APPENDIX E

WATERCOURSE CROSSINGS EFFECTS ASSESSMENT

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1.0 INTRODUCTION

The following appendix has been prepared in response to a request by the Federal Responsible Authorities (Transport Canada and Fisheries and Oceans Canada).

The Federal Authorities' scope for this stream crossing assessment includes activities related to the clearing, construction, commissioning, restoration, operation and maintenance, and decommissioning and abandonment of the KSL pipeline and other related permanent facilities. These watercourse crossings will require authorizations under the Fisheries Act and Navigable Waters Protection Act.

The following project activities are considered relevant to the Federal Authorities' stated regulatory responsibilities:

- crossings of watercourses during pipeline construction;
- crossings of watercourses for access roads and bridges;
- hydrostatic test (water withdrawal and releases);
- temporary construction-phase surface disturbance at water crossing; and
- pipeline monitoring, vegetation management and access management activities during the operational phase and decommission at water courses.

This Appendix contains information necessary for the Federal Agencies' Evaluation of impact significance and the preparation of the CEAA Screening Report. Environmental effects information is presented by valued component for watercourse crossings in the seven watersheds crossed by the pipeline route.

The information contained in the EA and Technical Reports was used to prepare this Appendix; no new project description information or environmental effects information is presented in this Appendix. The reader is directed to the Environmental Assessment Certificate (EAC) Application for a detailed assessment of all other project related impacts and the KSL Project Technical Reports for detailed environmental setting information. For example, baseline conditions upstream, downstream and at planned watercourse crossings are described in detail in the KSL Fish and Fish Habitat Technical Report, the fish-bearing and non-fish-bearing atlases.

2.0 APPROACH

The valued ecosystem and social components (VEC and VSC) defined for the project in the AToR were analyzed to determine potential project-related interactions at watercourse crossing locations. The analysis shows that a number of topics are not relevant for the assessment of project-related impacts at individual stream crossings, other topics are too broad to be reasonably applied to location-specific assessments.

A list of the VECs and VSCs considered in this Appendix is presented in Table 2.0-1.

TABLE 2.0-1
LIST OF VECs AND VSCs CONSIDERED FOR STREAM CROSSING ASSESSMENT

VEC/VSC	Applicable at Scale of Stream Crossing Assessment	Comments and Specific Topics Relevant to Stream Crossings
Geophysical Environment (See Section 3.0)	Yes	• Soil erosion • Natural hazards
Atmospheric Environment	No	• Topic too broad for stream crossing assessment
Aquatic Environment (See Section 4.0)	Yes	• Fish and Fish Habitat • Surface hydrology and water quality
Terrestrial Environment (Wildlife and Wildlife Habitat; Vegetation) (See Section 5.0)	Yes	• Vegetation • Invasive plants • Wildlife habitat
Species and Ecosystems at Risk (See Section 6.0)	Yes	• Aquatic species and riparian ecosystems
Archaeological and Heritage Resources (See Section 7.0)	Yes	• Archaeological sites near stream crossings
First Nations Community and Land Use (See Section 8.0)	Yes	• First Nations have interests at all stream crossings
Land and Resource Use (See Section 9.0)	Yes	• Plan policies regarding streams • Resource use and management activities at stream crossings • Domestic water quality and supply
Community and Regional Infrastructure and Services	No	• No interactions with utilities or services at stream crossings
Employment and Economy	No	• Topic too broad for stream crossing assessment
Human Health and Safety	No	• Topic too broad for stream crossing assessment
Navigable Waters (See Section 10.0)	Yes	• Transport Canada interests
Aesthetics and Viewsheds (See Section 11.0)	Yes	• Visual impacts related to clearing at some stream crossings

The construction, operation and potential decommission phases of the pipeline may cause potential effects at fish bearing stream crossings. Each of the potential effects will be mitigated to ensure the protection of the fisheries resources. For example, if flooding were to occur at the time the stream crossings are being installed this could result in sedimentation of the watercourse. This impact will be avoided by scheduling the stream crossing work during low flow conditions.

Potential effects to fish bearing stream crossings include

- fish mortalities from blasting,
- fish mortalities from spills,
- fish mortalities from entrainment at hydrostatic test water intakes,
- fish mortalities from instream construction activities,
- fish mortalities from increased fishing pressure,
- direct physical alteration of instream habitat at crossing sites, and
- physical alteration of instream habitat through sediment release.

Detailed descriptions of the mitigation measures proposed to avoid or reduce these potential effects are presented within Section 7.2.3 of this EAC Application.

2.1 KITIMAT WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Kitimat watershed is approximately 3.16 km^2 in size. This represents approximately 0.006 % of the total watershed area. The Kitimat watershed is located at the western end of the project route. A total of 45 stream crossings occur in this watershed between KP 0 and KP 74. The Kitimat Watershed has the highest potential for project-specific and cumulative effects of the seven watersheds crossed by the pipeline route due to its steep terrain, high annual rainfall and snowfall, and past land use practices (logging and road building) and high overall fisheries value.

A list of watercourse crossings in the Kitimat watershed and the location of the crossings along the pipeline route are presented in Table 2.1-1.

TABLE 2.1-1
STREAM CROSSINGS IN KITIMAT WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
ML 1	Unnamed Channel	Kitimat River	TBD	TBD	TBD
0.4	Unnamed Channel	Kitimat River	S4	Open	Moderate
1.5	Unnamed Channel	Kitimat River	S2	Open	High
4.7	Duck Creek	Kitimat River	S2	Open	High
5.4	Unnamed Channel	Kitimat River	S2	Open	Moderate
5.4	Unnamed Channel	Kitimat River	S2	Aug 1 - Jan 31	Moderate
5.8	Goose Creek	Kitimat River	S2	Aug 1 - Jan 31	Moderate
6.9	Unnamed Channel	Kitimat River	S2	Aug 1 - Jan 31	High
9.2	Unnamed Channel	Unnamed tributary to the Kitimat River	S3	Open	High
9.7	Unnamed Channel	Unnamed tributary to the Kitimat River	S3	Aug	High
10.0	Unnamed Channel	Unnamed tributary to the Kitimat River	S3	Aug	High
12.2	Little Wedeene River Wetland	Little Wedeene River	W2	Open	Low
12.9	Little Wedeene River	Kitimat River	S1	Open for HDD Jun 15 - Jul 15 for instream work	High
14.6	Trout Creek	Little Wedeene River	S2	Aug 1 - Jan 31	High
16.7	Unnamed Channel	Wedeene River	S3	Aug 1 - Jan 31	High
17.0	Wedeene River	Kitimat River	S1	Open for HDD, Jun 15 - Jul 15 for isolation	High
18.3	TBD	Wedeene River	TBD	Aug	TBD
21.3	TBD	Wedeene River	TBD	Aug	TBD
21.6	TBD	Wedeene River	TBD	Aug	TBD
22.7	TBD	Wedeene River	TBD	Aug	TBD
22.8	TBD	Wedeene River	TBD	Aug	TBD
23.3	TBD	Wedeene River	TBD	Aug	TBD
24.6	TBD	Wedeene River	TBD	Aug	TBD
25.6	Unnamed Channel	Lone Wolf Creek	S2	Aug	High
30.1	Cecil Creek	Kitimat River	S2	Open for HDD Jul 1 - Sep 15 for instream work	High
38.8	Chist Creek	Kitimat River	S1	Open for HDD Jul 15 - Aug 1 for instream work	High
40.9	Unnamed Channel	Chist Creek	S3	Open	Moderate

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
41.5	Unnamed Channel	Chist Creek	S3	Open	Moderate
41.6	Unnamed Channel	Kitimat River	S3	Aug 15 - Sep 30	High
41.9	Unnamed Channel	Kitimat River	S3	Open	High
41.9	Unnamed Wetland	Kitimat River	W1	Open	Moderate
43.8	Unnamed Channel	Kitimat River	S3	Aug 15 - Sep 15	High
44.5	Unnamed Channel	Kitimat River	S4	Aug - Sep	Moderate
45.0	Unnamed Channel	Kitimat River	S3	Aug 1 - Jan 31	Moderate
47.9	Unnamed Channel	Kitimat River	S3	Open	Moderate
48.9	Unnamed Channel	Kitimat River	S4	Open	Low
50.4	Unnamed Channel	Kitimat River	S3	Aug 1 - Jan 31	High
56.5	Unnamed Channel	Kitimat River	TBD	Open	Low
57.1	Unnamed Channel	Kitimat River	S2	Aug 1 - Jan 31	High
57.7	Unnamed Channel	Kitimat River	S3	Open	Moderate
59.8	Unnamed Channel	Kitimat River	S2	Aug 1 - Jan 31	High
60.9	Unnamed Channel	Hunter Creek	TBD		Low
61.4	Unnamed Channel	Hunter Creek	TBD		Low
63.4	Hunter Creek	Kitimat River	S1	Jul 1 - Jul 31	High
74.0	Unnamed Channel	Hoult Creek	TBD	Open	TBD

2.2 ZYMOETZ WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Zymoetz watershed is approximately 0.99 km^2 in size, representing approximately 0.033 % of the total watershed area. The Zymoetz watershed is located near the western end of the project route. A total of 4 stream crossings occur in this watershed between KP 79 and KP 104. Like the Kitimat watershed, the Zymoetz watershed has comparatively high potential for project-specific and cumulative effects due to its steep terrain, high annual rain, and snowfall and past land use practices west of the Clore River and high overall fisheries value. A list of watercourse crossings in the Zymoetz watershed and the location of the crossings along the pipeline route are presented in Table 2.2-1.

TABLE 2.2-1
STREAM CROSSINGS IN THE ZYMOETZ WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
88.5	Clore River	Zymoetz River	S1	Aerial anytime if no instream structure	TBD
99.6	Burnie River	Clore River	S1	Aug 1 - Sep 30	High
102.3	Unnamed Channel	Unnamed Tributary to the Burnie River	TBD	Open	TBD
102.6	Unnamed Channel	Unnamed Tributary to the Burnie River	TBD	Open	TBD

2.3 BULKLEY WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Bulkley watershed is approximately 3.96 km^2 in size. This represents approximately 0.033 % of the total watershed area. The Bulkley watershed is located in the central portion of the project route. A total of 31 stream crossings occur in this watershed between KP 104 to KP 174 and KP 195 to 214. Within the far western end of the watershed there is a comparatively high risk of potential project-specific and cumulative effects due to its steep terrain, high annual rain and snowfall and past land use practices (logging and road building). The remainder, which includes the majority of the watershed has rolling topography with less erosion risk but high fisheries value. A list of watercourse crossings in the Bulkley watershed and the location of the crossings along the pipeline route are presented in Table 2.3-1.

TABLE 2.3-1
STREAM CROSSINGS IN THE BULKLEY WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
104.6	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S4	Open	Low
106.6	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S2	Jun 15 - Aug 31	High
109.3	Unnamed Channel	Gosnell Creek	S2	Open for HDD Aug 1 - Dec 31 for instream work	High
109.5	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S3	Open	High
109.8	Gosnell Creek Side Channel	Gosnell Creek	S2	Open for HDD Aug 1 - Dec 31 for instream work	High
110.0	Gosnell Creek	Morice River	S1	Open for HDD Aug 1 - Dec 31 for instream work	High
112.1	Unnamed Channel	Gosnell Creek	S2	Aug 15 - Dec 31	High
116.9	Unnamed Channel	Unnamed Tributary to Gosnell Creek	TBD	Open	TBD
117.0	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S3	Open	Moderate
119.1	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S3	Jun 15 - Aug 31	High
119.8	Unnamed Channel	Unnamed Tributary to	S3	Jun 15 - Aug 31	High

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
		Gosnell Creek			
119.9	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S3	Jun 15 - Aug 31	High
121.4	Unnamed Channel	Unnamed Tributary to Gosnell Creek	S3	Jun 15 - Aug 31	High
124.5	Crystal Creek	Gosnell Creek	S1	Jul 15 - Aug 31	Moderate
130.4	Unnamed Channel	Morice River	S3	Open	Moderate
130.6	Morice River	Bulkley River	S1	Open for HDD and aerial, window for open cut would need regulator input	High
137.4	Unnamed Channel	Morice River	S2	Jun 15 - Aug 31	High
140.0	Unnamed Channel	Morice River	TBD	Open	TBD
140.7	Unnamed Channel	Morice River	TBD	Open	TBD
142.7	Cedric Creek	Morice River	S6	Open	Low
146.4	Unnamed Channel	Morice River	S3	Open	Moderate
147.8	Unnamed Channel	Morice River	S3	Open	Moderate
149.9	Lamprey Creek	Morice River	S2	July	High
150.9	Unnamed Channel	Lamprey Creek	S3	Open	Moderate
154.6	Unnamed Channel	RA 174b	S3	Sep 1 - Dec 31	High
154.8	Unnamed Channel	Morice River	S2	Sep 1 - Dec 31	High
163.0	Fenton Creek	Morice River	S2	July	High
165.3	Owen Creek	Morice River	S2	July	High
206.7	Unnamed Channel	Buck Creek	S3	Aug 1 - Mar 31	High
209.1	Unnamed Channel	Buck Creek	TBD	Open	TBD
209.4	Unnamed Channel	Buck Creek	TBD	Open	TBD

2.4 NECHAKO WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Nechako watershed is approximately 3.96 km^2 in size. This represents approximately 0.020 % of the total watershed area. The Nechako watershed is located in the central portion of the project route. A total of 39 stream crossings occur in this watershed between KP 174 – 195 and KP 214 - 362. The majority of the watershed has topography of forested low rolling hills with high fisheries value but low to moderate potential for project-specific and cumulative effects relative to other watersheds crossed by the pipeline route. A list of watercourse crossings in the Nechako watershed and the location of the crossings along the pipeline route are presented in Table 2.4-1

TABLE 2.4-1
STREAM CROSSINGS IN THE NECHAKO WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
179.0	Parrot Creek	Francois Lake	S2	Open	Moderate
180.4	Unnamed Channel	Parrott Creek	TBD	Open	TBD
180.6	Unnamed Channel	Parrott Creek	S3	Open	Low
184.9	Unnamed Channel	Parrot Creek	TBD	Open	Low
193.8	Unnamed Channel	Parrott Creek	TBD	Open	TBD
215.2	Allin Creek	Francois Lake	S2	Aug 1 - Mar 31	High
217.3	Unnamed Channel	Allin Creek	TBD	Open	TBD
229.6	Unnamed Channel	Beach Creek	TBD	Open	TBD
230.5	Unnamed Channel	Beach Creek	S3	Aug 1 - Mar 31	High
231.8	Unnamed Channel	Beach Creek	S3	Aug 1 - Mar 31	Moderate
238.9	Unnamed Channel	Tchesinkut Creek	S3	Aug 1 - Mar 31	Moderate
239.5	Tchesinkut Creek	Tchesinkut Lake	S3	Aug 1 - Mar 31	Moderate
244.3	Unnamed Channel	Tchesinkut Lake	S2	Open	Low
248.0	Unnamed Channel	Tchesinkut Lake	S3	Aug 1 - Mar 31	Moderate
257.3	Unnamed Channel	Baker Creek	TBD	TBD	TBD
257.3	Unnamed Channel	Baker Creek	TBD	TBD	Low
259.5	Unnamed Channel	Unnamed Tributary to Tchesinkut Creek	TBD	Open	TBD
266.9	Unnamed channel	Tchesinkut Creek	TBD	Open	TBD
268.6	Unnamed Channel	Tchesinkut Creek	TBD	Open	Low
278.9	Tchesinkut Creek	Endako River	S2	Aug 1 - Mar 31	High
280.6	Unnamed Channel	Sam Ross Creek	S3	Open	Low
280.8	Sam Ross Creek	Endako River	S3	Aug 1 - Mar 31	Moderate
283.7	Unnamed Channel	Endako River	S3	Aug 1 - Mar 31	Moderate
286.1	Unnamed Channel	Endako River	TBD	Open	TBD
291.0	Unnamed Wetland	Endako River	W2	Jul 15 - Apr 15	TBD
291.9	Unnamed Channel	Endako Marsh Lake	S4	Open	Moderate
292.1	Unnamed Channel	Endako Marsh Lake	TBD	Open	TBD
297.5	Endako River	Stellako River	S1	Oct 1 - Aug 15	High
305.1	Stern Creek	Fraser Lake	S2	Jul 15 - Apr 15	High
314.9	Ormond Creek (Alias Canyon Creek)	Fraser Lake	S2	Jul 15 - Apr 15	Moderate
326.6	Dog Creek	Nechako River	S3	Jul 15 - Apr 15	Moderate
330.2	Unnamed Channel	Tatsutnai Creek	S3	Open	Moderate

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
330.6	Tatsutnai Creek	Nechako River	S2	Jul 15 - Apr 15	Moderate
334.3	Nine Mile Creek	Nechako River	S2	Jul 15 - Sep 30	High
338.3	Unnamed Channel	Nechako River	S2	Jul 15 - Apr 15	High
340.2	Kluk Creek	Nechako River	S2	Jul 15 - Apr 15	High
343.6	Halsey Creek	Nechako River	S3	Jul 15 - Apr 15	Moderate
346.8	Unnamed Wetland	Trankle Creek	W2	Open	Moderate
347.1	Trankle Creek	Nechako River	S3	Jul 15 - Apr 15	Moderate
356.8	Clear Creek	Nechako River	S3 (W1 at ROW)	Jul 15 - Apr 15	Moderate

2.5 STUART WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Stuart watershed is approximately 1.94 km^2 in size. This represents approximately 0.012 % of the total watershed area. The Stuart watershed is located in the central portion of the project route. A total of five stream crossings occur in this watershed between KP 174 – KP 195 and KP 362 – KP 408. The majority of the watershed is forested low rolling hills and cleared pasture land with comparatively low to moderate potential for project-specific and cumulative effects. A list of watercourse crossings in the Stuart watershed and the location of the crossings along the pipeline route are presented in Table 2.5-1.

TABLE 2.5-1
STREAM CROSSINGS IN THE STUART WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Sensitivity (High, Moderate, Low)
370.1	QH Creek	Stuart River	S3	Jul 15 - Apr 15	Moderate
372.3	Unnamed channel	QH Creek	S3	Jul 15 - Apr 15	Moderate
376.4	Breadalbane Creek	Stuart River	S3	Jul 15 - Apr 15	Moderate
388.9	Stuart River	Nechako River	S1	Open for HDD and aerial Sep 1 - Oct 31 for open cut	High
399.6	Chinohchey Creek	Stuart River	S2	Jul 15 - Apr 15	High

2.6 FRASER WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Fraser watershed is approximately 1.71 km^2 in size, representing approximately 0.002 % of the total watershed area. The Fraser watershed is located in the central and near the eastern end of the project route. A total of 14 stream crossings occur in this watershed between KP 174 – 195 and KP 408 - 454. The majority of the watershed in the project RSA has topography of forested low rolling hills. Agricultural clearing and logging has occurred throughout the area. This watershed is considered to have low to moderate potential for project-specific and cumulative effects, relative to other watersheds crossed by the pipeline route. A list of watercourse

crossings in the Fraser watershed and the location of the crossings along the pipeline route are presented in Table 2.6-1.

TABLE 2.6-1
STREAM CROSSINGS IN THE FRASER WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Priority (High, Med, Low)
417.0	Unnamed Channel	Hoodoo Creek	S3	Jul 15 - Apr 15	Moderate
422.9	Crocker Creek	Salmon River	TBD	Open	Low
424.8	Crocker Creek	Salmon River	S2	Jul 15 - Apr 15	Moderate
425.5	Crocker Creek	Salmon River	S2	Jul 15 - Apr 15	Moderate
427.3	Unnamed Channel	Crocker Creek	S3	Open	Low
429.7	Unnamed Channel	Salmon River	TBD	Open	TBD
430.3	Salmon River	Fraser River	S1	Open for HDD Jul 15 - Oct 31 for instream work	High
434.1	Unnamed Channel	Salmon River	S3	Open	Moderate
440.3	Unnamed Channel	Salmon River	S3	Open	High
441.2	Salmon River	Fraser River	S1	Open for HDD Jul 15 - Oct 31 for instream work	High
447.2	Unnamed Wetland	Pastor Creek	W1	Open	Moderate
449.2	Salmon River	Fraser River	S1	Open for HDD Jul 15 - Oct 31 for instream work	High
450.1	TBD	Salmon River	TBD	Jul 15 - Apr 15	TBD
450.7	TBD	Salmon River	TBD	Jul 15 - Apr 15	TBD

2.7 PEACE WATERSHED WATERCOURSE CROSSINGS

The Project footprint within the Peace watershed is approximately 0.41 km^2 in size and. This represents approximately 0.001 % of the total watershed area. The Peace watershed is located in the east portion of the project route. A total of four stream crossings occur in this watershed between KP 454 – KP 462. A list of watercourse crossings in the Peace watershed and the location of the crossings along the pipeline route are presented in Table 2.7-1.

TABLE 2.7-1
STREAM CROSSINGS IN THE PEACE WATERSHED

KP	Watercourse Name	Mainstem	Provincial Class	Proposed Work Window	Fish Priority (High, Med, Low)
455.0	Balsam Creek	Echo Creek	S3	Open	Low
455.8	Echo Creek	Echo Lake	S2	Jul 15 - Apr 15	Moderate
458.7	Thorps Creek	Summit Lake	S4	Open	Low
461.6	Miller Creek	Summit Lake	S3	Open	Low

3.0 GEOPHYSICAL ENVIRONMENT

Potential project-related effects at stream crossings for this VEC may be caused by geophysical effects (earth flows, debris/earth slides, and rock slides) and surface water erosion.

Geophysical effects are likely to impact the project's watercourse crossings via the direct physical alteration of instream habitat, creation of a fish migration barrier and/or the physical alteration of instream habitat through sediment release. The seven watersheds that the pipeline traverses contain varying levels of geophysical risk at watercourse crossings. However, significant efforts have been made during the pipeline routing phase to avoid all potentially problematic areas that may present a risk of geohazards.

The risk of increased occurrences of geophysical effects is higher within the Kitimat and Zymoetz watersheds (KP 0 – KP 104) due to mountainous topography and high amounts of precipitation. The most commonly expected geophysical effects within this portion of the Project route include earth flows, debris/earth slides, and rock slides.

The majority of the Project route is located within the Bulkley and Nechako watersheds, which share similar geomorphologic characteristics. The landscape from the western end of the Bulkley watershed to the project endpoint within the Summit Lake watershed (KP 104.0 – KP 462.2) can be characterized as have low to moderate relief forested hills. A potential geophysical issue within this portion of the Project are earth slides within fine grained glaciolacustrine soils.

Surface water erosion could occur at several stream crossing locations along the entire project route, but it is manageable with specific construction Best Management Practices (BMPs). Surface water erosion occurs on slopes when a natural drainage or pumped water is allowed to travel down the along or across the Project footprint and gain enough velocity for the water to cause soil erosion, potentially expose the pipeline or impact a downslope watercourse. Sections of the pipeline route over 20 degrees in loose glaciofluvial sands and gravels and soft glaciolacustrine silts or sections of right-of-way traversing wet ground with an adjacent slope over 10 m high are susceptible to this type of erosion.

3.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline route west of Kitimat. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area. The implementation of Project facilities will include measures to minimize effects on the geophysical environment at stream crossings.

3.2 POTENTIAL EFFECTS AND MITIGATION MEASURES FROM PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

During the clearing, construction and restoration phases of the KSL project, disturbance of instream habitat will occur at the majority of pipeline crossings, since trenching of the watercourse will be required to complete most crossings. On crossings requiring a buried pipeline, mitigation and restoration will offset most impacts to the geophysical environment by restoring or maintaining streambank stability.

Potential impacts to the geophysical environment at stream crossings include slope instability and resulting geophysical effects and surface water erosion. This is likely to happen during the clearing and construction phases of the Project that will require blasting, removal of riparian vegetation, and operation of large machinery on steep slopes. In areas that are prone to surface water erosion, berms and ditches and other surface water control features will be utilized to minimise the impact to the right-of-way and adjacent access roads, railways, and watercourses.

The level of impacts will be largely dependent on the existing geophysical characteristics of the crossing, such as slope stability, vegetation, slope gradient, soils, bed material, and stream channel morphology. It is also these natural characteristics that will dictate the design and construction of the watercourse crossings. The techniques of stream crossings will include the use of channel isolation techniques, aerial crossings or HDD.

Potential effects on the geophysical environment within the seven Watersheds may include increased surface soil erosion and possibly increased slope instability at stream crossing sites. Successful route planning and use of construction BMPs will minimize the risk of impact to areas of geophysical sensitivity. It is anticipated that the construction, operation, and decommissioning phases of the pipeline will have negligible effects on the geophysical environment.

Table 3.2-1 summarizes the impact pathways, potential geophysical effects associated with the watercourse crossings in the seven Project watersheds. Table 3.2-1 summarizes the mitigation measures and residual effects associated with the geophysical effects.

TABLE 3.2-1
SUMMARY OF WATER COURSE CROSSING GEOPHYSICAL EFFECTS AND MITIGATION MEASURES

Watershed	Impact Pathways	Potential Geophysical Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Direct physical alteration of instream habitat at crossing sites, and • Physical alteration of instream habitat through sediment release. •	• Earthflows • Debris slides • Rockslides • Surface water erosion	• Steep mountainous terrain • High precipitation • Unstable slopes • Blasting of bedrock • Construction related and natural sources of surface flow • Unstable slopes comprised of clayey glaciolacustrine silts
Mitigation Measures: • Minimize watercourse crossings by adopting environmental objectives during route selection. • Restoration may require engineering input and will therefore be guided by engineering designs as well as onsite supervision by a restoration specialist. • The streambed and banks will be restored, based on preconstruction habitat surveys, and the natural drainage and channel configurations will be maintained or restored. The streambed and banks will be restored, based on preconstruction habitat surveys, and the natural drainage and channel configurations will be maintained or restored. • Construction of temporary vehicle crossings on fish-bearing watercourses will follow Provincial guidelines for installation of road crossings (BC Ministry of Forests 2002) or adhere to DFO Operational Statements (e.g., Clear Span Bridges, Ice and Snow Fill Bridges) where certain crossing types are used. • Vehicle crossings will be engineered to ensure adequate streambank stability. • Contour and stabilize banks and approach slopes. • Mitigation of the geophysical impacts will include the revegetation by native grass seeding, and planting and recruitment of native shrubs and trees. • Use qualified environmental monitors during all stream crossing construction activities, and follow emergency procedures for all incidents as presented in the EPP. • Blasting procedures for the project will be guided by Guidelines for the Use of Explosives in Canadian Fisheries Waters when blasting occurs within 80 m of a fish-bearing watercourse.			
Residual Effects: • No residual or cumulative geophysical effects were identified at the stream crossings in the Project watersheds. • No residual effect has been identified in relation to operations and maintenance activities. • No residual effect has been identified in relation to Project decommissioning.			

3.3 POTENTIAL EFFECTS OF THE GEOPHYSICAL ENVIRONMENT FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be no residual geophysical impacts at watercourse crossings. The effective restoration of the watercourse crossings will establish vegetative groundcover and stabilize banks. The Project Restoration Plan will provide further detail of reclamation grass seed mixtures, and planting prescriptions.

3.4 POTENTIAL EFFECTS OF THE GEOPHYSICAL ENVIRONMENT FROM PROJECT DECOMMISSIONING

The potential effects of the decommissioning and abandonment of the Project at watercourse crossings are anticipated to be negligible.

4.0 AQUATIC ENVIRONMENT

The KSL Project will interact with fish and fish habitat, surface hydrology and water quality at most watercourse crossing. These aquatic environment VECs are discussed in the following section.

Along its 462 km length, the proposed KSL Pipeline Looping Project route crosses 497 watercourses; of these, 143 crossings have been classified as fish-bearing and 354 classified as non-fish bearing. The fish-bearing watercourses total includes 34 watercourses that have had their status defaulted to fish-bearing, pending further investigation in 2007. Of the fish-bearing watercourses that have been investigated in the field, 14 are classified as S1, 34 classified as S2, 50 classified as S3, and six classified as S4. Five watercourses classified as wetlands also provide fish habitat. From the total of 497 watercourses, 54 were assigned a "High" sensitivity rating, 42 a "Moderate" rating, 371 assigned a "Low" sensitivity and 92 assigned "None" or having no sensitivity.

In total, 32 different fish species were captured along the KSL Pipeline Looping Project route between KP 0 and KP 462.2. This included 10 of the 16 fish species identified as Valued Ecosystem Components (VEC's) in the Approved Terms of Reference. No SARA, COSEWIC or provincially "Red" listed species were found in any of the watercourses sampled. There are six fish species on *SARA*, COSEWIC, and provincial lists that could occur in the Project area:

- White sturgeon,
- Interior Fraser coho,
- Eulachon,
- Dolly Varden,
- bull trout, and
- Westslope cutthroat trout.

Dolly Varden and bull trout were the only provincially "Blue" listed species sampled, with Dolly Varden present in 26 of the watercourses sampled, and bull trout present in only three of the watercourses. The Interior Fraser population of coho salmon is listed by COSEWIC as "Endangered", however no coho from this population were caught in watercourses along the KSL Project route. The Nechako River population of white sturgeon is also listed by COSEWIC and SARA as endangered. There is no crossing of the Nechako River proposed and no individuals were caught during sampling of tributaries of the Nechako River.

Direct and indirect mortality of fish may occur as a result of instream construction activities on fish-bearing watercourses. Potential causes of mortality include: dewatering of habitat, exposure to intense suspended sediment levels, direct impingement by construction equipment, entrainment into water intakes, and smothering of incubating eggs and alevins. This concern is restricted to the Project Footprint. (Note: effects of release of suspended sediment to downstream habitat is assessed as a habitat impact, see Potential Effect: Loss or Degradation of Instream Fish Habitat).

Direct and indirect mortality to fish from instream activities will be mitigated by specialized instream construction techniques, or offset by compensation.

See Section 7.2.3 of the EAC application for a detailed description of the potential effects and assessment of residual effects for the aquatic environment of the of the pipeline route.

4.1 IMPACT PATHWAYS

The potential effects on the aquatic environment will follow the impact pathways discussed below. Each of the impact pathways has corresponding mitigation measures, which will minimize potential effects. Detailed descriptions of the mitigation measures are presented within Section 7 of this application. The impact pathways that could affect the aquatic environment include:

- fish mortalities from blasting;
- fish mortalities from spills;
- fish mortalities from entrainment at water intakes;
- fish mortalities from instream construction activities;
- fish mortalities from increased fishing pressure;
- direct physical alteration of instream habitat at crossing sites; and
- physical alteration of instream habitat through sediment release.

4.1.1 Fish Mortalities from Blasting

Explosive charge use will be necessary during the construction phase of the Project and may occur near watercourse crossings. Explosive charges have the potential to harm or kill fish even when the charges are relatively small and the fish are a considerable distance from the explosion. This concern is restricted to the LSA spatial scale. Blasting procedures for the project will be guided by *Guidelines for the Use of Explosives in Canadian Fisheries Waters* (Wright and Hopky 1998) when blasting occurs within 80 m of a fish-bearing watercourse. Mitigation measures regarding blasting are discussed within Section 7.2.3 of this application.

4.1.2 Fish Mortalities from Accidental Spills

The release of toxic substances during construction has the capacity to cause mortality or sublethal health effects to fish. This potential impact is related to leaks and spills of lubricants, fuels, and hydraulic fluids directly from construction equipment or from fuelling and maintenance of this equipment. The concern is assessed at the LSA spatial scale, as it is unlikely that spills of sufficient magnitude would affect fish populations at a scale greater than the LSA.

Numerous procedures and plans have been devised to prevent release of hydrocarbons from construction machinery, to contain spills should they occur, and to remediate sites should spills

occur. Mitigation measures regarding spills of toxic substances are discussed within Section 7.2.3 of this application.

4.1.3 Fish mortalities from entrainment at water intakes

During flow isolation and hydrotest work during the construction phase of the KSL project, direct and indirect mortality to fish may occur as a result of entrainment at water intakes. Potential effects of entrainment are restricted to the LSA spatial scale or smaller.

4.1.4 Fish mortalities from instream construction activities

Direct and indirect mortality to fish could occur as a result of instream construction activities on fish-bearing watercourses. Potential causes of mortality include: dewatering of the pipeline trench, exposure to extremely high suspended sediment levels, direct impingement by construction equipment, entrainment into water intakes, and smothering of incubating eggs and alevins. This concern is restricted to the LSA and Project Footprint.

It is likely that instream construction activities present the greatest risk to the aquatic environment as the work includes the physical alteration of instream habitat and potentially, the physical handling of fish. Comprehensive mitigation measures, have been identified to avoid and minimize fish mortality risk at the Project watercourse crossings. Mitigation measures regarding instream construction activities are discussed within Section 7.2.3 of this application.

4.1.5 Fish mortalities from increased fishing pressure

Increased recreational fishing pressure from construction crews could potentially increase harvest and mortality rates of fish populations along the KSL route. The concern is restricted to the LSA spatial scale or smaller. Recreational fishing activities in the RSA are regulated through Provincial and Federal fishing regulations. Increased mortality from fishing can be mitigated by restricting pipeline construction personnel from fishing on the worksite.

4.1.6 Direct physical alteration of instream habitat at crossing sites

Instream habitat will be altered temporarily by trenching and backfilling during construction of buried pipeline crossings, and by installation of temporary vehicle crossings. The design and construction of the buried pipeline crossings and temporary vehicle crossings will take into consideration the physical characteristics of the watercourse.

Pipeline and vehicle crossing methods that protect fish and fish habitat are proposed for each crossing. The crossing methods proposed for both the pipeline and vehicles will consider the sensitivity and habitat potential at each crossing and immediately within the defined zone-of-influence, the species present and their respective life-history stages and the timing (season) proposed for construction. In addition, the vehicle crossing method proposed will also consider the availability of suitable existing crossings. In summary, all but 10 pipeline crossings of fish-bearing

streams will be completed using flow isolation as the preferred crossing technique. All but three crossings are planned for completion within a biologically-based instream work window designed to avoid times of risk to fish and fish habitat. Mitigation measures to avoid or reduce physical alteration of instream habitat at crossing sites are discussed within Section 7.2.3 of this application.

4.1.7 Physical alteration of instream habitat through sediment release

Instream habitat downstream of buried pipeline crossings and temporary vehicle crossings may potentially be affected by release of suspended sediments, where suspended sediment concentrations are high and habitat values are sensitive. Potential impacts of sediment input are greatest where spawning habitats occur, in particular where there are incubating eggs and alevins in the gravel. Effects on habitat will be mitigated by specialized construction and mitigation techniques. Effects are therefore expected to be short-lived and additionally mitigated by flushing flows during spring freshet or storm events. Mitigation measures regarding the physical alteration of instream habitat through sediment release are discussed within Section 7.2.3 of this application.

Five classes of potential effects on the aquatic environment have been identified:

1. direct and indirect mortality of fish;
2. loss or degradation of instream fish habitat;
3. loss or degradation of riparian habitat;
4. loss or degradation of habitat connectivity; and
5. interbasin transfer of aquatic organisms.

4.2 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Consequently, access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area. The enhancement or construction of watercourse crossings associated with Project facilities will include the same mitigation measures as applied to the construction of the crossings along the pipeline route.

4.3 POTENTIAL EFFECTS AND MITIGATION MEASURES OF THE AQUATIC ENVIRONMENT FROM PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

During the clearing, construction and restoration phases of the KSL project, disturbance of instream habitat will occur at the majority of pipeline crossings, due to the requirement of trenching to complete most crossings. For crossings that require a buried pipeline, the proposed mitigation

measures and restoration efforts will offset most impacts to the aquatic environment by restoring or maintaining streambank stability.

The level of impacts will be largely dependent on the existing aquatic ecosystem characteristics of the crossing, such as stream channel morphology, aquatic vegetation, riparian vegetation, substrate, channel depth and instream flow. It is also these natural characteristics that will dictate the design and construction of the watercourse crossings. The techniques of stream crossings will include the use of channel isolation techniques, aerial crossings or HDD.

Potential effects on the aquatic ecosystem within the seven Watersheds may include increased surface soil erosion and possibly increased slope instability at stream crossing sites. Successful route planning and employment of construction BMPs will minimize, if not eliminate, the risk of impact to areas of geophysical sensitivity. It is anticipated that the construction, operation, and decommissioning phase of the pipeline will have negligible effects on the aquatic environment.

Table 4.3-1 summarizes the impact pathways, potential effects on the aquatic environment and mitigation measures associated with each of the seven watersheds that the project intersects.

TABLE 4.3-1
SUMMARY OF WATER COURSE CROSSING AQUATIC ENVIRONMENT EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Aquatic Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Fish mortalities from blasting, • Fish mortalities from spills, • Fish mortalities from entrainment at water intakes, • Fish mortalities from instream construction activities, • Fish mortalities from increased fishing pressure, • Direct physical alteration of instream habitat at crossing sites, and • Physical alteration of instream habitat through sediment release	• Direct and indirect mortality of fish, • Loss or degradation of instream fish habitat, • Loss or degradation of riparian habitat, • Loss or degradation of habitat connectivity, and • Interbasin transfer of aquatic organisms	• Steep mountainous terrain • High precipitation • Unstable slopes • Blasting of bedrock • Construction related and natural sources of surface flow
Mitigation Measures: • Refer to Section 7.2.3 for a detailed list of mitigation measures that address the potential effects on the aquatic environment.			
Residual Effects: • Pipeline construction on the route will result in increased fish mortalities from instream construction activities. • Where crossings of fish-bearing streams are completed using flow isolation techniques inside work windows there is expected to be no residual effect. • Where crossings are completed using flow isolation techniques outside work windows there is expected to be some residual effect. Where open cut crossing methods are used, due to the infeasibility or failure of HDD, there is expected to be a residual effect to fish habitat. • If HDD is infeasible or fails for Gosnell Creek, flow isolation remains a viable contingency method no residual instream impact is expected. • Crossings completed using open cut techniques are expected to result in some residual effect. A residual effect has been identified for the loss of food inputs from riparian areas at vehicle and pipeline crossings. (this residual effect is less than significant) • No residual effect has been identified in relation to operations and maintenance activities. • No residual effect has been identified in relation to Project decommissioning.			

4.4 POTENTIAL EFFECTS OF THE AQUATIC ENVIRONMENT FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impact to the aquatic ecosystems. Restoration of the watercourse crossings will establish

vegetative groundcover and stabilize banks. A Project Restoration Plan will provide further detail of reclamation grass seed mixtures and plantings.

4.5 POTENTIAL EFFECTS OF THE AQUATIC ENVIRONMENT FROM PROJECT DECOMMISSIONING

The potential effects of the decommissioning and abandonment of the Project at watercourse crossings are anticipated to be negligible.

5.0 TERRESTRIAL ENVIRONMENT (WETLANDS, WILDLIFE AND WILDLIFE HABITAT, VEGETATION)

There are numerous stream crossings in the KSL project footprint and maintaining associated riparian habitat is a conservation concern for all water crossings on crown land and for all fish-bearing streams. Twenty-four stream crossings are through mature and old riparian and riparian floodplain forests and they cover approximately 11.3 km (2.4%) of the proposed route. Five of the riparian communities are in the Coastal Region; two in the Mountain Region and 17 are in the Interior Region.

Efforts will be made during the construction of watercourse crossings to retain riparian vegetation. Riparian vegetation provides bank stability, cover, food, and shade for wildlife and fish. Bank stability will be ensured through appropriate engineering input to the building of each watercourse crossing. Given the spatial footprint of stream crossings the loss of habitat is unlikely to be detectable outside the LSA.

Streambank and riparian area restoration work (i.e. willow staking, planting deciduous and coniferous shrubs and trees and installing coarse woody debris) will minimize the terrestrial impacts of the project at watercourses. Refer to Section 7.2.4 for a detailed description of the potential effects and assessment of residual effects for the terrestrial environment of the pipeline route.

5.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline route west of Kitimat. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area.

5.1.1 Wetland Effects

The Methanex lateral connection with the KSL pipeline route crosses two wetlands. Because of the previous disturbances to the affected wetlands, and the location of the pipeline lateral adjacent to an existing transmission corridor, potential effects on wetland hydrology and water quality are considered to be reversible in the short term, and of low magnitude.

5.1.2 Vegetation Effects

Construction of this lateral pipeline will require clearing of wetland vegetation for approximately 200 m of its length. To minimize effects on wetland habitat function as a result of clearing

vegetation, the same mitigation measures used during construction of the KSL pipeline route will be employed.

5.2 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR WETLANDS FROM PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

The KSL Project Footprint crosses approximately 96 wetlands along the entire length of the proposed route. The hydrologic function and water quality of these wetlands can be altered or degraded by pipeline clearing, construction, or restoration activities. Approximately 67, or 70%, of the wetlands may have experienced previous changes in hydrology or water quality due to the construction and maintenance of roads, railways, pipelines, and powerlines, or because they occur adjacent to or within a logging cutblock. The remaining 29 wetlands crossed by the pipeline route are undisturbed. The disturbance of wetlands from previous activities is taken into account in the effects assessment.

One of the most important measures to minimize project related effects on wetland hydrology and water quality is assuring that pre-construction elevations and contours are achieved during restoration.

Table 5.2-1 summarizes the impact pathways, potential wetland effects and mitigation measures associated with each of the seven watersheds that the project intersects.

TABLE 5.2-1
SUMMARY OF WATER COURSE CROSSING WETLAND ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Pipeline clearing, construction or restoration activities • Direct physical alteration of instream habitat at crossing sites, and • Physical alteration of instream habitat through sediment release	• Alteration or Degradation of Wetland Hydrology and Water Quality	• Previous changes in hydrology or water quality from construction and maintenance of roads, railways, pipelines, and powerlines, or because they occur adjacent to or within a logging cutblock. • Construction related and natural sources of surface flow
Mitigation Measures: • Pre-construction elevations and contours are achieved during restoration • PTP will also narrow down the proposed area of disturbance and protect the wetland by using fencing to clearing mark wetland boundaries using flagging, and limiting traffic in the restricted area, where feasible. • The width of grubbing through wet areas will be minimized to facilitate the re-establishment of shrub communities, whenever practical. • To limit sediment from entering wetlands, an undisturbed organic mat will be left as a buffer zone, if feasible. • Trench breakers will be installed at the edge of wetlands, where warranted, to prevent the pipe trench from acting as a drain. • To minimize direct degradation of wetland water quality, the spill prevention measures outlined in the KSL Project Environmental Protection Plan will be implemented. • Measures to avoid sedimentation deposition in wetlands will be implemented. • Water quality protection measures outlined in the Emergency Response Plan, the Environmental Protection Plan, and the Hydrostatic Test Plan will be utilized to minimize hydrologic function and water quality impacts in wetlands. • PTP will also monitor wetlands for hydrologic function during the post-construction monitoring program (i.e., first and second years following construction).			
Residual Effects: • There are no anticipated residual effects to the wetlands resulting from the clearing construction and restoration of the pipeline. • No residual effect has been identified in relation to operations and maintenance activities. • No residual effect has been identified in relation to Project decommissioning.			

5.3 POTENTIAL EFFECTS OF WETLANDS FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impacts to the wetlands affected by the Project. Restoration of the wetland crossings will

establish native vegetative groundcover and stabilize banks. A Project Restoration Plan will provide further detail regarding grass seed mixtures, and plantings.

5.4 POTENTIAL EFFECTS OF WETLANDS FROM PROJECT DECOMMISSIONING

The potential effects to wetlands from the decommissioning and abandonment of the Project at watercourse crossings are anticipated to be negligible.

5.5 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR TERRESTRIAL VEGETATION DURING PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Construction of the KSL Project will involve clearing of vegetation along the entire Project route. The amount of vegetation cleared as a result of the watercourse crossings is dependent on the amount of vegetation that exists at each crossing. The Project route was selected to minimize clearing of mature vegetation whenever practical, and as such, much of the clearing will occur in areas that have previously been disturbed by forest harvesting, utility corridors, industrial facilities, agriculture, and rural-residential development.

Clearing will also occur in areas with less human disturbance. Undisturbed vegetation including mature and old coniferous forests, riparian areas, wetlands, deciduous (aspen) stands, subalpine/alpine areas and a small grassland also occur at a number of locations along the entire length of the pipeline route.

Table 5.5-1 summarizes the impact pathways, potential effects, mitigation measures, and residual impacts to terrestrial vegetation associated with pipeline watercourse crossings.

TABLE 5.5-1
SUMMARY OF WATERCOURSE CROSSING TERRESTRIAL VEGETATION ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Pipeline clearing, construction or restoration activities	• Alteration or Degradation of Wetlands • Alteration or Degradation of Mature and Old Riparian and Floodplain Forest	• Invasive plant colonization. • Grazing livestock.
Mitigation Measures: • The removal of vegetation and disturbance of soil adjacent to wetlands will be minimized. • To preserve roots of woody wetland plants, shrubs and small deciduous trees will be cut, hydroaxed, or walked-down at ground level. • PTP will also minimize the width of grubbing through wet areas during construction to facilitate the restoration of shrub communities. • To restore shrub cover on wetland edges, willow (or other locally available shrub species) staking along the wetland edge will be used. • PTP will recontour the disturbed area and re-establish drainage patterns to promote natural regeneration of wetland plant species. • To monitor the efficacy of the restoration program and proposed mitigation measures, PTP will undertake post construction monitoring of the right-of-way. • Where HDD is not feasible, clearing of mature deciduous and coniferous trees will be minimized, and the width of temporary workspace will be narrowed to the extent practicable. • Where grading is not required, trees will be cut at ground level and temporary workspace will not be grubbed to allow for coppicing and keep root systems intact. • To retain stream bank stability and minimize erosion potential, PTP will implement bio-engineering along stream banks using appropriate species. • PTP will re-distribute coarse woody debris on ground surface during the final clean-up and restoration phase to restore the structural complexity and wildlife habitat function of riparian and floodplain forest, where this does not create forest health concerns. • Cleared riparian and floodplain forest will be seeded with appropriate seed mixes, and riparian shrubs and trees will be planted, as outlined in the Restoration Plan.			
Residual Effects: • Approximately 88 ha of wetland vegetation along the entire pipeline route will be altered or degraded by project clearing and construction. • Approximately 46 ha of riparian and floodplain forest will be cleared.			

5.6 POTENTIAL EFFECTS OF TERRESTRIAL VEGETATION FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impact to the terrestrial vegetation environment. The effective restoration of the terrestrial vegetation associated with watercourse crossings includes bank stabilization, and the establishment of vegetative groundcover. A Project Restoration Plan will provide further detail regarding seed mixtures and planting plans in wetlands, riparian areas, and floodplain habitats.

5.7 POTENTIAL EFFECTS OF TERRESTRIAL VEGETATION FROM PROJECT DECOMMISSIONING

The potential effects to terrestrial vegetation from the decommissioning and abandonment of the Project at watercourse crossings is expected to be negligible.

5.8 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR FOREST HEALTH DURING PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Construction of the KSL Project will involve clearing of trees for the pipeline alignment and associated temporary workspaces. The effects of the forest clearing adjacent to stream crossing will be depend on existing site conditions and requirement for forest removal. There are currently three types of forest health pathogens that affect the health of the forest surrounding the areas to be cleared: the mountain pine beetle infestation affects pine-dominated forests east of the Coast Mountains, while the spruce beetle infestation and various types of root rot are present at much lower intensity along the entire Project route. The mountain pine beetle outbreak is widespread and of high intensity in the RSA. It is anticipated that the construction of the watercourse crossings will produce insignificant impacts to the forest health of the adjacent area.

Table 5.8-1 summarizes the impact pathways, potential impacts to forest health and mitigation measures associated with the pipeline watercourse crossings.

TABLE 5.8-1
SUMMARY OF WATERCOURSE CROSSING FOREST HEALTH ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Pipeline clearing, construction or restoration activities • Bark beetle infestations • Root rot	• Disturbance of riparian forest habitat.	• Construction related and natural sources of surface flow
Mitigation Measures: • PTP will adopt Standard Operating Procedures for storage, hauling, and milling of mountain pine beetle – infested wood as specified by Ministry of Forests and Range Forest Districts • Spruce trees cleared from the Project route will be removed and processed before the spruce beetle flight period (May to July), to reduce the risk of infestation of adjacent spruce stands.			
Residual Effects: • No residual effects have been identified for watercourse crossings and forest health. • No residual effect has been identified in relation to operations and maintenance activities. • No residual effect has been identified in relation to Project decommissioning.			

5.9 POTENTIAL EFFECTS OF FOREST HEALTH FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impact to forest health. The effective restoration of forested areas impacted by watercourse crossings includes bank stabilization and the successful establishment vegetative groundcover and woody plants. A Project Restoration Plan will provide further details regarding seed mixtures and plantings.

5.10 POTENTIAL EFFECTS OF FOREST HEALTH FROM PROJECT DECOMMISSIONING

The potential effects of the decommissioning and abandonment of the Project at watercourse crossings are anticipated to be negligible.

5.11 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR INVASIVE SPECIES DURING PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Activities associated with clearing, construction and restoration of the KSL Project will promote the introduction, and acceleration of the spread of invasive plants. This potential exists along the entire project route. Table 5.11-1 summarizes the impact pathways, potential impacts of invasive species and mitigation measures associated with the pipeline watercourse crossings.

TABLE 5.11-1
SUMMARY OF WATERCOURSE CROSSING AND INVASIVE SPECIES ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace KP 454 – KP 462)	• Pipeline clearing, construction or restoration activities • Project decommissioning	• Introduction and spread of invasive species within riparian areas.	• Limited access to areas with invasive species established.
Mitigation Measures: • Follow the Invasive Species Management Plan to minimize the introduction and spread of noxious weeds during Project construction activities. • Employ standard weed control measures, such as cleaning of equipment of seeds and vegetative debris attached to the equipment prior to arrival on the right-of-way. • Pre-treat heavily infested weed areas along the Proposed Route by chemical, hand or mechanical means prior to construction where directed by the appropriate authority. • Minimize weed spread by cleaning equipment prior to moving from an area of high weed infestation. • Restore native vegetation as quickly as practical following ground disturbing activities. • Monitor the right-of-way during post-construction monitoring and operations for areas of new weed growth. Undertake measures to control weeds at these locations.			
Residual Effects: • Introduction and spread of invasive species immediately after construction may occur.			

5.12 POTENTIAL EFFECTS OF INVASIVE SPECIES FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, there is a risk of introducing invasive species to cleared areas. The Invasive Species Management Plan will provide instruction on how to manage invasive species that are introduced.

5.13 POTENTIAL EFFECTS OF INVASIVE SPECIES FROM PROJECT DECOMMISSIONING

The potential effects of invasive species resulting from the decommissioning and abandonment of the Project are anticipated to be minimal. However, there is a risk that invasive species may be introduced or spread during project decommissioning activities.

5.14 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR WILDLIFE AND WILDLIFE HABITAT DURING PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Project activities associated with watercourse clearing, construction and restoration of the Project area will interact directly or indirectly with wildlife and wildlife habitat. Clearing, construction, and restoration activities will result in the following potential effects:

- Alteration or degradation of habitat;
- Direct and indirect wildlife mortality; and
- Sensory disturbances to wildlife.

The KSL Pipeline route crosses a number of important seasonal habitats used by wildlife VEC species. Many wildlife VEC species use habitats near streams, wetlands and lakes, including migratory bird staging area, wood duck and sandhill crane nesting habitats, winter habitats for moose, habitats used by fisher and grizzly bears, and suitable streams for coastal tailed frogs. Land adjacent to many streams form natural wildlife movement corridors, and are important for maintaining connectivity.

The key wildlife issues associated with the construction of the watercourse crossings include: the clearing of riparian and floodplain forests; the alteration of coastal tailed frog streams; and the temporary increased human presence in wildlife movement corridors. Section 7.2.4 of this application discusses in detail the proposed mitigation measures that will minimize the impact to these VECs. Table 5.14-1 summarizes the impact pathways, potential impacts to the terrestrial vegetation and mitigation measures associated with the pipeline watercourse crossings.

TABLE 5.14-1
SUMMARY OF WATERCOURSE CROSSING WILDLIFE AND WILDLIFE HABITAT EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Alteration or degradation of important seasonal habitats. • Loss of site specific habitat features. • Alteration of wildlife movement corridors. • Direct wildlife mortality related to construction activities. • Wildlife mortality resulting from human-wildlife conflicts (i.e. problem bears, aggressive moose)	• Alteration or Degradation of Habitat • Direct and Indirect Wildlife Mortality	• Limited access to areas requiring replanting of riparian vegetation.

Mitigation Measures:

Alteration or Degradation of Habitat

- The proposed route is located adjacent to the existing PNG right of way, other linear disturbances such as roads, and power lines for approximately 60 % of its length, thereby minimizing the disturbance to wildlife habitat.
- The proposed route crosses large areas of currently disturbed forest (cutblocks, beetle killed forest, and early seral regenerating forest).
- The pipeline route generally avoids wetland and riparian areas.
- Conduct a pre-construction survey (route walk) in key areas to record any site-specific wildlife habitat features (e.g. wildlife trees, stick nests).

Wood Ducks

- General logging and clearing activities on the ROW are to occur outside of the migratory bird nesting period (April 1 to July 31 for KP 0 to KP 130; May 1 to July 31 for KP 130 to KP 462.5). If minor logging and clearing is required adjacent to a previously cleared area, this will be undertaken with the migratory bird nesting period only if the area has been pre-surveyed to confirm there are no active nests and in consultation with CWS.
- At swamps with appropriate wood duck habitat, PTP will record any wildlife trees to be cleared, and, if feasible, install wildlife trees and put up nest boxes during the restoration phase.

Sandhill Crane

- General logging and clearing activities on the ROW are to occur outside of the migratory bird nesting period (April 1 to July 31 for KP 0 to KP 130; May 1 to July 31 for KP 130 to KP 462.5). If minor logging and clearing is required adjacent to a previously cleared area, this will be undertaken with the migratory bird nesting period only if the area has been pre-surveyed to confirm there are no active nests and in consultation with CWS.
- If a sandhill crane nest is discovered within 400 m of the Project Footprint during construction, KSL will implement a Wildlife Incident Contingency Plan.

Coastal Tailed Frog Streams

- The removal of shrubs within 30 m of all streams will be minimized, and grubbing of the pipeline trench will occur only within 10 m of stream banks to protect, to the greatest extent practicable, the existing amphibian habitat.

Alteration of Wildlife Movement Corridors

- Work expeditiously to maintain a tight construction spread (i.e. interval between front end work activities such as grading and back end activities such as clean-up) to minimize potential barriers and hazards to wildlife.
- Leave gaps in set-up and welded pipe, spoil piles, and trench to allow wildlife to cross the right-of-way. Locate gaps at obvious game trails. Coincide breaks in pipe with gaps in topsoil or root zone material, spoil, snow (if present) and

rollback (if present) windrows.

- Install or maintain trench plugs across open trench to allow the cross-ditch movement of wildlife to and from the seasonal ranges along designated wildlife movement corridors and to special habitat features.
- Minimize the length of open trench (to generally less than 1 km in winter) and reduce the time the trench will be left open (to generally one day in winter) to limit the amount of interference with wildlife movements, whenever practical.
- Salvage and redistribute coarse woody debris in suitable habitat types for use by small mammals and other wildlife species, as appropriate and practicable.
- Use native plant species to maintain biodiversity, reduce weed cover, and help create wildlife movement corridors as outlined in the Restoration Plan.

Direct Wildlife Mortality Resulting from Construction Activities

- Remove trapped animals from the pipeline trench at the start of each day before conducting construction activities that may have the potential to harm an animal in the trench.
- Capture and move adult, tadpole, and metamorph coastal tailed frogs prior to stream crossing activities.
- Implement the Wildlife Incident Contingency Plan in the event of a wildlife mortality.

Wildlife Mortality Resulting from Human – Wildlife Conflicts

- PTP will implement a Bear Management Plan that outlines specific measures to prevent bear encounters, and the habituation of bears.
- Garbage will be collected daily in bear-proof containers, and disposed of in appropriate locations.
- PTP will also inform the pipeline construction workforce regarding wildlife and habitat protection measures prior to initiation of work by means of compulsory pre-job orientations.
- In the event that a wildlife encounter occurs, PTP will implement the Wildlife Incident Contingency Plan.

Sensory Disturbances to Wildlife

- PTP will inform the pipeline construction workforce regarding wildlife and habitat protection measures prior to initiation of work by means of compulsory pre-job orientations.
- PTP will conduct a pre-construction survey (route walk) to record any site-specific wildlife habitat features in the Project Footprint and will implement the Wildlife Incident Contingency Plan if important features are located.
- PTP will adhere to timing constraints to avoid sensory disturbances in identified important habitats:

Residual Effects:

- Approximately 88 ha of wetland habitat will be altered or degraded.
- Approximately 46 ha of riparian and floodplain forest will be cleared.
- The suitability of 52 streams used by coastal tailed frogs will be reduced.
- There is a residual effect of incidental construction-related mortality of individual coastal tailed frogs from the construction of the pipeline.

5.15 POTENTIAL EFFECTS OF WILDLIFE AND WILDLIFE HABITAT FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impact to wildlife and wildlife habitat associated with the watercourse crossings. The effective restoration of forested areas impacted by watercourse crossings will enhance degraded riparian habitat. The Project Restoration Plan will provide further detail of reclamation grass seed, shrub, and tree compositions. Furthermore, the effectiveness of mitigation measures will be monitored during the post-construction monitoring program.

5.16 POTENTIAL EFFECTS OF WILDLIFE AND WILDLIFE HABITAT FROM PROJECT DECOMMISSIONING

The potential effects of the decommissioning and abandonment of the Project at watercourse crossings are anticipated to be minimal.

6.0 SPECIES AND ECOSYSTEMS AT RISK

The KSL Project route crosses several streams utilized by aquatic species at risk. Species at risk are those listed federally by COSEWIC, on Schedule 1 of the Species at Risk Act, or listed provincially by the BC Conservation Data Centre.

The following aquatic species at risk are considered in the assessment of the KSL Project:

- white sturgeon,
- interior Fraser coho,
- eulachon,
- Dolly Varden,
- bull trout, and
- coastal cutthroat trout.

There are four rare plant communities that may be affected by the construction of pipeline watercourse crossings. Where the project route crosses rare plant communities, PTP will implement mitigation to minimize effects on these sensitive ecosystems.

- Sitka Spruce-Salmonberry Community. This is a red-listed plant community with one occurrence on the Project Footprint at KP 17.0 to KP 17.3.
- Old Growth Whitebark Pine Forest. The project footprint crosses this blue-listed plant community in three areas (KP 95.0 to KP 97.2, KP 99.1 to KP 99.2, and KP 100.5 to KP 102.2)
- Saskatoon-Slender Wheatgrass Community. This is a red-listed plant community with one occurrence on the Project Footprint at KP 242.5 to KP 243.4
- Hybrid White Spruce/Ostrich-fern Community. This is a red-listed plant community with one occurrence on the Project Footprint at KP 449.5 to KP 450.2.

Several wildlife habitats will also be affected at the watercourse crossings of the Project. Consequently, Species at risk may be listed federally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), included in Schedule 1 of the Species at Risk Act, or be listed provincially by the BC Conservation Data Centre. The following terrestrial species at risk may be affected by work associated with watercourse crossings:

- great blue heron (COSEWIC Special Concern, SARA, BC blue-listed),
- sandhill crane (BC blue-listed),
- coastal tailed frog (COSEWIC Special Concern, SARA, BC blue-listed),
- grizzly bear (COSEWIC Special Concern, SARA, BC blue-listed), and
- fisher (BC blue-listed).

The period of greatest risk to the above species and their habitats is during the clearing, construction, and restoration phase of the Project. Mitigation measures will be put in place to reduce the level of effects for all sensitive species and ecosystems at risk.

6.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline route west of Kitimat. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area.

6.2 POTENTIAL EFFECTS AND MITIGATION MEASURES FROM PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Project activities associated with clearing, construction and restoration of the Project area will interact directly or indirectly with species and ecosystems at risk. Clearing, construction, and restoration activities will result in the following potential effects:

- release of toxic substances during construction;
- release of erosion and sediment inputs into streams;
- impingement of fish against instream pumps;
- loss of riparian habitat; and
- loss or alteration of rare plants and plant communities.

Tables 6.2-1 and 6.2-2 summarize the impact pathways, potential effects to the species and ecosystems at risk and mitigation measures associated with the pipeline watercourse crossings.

TABLE 6.2-1
SUMMARY OF WATERCOURSE CROSSING AND AQUATIC ECOSYSTEM EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Pipeline clearing, construction or restoration activities	• Release of toxic substances during construction; • Release of erosion and sediment inputs into streams; • Impingement of fish against instream pumps; • Loss of riparian habitat; and • Loss or alteration of rare plants and plant communities	• Steep mountainous terrain • High precipitation • Unstable slopes • Blasting of bedrock • Construction related and natural sources of surface flow • Unstable slopes comprised of clayey glaciolacustrine silts
Mitigation Measures: • Use of specialized crossing techniques, such as flow isolation methods or horizontal directional drilling. • Adherence to least risk windows for instream construction. • Procedures to prevent release of hydrocarbons from construction machinery. • Control of erosion and sediment inputs from instream and upslope construction activities. • All intakes will be screened according to DFO guidelines and water releases will use appropriate dissipation devices to minimize scour and erosion. • Environmental monitoring of construction activities. • Additional management practices and emergency procedures as described the Environmental Protection Plan. • Any water extracted for pipe testing will meet provincial water quality guidelines for protection of aquatic resources prior to release back to watercourses (except where diverted water already exceeds these guidelines). • Larger streams will be crossed using HDD or flow isolation techniques, depending on flows encountered at the time of construction. • All small to medium-size fish-bearing streams will be crossed using flow isolation techniques, where flowing water is encountered. • Loss of instream cover will be compensated for through the deployment of instream restoration techniques (e.g., boulder clusters, root wads, whole tree revetments, spawning gravels).			
Residual Effects: • No residual effect to the white sturgeon has been identified. • No residual effect to the interior Fraser coho has been identified. • No residual effect to the eulachon has been identified. • No residual effect to the Dolly Varden, bull trout, or the coastal cutthroat trout has been identified.			

TABLE 6.2-2
SUMMARY OF WATERCOURSE CROSSING AND SENSITIVE WILDLIFE AND ECOSYSTEM EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Pipeline clearing, construction or restoration activities	• Loss of riparian habitat; and • Loss or alteration of rare plants and plant communities.	• Steep mountainous terrain • High precipitation • Unstable slopes • Blasting of bedrock • Construction related and natural sources of surface flow • Unstable slopes comprised of clayey glaciolacustrine silts

Mitigation Measures:

- Where the project route crosses rare plant communities, PTP will implement mitigation to minimize effects on these sensitive ecosystems.
- Plant communities at risk will be fenced off to restrict pipeline construction traffic.
- A Restoration Program that uses native plants will be implemented. The effectiveness of mitigation measures will be monitored during post construction monitoring.
- To avoid impacts minimize interactions of project clearing, construction and restoration activities on great blue herons and sand hill cranes, no general logging and clearing activities are to occur within the migratory bird nesting period (April 1 to July 31 between KP 0 and KP 130; May 1 to July 31 between KP 130 to KP 462.2) other than minor areas adjacent to a previously cleared area that has been pre-surveyed and following consultation with CWS.
- If a great blue heron rookery is discovered within 300 m of the Project Footprint during clearing, construction, or restoration, PTP will implement the Wildlife Incident Contingency Plan.
- If a sandhill crane nest is discovered within 400 m of the Project Footprint during construction, KSL will implement a Wildlife Incident Contingency Plan.
- The removal of shrubs within 30 m of all streams will be minimized, and grubbing of the pipeline trench will occur only within 10 m of stream banks to protect, to the greatest extent practicable, the existing amphibian habitat.
- To reduce the risk of mortality, PTP will capture and move adult, tadpole, and metamorph coastal tailed frogs prior to stream crossing activities, if possible.

Residual Effects:

- Approximately 1 ha of Sitka Spruce-Salmonberry rare plant community will be cleared.
- Approximately 9 ha of rare Old Growth Whitebark Pine forest will be cleared.
- Approximately 3 ha of Hybrid White Spruce/Ostrich Fern rare plant community will be cleared.
- Approximately 4 ha of Saskatoon-Slender Wheatgrass rare plant community will be cleared.
- Approximately 1 ha of suitable marbled murrelet nesting habitat will be cleared.
- No residual effect has been identified for the great blue heron.
- No residual effect has been identified for the sandhill crane.
- The suitability of 52 streams used by coastal tailed frogs will be altered; and incidental construction-related mortality of individual coastal tailed frogs may occur.

6.3 POTENTIAL EFFECTS OF SPECIES AND ECOSYSTEMS AT RISK FROM PROJECT OPERATION AND MAINTENANCE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impact to species and ecosystems at risk. Restoration of the watercourse crossings will establish vegetative groundcover and enhance degraded wildlife habitat. The Project Restoration Plan will provide further detail of reclamation grass seed, shrub, and tree compositions. Furthermore, the effectiveness of mitigation measures will be monitored during the post-construction monitoring program.

6.4 POTENTIAL EFFECTS OF SPECIES AND ECOSYSTEMS AT RISK FROM PROJECT DECOMMISSIONING

The potential effects of species and ecosystems at risk at watercourse crossings, during the decommissioning and abandonment of the Project are anticipated to be negligible.

7.0 ARCHAEOLOGICAL AND HERITAGE RESOURCES

The Project crosses 81 Archaeological Survey Units (ASUs) that were considered to have medium to high potential for the occurrence of archaeological resources as determined by the Archaeological Overview Assessment (this report is contained in Volume II of this Application). These archaeological potential areas were subject to field examination as part of the Archaeological Impact Assessment (AIA) for the KSL Project. Of the 81 ASUs, 32 polygons were rated as high archaeological potential and, 49 polygons were rates as medium archaeological potential. In addition to the ASUs, all previously recorded archaeological site locations within or in close proximity to the KSL Project were examined in order to verify their location and nature.

The AIA study identified two new archaeological sites (lithic scatters) within the study area in addition to six new locations of Culturally Modified Trees (CMTs) and two historic sits (a cabin and a disused trap box). There are also previously recorded archaeological sites in the study area in addition to three previously recorded CMT sites.

7.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline route west of Kitimat. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area.

The AOA and AIA studies concluded that there are no archaeological or heritage resources that will be impacted by the KSL Project related to the development of permanent and temporary facilities required for the Project.

7.2 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR CLEARING, CONSTRUCTION, AND RESTORATION

Archaeological sites that are within the area to be disturbed (logged, cleared, and graded) in order to build the KSL Project are in jeopardy of being impacted. However, it is noted that of the 16 archaeological and heritage sites potentially impacted by the KSL Project, only one of these sites is in the vicinity of a watercourse crossing (this is a previously recorded site near the Morice River crossing).

In order to mitigate impacts, avoidance of the impact is the primary method, when this is feasible. This will be accomplished by modifying the extent and location of the area that will require disturbance for the efficient and safe construction of the Project. Where avoidance is not feasible, mitigation measure will include, but not be limited to, systematic data recovery through controlled

excavation and/or surface collection, as well as stem round sampling on identified CMTs, prior to ground disturbing activities.

An Archaeological Resources Monitoring Plan will be developed for the purpose of implementing the mitigation measures. In addition, a contingency plan will be developed for the management of archaeological or heritage resources discovered during construction.

Table 7.2-1 summarizes the impacts and mitigation measures related to archaeological and heritage resources.

TABLE 7.2-1
SUMMARY OF WATER COURSE CROSSING ACHAEOLOGICAL AND HERITAGE RESOURCES EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Archaeological and Heritage Resources Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Direct physical alteration of an archaeological or heritage site.	• Loss or alteration of site results in a loss to the regional archaeological record.	• None identified.
Mitigation Measures: • Avoid archaeological and heritage sites where feasible. • For those sites that cannot be avoided, implement a mitigation strategy that includes systematic data recovery through controlled excavation and/or surface collection, and stem round sampling for CMTs. • Employ an Archaeological Resources Monitoring Plan for the purpose of implementing the mitigation measures. • Implement a contingency plan for the protection of archaeological and heritage resources discovered during construction.			
Residual Effects: • No significant residual effects were identified in relation to the clearing, construction, and restoration, operations and maintenance, and decommissioning and abandonment phases of the Project.			

7.3 POTENTIAL EFFECTS OF PROJECT OPERATION AND MAINTENANCE

There are no identified residual effects to archaeological and heritage resources related to operations and maintenance of the KSL Project at watercourse crossings.

7.4 POTENTIAL EFFECTS FROM PROJECT DECOMMISSIONING

There are no identified residual effects to archaeological and heritage resources related to decommissioning and abandonment of the KSL Project at watercourse crossings.

8.0 FIRST NATIONS COMMUNITY AND LAND USE

Along its 462 km length, the proposed KSL Pipeline Looping Project route crosses 497 watercourses; of these, 143 crossings have been classified as fish-bearing and 354 classified as non-fish bearing. In total, 32 different fish species were captured along the Project route between KP 0 and KP 462.2. This included 10 of the 16 fish species identified as Valued Ecosystem Components (VEC's) in the Approved Terms of Reference. First Nations Traditional Use Studies have identified traditional fishing sites along the length of the Project route that are used for harvesting of fish species in the study area. The protection of these fishing sites is of paramount importance to First Nations during the construction phase.

First Nations Traditional Use Studies have also identified plant and material-gathering areas along the length of the Project route, some of which may occur at proposed watercourse crossings. These plants and plant materials are used for a variety of medicinal, nutritional, and cultural purposes.

Efforts will be made during the construction of watercourse crossings to minimize impacts to riparian vegetation. Riparian vegetation provides bank stability, cover, food, and shade for wildlife and fish, as well as a source of traditional plants for First Nations. Bank stability will be ensured through appropriate engineering input to the building of each watercourse crossing. Given the spatial footprint of stream crossings the loss of habitat is unlikely to be detectable outside the LSA.

8.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Consequently, access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area. The enhancement or construction of watercourse crossings associated with Project facilities will include the same mitigation measures as applied to the construction of the crossings along the pipeline route.

8.2 POTENTIAL EFFECTS AND MITIGATION MEASURES FOR CLEARING, CONSTRUCTION AND RESTORATION

During the clearing, construction and restoration phases of the KSL project, disturbance of riparian and instream habitat used by First Nations harvesters will occur at the majority of pipeline crossings, due to the requirement of trenching to complete most crossings. For crossings that require a buried pipeline, the proposed mitigation measures and restoration efforts will offset most impacts to the aquatic environment by restoring or maintaining streambank stability.

The level of impacts will be largely dependent on the existing aquatic ecosystem characteristics of the crossing, such as stream channel morphology, aquatic vegetation, riparian vegetation, substrate, channel depth and instream flow. It is also these natural characteristics that will dictate the design and construction of the watercourse crossings. The techniques of stream crossings will include the use of channel isolation techniques, aerial crossings or HDD.

Table 8.2-1 summarizes the impacts and mitigation measures related to First Nations Community and Land Use at watercourse crossings.

TABLE 8.2-1
SUMMARY OF WATER COURSE CROSSING FIRST NATIONS COMMUNITY AND LAND USE EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential First Nations Community and Land Use Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Fish mortalities and physical alteration of instream habitat or downstream lake habitat. • Alteration or degradation of plant or material gathering sites.	• Loss of fishing opportunities. • Degradation of instream habitat. • Loss of plant and material gathering opportunities.	• None identified.
Mitigation Measures: • Refer to mitigation measures outlined in Section 7.2.3 and 7.2.4 of this Application related to fisheries and vegetation resources. • The scheduling of clearing and construction activities will be discussed with First Nations in order to help avoid impacts to First Nations fishing activities.			
Residual Effects: • No significant residual effect has been identified in relation to the clearing, construction and restoration phase, the operations and maintenance phase and the decommissioning and abandonment phase, at watercourse crossings.			

8.3 POTENTIAL EFFECTS OF PROJECT OPERATION AND MAINTENANCE ON FIRST NATIONS COMMUNITY AND LAND USE

During the operational and maintenance phase of the pipeline, it is expected that there will be minimal impact to the aquatic ecosystems or terrestrial vegetation habitat of importance to First Nations. Restoration of the watercourse crossings will establish vegetative groundcover and

stabilize banks. A Project Restoration Plan will provide further detail regarding seed mixtures and planting plans in riparian areas, and floodplain habitats.

8.4 POTENTIAL EFFECTS FROM PROJECT DECOMMISSIONING ON FIRST NATIONS COMMUNITY AND LAND USE

There are no identified residual effects to First Nations community and land use from the decommissioning and abandonment of the Project at watercourse crossings.

9.0 LAND AND RESOURCE USE

The Project crosses five Land and Resource Management Plan (LRMP) areas and two Sustainable Resource Management Plan (SRMP) areas including:

- the Kitimat Linkage Grizzly Bear Management Area identified in the Kalum LRMP;
- the proposed Burnie-Shea Protected Area, and the Herd Dome Area Specific Management Zone (ASMZ);
- the Thautil-Gosnell and Morice River ASMZs in the Morice LRMP area; and
- the Nourse-Allin-Maxan Trail and Tchesinkut Lake Recreation Emphasis Zones identified in the Lakes LRMP.

LRMPs and SRMPs are strategic land use planning tools used by the Province of British Columbia to guide use of land and resources.

The land and resource use planning strategies outlined in the LRMPs may result in potential effects at stream crossings. However, these strategies are too broad to effectively identify impacts at the individual stream crossing level. The land and resource use planning strategies are presented as background information on the possible future management of the land and water resources in the various watersheds.

9.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline route west of Kitimat. The Project also includes construction and operation of associated aboveground facilities including block valves and receiving traps for pipeline inspection tools at specific locations within the designated right-of-way. Access roads to the pipeline may require replacement of, or new crossing structures such as bridges and culverts. There is a proposed compressor station site at KP 246.5 in the Lakes LRMP area.

9.2 POTENTIAL EFFECTS AND MITIGATION MEASURES FROM PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Few potential effects have been identified at watercourse crossings. These effects are associated with land and resource management strategies contained on existing LRMPs (see Table 9.2-1).

TABLE 9.2-1
SUMMARY OF LAND USE CONCERNS AND POTENTIAL EFFECTS OF THE KSL PIPELINE

Land Use Concern	Potential Effect
Land and Resource Use Plans	• Conflict with identified management intent in land use plans. • Conflict with future industrial land use adjacent to the Project route in the Kitimat Valley. • Infringement on Provincially designated Old Growth Management Areas. • Infringement on provincially designated Mountain Goat Ungulate Winter Range areas. • Conflict with forest licensee operational plans
Current Use of Land and Resources	• Construction phase disruption of forestry operations. • Permanent loss or temporary alteration of forested land. • Loss or damage to existing forest research plots. • Increased risk of forest fire due to Project construction. • Inconvenience to land owners in the Project LSA. • Conflicts with mineral claims and operations. • Disruption of agricultural production. • Disruption of ranching activities. • Construction phase disruption of commercial fish, wildlife, and nature-based operations. • Construction phase disruption of public recreation use. • Disruption of seasonal hunting activities. • Increased motorized access to remote mountain areas.
Domestic Water Supply and Quality	• Alteration of surface water supply and quality for downstream users. • Alteration of water well flow and quality
Contaminated Sites	• Disturbance of previously contaminated soil

Table 9.2-2 summarizes the impact pathways, potential impacts to the Land and Resource Use Plans and mitigation measures associated with the pipeline watercourse crossings.

TABLE 9.2-2
SUMMARY OF WATERCOURSE CROSSING LAND AND RESOURCE USE EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Terrestrial Environment Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Conflict with identified management intent in land use plans • Domestic Water Supply and Quality • Sediment input to streams during land-based clearing, construction, and restoration activities (e.g. excavation, grading, blasting); • Contamination of watercourses from accidental spills or leaks from construction equipment; • Sediment input to streams during construction of pipeline water crossings; and • Alteration of water supply and quality during hydrostatic testing.	• Impact to sensitive aquatic resources, identified within Land and Resource Use Plans. • Alteration of surface water supply and quality for downstream users	• Watercourse connectivity between watercourse crossings and areas of water intake.

Mitigation Measures:

- In the Morice River ASMZ, the Project will be located outside of the Morice River floodplain, where feasible, and new road construction will be minimized in the Morice 100-year floodplain.
- Locate registered and unregistered points of diversion within 200 m downslope and 100 m upslope of clearing, construction, and restoration activities. Monitor pH, turbidity, total dissolved solids, total suspended solids, and true colour before, during, and after construction. If blasting will occur in the area, also monitor nitrates.
- Adhere to the Spill Prevention Management Plan and Emergency Response Plan.
- Adhere to the Sediment Control Plan.
- Select appropriate water body crossing techniques to minimize the risk of sedimentation.
- Adhere to the Hydrostatic Test Plan.
- Provide potable water to residents if water supply is degraded.
- Where required, compensate affected licensees.
- The timing of instream work generally coincides with periods of low stream flow.
- Monitoring will be undertaken to identify and correct any sediment input resulting from construction activity.

Residual Effects:

- No residual effect has been identified for project within the Morice River floodplain.
- Brief, low level increases in turbidity associated with the installation and removal of dams, flumes, and pumps.

9.3 POTENTIAL EFFECTS OF LAND AND RESOURCE USE FROM PROJECT OPERATION AND MAINTENANCE

Potential stream crossing-related land and resource use effects fall into three categories:

- Policies in Land and Resource Use Plans (LRMPs),
- Effects on resource use and management in or near streams, and
- Potential effects on domestic water supply and quality.

Stream-crossing related LRMP policies. The major stream crossing-related Project effects would occur at the Burnie River, Morice River, Stuart River, and Salmon River. LRMP policies dealing with stream crossings speak generally about maintaining the integrity of the waterbodies and their riparian areas. The KSL Project will minimize disturbance of crossing locations, and will restore streams and riparian areas following construction. Adopted plans do not prohibit utility crossings of streams. The recreational, aesthetic, and ecological value of streams will not be reduced by the KSL Project, and the Project is considered consistent with relevant LRMP policies.

Effects on resource use and management in or near streams. Forestry activities typically are limited in riparian areas. The Project's effects on forest harvest have been assessed and are considered to be fully mitigable. No interaction has been identified between the Project and forestry activities at stream crossings. The Project may result in the reduction in commercial timber producing capacity in stream crossing areas, but because riparian areas are typically excluded from harvest plans, no stream crossings-related Project effect on timber supply will occur. Use of forestry road bridge crossings of streams may experience short-term, temporary disruptions during Project construction. Through negotiated Road Use Agreements with permit holders, potential forest access impacts in stream crossings areas will be mitigated.

The Project does not interact with mining activity near streams, so there are no stream cross-related Project effects.

No residual stream crossing-related Project effects on agriculture have been identified. Any temporary effects on livestock, forage, or crop production will be fully mitigated. None of these potential effects are considered to be likely to occur near stream crossings.

Recreational access will be maintained to the extent feasible during Project construction. The Project is not anticipated to have residual effects on stream-based recreation during operation and maintenance of the Project, and no stream crossing-related Project effects on recreation are anticipated.

Public recreation use effects of stream crossings will be avoided or minimized by conducting public information programs so that people know where construction of the Project is active, by reducing the Project Footprint at stream crossings, and by adhering to the Navigable Waters Approval conditions for the Project. No residual effects during operation and maintenance of the Project on public recreation at stream crossings area are expected.

Effects on domestic surface water supply and quality. Potential effects on domestic water quality and quantity will be mitigated by implementation of a water supply testing program to be implemented before, during, and following construction. Implementing the Surface Water Quality Sediment Control Plan, Hazardous Waste Management and Spill Plan, Emergency Response Plan, and Hydrostatic Test Plan will avoid or other wise mitigate potential impacts.

9.4 POTENTIAL EFFECTS OF LAND AND RESOURCE USE FROM PROJECT DECOMMISSIONING

The potential effects of land and resource use during the decommissioning and abandonment of the Project at watercourse crossings are anticipated to be negligible.

10.0 NAVIGABLE WATERS

There are 21 watercourse crossings identified along the KSL pipeline route that cross 19 streams that currently have been deemed navigable by the Navigable Waters Protection Division of Transport Canada. Three of the crossings are on the Salmon River.

These navigable water crossings and the proposed pipeline crossing techniques are listed in Table 10-1.

TABLE 10-1
NAVIGABLE WATERCOURSE CROSSINGS

Watercourse Name	KP	Proposed Pipeline Crossing Technique	
		Primary	Contingency
Unnamed Channel	6.9	Flow Isolation	-
Little Wedeene wetland	12.2	Flow Isolation	Open Cut
Little Wedeene R.	12.9	HDD	Open Cut
Wedeene R.	17.0	HDD	Open Cut
Chist Cr.	38.8	HDD	Open Cut
Hunter Cr.	63.4	Flow Isolation	Flow Isolation (out of fisheries window)
Clore R.	88.5	Aerial	-
Burnie R.	99.6	Flow Isolation	HDD
Unnamed Channel	109.3	HDD	Flow Isolation
Gosnell Side Channel	109.8	HDD	Flow Isolation
Gosnell Cr.	110.0	HDD	Flow Isolation
Crystal Cr.	124.5	Flow Isolation	-
Morice R.	130.6	HDD	Aerial
Owen Cr.	165.3	Flow Isolation	-
Allin Cr.	215.2	Flow Isolation	-
Tchesinkut Cr.	278.9	Flow Isolation	-
Endako R.	297.5	HDD	Flow Isolation
Stuart R.	388.9	HDD	Open Cut
Salmon R. #1	430.3	Flow Isolation	Flow Isolation (out of fisheries window)
Salmon R. #2	441.2	Flow Isolation	Flow Isolation (out of fisheries window)
Salmon R. #3	449.2	Flow Isolation	Flow Isolation (out of fisheries window)

Bridges for the movement of construction equipment and vehicles are also required on four of the watercourses deemed navigable. These are listed as follows:

- Clore River KP 88.0 – Clearspan Bridge
- Burnie River KP 99.6 – Bailey Bridge with supports
- Crystal Creek KP 124.5 – Bailey Bridge with supports
- Salmon River (KP 430.5, KP 441.2, KP 449.2) – use existing bridges or build Bailey Bridges

10.1 PROJECT FACILITIES

Project facilities associated with the KSL Project, including Methanex Lateral, the Methanex Meter Station, the Compressor Station, above ground facilities (e.g. block valves) and the temporary use of access roads, do not interact with the designated navigable watercourses.

10.2 POTENTIAL EFFECTS AND MITIGATION MEASURES PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

Flow isolation and open cut construction techniques will require temporary closure of all or part of the stream at the crossing site during construction. Plans for the temporary flow diversion will require approval from Transport Canada and the conditions of the approval will provide the measures required for impact mitigation. HDD crossings will have no impact on the navigability of the watercourse. Similarly, bridge crossings, appropriately designed to provide sufficient clearance during flood events, will not interfere with navigability of the river in question.

10.3 POTENTIAL EFFECTS OF NAVIGABLE WATERS FROM PROJECT OPERATION AND MAINTENANCE

Because the KSL pipeline will be buried to appropriate depths across the majority of the navigable watercourse crossings, it will have no effect on the navigability of the watercourse. Similarly, aerial crossings, properly designed to provide adequate clearance between the expected high water level (e.g. 100 year flood level) and the bottom of the crossing structure, will have no effect on the navigability of the watercourse. All temporary equipment and vehicle crossing structures will be removed following Project construction and restoration.

Where requested by Transport Canada, signage will be erected to notify users of the waterway that a buried natural gas pipeline is present at that location.

11.0 AESTHETICS AND VIEWSHEDS

New clearing of forested land for pipeline construction will be visible from several viewpoints along the pipeline route. During the construction phase, access roads, shooflies, storage yards, camps, and other temporary sites will also be visible. These temporary facilities will be completely restored following construction and no long-term visual impacts are expected. It is unknown to what level the individual watercourse crossings will be visible but it is anticipated that the crossings will provide a minimal impact to the aesthetics and viewsheds of the project watersheds.

The criteria used to identify viewpoints that may be potentially impacted include:

- Existing vegetation cover (e.g. forested, shrubs or cleared)
- Number of potential viewers
- Season when views are likely to be affected
- Viewer distance from the pipeline route or facility
- Visibility of the Project from the viewpoints
- Likelihood of visibility
- Extent and type of present landscape disturbance
- The level of scenic value identified in land use plans, and
- Length of time the Project might be visible to a viewer.

The two most significant watercourse crossing that will have aesthetic and viewshed effects will be at the Stuart River and Salmon River. Both Rivers are established paddling routes and the specifically the Stuart River is used by commercial guide outfitters.

11.1 PROJECT FACILITIES

The construction and operation of the pipeline will include an approximately 2 km long lateral pipeline (Methanex Lateral) from the existing PNG transmission facilities at the existing Methanex Meter Station to the Project pipeline route west of Kitimat. The Methanex Lateral will be constructed adjacent to a transmission line and an existing PNG lateral. It will also be adjacent to a road for approximately 600 m. There will be no adverse aesthetic alterations to any watercourse caused by the construction of the Methanex Lateral.

There will be no aesthetic alterations to any watercourses during the constructions of the compressor station.

11.2 POTENTIAL EFFECTS AND MITIGATION MEASURES OF AESTHETICS AND VIEWSHEDS FROM PROJECT CLEARING, CONSTRUCTION, AND RESTORATION

The viewpoints selected for the determination of potential visual effects are:

- Burnie River Valley,
- Morice River valley,
- Stuart River Valley, and
- Salmon River Valley.

During construction activities, the amount of landscape disturbance will be minimized. By constructing the Project adjacent to existing linear features the visual impact of the Project will be reduced. Visual barriers and willow staking along shorelines have been identified as mitigation measures to avoid visual effects at watercourse crossings.

Table 11.2-1 summarizes the potential effects of the aesthetics and viewsheds for the watercourse crossings within the watersheds affected by the pipeline route.

TABLE 11.2-1
SUMMARY OF WATERCOURSE CROSSING AESTHETICS AND VIEWPOINT EFFECTS AND MITIGATION MEASURES

Watersheds	Impact Pathways	Potential Aesthetics and Viewshed Effects	Contributing Factors
• Kitimat (KP 0 – KP 79) • Zymoetz (KP 79 – KP 104) • Bulkley (KP 104 – KP 174, KP 195 – KP 214) • Nechako (KP 174 – KP 195, KP 214 – KP 362) • Stuart (KP 362 – KP 408) • Fraser (KP 408 – KP 454) • Peace (KP 454 – KP 462)	• Clearing of vegetation and construction of pipeline • Clearing and construction of the Methanex Lateral pipeline • Construction of compressor station at KP 246.5	• Visual disturbance of Enso Recreation Site viewpoint • Visual disturbance at the Upper Kitimat Recreation Site viewpoint • Visual disturbance in the Burnie River Valley • Visual disturbance in the Morice River Valley • Visual disturbance at the Nourse-Allin Creek and Maxan Lake Trail viewpoint • Visual disturbance of the Tchesinkut Lake viewpoint • Visual disturbance at the Highway 16 viewpoints • Visual disturbance of the Ormond Creek Trail viewpoint • Visual disturbance at the Nyan Wheti Trail viewpoint • Visual disturbance at the Omineca Trail viewpoint • Visual disturbance at the Stuart River paddling route viewpoint • Visual disturbance in the Salmon River Valley • Equipment and materials being transported along local roads and highways.	• Salvage of MPB infested timber. • Seasonal changes vegetation foliage. • Existing cutblocks and FSR's • Existing PNG ROW
Mitigation Measures: • Reducing the clearing width, whenever practical, at key viewsheds and special restoration measures at visually sensitive areas will mitigate visual impacts. • Restoration measures will be employed, primarily by screening foreground views and, specifically, the creation of visual barriers with plantings and willow staking along shorelines at specific locations.			
Residual Effects: • No residual effects have been identified for the aesthetic and viewpoints			

11.3 POTENTIAL EFFECTS OF AESTHETICS AND VIEWSHEDS FROM PROJECT OPERATION AND MAINTENANCE

The aesthetics and viewsheds of watercourse crossings will not be negatively affected by the operation and maintenance of the pipeline. Over the duration of the operation of the pipeline the vegetative screens will have sufficiently grown enough to block views of the pipeline.

11.4 POTENTIAL EFFECTS OF AESTHETICS AND VIEWSHEDS FROM PROJECT DECOMMISSIONING

In the event of project decommissioning there are negligible effects anticipated for the aesthetics and viewsheds of watercourse crossings.

12.0 CUMULATIVE EFFECTS

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present, and future human actions. It is now recognized that the combined effects of unrelated individual projects or activities could result in aggregate effects that may be different in nature or extent from the effects of the individual activities (Federal Environmental Assessment and Review Office 1994).

12.1 CUMULATIVE EFFECTS OF WATERCOURSE CROSSINGS

Riparian disturbance indicators provide an index of erosion, habitat loss, and mortality risk for aquatic ecosystem processes. Riparian disturbance was calculated as the number of stream crossings per km^2 for each major drainage within the CE indicator RSA. Current stream crossing density within the RSA is 0.39 crossings/km^2 indicating low overall risk for adverse cumulative effects (Table 8.3-3; BCFS and BCE 1995). Crossing density is highest in the Peace drainage (0.8 crossings/km^2), but is still rated as low risk. Crossing density in the Fraser, Kitimat, and Nechako drainages is somewhat higher than the regional average. The Stuart and Zymoetz drainages have crossing densities lower than the regional average.

The KSL Project will increase stream crossing density in all drainages it traverses. Forest harvest roads and other proposed linear facilities would further increase crossing density in all drainages, but projected cumulative effects risk would remain low.

Fisheries investigations conducted for the KSL Project documented 495 crossings with approximately 10% having a high sensitivity rating and 8% having a moderate sensitivity rating. No SARA, COSEWIC, or provincially “Red” listed species were found in any of the watercourses sampled. Dolly Varden and bull trout were the only provincially “Blue” listed species sampled, with Dolly Varden present in 26 of the watercourses sampled, and bull trout present in only three of the watercourses sampled. The KSL Project will increase the number of stream crossings in the overall RSA and individual drainages. Results of riparian disturbance analyses (Section 8.3.4) indicate that overall aquatic risk is expected to remain low.

Combined effects on aquatic habitat will be mitigated by appropriate crossing methodologies and a habitat compensation program to be developed with Fisheries and Oceans Canada (DFO) and BC Ministry of Environment (BC MOE). With the implementation of identified mitigation measures, incremental effects of aquatic and riparian habitat alteration are reversible in the medium- to long-term and of low magnitude at the regional scale. The KSL Project will not cause significant adverse cumulative effects on aquatic and riparian systems.

13.0 MONITORING AND FOLLOW UP

The environmental management program for the KSL Project has been designed to reduce project-related environmental risks during pipeline construction and specifies the procedures that will be employed to limit impacts to the environment, should an incident occur.

Project monitoring and follow-up initiatives are presented in:

The Environmental Protection Plan (EPP):

- general instructions,
- typical and special drawings,
- contingency plans, and
- Environmental Work Sheets

The Environmental Management Plans (EMPs)

- EMPs on a variety of topics will be completed prior to Project clearing and construction.

The Restoration Plan

- The guiding principles and framework for the KSL Restoration Plan and a list of the restoration units for the Project are presented in Section 9.3 of the Application.

13.1 ENVIRONMENTAL PROTECTION PLAN

The EPP for the KSL Project will contain a set of instructions that are developed to avoid or minimize adverse clearing and construction effects of the Project on the environment. The general and site-specific mitigation measures described in Section 7.0 of the EAC Application will be incorporated in the EPP. The EPP will apply to: every phase of the Project's surveying, clearing, grading, topsoil salvage, trenching, stringing, weeding, lowering-in, backfilling, testing, clean-up, restoration and water crossings.

13.2 ENVIRONMENTAL WORK SHEETS

A set of 1:20,000 scale Environmental Work Sheets (EWS) is contained in the EPP. These orthophoto-based maps show the pipeline route and the Project Footprint.

Environmental Features crossed by the pipeline route are displayed on the upper portion of each EWS. These will include:

- soil handling and erosion control measures,
- instream work windows (fish),

- restoration units, and
- restricted activity periods (wildlife).

13.3 ENVIRONMENTAL MANAGEMENT PLANS

PTP will prepare Environmental Management Plans (EMPs)on a variety of topics following the submission of the EAC Application. These will include:

- Access Management Plan;
- Hydrostatic Test Plan;
- Surface Water Quality and Sediment Control Plan; and
- Invasive Plant Management Plan

The EMPs will outline the Best Management Practices that will mitigate impacts to the watercourse crossings of the pipeline route.

13.4 RESTORATION PLAN

The development of the Restoration Plan will be an ongoing process and will entail additional consultation with Regulatory Agency staff, First Nations and individuals/groups with an interest in the use of the pipeline route following construction.

Implementation of the measures included in the KSL Restoration Plan will commence during the clearing phase of the construction process and will continue until the restoration phase of the Project is completed. Monitoring and follow-up plans have been developed to evaluate the effectiveness of the measurers, activities, and other works identified in the Restoration Plan (see Section 9).

The overall objective of the restoration work is to promote re-establishment of natural ecosystems that are compositionally and functionally similar to predisturbance conditions.

The goals of the Restoration Program applicable to the watercourse crossings of the pipeline route include:

- reinstate the ecological integrity and self-sustainability of key plant communities, wildlife habitats, wildlife movement corridors, wetlands and riparian ecosystems;
- restore important wildlife habitat features damaged by the Project;
- use native plants whenever feasible;
- maintain, and where appropriate, improve aquatic and terrestrial ecosystems by restoring ecological processes and functionality; and

- consider recreation use, landscape views and aesthetics in portions of the pipeline route where the Project activities may conflict with existing recreational activities or diminish visual quality on a landscape level.

13.4.1 Restoration Units

A total of 27 Restoration Units (RU) have been developed for the Project. The RUs have been derived in consideration of regional climates, (i.e., Coastal, Mountain or Interior), plant communities and soil moisture regime.

13.4.2 Watercourse Crossings Restoration

The Restoration Plan will include a detailed description of the watercourse crossing work that will be done in each Restoration Unit. Topics could include:

- streambank restoration,
- fish habitat enhancements,
- wetland restoration methods, and
- natural regeneration

The restoration strategy for the water crossings is to stabilize the bed and bank and restore wetland function, channel morphology, and integrity. General water course restoration measures are presented in Table 13.4-1

TABLE 13.4-1
GENERAL WATER CROSSING RESTORATION MEASURES

Location	Restoration Measures
All Fish-Bearing water crossings along pipeline route KP 0 to KP 463	• Identify site-specific habitat features (instream and streambank) at the pipeline crossing and record their location before construction work is initiated. • Prior to trenching, salvage the upper coarse-textured substrate material from the channel and banks and stockpile this material separately from lower substrate. • Following backfilling cap (re-distribute) the salvaged upper substrate material over streambed and extend cobbles and boulders to the high-water mark if adequate material is available. • Return the watercourse bed and banks to pre-construction configuration with no realignment of the channel. • Install appropriate erosion control and sediment control devices where necessary, (e.g., silt fences, straw bales, shrub plugs, etc.). • Seed with an appropriate seed mixture as outlined in Restoration Plan. • Replace any site-specific habitat features that are important for fish and other aquatic species, (e.g., log revetments, overhanging vegetation, boulder-clusters, large woody debris), as directed by the Environmental Inspector and Fisheries Resource Specialists.

13.5 ENVIRONMENTAL INSPECTION AND MONITORING

PTP will hire a minimum of one full-time Environmental Inspector (EI) for each pipeline spread. The environmental inspection team for each spread will consist of one lead EI and if required, one or more supporting Environmental Inspectors. EIs will be onsite when fully-functional spreads are at work. The geographical area of responsibility for each Environmental Inspector will be determined prior to clearing and construction activities. Refer to Section 9.4 for the list of responsibilities of an EI.

The Post-Construction Monitoring Program (PCMP) for the Project will be implemented. The PCMP will include an assessment of erosion control, restoration and any weed problem areas along the KSL pipeline route as well as an assessment of other specific environmental issues identified by regulatory agencies

14.0 RESIDUAL EFFECTS SIGNIFICANCE ASSESSMENT

The significance of residual effects on watercourse crossings from Project VECs and VSCs are predicted using the attributes presented in the Approved Terms of Reference. Table 14.0-1 provides a summary of the residual effects predicted to occur at the watercourse crossings.

TABLE 14.0-1
SUMMARY OF RESIDUAL EFFECTS SIGNIFICANCE ASSESSMENT

Residual Effect:	Spatial Context	Temporal Context	Assessment Criteria	Magnitude	Probability of Occurrence	Level of Confidence	Significance
Residual Geophysical Environmental Effects Assessment							
No residual effects were identified for the geophysical environment.	Project Footprint	N/A	N/A	N/A	N/A	N/A	None
Residual Aquatic Environment Effects Assessment							
Where crossings of fish-bearing streams are completed using flow isolation techniques inside work windows there is expected to be no residual effect.	Project Footprint	Immediate and isolated	Immediate reversibility	Negligible	Low	High	Less than significant
Where crossings are completed using flow isolation techniques outside work windows there is expected to be some residual effect. Compensation will be required to offset these impacts and will ensure that residual effects at these crossings are less than significant.	Project Footprint	Immediate and isolated	Immediate reversibility	Low	High	High	Less than significant
Crossings completed using open cut techniques are expected to result in some residual effect. Compensation will be required to offset these impacts and will ensure that residual effects at these crossings are less than significant.	Project Footprint	Immediate and isolated	Immediate reversibility	Low	High	High	Less than significant
A residual effect has been identified for the loss of food inputs from riparian areas at vehicle and pipeline crossings. (this residual effect is less than significant).	Project Footprint	Immediate and isolated	Medium-term reversibility	Negligible	Low	High	Less than significant

Residual Effect:	Spatial Context	Temporal Context	Assessment Criteria	Magnitude	Probability of Occurrence	Level of Confidence	Significance
Residual Wetland Effects Assessment							
No residual effects were identified for wetland environments.	Project Footprint	N/A	N/A	Negligible	High	High	None
Residual Terrestrial Vegetation Effects Assessment							
Approximately 88 ha of wetland habitat will be altered or degraded.	Project Footprint	Short-term and isolated	Permanent	Medium	High	High	Less than significant
Approximately 46 ha of riparian and floodplain forest will be cleared.	Project Footprint	Medium-term and isolated	Long-term reversibility	Medium	High	High	Less than significant
Residual Forest Health Effects Assessment							
No residual effects were identified for forest health.	Project Footprint	N/A	N/A	Negligible	High	High	None
Residual Invasive Species Effects Assessment							
Introduction of invasive species immediately after construction may occur.	Project Footprint	Short-term and occasional	Long-term reversibility	Low	High	High	Less than significant
Residual Wildlife and Wildlife Habitat Effects Assessment							
Approximately 88 ha of wetland habitat will be altered or degraded.	Project Footprint	Short-term and isolated	Permanent	Medium	High	High	Less than significant
Approximately 46 ha of riparian and floodplain forest will be cleared.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
The suitability of 52 streams used by coastal tailed frogs will be reduced.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
Alteration of wildlife movement patterns.	Local	Long-term and periodic	Medium-term reversibility	Low	High	High	Less than significant
Incidental construction-related mortality of individual coastal tailed frogs from the construction of the pipeline.	Project Footprint	Immediate and isolated	Permanent	Medium	High	High	Less than significant
Residual Species and Ecosystems at Risk Effects Assessment							
The residual effect to the white sturgeon population.	Project Footprint	Short-term and isolated	Short-term reversibility	Low	Low	High	Less than significant
The residual effect to the Fraser coho population.	Project Footprint	Immediate and isolated	Short-term reversibility	Low	Low	High	Less than significant

Residual Effect:	Spatial Context	Temporal Context	Assessment Criteria	Magnitude	Probability of Occurrence	Level of Confidence	Significance
The residual effect to the eulachon population.	Project Footprint	Immediate and isolated	Short-term reversibility	Low	Low	High	Less than significant
The residual effect to the Dolly Varden population.	Project Footprint	Immediate and isolated	Short-term reversibility	Low	Low	High	Less than significant
Approximately 1 ha of Sitka Spruce-Salmonberry rare plant community will be cleared.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
Approximately 9 ha of rare Old Growth Whitebark Pine forest will be cleared.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
Approximately 3 ha of Hybrid White Spruce/Ostrich Fern rare plant community will be cleared.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
Approximately 4 ha of Saskatoon-Slender Wheatgrass rare plant community will be cleared.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
The suitability of 52 streams used by coastal tailed frogs will be altered; and incidental construction-related mortality of individual coastal tailed frogs.	Project Footprint	Immediate and isolated	Long-term reversibility	Medium	High	High	Less than significant
Residual Archaeological and Heritage Resource Effects Assessment							
Permanent loss or alteration of archaeological and heritage resources within the Project Footprint.	Project Footprint	Long-term	Isolated permanent	Low	High	High	Less than significant
Residual First Nations Community and Land Use Effects Assessment							
Fish mortality and physical alteration of instream habitat at crossing sites or downstream lake habitat.	Local Study Area	Isolated	Medium-term reversibility	Low to medium	High	High	Less than significant (after habitat compensation)
Alteration or degradation of First Nations plant and material gathering sites.	Project Footprint	Medium-term	Medium-term reversibility	Medium	High	High	Less than significant

Residual Effect:	Spatial Context	Temporal Context	Assessment Criteria	Magnitude	Probability of Occurrence	Level of Confidence	Significance
Residual Land and Resource Use Effects Assessment							
Brief, low level increases in turbidity associated with the installation and removal of dams, flumes, and pumps.	Project Footprint	Immediate and isolated.	Immediate reversibility	Negligible	High	High	Less than significant
Residual Navigable Waters Effects Assessment							
No residual effects were identified.	Project Footprint	N/A	N/A	N/A	N/A	N/A	None
Residual Aesthetics and Viewsheds Effects Assessment							
Viewscape from recreational sites and hiking trails near watercourse crossings will be altered.	Project Footprint	Medium-term and continuous	Permanent reversibility	Low	High	High	Less than significant
Viewscapes in the Burnie and Morice River valleys will be altered.	Local Study Area	Medium-term and continuous	Permanent reversibility	Low	High	Moderate	Less than significant

15.0 REFERENCES

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