-bearing, or non-fish-bearing. All default fish-bearing and confirmed fish-bearing streams were ground truthed during 2010 field studies. Overall, 62 stream crossings were identified in the desktop analysis as non-fish-bearing areas. These areas were not ground-truthed during 2010 field studies as the main purpose of field studies was to confirm fish presence and characterize fish habitat. As these 62 crossings are non-fish bearing, further assessments were not required. Table 6.2-2 summarizes these non-fish-bearing streams by watershed.

Table 6.2-3 presents summary channel statistics for all stream crossings along the Bell-Irving route. Average bankfull width for the streams was 4.4 m. Average gradient for the streams was 2.8%. Average bankfull depth and pool depth were relatively similar throughout the Bell-Irving route, with streams in the Bell-Irving watershed slightly deeper (0.33 m) than the Nass watershed (0.14 m). All channel morphology types were observed within the study area. The majority of streams were characterized by a cascade-pool morphology followed by riffle-pool morphology along the Bell-Irving route. The majority of streams possessed gravel as the dominant substrate followed by cobble.

The majority of streams within the study area route possessed a high abundance of cover. Cover was divided into seven types according to RISC standards, including small woody debris (SWD), large woody debris (LWD), boulder/cobble, undercut banks, deep pools, overhanging vegetation, and instream vegetation. Overhanging vegetation was the dominant cover type for the Bell-Irving route. SWD and LWD were the most frequent sub-dominant cover type. Undercut banks and deep pools were the least present cover types.

Table 6.2-3. Summary of Channel Statistics for all Ground-truthed Streams

Watershed	Total Number Streams	Mean Width		Mean Gradient	Mean Depth	
		Bankfull (m)	Wetted (m)	(%)	Bankfull (m)	Pool (m)
Bell-Irving	7	8.5	1.0	3.4	0.33	0.07
Nass	14	2.8	1.0	2.5	0.14	0.07
All Watersheds	21	4.4	1.0	2.8	0.19	0.07

Data by watershed only include sites along the Bell-Irving route, sites within these watersheds along the main Project route are presented in the EAC application.

Figure 6.2-2 shows a histogram of riparian function of LWD, small organic debris, stream shade, and bank stability for all streams along the Bell-Irving route. For all riparian functions the majority of streams were ranked as high.

Different species have individual habitat requirements; however, field crews focused on the general habitat requirements of juvenile and adult salmonids. Table 6.2-1 summarizes the number of critical, important, and marginal overall habitat quality ranks of fish-bearing streams by watershed along the Bell-Irving route. In total, 18 streams were given habitat rankings. Marginal habitat rank represents low productive capacity of a stream reach, and along the Bell-Irving route 11 streams (61%), the majority of streams, were ranked as marginal. Critical habitat is categorized as rare or exceptionally productive habitat with very high habitat values. One stream (6%) was ranked as critical. Important habitat is habitat that provides rearing, overwintering, and spawning requirements for fish species. Six streams (33%), were ranked as important.

Thirteen species are present along the Bell-Irving route. Four salmon species, two sculpin species, two sucker species, one whitefish species, two char species, redside shiner, and threespine stickleback are present along the route. The list of species present within each watershed is provided in Table 6.2-4. These species were identified from Project-specific sampling data and existing historical data.

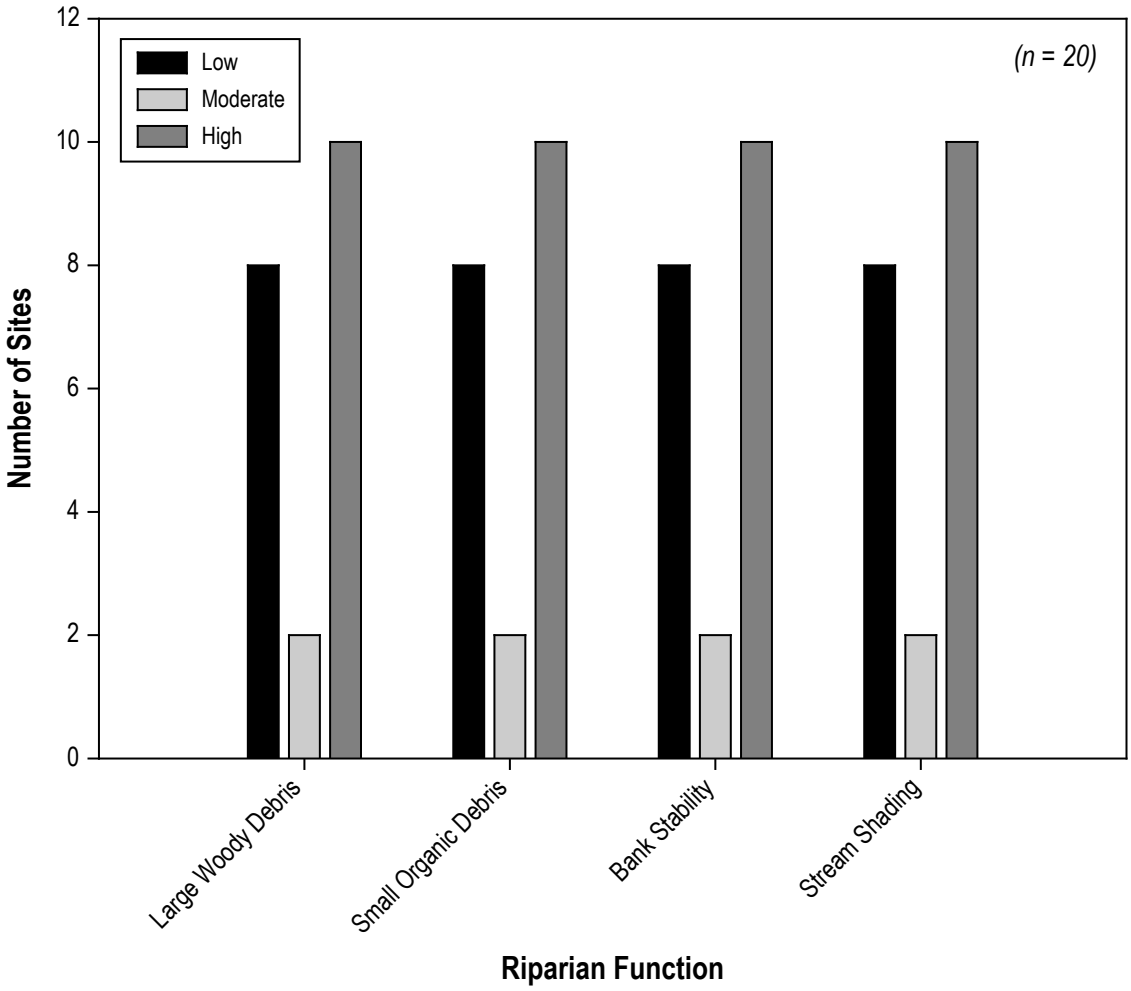
Table 6.2-5 summarizes the number of streams with provincially blue-listed species along the Bell-Irving route. Dolly Varden and coastal cutthroat trout are the most common along the Bell-Irving route, with only one record of Bull Trout along the route, which was found within the Bell-Irving River.

6.2.1.3 Wetlands

Aerial surveys were conducted along the Bell-Irving route. Three small wetlands were identified in close proximity to the proposed ROW. Aerial photos are presented in Appendix 6.2-3 and sampling results are presented in Appendix 6.2-4. Only one wetland (Unnamed wetland 1) was sampled because the other wetlands (Unnamed wetland 2 and 3) were within high gradient, non-fish-bearing regions of the Bell-Irving route. Locations for wetlands are shown on Figure 6.2-3.

6.2.1.4 Lakes

Aerial surveys were conducted along the Bell-Irving route. No lakes were found along the ROW corridor; as a result, lakes are not included in this assessment.

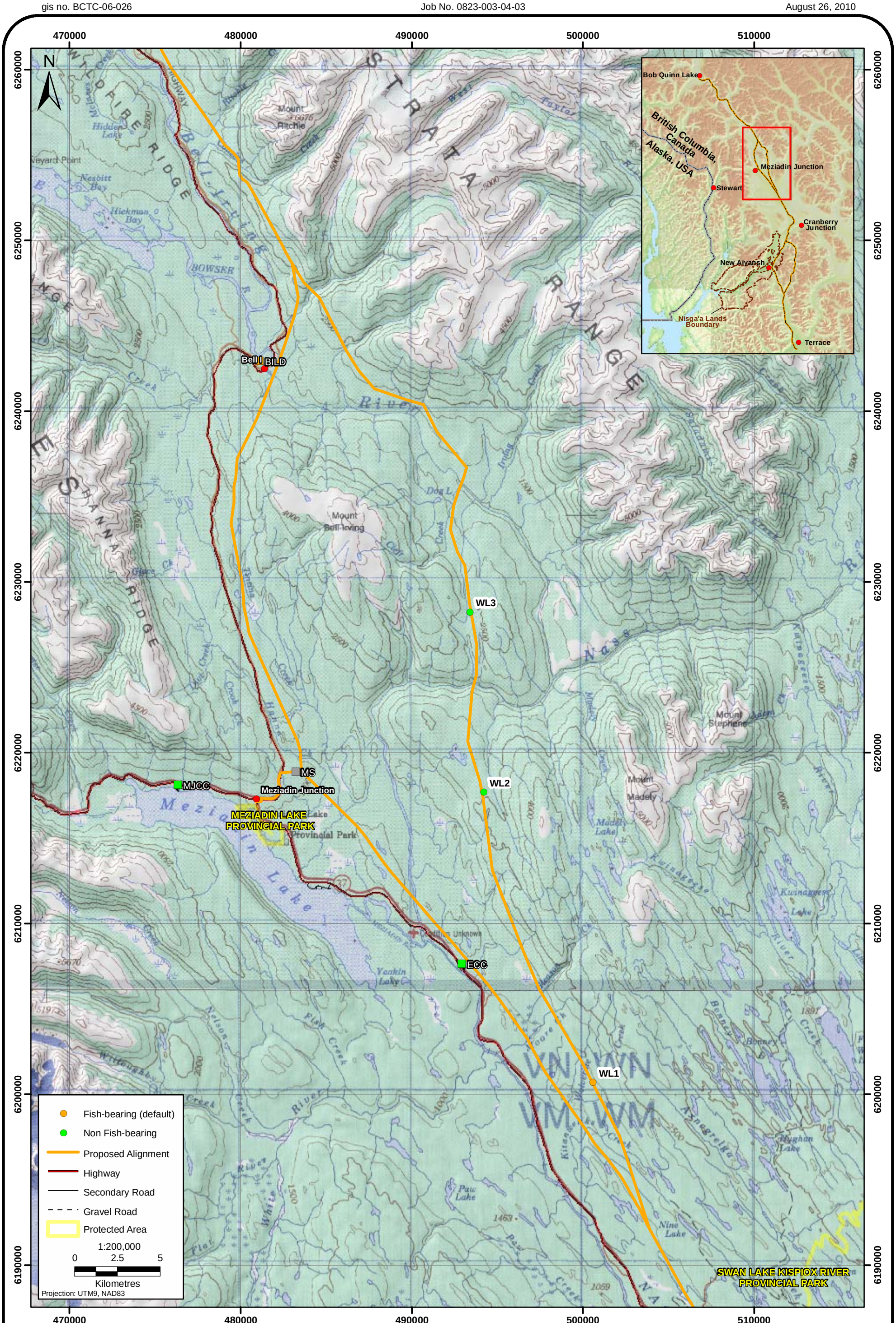


Summary of Riparian Function Ranks for All Streams Along the Bell-Irving Route

Figure 6.2-2

BC hydro

Rescan™ Engineers & Scientists



Proposed Northwest Transmission Line
Fish Bearing Classification for Non-Ground-Truthed Wetlands, 2010 - Bell Irving Route

FIGURE 6.2-3

Table 6.2-4. Summary of Known Fish Species along the Bell-Irving Route

	Watershed	
Species	**Nass**	**Bell-Irving**
Pacific Salmon:		
Chinook Salmon	O	X,O
Chum Salmon	O	-
Coho Salmon	O	X,O
Pink Salmon	O	-
Sockeye Salmon	O	O
Bull Trout*	-	O
Coastal Cutthroat Trout*	-	-
Coastrange Sculpin	O	-
Dolly Varden*	O	X,O
Largescale Sucker	X	-
Longnose Sucker	-	O
Mountain Whitefish	O	O
Pacific Lamprey	-	-
Prickly Sculpin	O	-
Rainbow Trout / Steelhead	X,O	X,O
Redside Shiner	X	-
Threespine Stickleback	X	-
Total	**13**	**8**

**Blue-listed species*
X = indicates that Project-specific sampling data were used to confirm fish species presence.
O = indicates that other sources of existing inventory data were used to confirm fish species presence.

Table 6.2-5. Summary of Fish-bearing Streams with Blue-listed Species

	Species					
	Project Sampling Data			Existing Sources of Data		
Total No. of Fish-Bearing Streams	**Dolly Varden**	**Coastal Cutthroat Trout**	**Bull Trout**	**Dolly Varden**	**Coastal Cutthroat Trout**	**Bull Trout**
21	1	0	0	2	3	1

Project sampling data: indicates that Project-specific sampling data were used to confirm fish species presence.
Existing Sources of Data: indicates that other sources of existing inventory data were used to confirm fish species presence.

6.2.2 Spatial and Temporal Boundaries

6.2.2.1 Spatial Boundaries

The spatial boundaries for the fish and aquatic habitat effects assessment consists of the proposed Bell-Irving route, which includes existing and proposed access roads. A buffer zone of 100 m on either side of the centerline for the proposed Bell-Irving route demarcates the local study area (LSA) for this effects assessment. The LSA differs from the baseline assessment boundary of 100m. However the characteristics of the 100 m baseline assessment are generally representative of the 200 m wide effects assessment band as stream characteristics will be similar throughout the entire reach of each stream. The regional study area (RSA) includes all watersheds the entire Project will pass through. All potential effects and habitat losses are considered with respect to fish and aquatic habitat existing in the local and regional study areas. This implies that potential effects are assessed at the scale of the entire length of a stream, or an entire lake, as appropriate for that local biological community, and to what extent these potential effects could have on the entire community rather than just on individuals. Applicable potential effects on a sub-local scale are noted and considered in this assessment.

6.2.2.2 Temporal Boundaries

This assessment considers two distinct phases of development: (1) construction and restoration, and (2) operations and maintenance. It is assumed that the Project will exist indefinitely once constructed; thus, closure and decommissioning are not included in the EA.

6.2.3 Issues Scoping

The principal issues identified for fish and aquatic habitat are access, alteration of land cover, and site contamination. The rationale for the identified principal issues is presented in Section 7.6.3 of the EAC Application.

6.2.4 Valued Environmental Components

The VECs selected for the fish and aquatic habitat assessment are presented in Table 6.2-6. A detailed rationale for the VEC selection is presented in Section 7.6.3 of the EAC Application.

For this assessment the following VECs were grouped together because of similar species habitat requirements and distribution along the Bell-Irving route:

- The chars Dolly Varden (*Salvelinus malma*) and bull trout (*S. confluentus*).
- Rainbow trout/steelhead (*Oncorhynchus mykiss*) and coastal cutthroat trout (O. clarki clarki).
- Anadromous (migratory) Pacific salmon, including coho (*O. kisutch*), chinook (*O. tshawytscha*), and sockeye (*O. nerka*).

Table 6.2-6. Fish and Aquatic Habitat Valued Environmental Components of the Bell-Irving Route

VEC	Source[1]	Rationale for Inclusion
Bull Trout	BC MOE, BC CDC, First Nation	Blue-listed fish species. Indicator stream ecosystem species. Potential loss of habitat.
Dolly Varden	BC MOE, BC CDC, First Nation	Blue-listed fish species. Indicator stream ecosystem species. Potential loss of habitat.
Rainbow Trout	BC MOE, First Nation	Indicator stream ecosystem species. Potential loss of habitat.
Steelhead	BC MOE, First Nation	Economically important to sport fishing industry. Indicator stream ecosystem species. Potential loss of habitat.
Coastal Cutthroat Trout	BC MOE, BC CDC, First Nation	Blue-listed fish species. Indicator stream ecosystem species. Potential loss of habitat.
Pacific Salmon	DFO, Nisga'a, First Nation	Culturally/commercially valuable species. Indicator species, important for sport fishing. Potential loss of habitat.
Fish Habitat	BC MOE, DFO, First Nation	Potential degradation or loss of habitat.

[1] *Indicates where the importance of the potential VEC was identified*
BC MOE-BC Ministry of the Environment; DFO-Fisheries and Oceans Canada; BC CDC-BC Conservation Data Centre.

Section 7.6.3 of the EAC Application includes the rationale for the grouping of specific VECs, and also includes a summary of the life history for each VEC.

6.2.5 Identification of Potential Effects and Mitigation

6.2.5.1 Effect Categories

Potential effects of the Bell-Irving route on fish and aquatic habitat were identified by reviewing the Project components and baseline data in the EAC Application. If a Project component is considered not to have any potential for interaction (and thus no potential effect), then no further consideration is given to the Project component in the assessment.

The fish and aquatic habitat environmental effects assessment was undertaken to evaluate potential effects on aquatic resources during construction and operation of the Project. Project fish and aquatic habitat issues identified in the AIR include:

- Assessing potential effects on fish and fish habitat from construction and operation activities along the transmission corridor, including development of site access roads that may be required to facilitate construction access and transmission line installation.
- Evaluating potential effects on freshwater aquatic habitat, including creeks, streams, wetlands, etc., associated with the modifications (including site access), and operations at substations.
- Determining risk of potential effects on threatened or endangered fish species within each of the watercourses during construction and operation of the transmission line and the substations.

Many of the issues listed above overlap in terms of definition and scope. Fish habitat and aquatic habitat is often the same, although some aquatic habitat may not support fish populations. Additionally, threatened or endangered fish species inhabit various types of habitat at different life stages including streams, rivers, lakes and wetlands. As a result the scope would be both geographical and temporal for the above effects. For the purposes of the fish and aquatic habitat section, effects are grouped into three categories for discussion:

- Lethal effects (direct and indirect mortality).
- Sub-lethal effects.
- Fish habitat loss (change in productive capacity of fish habitat, habitat loss, and alteration): formal definitions of habitat loss and productive capacity are presented in Section 7.6.5.1 of the EAC Application.

All of the potential effects (lethal, sub-lethal, and habitat loss) overlap each other in terms of their definition and scope. Each pathway describes one primary effect, but multiple effects may occur. Potential effects are discussed as they pertain to the Project's construction/restoration and operations/maintenance phases. The predicted potential effects of each Project component on each VEC are identified and assessed in the following section. For each VEC, a summary of the potential effects from various Project activities and the relevant mitigation measures appear in Tables 6.2-7 to 6.2-10 (found later in this section).

6.2.5.2 Phase 1: Construction and Restoration

The two Project components that could affect fish and aquatic habitat during the Project's construction and restoration phases are access roads and transmission lines. Potential Project component effects (lethal, sub-lethal, fish habitat loss) and associated mitigation measures are discussed for each selected VEC.

Lethal and Sub-lethal Effects

Potential Effects

Blunt Trauma

Potential causes of lethal tissue damage to fish in the Project area include construction equipment crossing streams for ROW clearing if crossing structures are not used, accidents during bridge and culvert construction, associated rock blasting at quarry sites close to watercourses and more intense fishing pressure from increased road access.

Noise

The sound waves created by blasting near water can potentially cause physical damage to fish eggs, larvae, juveniles, and adult.

In addition, noise pollution caused by construction machinery and blasting has been shown to affect fish behaviour. Specific examples of these effects are presented in Section 7.6.5.2 of the EAC Application. Sustained noise in a single area is not likely during any Project phases. However, sporadic noise will occur during the Project's construction phase.

Sedimentation

Smothering of fish life stages could occur in the event of sediment releases. There is increased potential for generating and releasing sediments during clearing activities for the ROW, access roads, and quarry sites. High precipitation in the summer, without the buffering effect of vegetation, could lead to increased sediment runoff into streams. Specific examples of these effects are presented in Section 7.6.5.2 of the EAC Application.

High levels of total suspended solids (TSS) can occur from sedimentation events during construction (e.g., materials accidently pushed instream, loosening materials along stream banks) and runoff during spring freshet and summer rains. Other sources of TSS include particulates from construction equipment activity and blasting. High TSS levels can lead to behavioural changes in fish as well as minor physical damages. Specific examples of these effects are presented in Section 7.6.5.2 of the EAC Application. These types of effects are possible during the construction phase when sedimentation events are most likely.

Petroleum Product Spills

Petroleum product spills (e.g., gasoline, diesel, fuel oil) can be toxic to fish and can cause mortality or sub-lethal effects (i.e., physiological and behavioural effects) such as decreased feeding activity or alterations to swimming behaviour. Specific examples of these effects are presented in Section 7.6.5.2 of the EAC Application. The potential for fish exposure to spilled toxins is possible during the construction phase.

Toxic Residues

Certain portions of the Bell-Irving route may require explosives for blasting rock along new access roads. Explosives typically contain ammonium nitrate as an oxidizing agent. Residues that contain ammonia, ammonium nitrate, or the oxidative intermediate nitrite, in high enough concentrations can be toxic to aquatic life. Specific examples of these effects are presented in Section 7.6.5.2 of the EAC Application. The accumulation of these residues on disturbed rock material and the nitrogen load to the aquatic environment depends on the volume of explosives used. These residues may enter the water immediately after blasting from particulates settling out of the air, or during precipitation

events as runoff. The potential for fish exposure to explosive residues may exist during the construction phase.

Metals Leaching/Acid Rock Drainage (ML/ARD)

Newly exposed potentially acid generating (PAG) rock could leach acid along the access roads. Provided that newly constructed access roads do not expose extensive areas of sulphide-bearing minerals in rock, this is unlikely to be a concern. However, metal leaching and acid rock drainage (ML/ARD) may occur along newly constructed access roads from exposed sulphide-bearing rock alongside rock-cuts or in quarries. The likely duration of any ML/ARD that occurs will be for the lifetime of the Project.

Leachates from ML/ARD have been shown to cause sub-lethal effects (i.e., physiological and behavioural changes) in fish. Specific examples of these effects are presented in Section 7.6.5.2 of the EAC Application. Leachates from ML/ARD (if any) from Project activities are not likely to be high enough to result in direct mortality.

VECs

All fish species, including Pacific salmon species, could be affected by direct mortality, smothering and physiological toxicity, behavioural changes, and physiological changes during construction. Fish spawn and rear in both small and large streams typical of those to be crossed by the access roads and transmission line. Based upon the baseline data within the study area and life history characteristics of Pacific salmon (McPhail 2007), Pacific salmon species are likely not present at higher gradient crossings where Dolly Varden and rainbow trout are more prevalent. Overwintering and rearing juvenile coho and chinook salmon could be affected in low gradient stream reaches. The early life stages of all fish are particularly susceptible to direct mortality, smothering from sedimentation events, and physiological toxicity from spills. Early life stages are also susceptible to behavioural changes and physiological changes from sedimentation events, spill events, dust, noise pollution, blast residues, and PAG leachates.

Mitigation

Mitigation measures to avoid impacts from blunt trauma, noise, sedimentation, petroleum product spills, and ML/ARD during the construction phase of the Project are presented in the EAC Application (Section 7.6.5.2, Chapter 11, and Chapter 12) and would apply equally to similar effects along the Bell-Irving route. In addition, Table 7.6-4 in the EAC Application lists the operating windows to be observed during clearing, construction and operation, for various fish species.

Fish Habitat Loss

Potential Effects

Riparian Habitat and Productivity Loss

Habitat loss refers to removing or physically altering aspects of the environment that are used either directly or indirectly by fish. Riparian vegetation provides numerous functions including shading, stabilizing stream banks, controlling sediments, contributing LWD and organic litter, and regulating composition of nutrients. Losing riparian function can lead to fish habitat loss and alteration. Specific examples of fish habitat loss due to riparian habitat and productivity loss are presented in Section 7.6.5.2 of the EAC Application. Road and stream crossing construction is likely to result in riparian habitat and productivity loss along the Bell-Irving route.

Fish Habitat and Passage

In some instances, stream crossings associated with roads have historically acted as barriers to fish passage, isolating populations and hindering migration to key habitats, such as spawning grounds or overwintering habitat. Poorly designed or installed stream crossings can lead to erosion, affecting downstream habitat by introducing excess quantities of fine sediment, and ultimately leading to road failure and elevated road maintenance costs.

Sedimentation

Incidental sedimentation events may occur within or near streams during the construction phase because of equipment activities and precipitation runoff. These events can temporarily elevate TSS as well as siltation of the substrate. Specific examples of habitat loss due to sedimentation are presented in Section 7.6.5.2 of the EAC Application.

Petroleum Product Spills and Residue

Contaminated habitat leading to decreased productive capacity could occur if petroleum products are spilled from equipment or haul loads or from blasting particulates containing toxic residues.

Metals Leaching/ Acid Rock Drainage (ML/ARD)

Productive capacity could be altered as a result of the Project as newly exposed Potentially Acid Generating (PAG) rock begins to leach acid along the access roads, and contaminated sediment settles onto the substrate of the streams. ML/ARD sites may be possible along access roads where exposed rock contains sulphide-bearing minerals. However, construction of new access roads is to be limited, thereby reducing the potential for ML/ARD problems resulting from this Project. In addition, at this time there are no sulphide-bearing mineral occurrences known along the Bell-Irving route study area and so the likelihood of PAG rock exposure is considered to be remote.

VECs

All VECs may be affected by changes in productive capacity and fish habitat loss during/after construction. Terrestrial inputs of invertebrates and nutrients, stream shade, organic litter, and LWD function in the riparian area may be affected by changes during the construction and restoration phase of the Project's transmission line and access roads.

Mitigation

Mitigation measures to avoid fish habitat loss from riparian habitat and productivity loss, alterations to fish habitat and passage, sedimentation, petroleum product spills, and residue and ML/ARD during the construction phase of the Project are presented in the EAC Application (Section 7.6.5.2, Chapter 11, and Chapter 12). In addition, Table 7.6-4 in the EAC Application lists the operating windows to be observed during clearing, construction and operation, for various fish species. Construction will use existing roads where possible (approximately 67% of roads to be used for access will be existing roads) in order to minimize the number of new roads required to be built. Construction activities will not involve in-stream work, with clear-span structures to be used when possible for all fish bearing or default fish bearing crossings to avoid adverse effects to fish and in-stream fish habitat. Implementing these construction mitigation measures (further detailed in Section 7.6.5.2 of the EAC Application) is likely to effectively prevent any significant residual adverse effects from occurring.

Table 6.2-7. Summary of Dolly Varden and Bull Trout Effects Assessment

Project Phase, Component, Activity	Location of Effect	Description of Effect	Type of Effect	Mitigation and Management	Potential for Residual Effects?	Description of Residual Effects	Magnitude	Extent	Duration	Frequency	Reversibility	Resilience / Adaptability	Significance	Likelihood of Effects	
														Probability	Confidence Level
Construction and Restoration															
Access and Construction Requirements	Bell-Irving route	Impact with construction machinery causing mortality. Noise from blasting and construction activities causing mortality.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1] and temporary ford stream crossings[2]; Adhere to appropriate construction operating window for in-stream work[3] and the Access Plan, Follow DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.[4]	Yes	Blunt tissue trauma causing mortality to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing smothering and mortality.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1]; Adhere to appropriate construction operating window for in-stream work[3] and the Sediment and Erosion Control Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing mortality of early fish life stages.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Construction and Access Requirements	Bell-Irving route	Spill event from construction causing physiological toxicity and mortality.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to mortality of early fish life stages.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Noise from blasting and construction activities causing sub-lethal effects.	Adverse	Follow DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.[4]	Yes	Increase in noise pollution causing sub-lethal behavioural changes, Nitrogen residues from blasting causing behavioural changes and physiological stress.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing sub-lethal effects.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1]; Adhere to appropriate construction operating window for in-stream work[3] and the Sediment and Erosion Control Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress, Elevated dust generation because access road not wetted during construction.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Construction and Access Requirements	Bell-Irving route	Spill event from construction causing physiological toxicity and sub-lethal effects.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to behavioral changes and physiological stress to all fish life stages.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	ML/ARD leachates from construction causing sub-lethal effects.	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	ML/ARD resulting in behavioural changes and physiological stress.	Low	Landscape	Far Future	Continuous	Reversible Long-term	High	Not Significant	Low	Intermediate

(continued)

Table 6.2-7. Summary of Dolly Varden and Bull Trout Effects Assessment (completed)

Project Phase, Component, Activity	Location of Effect	Description of Effect	Type of Effect	Mitigation and Management	Potential for Residual Effects?	Description of Residual Effects	Magnitude	Extent	Duration	Frequency	Reversibility	Resilience / Adaptability	Significance	Likelihood of Effects	
														Probability	Confidence Level
Operations and Maintenance															
Access	Bell-Irving route	ML/ARD leachates from construction causing sub-lethal effects throughout the life of the Project.	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	ML/ARD resulting in behavioural changes and physiological stress.	Low	Landscape	Far Future	Continuous	Reversible Long-term	High	Not Significant	Low	Intermediate
Access, Transmission Lines and Structures	Bell-Irving route	Sedimentation event from maintenance causing sub-lethal effects.	Adverse	Adhere to DFO's operational statements for bridge maintenance[5]; Adhere to appropriate construction operating window for in-stream work[3], the Sediment and Erosion Control Plan and Access Road Maintenance Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access	Bell-Irving route	Impact with construction machinery causing mortality.	Adverse	Adhere to DFO's operational statements for bridge maintenance[5]; Adhere to appropriate construction operating window for in-stream work[3] and the Access Road Maintenance Plan.	Yes	Blunt tissue trauma causing mortality to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access, Transmission Lines and Structures	Bell-Irving route	Spill event from maintenance causing physiological toxicity and sub-lethal effects.	Adverse	Spill Prevention and Emergency Response Plan and Access Road Maintenance Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to behavioral changes and physiological stress to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High

1. (DFO 2007b)
2. (DFO 2007e)
3. (BC MWLAP 2004)
4. (Wright and Hopky 1998)
5. (DFO 2007a)

Table 6.2-8. Summary of Rainbow Trout, Steelhead, and Coastal Cutthroat Trout Effects Assessment

Project Phase, Component, Activity	Location of Effect	Description of Effect	Type of Effect	Mitigation and Management	Potential for Residual Effects?	Description of Residual Effects	Magnitude	Extent	Duration	Frequency	Reversibility	Resilience / Adaptability	Significance	Likelihood of Effects	
														Probability	Confidence Level
Construction and Restoration															
Transmission Lines, Access and Construction Requirements	Bell-Irving route	Impact with construction machinery causing mortality, Noise from blasting and construction activities causing mortality.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1] and temporary ford stream crossings[2]; Adhere to appropriate construction operating window for in-stream work[3] and the Access Plan, Follow DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.[4]	Yes	Blunt tissue trauma causing mortality to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines, Access and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing smothering and mortality.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1]; Adhere to appropriate construction operating window for in-stream work[3] and the Sediment and Erosion Control Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing mortality of early fish life stages.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Construction and Access Requirements	Bell-Irving route	Spill event from construction causing physiological toxicity and mortality.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to mortality of early fish life stages.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Noise from blasting and construction activities causing sub-lethal effects.	Adverse	Follow DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters .[4]	Yes	Increase in noise pollution causing sub-lethal behavioural changes, Nitrogen residues from blasting causing behavioural changes and physiological stress.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines, Access, and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing sub-lethal effects.	Adverse	Adhere to DFO's operational statements for clear-span bridges;[1] Adhere to appropriate construction operating window for in-stream work[3] and the Sediment and Erosion Control Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress, Elevated dust generation because access road not wetted during construction.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Construction, and Access Requirements	Bell-Irving route	Spill event from construction causing physiological toxicity and sub-lethal effects.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to behavioral changes and physiological stress to all fish life stages.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	ML/ARD leachates from construction causing sub-lethal effects.	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	ML/ARD resulting in behavioural changes and physiological stress.	Low	Landscape	Far Future	Continuous	Reversible Long-term	High	Not Significant	Low	Low

(continued)

Table 6.2-8. Summary of Rainbow Trout, Steelhead, and Coastal Cutthroat Trout Effects Assessment (completed)

Project Phase, Component, Activity	Location of Effect	Description of Effect	Type of Effect	Mitigation and Management	Potential for Residual Effects?	Description of Residual Effects	Magnitude	Extent	Duration	Frequency	Reversibility	Resilience / Adaptability	Significance	Likelihood of Effects	
														Probability	Confidence Level
Operations and Maintenance															
Access	Bell-Irving route	ML/ARD leachates from construction causing sub-lethal effects throughout the life of the Project	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	ML/ARD resulting in behavioural changes and physiological stress.	Low	Landscape	Far Future	Continuous	Reversible Long-term	High	Not Significant	Low	Low
Access, Transmission Lines, and Structures	Bell-Irving route	Sedimentation event from maintenance causing sub-lethal effects	Adverse	Adhere to DFO's operational statements for bridge maintenance;[5] Adhere to appropriate construction operating window for in-stream work[3], the Sediment and Erosion Control Plan and Access Road Maintenance Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access	Bell-Irving route	Impact with construction machinery causing mortality.	Adverse	Adhere to DFO's operational statements for bridge maintenance;[5] Adhere to appropriate construction operating window for in-stream work[3] and the Access Road Maintenance Plan.	Yes	Blunt tissue trauma causing mortality to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access, Transmission Lines, and Structures	Bell-Irving route	Spill event from maintenance causing physiological toxicity and sub-lethal effects.	Adverse	Spill and Emergency Response Plan and Access Road Maintenance Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to behavioral changes and physiological stress to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High

1. (DFO 2007b)
2. (DFO 2007e)
3. (BC MWLAP 2004).
4. (Wright and Hopky 1998)
5. (DFO 2007a)

Table 6.2-9. Summary of Pacific Salmon

Project Phase, Component, Activity	Location of Effect	Description of Effect	Type of Effect	Mitigation and Management	Potential for Residual Effects?	Description of Residual Effects	Magnitude	Extent	Duration	Frequency	Reversibility	Resilience / Adaptability	Significance	Likelihood of Effects	
														Probability	Confidence Level
Construction and Restoration															
Access and Construction Requirements	Bell-Irving route	Impact with construction machinery causing mortality, Noise from blasting and construction activities causing mortality.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1] and temporary ford stream crossings[2]; Adhere to appropriate construction operating window for in-stream work[3] and the Access Plan, Follow DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.[4]	Yes	Blunt tissue trauma causing mortality to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing smothering and mortality.	Adverse	Adhere to DFO's operational statements for clear-span bridges[1]; Adhere to appropriate construction operating window for in-stream work[3] and the Sediment and Erosion Control Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing mortality of early fish life stages.	Medium	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Construction and Access Requirements	Bell-Irving route	Spill event from construction causing physiological toxicity and mortality.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in contaminated water flowing into streams leading to mortality of early fish life stages.	Medium	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Noise from blasting and construction activities causing sub-lethal effects.	Adverse	Follow DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters .[4].	Yes	Increase in noise pollution causing sub-lethal behavioural changes, Nitrogen residues from blasting causing behavioural changes and physiological stress.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing sub-lethal effects.	Adverse	Adhere to DFO's operational statements for clear-span bridges;[1] Adhere to appropriate construction operating window for in-stream work[3] and the Sediment and Erosion Control Plan; Site isolation, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress, Elevated dust generation because access road not wetted during construction.	Medium	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Construction and Access Requirements	Bell-Irving route	Spill event from construction causing physiological toxicity and sub-lethal effects.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress, Elevated dust generation because access road not wetted during construction.	Medium	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	ML/ARD leachates from construction causing sub-lethal effects.	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	ML/ARD resulting in behavioural changes and physiological stress.	Low	Landscape	Far Future	Continuous	Reversible Long-term	High	Not Significant	Low	Low

(continued)

Table 6.2-9. Summary of Pacific Salmon (completed)

Phase/ Component / Activity	Location	Effect	Type of Effect	Mitigation / Management	Potential for Residual Effects	Description of Residual Effects	Magnitude	Extent	Duration of Effect	Frequency	Reversibility	Resilience (Context)	Significance	Likelihood of Effects	
														Probability	Confidence Level
Operations and Maintenance															
Access, Transmission Lines and Structures	Bell-Irving route	Sedimentation event from maintenance causing sub-lethal effects.	Adverse	Adhere to BCTC's Standard Operating Procedure for Road Construction, Maintenance and Deactivation.	Yes	Increase in turbid water flowing into streams causing sub-lethal behavioural changes and physiological stress.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access	Bell-Irving route	Impact with construction machinery causing mortality.	Adverse	Adhere to BCTC's Standard Operating Procedure for Road Construction, Maintenance and Deactivation.	Yes	Blunt tissue trauma causing mortality to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access, Transmission Lines and Structures	Bell-Irving route	Spill event from maintenance causing physiological toxicity and sub-lethal effects.	Adverse	BCTC's Spill Response Procedures and Standard Operating Procedure for Road Construction, Maintenance and Deactivation.	Yes	Increase in contaminated water flowing into streams leading to behavioral changes and physiological stress to all fish life stages.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High

1. (DFO 2007b).
2. (DFO 2007e).
3. (BC MWLAP 2004).
4. (Wright and Hopky 1998).

Table 6.2-10. Summary of Fish Habitat Effects Assessment

Phase/ Component / Activity	Location	Effect	Type of Effect	Mitigation / Management	Potential for Residual Effects	Description of Residual Effects	Magnitude	Extent	Duration of Effect	Frequency	Reversibility	Resilience (Context)	Significance	Likelihood of Effects	
														Probability	Confidence Level
Construction and Restoration															
Transmission Lines, Access and Construction Requirements	Bell-Irving route	Riparian loss and/or alteration causing productivity and habitat loss.	Adverse	Site-specific prescriptions at stream crossings to retain riparian cover, Use certain mitigation measures stated in DFO's operational statement for overhead line construction[1] and BCTC Approved Work Practices for Managing Riparian Vegetation.	Yes	Decreased primary and secondary production, Channel integrity loss, Fish habitat complexity loss and/or alteration.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	High	High
Transmission Lines, Access and Construction Requirements	Bell-Irving route	Sedimentation event from construction causing productivity and habitat loss.	Adverse	Adhere to DFO's operational statements for clear-span bridges[2] and DFO's guidance for riparian revegetation[3], Adhere to appropriate construction operating window for instream work[4] and the Sediment and Erosion Control Plan, Site isolation, Water quality maintenance.	Yes	Increase in TSS causing productivity loss, Decreased primary and secondary production, Increased fish habitat loss.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Transmission Lines and Structures, Access and Construction Requirements	Bell-Irving route	Spill event from construction causing productivity loss.	Adverse	Spill Prevention and Emergency Response Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Decreased primary and secondary production.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access and Construction Requirements	Bell-Irving route	ML/ARD leachates from construction causing productivity loss.	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	Decreased primary and secondary production.	Low	Landscape	Far Future	Continuous	Reversible Long-term	High	Not Significant	Low	Intermediate
Access and Construction Requirements	Bell-Irving route	Stream crossings causing habitat loss and migration barriers.	Adverse	Follow Fish Stream Crossing Guidebook[5] and BCTC Environmental Field Guides, and DFO Operational Statements for clear-span bridges.2	Yes	Increased fish habitat loss.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Operations and Maintenance															
Access	Bell-Irving route	ML/ARD leachates from construction causing productivity loss throughout the life of the Project.	Adverse	Implementation of ML/ARD Prediction and Prevention Management Plan, Water and sediment quality maintenance.	Yes	Decreased primary and secondary production.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access, Transmission Lines and Structures	Bell-Irving route	Sedimentation event from maintenance causing productivity and habitat loss.	Adverse	Adhere to DFO's operational statements for bridge maintenance[6] and DFO's guidance for riparian revegetation[3], Adhere to appropriate construction operating window for instream work[4] and the Sediment and Erosion Control Plan, Site isolation, Water quality maintenance.	Yes	Increase in TSS causing productivity loss, Decreased primary and secondary production, Increased fish habitat loss.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access, Transmission Lines and Structures	Bell-Irving route	Riparian alteration causing productivity and habitat loss.	Adverse	Adhere to BCTC Approved Work Practices for Managing Riparian Vegetation.	Yes	Decreased primary and secondary production, Channel integrity loss, Fish habitat complexity loss and/or alteration.	Low	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High
Access, Transmission Lines and Structures	Bell-Irving route	Spill event from maintenance causing productivity loss.	Adverse	Spill Prevention and Emergency Response Plan and Access Road Maintenance Plan, Spill kits, Equipment maintenance, Stream setback distances, Water quality maintenance.	Yes	Decreased primary and secondary production.	Negligible	Local	Short-term	Sporadic	Reversible Short-term	High	Not Significant	Low	High

1. (DFO 2007d)
2. (DFO 2007b)
3. (DFO 2007c)
4. (BC MWLAP 2004)
5. (BC MOF 2002)
6. (DFO 2007a)

6.2.5.3 Phase 2: Operations and Maintenance

Lethal/Sub-lethal Effects and Fish Habitat Loss

Potential Effects

Noise and toxic residues are not likely to occur during operations and maintenance activities associated with the Project components because there will be no major construction or blasting activities.

Blunt trauma, sedimentation, and petroleum product spills may occur during operations and maintenance activities because of regular bridge and access road maintenance activities and management of riparian vegetation. Potential adverse sedimentation effects may be introduction of deleterious substances (i.e., silt washing off roads) during rain events and in wet weather when there is heavy traffic. Potential petroleum product spill effects could be caused by the introduction of deleterious substances (i.e., machinery products) during bridge maintenance, road maintenance, and riparian vegetation management activities.

Riparian habitat and productivity loss could occur during operations and maintenance activities because of regular bridge maintenance activities and management of transmission line riparian vegetation.

Fish habitat loss and fish passage restrictions could occur during operations and maintenance activities because of regular bridge maintenance activities and management of transmission line riparian vegetation.

VECs

All VECs could be affected by fish habitat loss, direct mortality, smothering and physiological toxicity, behavioural changes, and physiological changes during operation and maintenance. These species' early life stages are particularly susceptible to direct mortality, smothering from sedimentation events, and physiological toxicity from spills. Early life stages are also susceptible to behavioural changes and physiological changes from sedimentation events, spill events, dust, and PAG leachates.

Mitigation

Mitigation measures during the operation phase of the Project are presented in the EAC Application (Section 7.6.5.2, Chapter 11, and Chapter 12). In addition, Table 7.6-4 in the EAC Application lists the operating windows for various fish species

6.2.6 Potential Residual Effects and Significance

6.2.6.1 Phase 1: Construction and Restoration

Identification of Residual Effects

Potential residual effects are presented in Tables 6.2-7 to 6.2-10 for each VEC. After implementing mitigation measures, the magnitude of the adverse residual effects is likely to be low for all potential effects, except blunt trauma from machinery causing mortality and noise from blasting causing mortality where the magnitude of sub-lethal effects are negligible.

The extent of potential residual adverse effects will be local for all potential effects, except for ML/ARD effects, which, if they occur, will be landscape. The duration of the residual effects is likely to be short-term (i.e., effect lasts 1 year or less), except ML/ARD effects, which are far-future (i.e., lasts more then 30 years). The frequency of the residual effects is sporadic (i.e., occurs rarely), except for

ML/ARD effects, which are continuous (i.e., effect occurs constantly during and after the project). The reversibility of the adverse residual effects is short-term (i.e., effects can be reversed relatively quickly) for all potential effects, except ML/ARD effects, which are reversible and long-term (i.e., effect can be reversed over several years) after mitigation measures. The resilience of the environment to adverse residual effects is high (i.e., the receiving environment can respond and adapt) for all potential effects.

Significance of Residual Effects

Provided that mitigation measures are implemented as planned, all potential effects of the Project on the Bell-Irving route are likely to be not significant in terms of the viability of the VECs (Tables 6.2-7 to 6.2-10). Implementing riparian habitat mitigation measures detailed in Section 7.6.5.2 of the EAC Application is likely to effectively prevent any significant residual adverse effects from occurring.

Likelihood of Effects

For all fish species VECs (Tables 6.2-7 to 6.2-10), the probability of the effects are low (i.e., effect is unlikely but could occur). The confidence of this assessment is high (i.e., low degree of uncertainty and variation from the predicted effect). One potential exception is ML/ARD effects resulting in behavioural changes and physiological stress to fish. The probability that ML/ARD effects will occur is low; however, the confidence in the assessment is intermediate because it is not certain that exposed rocks from new access roads will not be acid generating, or of a small enough magnitude to not cause any adverse effect. However, the potential for adverse effects is substantially reduced because 67% of the access roads to be used for the Bell-Irving route will be existing roads.

For the fish habitat VEC, the probability of occurrence for adverse effects is low for sedimentation, spills, and fish habitat loss. The confidence in this assessment is high (i.e., degree of uncertainty and variation from the predicted effect is likely to be low). One exception is ML/ARD effects resulting in decreased production. The probability of ML/ARD effects is low; however, the confidence in the assessment is intermediate because it is not certain that exposed rocks from new access roads will not be acid generating, or small enough in magnitude to not cause any effect.

The other residual effect exception is riparian loss along the transmission ROW (causing decreased primary and secondary production, channel integrity loss, and fish habitat complexity alteration). The probability of riparian loss effects is considered high. This is because, the ROW will have to be cleared in a number of cases to facilitate construction of the transmission line and ensure appropriate conductor clearance. However, the degree of clearing will vary from no clearing (full retention) at some stream crossings to clearing all trees except for low lying brush. Complete clearing will be limited to new access roads and tower structures, and substation. In all other areas, it is unlikely that vegetation will need to be cleared to a height less than 3 m.

6.2.6.2 Phase 2: Operations and Maintenance

Identification of Residual Effects

Potential residual effects for operations and maintenance are listed and described in Tables 6.2-7 to 6.2-10 for each VEC.

The magnitude of potential residual adverse effects is likely to be negligible from sedimentation, spill events, and ML/ARD. The extent of the residual effects will be local for all potential effects. The duration of the residual effects are likely to be short term for all potential effects. The frequency of the residual effects will likely be sporadic (i.e., occurs rarely) for all potential effects. The reversibility

of the residual effects will likely be short-term for all potential effects. The resilience of the environment to residual effects is likely to be high (i.e., the receiving environment can respond and adapt) for all potential effects.

Significance of Residual Effects

Provided that mitigation measures are implemented as planned, all potential effects of the Project on the Bell-Irving route are likely to be not significant in terms of the viability of the VECs (Tables 6.2-7 to 6.2-10).

Likelihood of Effects

For all fish species VECs and fish habitat VEC (Tables 6.2-7 to 6.2-10), the probability of adverse effects occurrence is likely to be low for all potential effects. The confidence in this assessment is high (i.e., low degree of uncertainty and variation from the predicted effect is likely to be low) for all potential residual effects.

6.3 ARCHAEOLOGY AND HERITAGE RESOURCES

This effects assessment for Archaeology and Heritage Resources for the proposed Bell-Irving route was conducted to identify archaeological sites and designated heritage sites, including sites of historical, paleontological, and architectural significance, which could be directly or indirectly affected by this route option. No previous archaeological study has been conducted for the Bell-Irving route and relatively little previous archaeological work has been conducted in this area.

The methods employed were consistent with those used in the Archaeology and Heritage Resources baseline study and EAC Application for the NTL Project (see Section 7.10 of the NTL EAC Application). This included a review of relevant and publically available First Nations traditional land use studies, a review of previously recorded archaeological sites in the study area, and an AIA of the proposed 80 m wide corridor of the Bell-Irving route alignment. The AIA was conducted in accordance with HCA Heritage Inspection Permits 2007-200 and 2007-258. Participants from the Gitanyow First Nation and the Skii km Lax Ha participated in the fieldwork. Fieldwork was conducted between July 27 and August 8, 2010.

6.3.1 Environmental Setting

The proposed Bell-Irving Route option diverges from the proposed NTL ROW near Kitanweliks Creek and follows a northerly path around the east side of Mount Bell-Irving (Figure 1.2-1). The route crosses the Nass and Bell-Irving rivers, and then rejoins the proposed NTL ROW north of Spruce Creek. The length of the Bell-Irving route option is approximately 60 km. The route was selected in part to follow existing logging roads in this area. Approximately 30% of the Bell-Irving route corridor has been previously logged, and portions of the route were likely subject to archaeological assessments in the 1990s as part of forestry operations.

Terrain along the Bell-Irving route is generally characterized by gentle and moderate slopes, generally hilly or following side-slopes. The route crossing at the Nass River is a steep canyon, and the crossing at the Bell-Irving River is a pronounced valley (Plate 6.3-1). Forest cover consists of hemlock, fir, spruce, alder, birch, pine, and cottonwood. Alder, blueberry, and devil's club are the common understory. One previous forest burn covers a large area north of the Nass River. Otherwise the main type of previous disturbance includes cutblocks and logging roads (Plate 6.3-2).

Plate 6.3-1. View north of the Nass River where the Bell-Irving route will cross.

Plate 6.3-2. View south from the northern end of the Bell-Irving route. Spruce Creek valley in photo centre.

During fieldwork conducted as a part of the AIA, the route was initially assessed by low, slow helicopter overflights to identify areas that would require truck-based ground-truthing and/or pedestrian

traverses. Approximately 30% (~18 km) of the route passes through previously logged cutblocks, many of which were assessed aerially. Approximately 33 km of the route were assessed by pedestrian traverse and only 8.5 km were assessed by truck based ground-truthing in areas where the route is within or immediately adjacent to road ROWs. Pedestrian traverses focused on areas with archaeological potential that had not been previously affected by past logging activities. Shovel testing focused on areas with potential for subsurface archaeological materials which were identified during pedestrian traverses. A total of 171 shovel tests were conducted at 24 locations along this route. No new archaeological sites were identified.

No previously recorded archaeological sites are near this route. The closest archaeological sites are several kilometres to the west, along the Nass and Bell-Irving rivers and Meziadin and Bowser lakes.

6.3.2 Spatial and Temporal Boundaries

The spatial boundaries for the archaeological and heritage resources effects assessment is the area within which sites could be affected during construction of the Bell-Irving route, including the entire width of the area within which the ROW would be initially cleared. As per the approved AIR for the Project, areas immediately adjacent to the proposed ROW where unintended or indirect effects could occur during construction were also considered.

The effects assessment considers the effects of the Project on archaeological and designated heritage sites during two time frames: (1) construction and restoration (three years), and (2) operations and maintenance (50+ years). Archaeological sites and designated heritage sites would be most at risk of adverse effects during the Project's construction and restoration phase. The operations and maintenance phase is not expected to result in any significant effects.

6.3.3 Issues Scoping

The primary goal of the archaeology and heritage resources effects assessment is to identify potential effects to archaeological sites and designated heritage sites, including significant historic, paleontological, and architectural sites, resulting from the Project. No significant architectural or paleontological sites were identified during the baseline study, and as such, these types of sites are not discussed further.

6.3.4 Valued Environmental Components

The valued environmental components (VECs) considered during the archaeology and heritage resources effects assessment are:

- archaeological sites protected by the HCA; and
- designated heritage sites.

Please note that traditional use sites or recent land use sites fall outside the scope of this archaeological study and are not considered in this section. These considerations are outlined in Sections 6.11 and 6.13.

6.3.5 Identification of Potential Effects and Mitigation

Because no archaeological sites were identified during the study, no adverse residual effects to archaeological sites and designated heritage sites are likely, should the Bell-Irving route be selected along its current proposed alignment.

6.3.6 Potential Residual Effects and Significance

The likelihood of residual effects to archaeological sites and designated heritage sites is low for the Bell-Irving route along its current proposed alignment.

6.4 TERRAIN STABILITY

6.4.1 Introduction

This section presents the environmental information pertaining to terrain stability along the Bell-Irving route and provides an assessment of potential effects of terrain stability along this route. The methods for the assessment are those described in Chapter 5 of this report and Chapter 5 of the EAC Application. This section is supplemental to Section 7.5 of the EAC Application.

6.4.2 Environmental Setting

The Bell-Irving route is in the Nass Basin at the base of the Skeena Mountains to the northeast and the Coast Mountains to the southwest. This area of relatively low relief is drained by the Nass River and its tributaries, including the Bell-Irving River.

The bedrock geology is characterized by sedimentary rock of the Bowser Lake Group of Middle Jurassic to Late Cretaceous age. Bedrock comprising medium to fine-grained sandstone and shaley siltstone was observed on the southern side of Spruce Creek near the northern end of the route. Glacial deposits of till cover most of the area as a veneer or blanket. The moraine soils were deposited during the last period of major glaciation at least 10,000 years ago and generally consist of compact to dense silty sand and sandy silt. The rivers and larger creeks have eroded into the underlying bedrock to form steep banks covered in places by colluvial soil. Fluvial deposits form fans at the distal end of most of the larger creeks including Gleason Creek and Spruce Creek. Fluvial deposits also form terraces along the banks of the Bell-Irving River.

Terrain stability maps have been prepared based on terrain classification mapping and slope gradient. The terrain stability maps are shown in Figures 6.4-1 to 6.4-3. Most of the terrain within the route corridor is stable to moderately stable. Sections of river and creek banks at the Nass River, Gleason Creek, Spruce Creek, and two unnamed creeks are potentially unstable (Class IV or Class V) where the banks are moderately steep to steep.

The distribution of landslides near the Bell-Irving route appears to be limited to local areas of instability on steep creek banks where minor rock fall, rock ravelling, or shallow soil movement are encountered. Landslide features have been identified on the northern bank of Gleason Creek upstream of the route and at two creek gullies on the northern side of the Nass River where steep-sided gullies have eroded into bedrock (Plate 6.4-1). A large landslide has also been identified on the hillside below a forestry access road approximately 9 km NNE of Gleason Creek and about 400 m to the west of the alignment. This landslide appears to be related to logging road activity. The location of landslide features are shown on the terrain stability classification maps in Figures 6.4-1 to 6.4-3.

Snow avalanches are not expected to affect this segment of the Project.

6.4.3 Spatial and Temporal Boundaries

The effects assessment considers a 2 km wide area that follows the route starting south of Gleason Creek to north of Spruce Creek and crossing the Nass River, Bell-Irving River, and several smaller creeks. The width of the area was selected to include potential terrain stability hazards upslope and downslope of the route.

495000 500000

6210000 6205000 6200000 6195000

N

Mv/Mb
Us
Mbv
Mbv
Mbv-V
Mbv
Mb=Ff//O
Mb/Mv //Ob
Rr
Mb/Mv
R
O
gFf
Cv/Rs
CV/Rs
Ffl//Ob
gFf
Ffl//Ob
Mv/Cv
Rd //Mb
Mv/Mb//Ff
Mv
Rm /Mb/Rr
Mv/Mr/O
Mv/M /O
Mv
Rm /Mb
Mv/Mv/O
Mv
Rr /Rr//O

Gleason Creek

eziadin Junction

C
B
A

Transmission Line
Route Alternative
Paved Road
Gravel Road
Rough Road
Road Bridge
Trail
20 m Contour
100 m Contour
River
River - Intermittent
Ditch
Lake / River

Terrain Stability Rating

I - Stable
II - Generally Stable
III - Moderately Stable
IV - Marginally Stable
V - Unstable
Terrain Polygon Boundary
Landslide with Scarp

[1]Simplified label follows the format below for the primary and secondary components.

Primary Surficial Material
Secondary Surficial Material
Geomorphological Process
Fp//Rh-V
Surface Expression
Component Relation
Surface Expression

1:50,000

0 1 2

Kilometres

Projection: UTM9, NAD83

BC hydro

Proposed Northwest Transmission Line
Terrain Stability Classification - Map A

FIGURE 6.4-1

Rescan™

490000 495000

6230000 6225000 6220000 6215000

N

Mb
Mv//Mb
Rh
Mbv
Mv
Rmh
Mv//Mb
Us//Fft
Us-V
Ft/Fl
Cv/R=Mv
Cv/R=Mv
Mv//R
Us-V
Mb
Mb
Rm
MB//Mv //Mb
Rrh
Mbv-V
Mv//Mb
Rrh
Mbv
Mv/Mb

Nass River

Bell-Irving River

Meziadin Junction

A B C

Transmission Line Route Alternative
Paved Road
Gravel Road
Rough Road
Road Bridge
Trail
20 m Contour
100 m Contour
River
River - Intermittent
Ditch
Lake / River

Terrain Stability Rating

I - Stable
II - Generally Stable
III - Moderately Stable
IV - Marginally Stable
V - Unstable
Terrain Polygon Boundary
Landslide with Scarp

[1]Simplified label follows the format below for the primary and secondary components.

Primary Surficial Material
Secondary Surficial Material
Geomorphological Process
Fp//Rh-V
Surface Expression
Component Relation
Surface Expression

1:50,000

0 1 2

Kilometres

Projection: UTM9, NAD83

BC hydro

Proposed Northwest Transmission Line
Terrain Stability Classification - Map B

FIGURE 6.4-2

Rescan™

485000 490000

6245000 6240000 6235000

N

M1 C1 M2 C2 Mbv//Cv Flf Cv//Cb CV//Cb-V Mbv/Cbv Cv Ff Mbv Rmr Cbv//Mbv Cv/Cb Cv//Rh sgFt sgFt Mv/Mb Rh SgFt SgFt Mb//Mv R Us Mb Mv//Mb Rh

Spruce Creek Bell-Irving River Cleft Creek

Meziadin Junction

A B C

Transmission Line Route Alternative
Paved Road
Gravel Road
Rough Road
Road Bridge
Trail
20 m Contour
100 m Contour
River
River - Intermittent
Ditch
Lake / River

Terrain Stability Rating

I - Stable
II - Generally Stable
III - Moderately Stable
IV - Marginally Stable
V - Unstable
Terrain Polygon Boundary

[1]Simplified label follows the format below for the primary and secondary components.

Primary Surficial Material / Secondary Surficial Material / Geomorphological Process
Fp//Rh-V
Surface Expression / Component Relation / Surface Expression

1:50,000

0 1 2
Kilometres

Projection: UTM9, NAD83

BC hydro

Proposed Northwest Transmission Line
Terrain Stability Classification - Map C

FIGURE 6.4-3

Rescan™

Construction will be scheduled within the overall three year construction phase. The construction stage will be followed by the operation and maintenance phase for the NTL Project, which will occur for a minimum of 50 years.

Plate 6.4-1. Creek gullies on the north side of the Nass River.

6.4.4 Issues Scoping

The effects assessment considers the potential effects of the proposed construction and operation of the NTL Project on existing terrain conditions (slope stability).

During the planning and detailed design phase, the location of transmission structure infrastructure, existing access roads, and proposed new access roads will be selected to avoid potentially unstable terrain and landslides. If potentially unstable terrain or terrain hazards cannot be avoided, a detailed assessment of terrain stability or geotechnical investigation will be required for designing mitigation measures and developing management plans.

Project development including road building and logging will be undertaken in accordance with various provincial guidelines and BC Hydro operating procedures including:

- BC *Forest and Range Practices Act* (2002)
- BC Forest Service (1999). *Mapping and assessing terrain stability guidebook*.
- BC Ministry of Forests and Range (2002). *Forest road engineering guidebook*.
- BC Ministry of Forests. Land Management Handbook 57. *Forest Management on Fans: hydrogeomorphic hazards and general prescriptions* (Wilford, Sakals, and Innes 2005).
- BC Hydro Standard Operating Procedure: Road Construction, Maintenance and Deactivation.

Terrain stability has been identified as an issue of concern related to Project construction and operation. The detailed issues of concern are presented in Section 7.5.3 of the EAC Application. The principal issues have been categorized as Alteration of Land Cover and Access.

6.4.5 Valued Environmental Components

The VEC is terrain stability. Terrain stability represents a physical feature of the environment that may undergo gradual modification over extended periods of time as a result of natural processes caused by weathering and tectonic activity. These natural processes could be affected by construction activity including ROW clearing, tower construction, or access road construction.

Terrain stability conditions may deteriorate and lead to soil erosion, vegetation loss, and sedimentation of waterbodies, or could present a public safety concern if not identified and controlled effectively.

6.4.6 Identification of Potential Effects and Mitigation

The potential interaction between the Project components of the Bell-Irving route and the environment are discussed and evaluated based on the construction/restoration phase and the operations/maintenance phase. Each phase considers the main components of the Project that could have an effect on terrain stability or related factors that could affect land cover and access.

Access for construction will likely make use of existing access roads, some of which may have to be upgraded. Constructing new access roads, upgrading existing roads, and clearing the transmission line ROW represent the components that are most likely to have an adverse effect on the environment in areas where steep, potentially unstable terrain is encountered or where construction is carried out on active fluvial fans.

6.4.6.1 Phase 1: Construction and Restoration

There is a potential for soil erosion in wetland areas, floodplains, and fluvial fans where deposits of silt, silty clay, and silty sand are disturbed by activities such as ROW clearing, foundation construction, or road building. The proposed route crosses the apex of a fluvial fan at Gleason Creek, 1 km above a fluvial fan on an unnamed creek north of Gleason Creek, the edge of fluvial fans and fluvial terrace deposits on the southern side of Bell-Irving River, and 0.8 km above a fluvial fan on an unnamed creek south of Spruce Creek. During detailed design, efforts will be made to utilize existing roads in the area and avoid construction within wetland areas, floodplains, and active fans.

A moderate to high likelihood of landslides can be expected in areas where the route crosses terrain classified as marginally stable or unstable. There is a potential for landslide initiation caused by ROW clearing and access road construction in these areas. Landslides could compromise road and highway infrastructure, affect natural watercourses and fish habitat, adversely affect water supplies, or adversely affect public safety. Areas of potential instability have been identified on steep banks at the proposed crossing of the Nass River, on the moderately steep banks at Gleason Creek, and steep banks at Spruce Creek. The majority of steep slopes within the study area are controlled by shallow bedrock or bedrock outcrop. During detailed design, it should be possible to avoid the areas of potential instability.

Where road construction cannot be avoided on terrain classified as marginally stable or unstable, a detailed assessment of slope stability will be undertaken by a qualified terrain specialist. This will include an assessment of terrain adjacent to the ROW that, in the event of failure caused by construction, could affect the transmission line or associated infrastructure. Mitigation plans for ROW clearing and transmission line construction will be developed based on the results of the terrain stability assessment and will include plans for controlling surface water runoff.

Road construction will be completed in accordance with an approved design based on forestry road engineering standards and BC Hydro Road Maintenance Field Guides. No new road construction is

expected to be required to cross fluvial fans. If new road construction is required on fans the hydrogeomorphic condition of the fan will be assessed by a qualified professional. Road construction practices will follow Standard Operating Procedures and will incorporate prescriptions based on the BC MOFR's Land Management Handbook 57 to minimize fan destabilization (Wilford, Sakals, and Innes 2005). No residual adverse effects are likely during road construction if good engineering design and construction practices are followed.

6.4.6.2 Phase 2: Operations and Maintenance

Regular inspection and maintenance of the transmission line ROW will be undertaken during operations to identify potential terrain stability concerns. Appropriate mitigation strategies will be used if required. Potential residual adverse effects are not likely.

It is not likely that road construction will be required on steep terrain, and therefore the risk of landslides is low. Regular inspection and maintenance will be undertaken to identify potential concerns. Appropriate mitigation strategies will be used if required. Potential residual effects are not likely.

6.4.7 Potential Residual Effects and Significance

The potential for adverse environmental effects during the construction and restoration phase and during the operations and maintenance period will be reduced by incorporating various design mitigation measures such as:

- transmission line ROW and tower construction in areas that avoid or span steep, potentially unstable terrain;
- avoid low-lying areas susceptible to flooding;
- access road construction in areas that avoid steep potentially unstable terrain classified as moderate to high likelihood for slope failure and construction in accordance with approved designs based on forest road engineering standards and BC Hydro Road Maintenance Field Guides; and
- ROW clearing and access road construction in areas that avoid fluvial fans.

Adverse environmental effects associated with terrain stability or fan destabilization can be avoided or minimized by careful planning that involves detailed assessment by qualified professionals, engineering design based on good engineering practice and implementation of best management practices during construction.

Residual adverse effects are not likely along the Bell-Irving route if these mitigation measures are followed.

6.5 SURFICIAL MATERIALS AND SOILS

6.5.1 Environmental Setting

The study area comprises a 2 km wide, 60 km long Bell-Irving route (Figure 6.5-1). The main objectives of the surficial materials and soils study are to:

- map and characterize soils and their parent (surficial) materials within the study area; and
- identify soil landscape characteristics within the study area that could be affected from the construction and operation of the proposed Bell-Irving route.

6.5.1.1 Methods

Terrain mapping information was obtained from a series of 1:50,000 scale provincial terrain and surficial geology maps (BC MOE 1976, 1981).

Ground-truthing was carried out at a reconnaissance level with a field survey conducted in August of 2010. The vegetation and wildlife site investigations were carried out at the same time and at the same location as the soil inspection sites. In total, 28 soil inspection sites were located within the study area, within the 38 m-wide Right of Way (ROW) and beyond (Figure 6.5-2). The inspection sites were selected based on the rational of capturing representative soils information on larger polygons that extended beyond the limits of the ROW and within the route corridor. Thus, it is anticipated that any changes to the proposed ROW, within the bounds of the route corridor, will be largely accounted for by the data presented in this report.

Soil and site information was recorded at all sites and included Universal Transverse Mercator (UTM) coordinates, slope, surficial material, geomorphic process, soil drainage, soil texture, coarse fragment content, root depth and description, soil horizon designation and depth, soil colour, depth to bedrock, and depth to the water table.

Soil drainage information as derived from site inspection data was re-classified according to the following criteria for data analyses purposes:

- Class 1: very rapidly;
- Class 2: well drained;
- Class 3: moderately;
- Class 4: imperfectly;
- Class 5: poorly drained; and
- Class 6: very poorly drained.

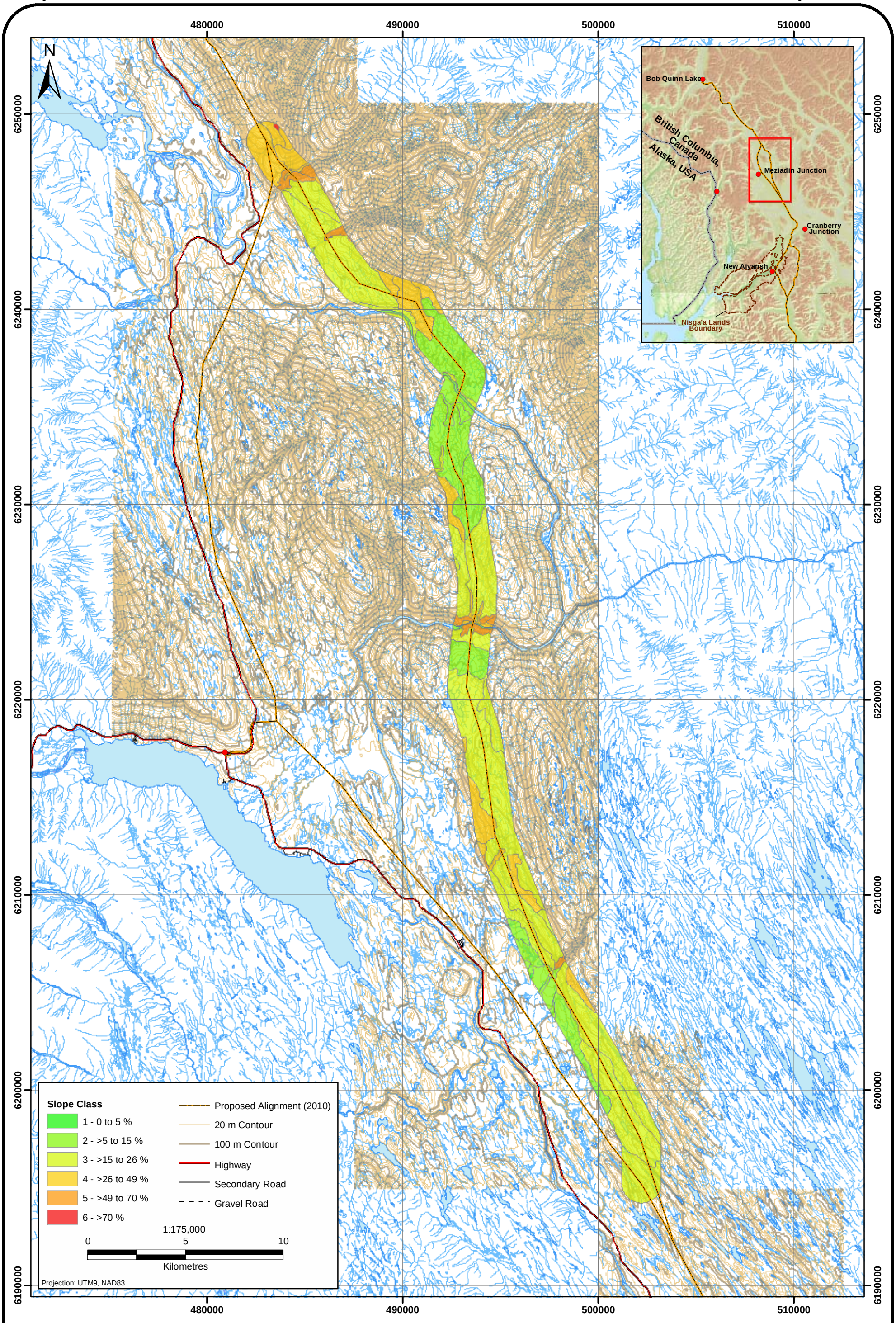
Slope classes were created based on the following terrain classification categories (Howes and Kenk 1997):

- Class 1: level (slope of 0 to 5%);
- Class 2: gentle (slope of >5 to 15%);
- Class 3: moderately gentle (slope of >15 to 26%);
- Class 4: moderate (slope of >26 to 49%);
- Class 5: moderately steep (slope of >49 to 70%); and
- Class 6: steep (slope of >70%).

6.5.1.2 Results and Discussion

Soil development and characteristics are a direct result of the interaction of climate, physiography (including geology and topography), and surficial materials over time (weathering).

Appendix 6.5-1 contains the raw data collected during the field work.



Proposed Northwest Transmission Line
Bell-Irving Route - Slope Class Map

FIGURE 6.5-1