

13 VEGETATION AND ECOLOGICAL COMMUNITIES

13.1 Approach

Vegetation and ecological communities includes rare and sensitive ecological communities and ecological communities at risk – including wetlands, rare plants, and a description of the composition, distribution, and abundance of terrestrial flora associated with the distribution of ecosystems within the assessment area. Vegetation and ecological communities were selected as a valued component (VC) due to:

- An interaction with Project components and activities resulting in land clearing and water impoundment
- Aboriginal concerns of potential changes to plants used for food, medicine, and cultural purposes
- Public and stakeholder concerns of potential changes to plants used for food, agriculture, and timber harvesting
- Federal and provincial regulations on vegetation and biodiversity

Potential changes to vegetation can also have indirect interactions on wildlife resources that are used by Aboriginal groups, the public, or are managed by provincial and federal regulations. Potential effects of the Project on wildlife resources are discussed in Volume 2 Section 14 Wildlife Resources, the potential effects on the current use of vegetation by Aboriginal groups are discussed in Volume 3 Section 19 Current Use of Land and Resources for Traditional Purposes, and potential impacts of the Project on the exercise of asserted or established Aboriginal and treaty rights are discussed in Volume 5 Section 34 Asserted or Established Aboriginal Rights and Treaty Rights, Aboriginal Interests and Information.

13.1.1 Regulatory and Policy Setting

The following is a summary of federal and provincial legislation governing vegetation and ecological communities.

13.1.1.1 Species at Risk Act

The Government of Canada proclaimed the federal *Species at Risk Act* (SARA) in June 2003 as part of a three-part strategy for the protection of species at risk in Canada. The other two parts of the strategy include the Accord for the Protection of Species at Risk and the Habitat Stewardship Program for Species at Risk. The *Species at Risk Act* was developed following the implementation of the Canadian Biodiversity Strategy in response to the United Nations' Convention on Biological Diversity. The purpose of SARA is "to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk" (Government of Canada 2012).

1 **13.1.1.2 Forest Range and Practices Act**

2 The *Forest and Range Practices Act* (FRPA) and its regulations govern the activities of B.C.
3 forest and range licensees, including requirements for planning, road building, logging,
4 reforestation, and grazing. It took effect January 31, 2004, and any activities already
5 approved prior to this time under the existing Forest Practices Code may continue and are
6 governed by the *Forest Practices Code of British Columbia Act* and its regulations.

7 In 2004, the B.C. Ministry of Water, Land, and Air Protection – now the B.C. Ministry of
8 Environment (BCMOE) – established a category of species at risk by order made under
9 FRPA. This category represents those species that may be affected by forest or range
10 management on Crown land and are listed by the Committee on the Status of Endangered
11 Wildlife in Canada (COSEWIC). Identified wildlife are selected from the provincially red- or
12 blue-listed species. Red-listed plants or plant communities are also included. An inter-agency
13 committee – composed of individuals with environment or forestry backgrounds – consults
14 with species experts to determine which of these species and plant communities should be
15 recommended for designation as Identified Wildlife.

16 In relation to ecosystems and rare plants, under the FRPA, the Lieutenant
17 Governor-in-Council may make regulations authorizing the Minister of Environment to
18 establish under Section 149.1 (a):

19 “an area as a wildlife habitat area and objectives for the wildlife habitat
20 area”

21 Wildlife Habitat Areas are areas managed for selected species and plant communities that
22 have been designated as Identified Wildlife. These areas are mapped and approved by the
23 chief forester and deputy Minister of Environment.

24 General wildlife measures direct what forest and range management practices can occur
25 within a Wildlife Habitat Area. They may restrict forest or range activities to minimize
26 disturbance or may restrict activities entirely within an area in order to maintain the integrity of
27 the habitat.

28 **13.1.2 Key Issues and Identification of Potential Effects**

29 Issues, concerns, and interests identified during consultation with the public, Aboriginal
30 groups, and government agencies guided the scope of the vegetation and ecological
31 communities' assessment (see Volume 1 Section 9 Information Distribution and
32 Consultation).

33 Discussions during the Wildlife Technical Advisory Committee (TAC) and concerns identified
34 in various Traditional Land Use Studies were also considered.

35 **13.1.2.1 Wildlife Technical Advisory Committee**

36 A summary of the TAC process is provided in Section 9.3 Agency Information Distribution
37 and Consultation in Volume 1 Section 9 Information Distribution and Consultation. Key
38 discussions, issues, and concerns raised by the Wildlife TAC are summarized in Table 9.3.3
39 in Section 9.3.

40 Participants observed a potential limitation in assessing effects to rare plants where it was
41 difficult to assess the importance in a regional context. Three ideas to address the issue
42 included:

- 1 • Using sampling along the transmission line as a ‘random sample’ of the surrounding
2 region
- 3 • Investigating soil characteristics and chemistry to predict locations of other plants
- 4 • Visiting herbariums to see if there are other records of rare plants found within the region
- 5 Subsequent sampling did look along the transmission line, and various herbariums were
6 visited. Soil characteristics, geology, and ecosystem unit were all considered during field
7 studies for rare plants.

8 **13.1.2.2 Traditional Use Studies**

9 Traditional Land Use Studies were prepared for a number of Aboriginal group communities.
10 These included Blueberry River First Nation Traditional Land Use Study (Bouchard and
11 Kennedy 2011); Duncan’s First Nation Ethnohistorical Review (Bouchard and
12 Kennedy 2012a); Horse Lake First Nation Ethnohistorical Overview (Bouchard and
13 Kennedy 2012b); Doig River First Nation, Prophet River First Nation, Halfway River First
14 Nation, and West Moberly First Nation Traditional Land Use Study (Candler 2012), Sauteau
15 First Nation Culture and Traditions Study (Nesoo Watchie Resource Management Ltd. 2011),
16 Kelly Late Métis Settlement Society Aboriginal Traditional Knowledge Assessment
17 (KSDavidson & Associates and KCD Consulting Incorporated 2012), Dene Tha’ Traditional
18 Land Use with Respect to BC Hydro’s Proposed Site C Dam (Stevenson 2012), and Fort
19 Nelson First Nation Background and Rationale for Involvement in the Site C Project
20 (Wolfenden 2012).

21 Specific issues and concerns raised by the Aboriginal groups within the various reports, as
22 well as the approach used to address the issues, are presented in Table 13.1. Not all issues
23 identified by Aboriginal groups were included as key indicators. Food plants identified by
24 Aboriginal groups were not included within the assessment as plant species are not being
25 assessed individually; instead, effects to ecosystems that contain described plant
26 assemblages are assessed under terrestrial ecosystems, including those that are rare,
27 sensitive, or of conservation concern. Harvesting of plants for traditional purposes is
28 considered in the assessment of the potential effects of the Project on Current Use of Lands
29 and Resources for Traditional Purposes, which is found in Volume 3 Section 19.

1 **Table 13.1 Key Issues: Vegetation and Ecological Communities**

Key Issues	Approach to Addressing Key Issues
Loss of ecosystems important for Aboriginal food resources of interest	The potential changes to terrestrial ecosystems have been assessed, which will account for changes to ecosystems which support particular Aboriginal food species.
Loss of old-growth forests	Considered by assessing the loss of older forest types that are identified as structural Stage 7
Spread of invasive plants	Considered as part of the assessment under habitat alteration
Exposure of plants to contaminants, including dust	Considered as part of the assessment under habitat alteration
Loss of muskegs	Considered within the assessment under wetlands
Change in vegetation and ecological health due to a decrease in the water quality or quantity	Considered as part of the assessment under habitat alteration
Bank erosion	Considered as part of the assessment under habitat alteration – specifically, operations

2 **13.1.2.3 Project Interactions**

3 Potential project interactions with vegetation and ecological communities are summarized in
 4 Volume 2 Appendix A Project Interactions Matrix, Table 2. As defined in Volume 2 Section 10
 5 Effects Assessment Methodology, a rank of “2” was given where interactions may result in an
 6 adverse effect, and the nature of the effect or the effectiveness of mitigation measures are
 7 uncertain.

8 Project interactions with a ranking of “2” are summarized in Table 13.2. The assessment was
 9 completed for both the construction and operational phases of the Project. Since many of the
 10 Project activities are similar across all Project components, Table 13.2 is an abbreviated
 11 version of Table 2 provided in Volume 2 Appendix A Project Interactions Matrix. These
 12 interactions were taken forward through the effects assessment.

13 Section 11.2.4 of the EIS Guidelines states that the assessment of potential adverse effects
 14 to the vegetation and ecological communities VC will take into account the potential for the
 15 Project to result in changes to the following key aspects:

- 16 • The area of vegetation/ecological community loss, assessed by overlaying the project
 17 activity zone on the ecosystem maps and conducting a GIS-based analysis of the area
 18 lost due to project activities
- 19 • The area of vegetation/ecological community fragmentation, identified through GIS
 20 analysis
- 21 • The area of temporary vegetation/ecological community disturbance will be assessed by
 22 overlaying the project activity zone on the ecosystem maps and conducting a GIS-based
 23 analysis of the area disturbed
- 24 • Long-term effects of maintenance of vegetation/ecological communities in an early seral
 25 stage along the transmission line and around the dam site
- 26 • Wetlands

1 These key aspects are considered under one general effect category – habitat alteration and
 2 fragmentation – which covers both the temporary and permanent loss, and the fragmentation
 3 of vegetation and ecological communities, including wetlands.

4 **Table 13.2 Interactions of the Project with Vegetation and Ecological Communities**

Project Activities and Physical Works	Key Aspects
	Habitat Alteration and Fragmentation – Includes Temporary or Permanent Loss and Fragmentation of Vegetation and Ecological Communities (Including Wetlands)
Construction	
Dam, Generating Station, and Spillways	
• Site clearing and preparation	✓
• Temporary and permanent access roads	✓
• Waste treatment and management facilities	✓
• Hazardous materials storage and refuelling sites	✓
• Truck washing sites	✓
• Relocation of surplus excess material	✓
• Temporary construction access bridge across the Peace River	✓
• Sand and gravel source pits	✓
• Stage 1 and 2 channelization and diversion works	✓
• Existing infrastructure relocation	✓
Reservoir	
• Existing infrastructure inventory, protection, and relocation	✓
• Hudson’s Hope shoreline protection	✓
• Road upgrade and winter road construction	✓
• Clearing of vegetation and timber	✓
• Post-harvest terrestrial debris management	✓
• Access deactivation and reclamation	✓
• Aquatic debris management during inundation	✓
• Water management during diversion, reservoir filling, and commissioning	✓

Project Activities and Physical Works	Key Aspects
	Habitat Alteration and Fragmentation – Includes Temporary or Permanent Loss and Fragmentation of Vegetation and Ecological Communities (Including Wetlands)
Quarried and Excavated Materials	
• Site preparation and earthworks, drainage, railway construction	✓
• 85th Avenue Industrial Lands conveyor belt	✓
Construction Access Road Development	
• Site preparation and earthworks, drainage, railway construction	✓
Highway 29 Realignment	
• Realign highway sections	✓
Worker Accommodation	
• Temporary accommodation	✓
Transmission System	
• Clearing and preparation	✓
• Access construction and right-of-way improvement	✓
• Tower installation	✓
• Construction site decommissioning and reclamation	✓
• Upgrades to Peace Canyon substation	✓
Operations	
Dam, Generating Station, and Spillways	
• Reservoir and downstream water management	✓
• Maintenance of powerhouse and substation	
Reservoir	
• Debris management	✓
• Hudson’s Hope shoreline protection maintenance	✓
Transmission line	
• Right-of-way vegetation maintenance	✓
• Maintenance of access roads	✓

1 **13.1.3 Standard Mitigation Measures and Effects Addressed**

2 A rank of “0” means there is no interaction between the Project components and the VC.
 3 Volume 2 Appendix A Project Interactions Matrix, Table 2 provides a rationale for why some
 4 activities were ranked “0”. These were not carried forward through the effects assessment.
 5 A rank of “1” means that an interaction would occur, but that it is well understood and can be
 6 avoided or mitigated through the application of standard mitigation measures and would be
 7 negligible. No Project activities were assigned a ranking of “1”.

8 **13.1.4 Selection of Key Indicators**

9 Section 11.2.3 of the EIS Guidelines states that the key indicators for the vegetation and
 10 ecological communities VC will include:

- 1 • Total area (hectares) of each ecosystem type, including wetlands, within the mapped area
- 2 • Area (hectares) of each ecosystem by structural stage will be calculated for each of the
- 3 mapped ecosystems using the final map databases. The seven class structural stage
- 4 classification system will be used (B.C. Ministry of Environment, Lands and Parks and
- 5 B.C. Ministry of Forests 1998).
- 6 • Number of unique ecosystems mapped, and their distribution within the technical study
- 7 area described
- 8 • Number of and distribution of rare plant species observed within the technical study area

9 Section 11.2.3.1 of the EIS Guidelines further states that the EIS will describe ecological
 10 communities at risk that are “currently designated on the provincial Red and Blue lists,
 11 communities that are ranked 1 or 2 for Goal 2 of the Conservation Framework, and sensitive
 12 communities that are communities that are less resilient to disturbance such as wetlands.”

13 The key indicators include the requirements as stipulated within the EIS Guidelines. Many of
 14 these requirements are duplicated and for assessment purposes are provided under a
 15 general category: terrestrial ecosystems. As such, the key indicators have been grouped as
 16 follows:

- 17 • Terrestrial ecosystems – including structural stages – that are vulnerable to environmental
 18 effects of the Project, are a management concern, and have been identified as important
 19 by Aboriginal groups, communities, or public stakeholders. All terrestrial ecosystems
 20 within the Local Assessment Area (LAA) are reported (see Volume 2 Appendix R
 21 Terrestrial Vegetation and Wildlife Report), but the focus of the effects assessment is on
 22 rare and sensitive ecological communities. Rare communities include current provincial
 23 red- and blue-listed and/or communities ranked 1 or 2 for Goal 2 (to prevent species and
 24 ecosystems from becoming at risk) of the Conservation Framework. Sensitive ecological
 25 communities include wetlands, tufa seeps, marl fens, grasslands, and old-growth forests.
- 26 • Rare plants that include red- and blue-listed vascular plants, mosses, and lichens.

27 The list of key indicators and the rationale for selection are summarized in Table 13.3.

28 **Table 13.3 Key Indicators for Vegetation and Ecological Communities**

Key Aspects	Key Indicators	Rationale for Selection of the Key Indicators
Habitat alteration and fragmentation – includes temporary or permanent loss and fragmentation of vegetation and ecological communities (including wetlands)	Terrestrial ecosystems	Provincial ecosystems at risk
		Provincial and federal ecosystems of interest
	Rare plants	Biodiversity
Provincial species at risk and of conservation concern		

29 **13.1.5 Spatial and Temporal Boundaries**

30 **13.1.5.1 Spatial Boundaries**

31 The spatial boundaries used in the assessment include the:

- 32 • **Local Assessment Area (LAA):** the area within which the potential adverse effects of the
 33 Project are assessed. The LAA encompasses the Project activity zone, buffered by an

1 additional 1,000 m. This buffer is larger than was suggested in Table 11.2 of the EIS
2 Guidelines. A 1,000 m buffer, which was selected to allow adequate characterization of
3 the terrestrial environment surrounding the Project activity zone, extends far enough to
4 include all potential direct and indirect effects at all construction sites and during
5 operations. This includes new roads, roads requiring sizable upgrades, quarries, the dam
6 site, and the transmission line. For the proposed reservoir, the erosion impact line has a
7 1,000 m buffer.

8 The LAA also extends downstream from the dam to the Alberta border, and includes a
9 1,000 m buffer on both the south and north banks of the Peace River (Figure 13.1). This
10 considers potential effects to riparian vegetation that could be affected by reductions in
11 the magnitude of peak flows, and more frequent high and low flows from the dam
12 downstream to the Pine River confluence (see Section 11.4 Surface Water Regime in
13 Volume 2 Section 11 Environmental Background).

14 • **Regional Assessment Area (RAA):** the area within which projects and activities – the
15 residual effects of which may combine with residual effects of the Project – are identified
16 and taken into account in the cumulative effects assessment. The proposed dam,
17 reservoir, transmission line, Highway 29 realignment, temporary access roads, and
18 quarries occur within five Wildlife Management Units that are designated 7-31, 7-32, 7-33,
19 7-34, and 7-35 (Figure 13.1). The Wildlife Management Unit boundaries provide a larger
20 RAA boundary than what was suggested in Table 11.2 of the EIS Guidelines. The
21 updated boundary includes most of the Peace Lowlands ecosection and incorporates all
22 Project components and activities.

23 **13.1.5.2 Temporal Boundaries**

24 The temporal boundaries of the effects assessment of the Project include short- and
25 medium-term (construction phase; Year 0 - 8) and long-term (operations phase; begin in
26 Year 8 and may continue throughout the life of the Project) time frames.

27 **13.2 Baseline Conditions**

28 The following section provides a summary of the baseline conditions for terrestrial
29 ecosystems and rare plants. This section is supported by more detailed information
30 presented in Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

31 **13.2.1 Terrestrial Ecosystems**

32 For a detailed description of the baseline work completed for terrestrial ecosystem, including
33 rare and sensitive ecosystems, see Volume 2 Appendix R Terrestrial Vegetation and Wildlife
34 Report, Part 1 Vegetation and Ecological Communities.

35 **13.2.1.1 Terrestrial Habitats**

36 Biogeoclimatic zones

37 The Peace River from Hudson's Hope to the Alberta border lies within the Peace River Basin
38 ecoregion, one of the three ecoregions that make up the Boreal Plains ecoprovince. The
39 Peace Lowland ecosection is the only ecosection occurring within the Peace River Basin. The
40 Halfway Plateau ecosection makes up a small area of the LAA. The proposed West Pine
41 Quarry site lies within the Hart Foothills ecosection, with a small portion in the Northern Hart
42 Ranges ecosection.

1 The Peace River Valley lies within the Peace moist, warm Boreal White and Black Spruce
2 (BWBSmw) subzone variant. Other subzone variants present in the LAA include the Murray
3 wet, cool Boreal White and Black Spruce (BWBSwk1), the Finlay-Peace wet, cool Sub-boreal
4 Spruce (SBSwk2), and the Bullmoose moist, very cold Engelmann spruce-subalpine fir
5 (ESSFmv2).

6 Habitat Mapping Approach

7 The terrestrial ecosystems in the LAA were mapped using a combination of two
8 methodologies – Terrestrial Ecosystem Mapping (TEM), and a broader habitat mapping
9 technique that used inputs from existing biophysical mapping, Predictive Ecosystem Mapping
10 (PEM), and Vegetation Resource Inventory (VRI) mapping.

11 Over 30% of the LAA was mapped as seral (\$) 01 forest (Table 13.4). This well-drained,
12 mesic, aspen-dominated forest covers much of the valley slopes of the BWBSmw variant.
13 Moister ecosystems such as the \$05 aspen unit were most commonly found on lower slopes,
14 as were smaller amounts of moist balsam poplar forest (\$07). The Fm02 poplar floodplain
15 unit is present in the valley bottom adjacent to the Peace River and its larger tributaries. Dry
16 aspen forest (\$03) was mapped on warm aspects, mainly on the north side of the river.
17 Shrubby aspen forest (AS) complexed with grassland slopes (WW) and eroding cutbanks
18 (CB) were mapped in gullies and on the steepest, driest warm aspect slopes.

19 **Table 13.4 Mapped Ecosystem Areas in the Local Assessment Area**

Ecosystem type	Site Series	Amount in LAA (ha)
Dry coniferous forest	02, 03	3,117
Dry deciduous forest	\$02, \$03	6,482
Mesic coniferous forest	01, 04, 06	11,372
Mesic deciduous forest	\$01, \$04	27,269
Moist coniferous forest	05, 07	2,971
Moist deciduous forest	\$05, \$07	4,394
Wet coniferous forest	08	2,126
Floodplain forest	Fm02	2,699
Grassland	WW	2,667
Wetland	TS, SE, WS, WH Wf02, Wf13	3,965
Nonvegetated	CB, ED, GB	2,057
Anthropogenic	CF, GP, MI, RN, RW, RY, RZ, UR	10,758
Water	RI, RE, OW, PD	6,517
Other (avalanche path)		31
Grand Total		86,424

20 Lodgepole pine forests (02) were rare and generally occurred only on coarse-textured,
21 gently-sloped terraces. The riparian wetland (WH) was the most common wetland type, and
22 was mapped along the shores and backchannels of the Peace River. Sedge and willow
23 wetlands (SE, WS) were rare in the river valley.

24 Approximately 10% of the LAA was mapped as cultivated field (CF). One per cent was
25 mapped as gravel bar (GB), but neither the extent nor the location of this unit can be
26 specified at any moment, as it varies with the level of the river at any particular time and is
27 subject to movement from one year to the next.

1 Polygons mapped as structural Stage 5 (young forest) made up over 29% of the LAA (based
 2 on a broad review using a mapped polygons first decile only). Deciles are the percentage
 3 assigned to the components of a map polygon on the habitat maps. A polygon can have up to
 4 three deciles, which add up to 100%. A summary of structural stages mapped – based on the
 5 first decile – is presented in Table 13.5. More detailed summaries for all deciles are in
 6 Volume 2 Appendix R Terrestrial [Wildlife and Vegetation Effects Assessment](#). ~~Vegetation and~~
 7 ~~Wildlife Report~~.

8 **Table 13.5 Mapped Structural Stage Area in LAA – First Decile**

Subzone Variant	Structural Stage ^a	Total in LAA (ha)	Percent of LAA (%)
BWBSmw1	None	7,674	8.9
	1	2,082	2.4
	2	12,315	14.3
	3	11,647	13.5
	4	9,174	10.6
	5	24,672	28.5
	6	16,667	19.3
	Total	85,357	98.8
BWBSwk1	3	2	<0.1
	5	191	0.2
	Total	193	0.2
ESSFmv2	3	30	<0.1
	5	111	0.1
	6	44	0.1
	Total	185	0.2
SBSwk2	None	44	0.1
	1	4	<0.1
	2	3	<0.1
	3	90	0.1
	4	29	<0.1
	5	290	0.3
	6	221	0.3
	7	9	0.0
Total	689	0.8	
Grand Total		86,424	100.0

9 **NOTE:**

10 ^a None – river, lake, pond, open water, urban, railway, reservoir, road, and rural that are mapped without structural stages

13.2.1.2 Rare and Sensitive Ecological Communities

For a detailed description of the baseline work completed for rare plant see Volume 2 Appendix R Terrestrial [Wildlife and Vegetation Effects Assessment](#) ~~Terrestrial Vegetation and Wildlife Report~~, Part 1 Vegetation and Ecological Communities.

Two red-listed and 15 blue-listed communities are defined for the BWBSmw, BWBSwk1, ESSFmv2, and SBSwk2 subzone variants. Some of the communities occur in more than one variant. Of the 17 communities, 12 potentially occur in the BWBSmw subzone, four in the SBSwk2, one in the ESSFmv2, and six in the BSBSwk1 subzone. The site series associated with each listed community was correlated with the corresponding ecosystem unit mapped in the LAA. Ten ecosystem units associated with 16 rare ecological communities were identified. They occupy 10,696 ha within the LAA.

Ecological communities that are not red- or blue-listed by the B.C. Conservation Data Centre but are ranked as priority 1 or 2 under Goal 2 of the Conservation Framework are considered as sensitive communities for this assessment. Two communities – both associated with site series in the SBSwk2 – are ranked as priority 2 under Goal 2 of the Conservation Framework. These include communities associated with the 01 and 05 site series. The area of those two site series mapped within the LAA is 305 ha.

Other sensitive communities within the LAA are broader habitats that are rare on the landscape or are sensitive to changes in hydrology or to anthropogenic interactions. These include grasslands, old-growth forest, wetlands, marl fens, and tufa seeps. In total, 2,667 ha are mapped as grassland within the LAA. Old-growth forest – forest mapped as structural Stage 7 within the LAA – totals 1,131 ha. Wetlands mapped in the LAA occur in six vegetated ecosystem units and two water units, and total 4,074 ha. Seven tufa seeps and one marl fen were also located in the LAA during field studies.

13.2.2 Rare Plants

For a detailed description of the baseline work completed for rare plant see Volume 2 Appendix R Terrestrial [Wildlife and Vegetation Effects Assessment](#) ~~Vegetation and Wildlife Report~~, Part 1 Vegetation and Ecological Communities.

For this assessment, rare plants were defined to include the following vascular plants, mosses, and lichens:

- Taxa listed on Schedule 1 of SARA as amended (Government of Canada 2008)
- Taxa assigned a status of Extinct, Extirpated, Endangered, Threatened, or Special Concern by COSEWIC (COSEWIC 2012)
- Taxa on the BCMOE provincial red or blue lists (B.C. Conservation Data Centre 2011)

Thirty-nine B.C. red- or blue-listed vascular plant taxa are known to occur within the LAA. This includes occurrences found during the 2008, 2011, and 2012 site-specific surveys, as well as records from previous botanical work in the area. Of these 39 taxa, 11 are red-listed and 28 are blue-listed. No SARA Schedule 1 plant taxa were found, and no plant species ranked by COSEWIC as Extinct, Extirpated, Endangered, Threatened, or Special Concern were observed.

Three blue-listed moss species were identified during the 2008 field surveys. The three species were found in five occurrences. No SARA Schedule 1 mosses were reported, nor

1 were any listed by COSEWIC as Extinct, Extirpated, Endangered, Threatened, or Special
 2 Concern.

3 The 2008 surveys documented 29 occurrences of 10 BCMOE-listed lichen species. The 29
 4 occurrences were primarily in non-wetland habitats. No SARA Schedule 1 lichens were
 5 found, and no lichens listed by COSEWIC as Extinct, Extirpated, Endangered, Threatened, or
 6 Special Concern were located.

7 **13.2.3 Vegetation Use by Aboriginal Groups**

8 Traditional Land Use studies prepared for the Project indicate that Aboriginal groups currently
 9 harvest plants and earth resources in the LAA for medicinal, subsistence and cultural
 10 purposes (Candler 2012; Bouchard and Kennedy 2011; Bouchard and Kennedy 2012a;
 11 Bouchard and Kennedy 2012b; Nesoo Watchie Resource Management Ltd 2011). Table 13.6
 12 lists the species harvested by Aboriginal groups and the ecosystem in which they are found.
 13 Harvesting of plants for traditional purposes is considered in the assessment of the potential
 14 effects of the Project on Current Use of Lands and Resources for Traditional Purposes, which
 15 is found in Volume 3 Section 19.

16 **Table 13.6 Aboriginal Plant Species of Interest Occurrence in Terrestrial**
 17 **Ecosystems**

Plant species	Terrestrial Ecosystem
Bearberry	This species was not recorded during ecosystem mapping surveys
Blackberry	This species was not recorded during ecosystem mapping surveys.
Blueberry	Upland and riparian forests
Bulrush	This species was not recorded during ecosystem mapping surveys.
Chokecherry	Upland forests, grasslands
Cloudberry	Forested wetland
Cow parsnip	Moist forests and Avalanche tracks
Cranberry	Upland and riparian forests and forested wetland
Huckleberry	Upland forests
Labrador Tea	Westland
Mint	This species was not recorded during ecosystem mapping surveys
Peppermint	This species was not recorded during ecosystem mapping surveys
Raspberry	Upland forest, riparian forests and forested wetlands
Rat root	This species was not recorded during ecosystem mapping surveys
Rose	Upland and riparian forests and forested wetland
Saskatoon berry	Upland forest
Sage	Cutbanks
Soapberry	This species was not recorded during ecosystem mapping surveys
Nettle	Floodplain forests and Avalanche tracks
Wild strawberry	Upland forest
Wild onion	Grasslands
Wild potatoes	This species was not recorded during ecosystem mapping surveys

13.3 Effects Assessment

Section 11.2.4 of the EIS Guidelines states that the assessment of potential adverse effects to the vegetation and ecological communities VC will take into account the potential for the Project to result in changes to the following key aspects:

- The area of vegetation/ecological community loss, assessed by overlaying the project activity zone on the ecosystem maps and conducting a GIS-based analysis of the area lost due to project activities
- The area of vegetation/ecological community fragmentation, identified through GIS analysis
- The area of temporary vegetation/ecological community disturbance will be assessed by overlaying the project activity zone on the ecosystem maps and conducting a GIS-based analysis of the area disturbed
- The long-term effects of maintenance of vegetation/ecological communities in an early seral stage along the transmission line and around the dam site
- Wetlands

These key aspects are considered under one general effect – habitat alteration and fragmentation – which covers both the temporary and permanent loss, and the fragmentation of vegetation and ecological communities, including wetlands.

An analysis based on the Geographical Information System (GIS) provides a quantitative assessment, measuring change within the LAA by overlaying the Project activity zone with ecosystem mapping and known spatial locations of ecosystems and specific rare plant populations (see Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report).

Vegetation and ecological communities and rare plant populations in the LAA adjacent to any Project components may still be changed through edge effects associated with fragmentation, spread of invasive species, or changes in hydrology, but the exact spatial extent of any change is difficult to quantify. A qualitative assessment of changes in the condition of a community and rare plants due to these stresses – including long-term maintenance of the transmission line right-of-way – is considered.

13.3.1 Effects Assessment – Habitat Alteration and Fragmentation during Construction and Operations

Habitat alteration for vegetation is defined as a temporary or permanent removal or loss of habitat or a reduction in habitat suitability. Fragmentation involves the ‘separation’ of habitat patches into one or more pieces – a process that requires some portion of the original habitat patch or rare plant occurrence to be lost or transformed into a less favourable or inhospitable habitat.

For the Project, the greater potential for changes to terrestrial ecosystems and rare plants would be expected to occur during the construction phase. Habitat alteration through clearing of vegetation and grubbing during site preparation would be predominant during the early stages. As construction proceeds, water diversion associated with dam construction has the potential to change flow regimes on the Peace River (see Section 11.4 Surface Water Regime in Volume 2 Section 11 Environmental Background for more details), which may change occurrences along the river margins. In the final stages of construction, reservoir

1 filling would change the occurrence of terrestrial ecosystems and rare plants through
2 inundation of existing habitats. Occurrences within the proposed reservoir would be
3 inundated during filling, while those near the new shoreline could experience changes to their
4 supporting habitats.

5 Clearing activities have the potential to indirectly change nearby occurrences and habitat not
6 directly located within the Project activity zone. These include:

- 7 • Increased competition with invasive plant species introduced or dispersed by site clearing
8 activities
- 9 • Contamination from road salt, herbicide, silt, or accidental spills of industrial fluids
- 10 • Changes to hydrologic regimes – drying of wetlands, flooding of uplands – due to
11 vegetation clearing, road building, and ground disturbance nearby
- 12 • Increased dust deposition on leaves and floral parts due to vegetation clearing and
13 grubbing activities
- 14 • Increased incidental human disturbance with foot and vehicle traffic

15 During the operations phase, most of the adverse changes to terrestrial ecosystems and
16 known rare plant occurrences would have already occurred. Maintenance of the various
17 Project components could alter adjacent occurrences or sites where new populations have
18 become established. Some Project components – such as the transmission line right-of-way
19 – will be maintained in a grass-shrub successional stage. Periodic brushing and herbicides
20 will be used to limit tree growth. Elimination of the tree layer will prevent development or
21 recovery of forested rare ecosystems.

22 Operation of the dam is expected to result in changes to the surface water regime
23 downstream. These conditions would be similar to the conditions currently experienced
24 downstream of the Peace Canyon Dam (see Volume 2 Appendix D Surface Water Regime
25 Technical Memos), and would be dampened by flow attenuation and tributary inputs –
26 especially from the Pine River. The operational releases of the Peace Canyon Dam are
27 bounded by the minimum flow requirement of 283 m³/s and the maximum licensed discharge
28 of 1,982 m³/s. The proposed minimum flow for the Project is 390 m³/s and the proposed
29 maximum turbine discharge capacity is about 2,520 m³/s. The range of operational releases
30 is 1,699 m³/s under existing conditions, and would be approximately 2,130 m³/s with the
31 Project. The measurable changes are greatest in the approximate 16 km section of the Peace
32 River between the proposed Site C dam and the Pine River confluence. With more frequent
33 high and low flows, and associated wetted and dewatered areas, shoreline occurrences of
34 rare plants and rare and sensitive ecosystems could be changed. See Section 12.4.2.2 in
35 Volume 2 Section 12 Fish and Fish Habitat for a comparison of Peace River wetted surface
36 areas from the proposed Site C dam to the Pine River confluence. For rare plants, it is difficult
37 to predict in what manner a particular species will be affected, since the disturbance
38 responses for most rare plants have not been documented. Certain rare plant species will
39 tolerate a high level of ground or vegetation disturbance; other rare plant taxa require an
40 undisturbed environment and quickly decline when the habitat is degraded or disturbed.
41 Because no empirical data on disturbance response for any of the rare plants could be
42 located, it was assumed any Project-related activity that would change any environmental
43 parameter within an occurrence would have an interaction. While this is likely a conservative
44 assumption, the analysis takes a precautionary approach in the absence of scientific
45 consensus.

1 **13.3.1.1 Terrestrial Ecosystems**

2 Within the LAA there are 86,424 ha of land represented by 60 different ecosystem units,
 3 although some of the same nonvegetated-anthropogenic ecosystem units occur in different
 4 sub-zone variants. The Project components overlap over 15,000 ha, with the majority of the
 5 ecosystem units losing less than 15% of the total available within the LAA. The ecosystems
 6 more prominently represented within the LAA, which have the largest proportional loss, are
 7 the valley bottom forest and the riparian wetland types that overlap with the reservoir. The
 8 total amount of each ecosystem affected is provided in Volume 2 Appendix R Terrestrial
 9 Vegetation and Wildlife Report, Part 1 Vegetation and Ecological Communities.

10 Road construction is often cited as a cause of fragmentation of natural habitat (Reed
 11 et al. 1996; Findlay and Bourdages 2000; Carr et al. 2002; Hansen and Clevenger 2005). The
 12 construction of the road itself replaces a portion of the original habitat with nonvegetated road
 13 surface, roadbed material, and any associated drainage structures. Road construction has
 14 other consequences beyond loss of habitat. Corridors such as roads are colonization sites
 15 and dispersal routes for exotic species – in part because of reduced competition from native
 16 species not adapted to the conditions of disturbed habitat (Vankat and Roy 2002). Weed
 17 seeds are carried by vehicles and distributed along roadsides (Hansen and Clevenger 2005;
 18 Parendes and Jones 2000; Watkins et al. 2003). Habitat edges close to roadsides may
 19 function like corridors to facilitate further spread of exotics away from roads and into
 20 undisturbed areas (Vankat and Roy 2002).

21 Fragmentation as a result of the Project has been assessed by quantifying the amount of new
 22 permanent road to be constructed (Table 13.7).

23 **Table 13.7 Length of New Permanent Road Associated with the Project**

Description	Linear Length (km)
Highway 29 realignment	30.2
Jackfish Lake Road extension	32.6
Old Fort Road	1.0
Total	63.7

24 Most of the linear disturbances associated with the Project are located along existing
 25 roadways, an existing railway line, an existing transmission line corridor, or within habitat
 26 already affected by human activities – such as Cultivated Field – so the extent of new
 27 fragmentation is limited. Of the 64 km of new permanent roads that would be constructed by
 28 the Project, nearly half is associated with the realignment of Highway 29 where the new
 29 alignments would pass through a number of cultivated fields, thereby limiting further habitat
 30 fragmentation. The remaining sections of new permanent roads would be located to the south
 31 of the Peace River along an extension of the Jackfish Lake Road. This new segment would
 32 be built adjacent to the existing corridor for the transmission line and railway. It passes
 33 through a variety of terrestrial habitats – including a number of wetlands in the eastern portion
 34 – as it approaches the dam site, thereby contributing to fragmentation of these habitats.

35 **Rare Ecological Communities**

36 Summaries of the area affected within Project activity zone that were mapped as ecosystem
 37 units associated with rare communities are presented in Table 13.8. Losses of rare ecological
 38 communities due to construction in forested sites within the BWBSmw in the LAA, include:
 39 27% of the blue-listed 05/SO – White spruce/Oak fern – Wild sarsaparilla; 44% of the

1 blue-listed 07/SH – White spruce/Red swamp currant/Horsetails; and 42% of the blue-listed
 2 09/Fm02 – Balsam poplar – White spruce/Mountain alder – red-osier dogwood. In addition,
 3 construction activities have the potential to affect over 12% of the available Sedge wetland
 4 (00/SE) in the BWBSmw, which is associated with four listed ecological communities, and
 5 13% of the Willow sedge wetland (00/WS), which is associated with one listed ecological
 6 community. A portion of this potential loss would be caused by the construction of the
 7 transmission line. Losses may be mitigated if transmission towers were placed to avoid
 8 wetland habitat. Potential interactions may still occur if construction results in changes in
 9 hydrology or sediment runoff.

10 Additional ecological community loss would also occur during operation, with bank erosion
 11 along the reservoir.

12 **Table 13.8 Areas of Ecosystem Units Associated with Rare Communities Potentially**
 13 **Affected by the Project**

Ecosystem Unit (Associated Rare Community)	Total Area in LAA (ha)	Area (ha) Within the Project Activity Zone						Phase	
		Dam	Reservoir	Transmission Line	Highway 29	Roads	Quarry		Total
BWBSmw1									
00/SE (Arctic rush - Nuttall's alkaligrass – Seablite) (Mat muhly - Arctic rush - Nevada bluegrass) (Common cattail marsh) (Scrub birch /Water sedge)	1,169	40	47	35	0	19	1	142	Construction
		0	< 1	54	0	0	0	55	Operations
00/WS (Scrub birch /Water sedge)	363	3	28	14	0	5	0	50	Construction
		0	0	16	0	0	0	16	Operations
05/SO (White spruce/Oak fern – Wild sarsaparilla)	1,215	22	296	4	<1	5	0	328	Construction
		0	117	4	0	0	0	121	Operations
07/SH (White spruce/Red swamp currant/ Horsetails)	1,699	18	716	5	< 1	3	< 1	743	Construction
		0	18	5	0	0	0	23	Operations

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Ecosystem Unit (Associated Rare Community)	Total Area in LAA (ha)	Area (ha) Within the Project Activity Zone							Phase
		Dam	Reservoir	Transmission Line	Highway 29	Roads	Quarry	Total	
08/BT (White spruce - Black spruce /Labrador tea/Glow moss) (Black spruce/ Common horsetail/ Peat-mosses) (Black spruce/ Lingonberry/ Peat-mosses)	2,051	7	13	54	0	19	< 1	93	Construction
		0	< 1	58	0	0	0	58	Operations
09/Fm02 (Balsam poplar – White spruce /Mountain alder – red-osier dogwood)	2,664	36	1,080	0	1	< 1	0	1,117	Construction
		0	18	0	0	0	0	18	Operations
10/TS (Tamarack/ Water sedge /Golden fuzzy fen moss)	1,405	13	13	32	0	9	< 1	68	Construction
		0	0	47	0	0	0	47	Operations
BWBSwk1									
04/SW (White spruce – Lodgepole pine/ Soopolallie/ Showy aster)	52	0	0	0	0	0	23	23	Construction
SBSwk2									
00/Wf13 (Narrow-leaved cotton-grass – Shore sedge)	9	0	0	0	0	< 1	< 1	< 1	Construction
02/LH (Lodgepole pine/Black huckleberry/ Reindeer lichens)	70	0	0	0	0	0	25	25	Construction

1 **Sensitive Ecological Communities**

2 Tufa Seeps and Marl Fens

3 Five of the seven tufa seeps within the LAA would be directly affected. The marl fen at
 4 Watson Slough would be inundated by the reservoir and lost. Of the two remaining tufa
 5 seeps, one would be crossed by the proposed transmission line and the other would be
 6 immediately outside the reservoir.

7 Old Growth

8 A summary of area in hectares of structural Stage 7 forest within the LAA and potentially
 9 affected by the Project is presented in Table 13.9. Project construction and operations would
 10 remove less than 5% of the old growth mapped in the LAA. During operations, losses of old
 11 growth may result from bank erosion.

12 **Table 13.9 Area of Structural Stage 7 Affected by the Project**

Total Area (ha) in LAA	Hectares in Project Activity Zone							Phase
	Dam	Reservoir	Transmissi on Line	Highway	Roads	Quarry	Total	
1,135	0	39	0	0	0	4	43	Construction
		3	0	0	0	0	3	Operations

13 Grasslands

14 A summary of area in hectares of grassland within the LAA and potentially affected by the
 15 Project is presented in Table 13.10. Slightly over 10% of the grassland mapped in the LAA
 16 would be lost due to the Project, during filling of the reservoir – 86 ha – with an additional
 17 101 ha expected to be lost during operations, due to bank erosion.

18 **Table 13.10 Area of Grassland Affected by the Project**

Total Area (ha) in LAA	Hectares in Project Activity Zone							Phase
	Dam	Reservoir	Transmissio n Line	Highway	Roads	Quarry	Total	
2,667	44	86	8	27	4	0	169	Construction
	0	101	7	0	0	0	108	Operations

19 Wetlands

20 A summary of the total area in hectares of wetlands within the LAA and potentially affected by
 21 the Project is presented in Table 13.11. The total area of wetlands directly affected due to
 22 Project construction would be 675 ha. The greatest proportional loss of vegetated wetlands is
 23 to the WH riparian wetland, primarily found along the margins and backchannels of the Peace
 24 River. An additional 121 ha of wetland has the potential to be affected during operations, but

1 this would depend on vegetation maintenance activities where the transmission line
2 right-of-way already exists. It should be noted that a portion of this change is due to the
3 transmission line. If the line is constructed to pass over the wetlands and towers are not
4 placed within them, there may be little direct change, although indirect changes from changes
5 in hydrology or sediment runoff are still possible.

6 **Table 13.11 Wetland Area Affected by the Project**

Ecosystem Unit	Total Area (ha) in LAA	Hectares in Project Activity Zone						Phase	
		Dam	Reservoir	Transmission Line	Highway 29	Roads	Quarry		Total
BWBSmw1									
00/OW Open water	75	2	14	< 1	0	< 1	0	17	Construction
		0	0	1	0	0	0	1	Operations
00/PD Pond	34	0	4	< 1	0	< 1	< 1	5	Construction
		0	< 1	2	0	0	0	2	Operations
00/SE Sedge Wetland	1,169	40	47	35	0	19	1	142	Construction
		0	< 1	54	0	0	0	55	Operations
00/WH Willow - Horsetail - Sedge - Riparian Wetland	1,010	1	391	< 1	0	0	0	392	Construction
		0	< 1	< 1	0	0	0	1	Operations
00/WS Willow-Sedge Wetland	363	3	28	14	0	5.0	0	50	Construction
		0	0	16	0	0.0	0	16	Operations
10/TS Tamarack - Sedge - Fen	1,405	13	13	32	0	9	< 1	68	Construction
		0	0	47	0	0	0	47	Operations
SBSwk2									
00/Wf13 Narrow-leaved cotton-grass-Shore Sedge	9	0	0	0	0	< 1	< 1	< 1	Construction

7 **13.3.1.2 Rare Plants**

8 ~~In total, 142 BCMOE-listed vascular plant occurrences have the potential to be changed by~~
9 ~~the Project. The large majority — 122 — are expected to be lost during construction~~
10 ~~(Table 13.12). No occurrences of SARA Schedule 1 plants – including vascular plants,~~
11 ~~mosses, and lichens – are known to exist in the LAA. Likewise, no occurrences of vascular~~
12 ~~plants, mosses, or lichens ranked by COSEWIC as Extinct, Extirpated, Endangered,~~
13 ~~Threatened, or Special Concern are recorded from the LAA. In total, 175 BCMOE-listed~~
14 ~~vascular and non-vascular plant occurrences have the potential to be changed by the Project.~~
15 ~~The large majority – 150 occurrences – are expected to be lost during construction. Five~~
16 ~~BCMOE-listed moss occurrences and 28 BCMOE-listed lichen occurrences may be affected~~
17 ~~by the Project during construction and operations (Tables 13.12 and 13.13).~~

1 **Table 13.12 Rare ~~Vascular~~ Plant Occurrences Potentially Affected During**
 2 **Construction**

Species	Dam	Reservoir	Transmission Line	Highway 29	Roads	Quarry	Total
Vascular Plants							
<i>Anemone virginiana</i> var. <i>cyliandroidea</i> (riverbank anemone)	2	8	0	2	0	1	13
<i>Arnica chamissonis</i> ssp. <i>incana</i> (meadow arnica)	0	2	2	0	0	0	4
<i>Artemisia herriotii</i> (western mugwort)	0	15	0	0	0	0	15
<i>Calamagrostis montanensis</i> (plains reedgrass)	3	0	0	0	0	1	4
<i>Carex heleonastes</i> (Hudson Bay sedge)	0	1	0	0	0	0	1
<i>Carex sychnocephala</i> (many-headed sedge)	0	1	0	0	0	0	1
<i>Carex tenera</i> (tender sedge)	0	5	0	0	0	0	5
<i>Carex torreyi</i> (Torrey's sedge)	0	0	0	0	0	1	1
<i>Carex xerantica</i> (dry-land sedge)	0	0	0	0	0	1	1
<i>Chrysosplenium iowense</i> (Iowa golden-saxifrage)	0	1	1	0	0	0	2
<i>Cicuta virosa</i> (European water-hemlock)	1	0	2	0	3	0	6
<i>Cirsium drummondii</i> (Drummond's thistle)	2	4	1	0	0	0	7
<i>Epilobium halleianum</i> (Hall's willowherb)	0	1	0	0	0	0	1
<i>Epilobium saximontanum</i> (Rocky Mountain willowherb)	0	1	0	0	0	0	1
<i>Galium labradoricum</i> (northern bog bedstraw)	0	1	2	0	0	0	3
<i>Glyceria pulchella</i> (slender mannagrass)	0	1	0	0	0	0	1
<i>Helictotrichon hookeri</i> (spike-oat)	2	0	0	0	0	1	3
<i>Juncus arcticus</i> ssp. <i>alaskanus</i> (arctic rush)	0	4	0	0	0	0	4
<i>Malaxis brachypoda</i> (white adder's-mouth orchid)	0	0	1	0	0	0	1
<i>Muhlenbergia glomerata</i> (marsh muhly)	0	1	0	0	0	0	1
<i>Oxytropis campestris</i> var. <i>davisii</i> (Davis' locoweed)	0	8	0	0	0	0	8
<i>Pedicularis parviflora</i> ssp. <i>parviflora</i> (small-flowered lousewort)	0	0	1	0	0	0	1
<i>Polypodium sibiricum</i> (Siberian polypody)	0	0	0	0	0	2	2
<i>Salix serissima</i> (autumn willow)	0	1	0	0	0	0	1

Species	Dam	Reservoir	Transmission Line	Highway 29	Roads	Quarry	Total
<i>Schizachyrium scoparium</i> (little bluestem)	0	1	0	0	0	0	1
<i>Silene drummondii</i> var. <i>drummondii</i> (Drummond's campion)	0	1	0	0	0	2	3
<i>Sphenopholis intermedia</i> (slender wedgegrass)	1	2	0	0	0	0	3
<i>Symphyotrichum puniceum</i> var. <i>puniceum</i> (purple-stemmed aster)	2	3	14	0	7	0	26
<i>Trichophorum pumilum</i> (dwarf clubrush)	0	1	0	0	0	0	1
<i>Utricularia ochroleuca</i> (ochroleucous bladderwort)	0	0	0	0	1	0	1
Total Vascular Plants	13	63	24	2	11	9	122
Mosses							
<i>Amblyodon dealbatus</i> (no common name)	0	1	0	0	0	0	1
<i>Pohlia sphagnicola</i> (no common name)	0	1	2	0	0	0	3
Total Mosses	0	2	2	0	0	0	4
Lichens							
<i>Collema multipartitum</i> (protracted tarpaper)	0	2	0	0	0	0	2
<i>Leptogium intermedium</i> (fourty-five vinyl)	0	1	0	0	0	0	1
<i>Peltigera evansiana</i> (peppered pelt)	1	2	1	0	0	0	4
<i>Phaeophyscia hirsute</i> (smiling shadow)	1	1	0	0	0	0	2
<i>Phaeophyscia kairamoii</i> (five o'clock shadow)	0	2	1	0	0	0	3
<i>Physcia stellaris</i> (immaculate rosette)	0	6	1	0	2	0	9
<i>Ramalina sinensis</i> (threadbare ribbon)	0	1	0	0	0	0	1
<i>Squammarina lentigera</i> (snow-white dimple)	0	2	0	0	0	0	2
Total Lichens	2	17	3	0	2	0	24

1 The reservoir would remove 63 known rare vascular plant occurrences. Many species were
2 principally found in this area and include riverbank anemone (*Anemone virginiana* var.
3 *cylindroidea*), western mugwort (*Artemisia herriotii*), tender sedge (*Carex tenera*), arctic
4 rush (*Juncus arcticus* ssp. *alaskanus*), and Davis' locoweed (*Oxytropis campestris* var.
5 *Davisii*). The Watson Slough wetland complex is the only known location in the LAA of six
6 rare taxa that includes Hudson Bay sedge (*Carex heleonastes*), many-headed sedge (*Carex*
7 *sychnocephala*), slender mannagrass (*Glyceria pulchella*), marsh muhly (*Muhlenbergia*
8 *glomerata*), autumn willow (*Salix serissima*), and dwarf clubrush (*Trichophorum pumilum*).

9 The reservoir would also affect two rare moss occurrences – *Amblyodon dealbatus* and
10 *Pohlia sphagnicola*. *Amblyodon dealbatus* was not found anywhere else within the LAA. In

1 addition, 17 rare lichen occurrences may be lost under the reservoir. This includes several
2 species that were not found in other areas of the LAA – protracted tarpaper (*Collema*
3 *multipartitum*), threadbare ribbon (*Ramalina sinensis*), and snow-white dimple (*Squamarina*
4 *lentigera*).

5 The dam site would affect 13 known rare vascular plant occurrences. Two of the species –
6 spike-oat (*Helictotrichon hookeri*) and plains reedgrass (*Calamagrostis montanensis*) – are
7 restricted to grassland habitats, while the other five species were found in varied habitats.
8 The dam site also contains two rare lichen occurrences that are expected to be affected by
9 Project construction. Both of these species – smiling shadow (*Phaeophyscia hirsute*) and
10 peppered pelt (*Peltigera evansiana*) – are found at other locations in the LAA. No rare moss
11 occurrences are known from the dam site.

12 It is expected that habitat alteration would result in the extirpation of most of the rare plant
13 occurrences within the dam site. Depending on the extent and intensity of the vegetation
14 clearing in this area, some occurrences may survive. As construction proceeds, changes due
15 to dust deposition, additional vegetation clearing, and other construction-related activities
16 would further reduce the viability of these remaining occurrences.

17 Nine rare vascular plant occurrences are known from the proposed quarry locations.
18 Specifically, the occurrences are located at the 85th Avenue Industrial Lands, Area E, and
19 Portage Mountain sites. One of the species – Siberian polypody (*Polypodium sibiricum*) – was
20 not found anywhere else in the LAA. The species was found only on cliffs at the Portage
21 Mountain site. The total area affected by quarry developments is considered to be an
22 overestimate, as the Project activity zone associated with some of the quarries is larger than
23 what is anticipated.

24 Only two known rare vascular plant occurrences are situated along the Highway 29
25 realignment sections. These are both riverbank anemone occurrences associated with upland
26 habitats. Other road developments could affect 11 known rare vascular plant occurrences.
27 The 11 occurrences were of three different wetland species: European water-hemlock (*Cicuta*
28 *virosa*), purple-stemmed aster (*Symphyotrichum puniceum* var. *pPuniceum*), and ochroleucus
29 bladderwort (*Utricularia ochroleuca*). In addition, two occurrences of the BCMOE-listed lichen
30 immaculate rosette (*Physcia stellaris*) could be affected by access road construction.

31 Direct changes to rare plant occurrences in these areas would begin with vegetation clearing
32 and grubbing to prepare the highway realignment sections. Construction activities could alter
33 adjacent suitable rare plant habitat due to increased dust, altered hydrology, and increased
34 competition from invasive plants. Finally, revegetation and reclamation efforts may alter
35 community structure, affecting the quality of rare plant habitat.

36 Twenty-four BCMOE-listed vascular plant occurrences are known along the transmission line
37 right-of-way. The majority of these are located in wetland habitats within and adjacent to the
38 existing cleared right-of-way. Over half of the 24 occurrences are purple-stemmed aster,
39 which occurs in large numbers within the existing right-of-way. Two species – white
40 adder's-mouth orchid (*Malaxis brachypoda*) and small-flowered lousewort (*Pedicularis*
41 *parviflora* ssp. *parviflora*) – were found nowhere else in the LAA.

42 Two occurrences of the BCMOE-listed moss *Pohlia sphagnicola* are located along the
43 transmission line construction corridor. In addition, three occurrences of three BCMOE-listed
44 lichens – peppered pelt, five o'clock shadow (*Phaeophyscia kairamo*), and immaculate
45 rosette – exist in the transmission line corridor. All four of these rare moss and lichen species
46 occur at other sites in the LAA.

1 Construction interactions with rare plants along the transmission line are particularly complex
2 and difficult to predict, due to the diffuse and transitory nature of the activities. It is expected
3 that many of the rare plant occurrences will be affected during the initial vegetation clearing
4 and widening of the right-of-way. Many of the existing occurrences are located in the currently
5 cleared right-of-way and would be expected to at least partially survive clearing if it is similar
6 to the current ongoing maintenance along the line.

7 Tower placement and line stringing activities could interact with existing rare plant
8 occurrences and potential habitat both directly (e.g., trampling, hydrologic modification) and
9 indirectly (e.g., increased invasive species potential, increased dust deposition). The level of
10 interaction depends on where the activities occur. Reclamation and restoration activities
11 post-construction would alter community structure, thereby altering the suitability of the rare
12 plant habitat and affecting the viability of some occurrences. Only two additional known rare
13 vascular plant occurrences are located along the existing transmission line right-of-way, but
14 are outside the construction zone of influence. These two species are Hall's willowherb
15 (*Epilobium halleanum*) and northern bog bedstraw (*Galium labradoricum*).

16 The 20 additional rare vascular plant occurrences potentially interacting with the Project
17 during operations are mostly-located downstream of the dam along the river margin. Eight
18 occurrences are western mugwort and three are riverbank anemone. Seven occurrences are
19 composed of six other river corridor-associated species. Additionally, one occurrence of a
20 BCMOE-listed moss, and four occurrences of four BCMOE-listed lichens have the potential to
21 be affected by Project operations along the downstream reach.

22 Rare plant changes downstream are primarily related to changes in the hydrologic regime.
23 Changes to daily and seasonal flow patterns could alter downstream vegetation, potentially
24 altering the viability of rare plant occurrences and changing the suitability of the habitat. In
25 addition, indirect changes to downstream rare plant occurrences could result from
26 sedimentation, increased competition with invasive species, and changes to water quality.
27 These indirect changes are expected to lessen with distance downstream from the dam site.
28 Table 13.13 summarizes the rare plant occurrences potentially affected during operations.

1 **Table 13.13 Rare ~~Vascular~~ Plant Occurrences Potentially Affected During Operations**

Species	Transmission Line	Downstream	Total
Vascular Plants			
<i>Anemone virginiana</i> var. <i>cylindroidea</i> (riverbank anemone)	0	3	3
<i>Artemisia herriotii</i> (western mugwort)	0	8	8
<i>Atriplex gardneri</i> var. <i>gardneri</i> (Gardner's sagebrush)	0	1	1
<i>Eleocharis elliptica</i> (elliptic spike-rush)	0	1	1
<i>Epilobium halleanum</i> (Hall's willowherb)	1	0	1
<i>Epilobium saximontanum</i> (Rocky Mountain willowherb)	0	1	1
<i>Galium labradoricum</i> (northern bog bedstraw)	1	0	1
<i>Juncus confusus</i> (Colorado rush)	0	2	2
<i>Oxytropis campestris</i> var. <i>davisii</i> (Davis' oxytrope)	0	1	1
<i>Penstemon gracilis</i> (slender penstemon)	0	1	1
Total Vascular Plants	2	18	20
Mosses			
<i>Aloina bifrons</i> (no common name)	<u>0</u>	<u>1</u>	<u>1</u>
Total Mosses	<u>0</u>	<u>1</u>	<u>1</u>
Lichens			
<i>Lempholemma polyanthes</i> (mourning phlegm)	<u>0</u>	<u>1</u>	<u>1</u>
<i>Leptogium intermedium</i> (fourty-five vinyl)	<u>0</u>	<u>1</u>	<u>1</u>
<i>Leptogium tenuissimum</i> (birdnest vinyl)	<u>0</u>	<u>1</u>	<u>1</u>
<i>Peltigera evansiana</i> (peppered pelt)	<u>0</u>	<u>1</u>	<u>1</u>
Total Lichens	<u>0</u>	<u>4</u>	<u>4</u>

2 As a result, the construction and operation of the Project has the potential to cause an effect
 3 on vegetation and ecological communities by the ~~e~~-alteration and fragmentation of habitat, for
 4 the terrestrial ecosystems and rare plants discussed above.

5 **13.3.2 Mitigation Measures – Habitat Alteration and Fragmentation**

6 To reduce adverse Project effects to terrestrial ecosystems and rare plants, three general
 7 categories of mitigation were applied: 1) avoidance, 2) reduction, and 3) compensation.

8 **Avoidance of habitat loss** is the avoidance of direct or indirect effects to known rare plant
 9 occurrences and rare and sensitive ecosystems through changes to the design of the Project
 10 (see Section 4.2 Project Evolution in Volume 1 Section 4 Project Description) or of
 11 construction and operations methods. Through the implementation of avoidance measures –
 12 discussed in more detail below – effects to a specific occurrence are eliminated within the
 13 site-specific areas where they are applied. Complete avoidance of a rare plant occurrence or

1 habitat is feasible for the placement of select new temporary access roads; some existing
2 access road sections where vegetation disturbance is planned; areas along the transmission
3 line corridor; and some limited-activity areas at the dam site.

4 **Effect reduction** is the lessening of direct and indirect effects to rare and sensitive
5 occurrences through the targeted modification of construction and operations methods, and
6 possibly translocation. Translocation, which is the removal of live rare plant individuals or
7 propagules – e.g., seeds, spores, shoots – from the Project activity zone, and their
8 subsequent re-establishment at another location. This can occur directly – the individual is
9 removed and then immediately transplanted to the new habitat, or indirectly – through an
10 intermediary nursery or seed bank.

1 **Compensatory mitigation** is the protection and enhancement of off-site suitable rare and
 2 sensitive occurrences as compensation for habitat lost or degraded due to the Project. This
 3 can be in-kind – off-site habitat that is similar to that lost within the Project activity zone, or
 4 out-of-kind – off-site habitat that is different from that lost within the Project activity zone.
 5 Compensatory mitigation is most appropriate for areas where avoidance and reduction are
 6 not feasible, such as the reservoir, intensive work areas at the dam site, and quarries. Within
 7 compensatory mitigation, basic research into the distribution or taxonomy of rare plant
 8 species that are affected by the Project can also be explored. The additional knowledge
 9 gained will assist in the development of more effective protection and recovery strategies for
 10 these rare plant species throughout their range.

11 The B.C. Ministry of Environment's Conservation Framework program provides a set of tools
 12 that prioritize and select appropriate conservation actions for rare species and ecosystems in
 13 the province (BCMOE 2012a). The relevant Conservation Framework outputs for the vascular
 14 plant species that are expected to be directly affected by the Project are presented in
 15 Table 13.14. The Conservation Framework priorities and action groups will be considered
 16 when applying mitigation.

17 **Table 13.14 Rare Vascular Plant Occurrences and Conservation Framework Priorities**

Species	Total ^a	Provincial List	Conservation Framework Priority ^b	Conservation Framework Action Groups ^c
<i>Atriplex gardneri</i> var. <i>gardneri</i> (Gardner's sagebrush)	1	Red	1	Plan; Private Land; Habitat Protect; Habitat Restore; COSEWIC; <i>Wildlife Act</i> ; Status Report; Inventory
<i>Cirsium drummondii</i> (Drummond's thistle)	7	Red	1	Inventory; Status Report; Plan; <i>Wildlife Act</i> ; COSEWIC; Habitat Restore; Habitat Protect; Private Land
<i>Juncus confusus</i> (Colorado rush)	2	Red	1	Inventory; Status Report; <i>Wildlife Act</i> ; COSEWIC; Plan; Private Land; Habitat Protect; Habitat Restore
<i>Schizachyrium scoparium</i> (little bluestem)	1	Red	1	Inventory; Status Report; <i>Wildlife Act</i> ; COSEWIC; Plan; Private Land; Habitat Protect; Habitat Restore
<i>Anemone virginiana</i> var. <i>cylindroidea</i> (riverbank anemone)	16	Blue	2	Inventory
<i>Carex sychnocephala</i> (many-headed sedge)	1	Blue	2	Monitor Trends
<i>Carex torreyi</i> (Torrey's sedge)	1	Blue	2	Inventory
<i>Chrysosplenium iowense</i> (Iowa golden-saxifrage)	2	Blue	2	Inventory
<i>Epilobium halleianum</i> (Hall's willowherb)	2	Blue	2	Inventory
<i>Epilobium saximontanum</i> (Rocky Mountain willowherb)	2	Red	2	Inventory
<i>Galium labradoricum</i> (northern bog bedstraw)	4	Blue	2	Inventory

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Species	Total ^a	Provincial List	Conservation Framework Priority ^b	Conservation Framework Action Groups ^c
<i>Helictotrichon hookeri</i> (spike-oat)	3	Blue	2	Inventory
<i>Oxytropis campestris</i> <i>var. davisii</i> (Davis' locoweed)	9	Blue	2	No New Action
<i>Penstemon gracilis</i> (slender penstemon)	1	Red	2	Inventory; Status Report; <i>Wildlife Act</i>
<i>Polypodium sibiricum</i> (Siberian polypody)	2	Red	2	Inventory
<i>Salix serissima</i> (autumn willow)	1	Blue	2	Inventory
<i>Symphotrichum puniceum</i> <i>var. puniceum</i> (purple-stemmed aster)	26	Blue	2	Inventory
<i>Arnica chamissonis</i> ssp. <i>incana</i> (meadow arnica)	4	Blue	3	No New Action
<i>Carex heleonastes</i> (Hudson Bay sedge)	1	Blue	3	No New Action
<i>Carex tenera</i> (tender sedge)	5	Blue	3	No New Action
<i>Carex xerantica</i> (dry-land sedge)	1	Red	3	Inventory
<i>Cicuta virosa</i> (European water-hemlock)	6	Blue	3	No New Action
<i>Eleocharis elliptica</i> (elliptic spike-rush)	1	Blue	3	No New Action
<i>Glyceria pulchella</i> (slender mannagrass)	1	Blue	3	No New Action
<i>Juncus arcticus</i> ssp. <i>alaskanus</i> (arctic rush)	4	Blue	3	No New Action
<i>Malaxis brachypoda</i> (white adder's-mouth orchid)	1	Blue	3	No New Action
<i>Trichophorum pumilum</i> (dwarf clubrush)	1	Blue	3	No New Action
<i>Utricularia ochroleuca</i> (ochroleucous bladderwort)	1	Blue	3	Taxonomy
<i>Calamagrostis montanensis</i> (plains reedgrass)	4	Blue	4	Inventory
<i>Muhlenbergia glomerata</i> (marsh muhly)	1	Blue	4	Inventory
<i>Pedicularis parviflora</i> ssp. <i>parviflora</i> (small-flowered lousewort)	1	Blue	4	No New Action

Species	Total ^a	Provincial List	Conservation Framework Priority ^b	Conservation Framework Action Groups ^c
<i>Silene drummondii</i> var. <i>drummondii</i> (Drummond's campion)	3	Blue	4	No New Action
<i>Sphenopholis intermedia</i> (slender wedgegrass)	3	Blue	4	No New Action
<i>Artemisia herriotii</i> (western mugwort)	23	Red	6	No New Action
Total (34 species)	142			

NOTES:

^a Total number of occurrences potentially affected during construction or operation

^b Highest assigned priority of the three B.C. Conservation Framework goals

^c Conservation action(s) required for the species according to the B.C. Conservation Framework (BCMOE 2012a)

COSEWIC (Send to COSEWIC): Send to COSEWIC for assessment as a first step to listing under the federal *Species at Risk Act* as Extirpated, Endangered, Threatened, or Special Concern or for assessment at a higher or lower risk category

Habitat Protect (Ecosystem and habitat protection): Use legislation, policies and guidelines to protect the ecological community or species' habitat. For example, *Forest & Range Practices Act*, protected areas, land use orders, stewardship, and best management practices. For species, may require research on habitat needs or inventory to determine suitable areas for protection.

Habitat Restore (Ecosystem and habitat restoration): Apply management and/or restoration techniques to maintain or restore the ecological community or species' habitat. Includes invasive species control, maintaining or restoring natural processes and key structures, fire suppression, and prescribed burn

Inventory: Inventory the species or ecological community to confirm or determine status rank. May require research on inventory techniques.

Monitor trends: Monitor the species, its habitat, or the ecological community at an interval appropriate to the life history of the organism, or the successional development of the ecological community. May require research on monitoring techniques.

No new action: Existing management is effective; no additional conservation action is warranted. Assess whether ongoing programs need to be maintained. May require effectiveness evaluation of existing activities and monitoring of the species, habitat, or ecological community.

Plan (Planning): Includes preparing a Management Plan or Recovery Strategy and Action Plan, landscape planning, or updating an existing plan; also includes implementing and monitoring effectiveness of the plan and monitoring the effect on the species' population or habitat or an ecological community. May require research on threats, habitat use, mitigation or recovery techniques.

Private Land (Private land stewardship): This group contains a subset of ecosystems and species from the ecosystem and habitat protection and restoration action groups that are of conservation concern, but occur on private land and /or in situations outside the scope of more traditional legislation, policies, and formal guidelines

Status Report (Compile status report): Compile or update a status report. May require research on threats, trends, habitat use, life history, or demography.

Taxonomy (Review taxonomy and classification): Invest in taxonomic studies to determine taxonomic validity for species or invest in classification and correlation of newly identified ecological communities

Wildlife Act (List under Wildlife Act): List under *Wildlife Act* as an Extirpated, Endangered or Threatened species. Includes describing residences as per the provisions of the act where warranted.

Table 13.15 describes specific mitigation measures for avoiding, reducing, and compensating for, the potential for the Project to alter and fragment habitat for terrestrial ecosystems and rare plants.

1 **Table 13.15 Mitigation Measures to Reduce Habitat Alteration and Fragmentation**

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Avoidance				
Construction	Habitat alteration and fragmentation: old growth, grasslands, and wetlands	Project design to date has located new proposed roads and other linear disturbances along existing disturbed areas as much as possible to minimize the effects of habitat loss. During final design, transmission towers and temporary roads will be placed away from wetlands and known rare plant occurrences where feasible. All known occurrences will be provided as inputs during the final design phase for consideration. If there is limited or no existing data to help facilitate avoidance measures, then supplemental pre-construction surveys will be conducted. <u>These pre-construction surveys will target rare plants as defined in Section 13.2.2—including vascular plants, mosses, and lichens.</u> If avoidance is not feasible, other mitigation measures will be considered, including effect reduction and compensation.	Recommended mitigation measures will reduce but not fully mitigate the potential effects of the Project	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
	Tufa seep, wetlands, and rare plants	<p>An Environmental Protection zone will be established to protect occurrences located adjacent to construction areas. Signage will be added where necessary to indicate the boundaries of the exclusion area. Construction personnel will be required to attend a field-based orientation session where the exclusion areas will be explained, and the importance of avoiding disturbance within them will be stressed. This will form part of the Environmental Training Management Plan (Section 35.2.2.8 in Volume 5 Section 35 Summary of Environmental Management Plans).</p> <p><u>A Wetland Mitigation and Compensation Plan will be developed, incorporating information on location, size and type of wetlands affected by the Project. The plan will include applying a mitigation hierarchy that prioritizes mitigation actions to be undertaken:</u></p> <ol style="list-style-type: none"> <u>1. Avoid direct effects where feasible;</u> <u>2. Minimize direct effects where avoidance is not feasible;</u> <u>3. Maintain or improve hydrology where avoidance is not feasible;</u> <u>4. Replace like for like where feasible;</u> <u>5. Improve the function of existing wetland habitats; and</u> <u>6. Create new wetland habitat</u> <p><u>The wetland mitigation plan will be developed using the mitigation hierarchy outlined above and will incorporate expert advice provided by Ducks Unlimited. A staged approach for the plan is proposed which includes the development of conceptual plans for wetland mitigation projects, development of detailed designs, and production of completed construction plans. The plan will be developed with appropriate federal and provincial regulatory authorities and advice and input gained through consultation with First Nation and Aboriginal groups will be included in the plan.</u></p>		

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction	Habitat alteration and fragmentation: grasslands, wetlands, and rare plants Old growth, wetlands, and rare plants	A Soil Management, Site Restoration, and Revegetation Plan (Section 35.2.2.19 in Volume 5 Section 35 Summary of Environmental Management Plans) will be developed. The plan will take into account the location of known occurrences, and will suggest the seed mixes and methods to avoid indirect loss or alteration to nearby occurrences. Temporary construction access roads will be closed and reclaimed following construction. During construction, access roads will be controlled to limit use.	Effective – these are standard measures that have been applied successfully in the past	BC Hydro
Operations	Habitat alteration and fragmentation: wetlands and rare plants	A spatial database of known rare plant occurrences in the vicinity of Project components will be maintained and searched to avoid effects during operations and maintenance activities. The database will be actively updated as new information becomes available.	Effective – this process is currently used by BC Hydro	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Reduction				
Construction	Habitat alteration and fragmentation: old growth, grasslands, wetlands, and rare plants	<p>Efforts have been made during Project design to use existing access corridors, plan for deactivation of temporary access roads, and minimize disturbance to help limit additional fragmentation. Project components where this has occurred are listed below.</p> <ul style="list-style-type: none"> • Substation and Transmission Lines to Peace Canyon Dam: Constructing the new transmission lines adjacent to the existing line, and using the existing corridor and maintenance access roads. • Highway 29 Realignment: Using portions of existing roads and selecting borrow sites that already exist or that would be eventually covered by the reservoir. • Quarried and Excavated Construction Materials: Further developing existing quarry sites (e.g., Wuthrich, Del Rio, and West Pine) and using a site that has already been affected by development (85th Avenue Industrial Lands). • Construction Access Roads: Use of existing infrastructure for moving material, upgrading existing access roads, and deactivation of temporary roads used for reservoir clearing, and placing the south bank access to the Dam Site along the existing transmission line corridor. 	Recommended mitigation measures will reduce but not fully mitigate the potential effects of the Project	BC Hydro
Construction	Habitat alteration and fragmentation: wetlands and rare plants	The construction methods used will take into account the location of known occurrences and high-suitability habitat. Where complete avoidance is not feasible, effect reduction will be considered. This can include timing construction activities to winter months, and surface protection measures such as placing ramps to reduce vehicle compaction within occurrences, or using rubber-tired versus tracked equipment to minimize ground disturbance.	Recommended mitigation measures will reduce but not fully mitigate the potential effects of the Project	BC Hydro

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Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction	Habitat alteration and fragmentation: grasslands, wetlands, and rare plants	The indirect effects associated with increased dust deposition are expected to be diffuse, and are not considered to threaten the continued viability of any known rare plant occurrences. Fugitive dust from construction activities will be minimized through the application of an Air Quality Monitoring and Dust Control Plan (Section 35.2.2.7 in Volume 5 Section 35 Summary of Environmental Management Plans).	Effective – these are standard measures that have been applied successfully in the past	BC Hydro
Construction and Operations	Habitat alteration and fragmentation: wetlands	<p>Construction and maintenance activities in and around watercourses and wetlands will conform to BC Hydro’s regulator-accepted practices including Approved Work Practices for Managing Riparian Vegetation (BC Hydro et al. 2003). An Agreement between BC Hydro, the B.C. Ministry of Environment, and Fisheries and Oceans Canada (BC Hydro et al. 2009) identifies other accepted work practices that are to be developed and available for use in the near future. Additional guidance will be used from Standards and Best Practices for Instream Works (B.C. Ministry of Water, Land and Air Protection 2004) and the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al. 1992), which are designed to reduce sedimentation and avoid introduction of deleterious substances to aquatic environments.</p> <p>Maintaining surface flow patterns is important in the retention of functioning wetlands. Construction activities will be designed and carried out in a manner that seeks to maintain the hydrology of adjacent wetlands, particularly where known rare plant occurrences are present. Measures will be implemented to maintain existing hydrological patterns as much as possible, if roads cannot avoid wetlands. Culverts will be installed under access roads to maintain hydrological balance, and sedimentation barriers will be installed as needed.</p> <p><u>A hydrologist will be employed to assist with developing site-specific measures to reduce changes to existing hydrologic balance and wetland function during construction of the Jackfish Lake Road and Project access roads and the transmission line.</u></p>	Effective – these are standard measures that have been applied successfully in the past	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and Operations	<p>Habitat alteration and fragmentation: old growth, grasslands, wetlands, and rare plants</p> <p>Tufa seeps, grasslands, wetlands, and rare plants</p>	<p>All activities that involve potentially harmful or toxic substances such as oil, fuel, antifreeze, and concrete will follow approved work practices and consider the provincial BMP guidebook <i>Develop with Care</i> (BCMOE 2012b). All construction machinery and vehicles will be properly maintained to ensure that harmful fluids do not leak into aquatic environments or other sensitive areas. Prior to initiating construction activities in proximity to any water body, the hydraulic, fuel, and lubrication systems of all equipment will be checked to ensure that systems are in good condition and free of leaks. Biodegradable hydraulic fluids will be considered for machines used for in-stream works. All machines will have a spill kit, and operators will be educated its use. Maintenance and refuelling will be conducted at a designated area at an approved distance from watercourses. BC Hydro’s fuel handling and storage management plan (Section 35.2.2.11 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) will include appropriate planning for fuel handling and storage, spill prevention, and emergency response.</p> <p>A Vegetation and Invasive Plant Management Plan (Section 35.2.2.22 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) will be developed and implemented during the entire construction phase (including restoration) and integrated during operations. The plan will be designed using the locations of known rare plant or sensitive site occurrences and locations of high-suitability habitats as inputs. Weed control efforts will be coordinated with the rare plant botanists to ensure that effects to occurrences are avoided or reduced.</p>	Effective – these are standard measures that have been applied successfully in the past	BC Hydro

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Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
	<p>Grasslands, wetlands, and rare plants</p> <p>Old growth, wetlands and rare plants</p>	<p>Disturbed sites will be replanted quickly with ground cover, shrubs, or trees that are regionally appropriate once erosion concerns have been addressed. This will be part of BC Hydro's Soil Management, Site Restoration and Revegetation Plan (Section 35.2.2.19 in Volume 5 Section 35 Summary of Environmental Management Plans). Additional mitigation measures to reduce the spread of invasive species are described below.</p> <p>Prior to work commencing, surveys will be conducted to identify invasive species populations. Treatment will be initiated as required.</p> <p>All vehicles entering and leaving work sites will be washed thoroughly, with special attention to wheel wells, tire treads, and tracks where mud and seeds of noxious weeds may be lodged.</p> <p>Wash areas will be located away from any water body and riparian areas. Used wash water will be treated to prevent seed dispersal.</p> <p>BC Hydro has considerable experience managing and maintaining an extensive transmission line network within the province, including the existing transmission corridor along which the new lines will be constructed. The Integrated Vegetation Pest Management Plan for Transmission Line Rights-of-Way (BC Hydro 2010) will be followed in order to reduce or avoid the spread of invasive species during the operations phase of the transmission line and the Pest Management Plan For Management of Vegetation at BC Hydro Facilities (BC Hydro 2012b) will be used to manage invasive species at other Project facilities.</p>		
Construction	Habitat alteration and fragmentation: rare plants	An experimental rare plant translocation program will be considered for suitable rare plant species found within the reservoir and other areas where Project components are certain to remove the populations. The translocation program will follow the B.C. Ministry of Environment's Guidelines for Translocation of Plant Species at Risk in British Columbia (Maslovat 2009). Translocation of endangered plants is generally thought to have a low likelihood of success and should be considered a follow-up monitoring opportunity, rather than a means to relocate occurrences to prevent their loss.	Recommended mitigation measures will reduce but not fully mitigate the potential effects of the Project; not practical for all species	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Compensation				
Initiated during Construction	Habitat alteration and fragmentation: wetlands and rare plants	<p>With the creation of the Project, BC Hydro will fund a compensation program. This program would include:</p> <ul style="list-style-type: none"> A survey of habitat enhancement projects in the RAA will be conducted to identify projects that might provide compensation for rare and sensitive habitats and protect occurrences of rare plants (e.g., wetlands). If suitable habitat enhancement projects can be found, BC Hydro will provide assistance (financial or in-kind) to the managing organization. The inventories will also identify areas that are under threat from development or in need of habitat enhancement. Where opportunities exist, BC Hydro will consider direct purchase – if offered for sale – and management of these lands to enhance or retain rare plant values. BC Hydro will also consider contributing to other protection options where direct purchase is not feasible. <p>BC Hydro will fund or undertake targeted surveys in the RAA to locate additional occurrences of the 18 directly affected rare plant species that the Conservation Framework identifies as requiring additional inventories (Table 13.14). Full element occurrence data will be collected and transmitted to the B.C. Conservation Data Centre for each additional occurrence found.</p> <p>The proponent will fund or undertake a study in an attempt to clarify the taxonomy of ochroleucus bladderwort. This is the only species of the 34 directly affected taxa for which the Conservation Framework identifies further taxonomic research as being required for its conservation. The study plan will be developed in consultation with the B.C. Conservation Data Centre and may include field, herbaria, and genetic work.</p>	<p>Recommended mitigation measures will reduce but not fully mitigate the potential effects of the Project, but effective where practicable</p> <p>Effectiveness is low for the Project during construction, but knowledge gained could be beneficial if applied during operations or could be applied to other future projects</p>	BC Hydro

1 **13.3.2.1 Other Mitigation Options Considered**

2 Avoidance and reduction measures have been employed to reduce wetland loss but
3 removing Watson’s Slough and the associated marl fen from the reservoir is not
4 technically or economically feasible. Protection of Watson’s Slough from inundation from
5 the reservoir would have required a large berm several metres in height. The
6 effectiveness of such a berm would be uncertain, and seepage from the reservoir and
7 input from natural springs may have affected the slough.

8 **13.4 Residual Effects**

9 **13.4.1 Characterization of Residual Effects**

10 Although the mitigation measures summarized above would reduce the effect to
11 vegetation and ecological communities, a residual adverse effect remains. This is
12 particularly the case with the reservoir, dam site, and quarries, where the direct effect of
13 habitat alteration and fragmentation cannot be avoided or reduced.

14 As a result, the construction and operation of the Project is likely to result in a residual
15 adverse effect on vegetation and ecological communities by the alteration and
16 fragmentation of habitat for the terrestrial ecosystems and rare plants discussed above,
17 specifically:

- 18 • Loss of riparian forests, specifically loss of 44% of the blue-listed 07/SH – White
19 spruce/Red swamp currant/Horsetails and 42% of the blue-listed 09/Fm02 – Balsam
20 poplar – White spruce/Mountain alder – red-osier dogwood in the LAA
- 21 • Loss of rare and sensitive ecosystems such as tufa seeps – five of seven
22 occurrences will be lost, and marl fens
- 23 • Loss of 675 ha of wetlands
- 24 • Loss of ~~122~~ 175 rare plant occurrences

25 The characterization of the residual Project effect assumes that the specific mitigation
26 measures described above are all implemented.

27 The criteria used to characterize residual adverse effects are provided in Table 13.16.

1 **Table 13.16 Characterization Criteria for Residual Effects on Vegetation and**
 2 **Ecological Communities**

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The ultimate long-term trend of the effect relative to baseline case.	Negative: Condition of the VC is worsening in comparison to baseline conditions
		Positive: Condition of the VC is improving in comparison to baseline conditions
Magnitude	The amount of change in a key indicator or variable relative to baseline case.	Low: Less than 10% change
		Moderate: Between 10% and 20% change
		High: Greater than 20% change
Geographical Extent	The geographic area in which an environmental effect of a defined magnitude occurs.	Site-specific: The extent of the effect will have sub-local implications to key indicators
		Local: The extent of the effect will have sub-population implications to key indicators within the LAA
		Regional: The extent of the effect will have broader population implications to key indicators
Duration	The period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived.	Short-term: Effect is limited to <1 year
		Medium-term: Effect occurs >1 year but only during construction
		Long-term: Effect lasts into operation but dissipates during the life of the Project
		Permanent: Effect lasts during the life of the Project and possibly beyond
Frequency	The number of times during a project or a specific project phase that an environmental effect may occur.	Once: Occurs once
		Continuous: Occurs on a regular basis and at regular intervals
		Weekly: Occurs on a regular basis within one month but is sporadic throughout a year
		Monthly: Occurs on a regular basis for more than a month but is sporadic throughout a year
Reversibility	The degree or likelihood to which existing baseline conditions can be regained after factors causing the effect are removed.	Reversible with reclamation and/or over time
		Irreversible over time, even with reclamation
Context	The extent to which the area effected has already been adversely affected by human activities, and is ecologically fragile with little resilience and resistance to imposed stresses.	High resilience: Area or key indicator persists when it is subjected to frequent natural or anthropogenic disturbances
		Low resilience: Area is relatively pristine with little or no recent disturbance, or the key indicator requires long-term ecosystem stability in order to thrive
Level of Confidence	An evaluation of the scientific certainty in the review of Project-specific data, relevant literature, and professional opinion.	Low: The effectiveness of mitigation or scale of the effect is poorly understood; follow-up monitoring is recommended
		Moderate: Greater certainty in understanding an effects outcome but reflective of modelling confidence and an understanding of effect pathways
		High: Detailed mapping and an understanding of effect pathways are well understood
Probability	The likelihood that an adverse effect will occur	Low: An effect is unlikely to occur
		High: An effect is likely to occur

1 The duration of the residual adverse effect on vegetation and ecological communities
2 ranges from long term to permanent. This reflects the fact that changes in riparian
3 forests will likely extend beyond the life of the Project while changes to some rare plant
4 populations—those currently occurring in disturbed areas such as the transmission
5 line—are expected to dissipate during the life of the Project. The magnitude of the effect
6 of habitat alteration and fragmentation on terrestrial ecosystems, rare and sensitive
7 ecological communities and rare plants occurrences varies depending on the indicator,
8 with some changes greater than 20% and some less than a 10% resulting in a
9 characterization of low to high magnitude. Geographic extent of the residual effect
10 ranges from local to regional. The extent of the change to terrestrial ecosystems and
11 wetlands is local, that is, within the LAA. The change to rare ecological communities and
12 rare plants may extend outside the LAA because of their limited range and low number
13 of occurrences, the consequences of which are of regional importance. There is a low
14 level of confidence about the scale of the effect and effectiveness of measures to
15 mitigate the potential loss of rare plants. Context varies between low and high depending
16 on the species. Some rare plant populations are highly resilient and can exist in
17 disturbed areas such as the transmission line while others are less resilient to
18 disturbance. Similarly the level of confidence ranges from low to moderate reflecting the
19 varying degree of knowledge and understanding of how rare and sensitive ecological
20 communities and rare plant populations will respond to the initial habitat alteration and
21 fragmentation and subsequent mitigation.

22 | Characterization of potential effects on the [vegetation and ecological communities](#)
23 | ~~agricultural land base~~ is shown in Table 13.17.

1 **Table 13.17 Characterization of Residual Effects on Vegetation and Ecological Communities**

Key Indicator	Residual Environmental Effect								
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability	Level of Confidence
Habitat alteration and fragmentation	Negative	High-Low	Regional-Local	Permanent-Long-term	Once-Continuous	Irreversible-Reversible	Low and High resilience	High	Moderate-Low

1 **13.4.2 Thresholds for Determining Significance**

2 The significance of each residual environmental effect is evaluated, taking into
3 consideration the above criteria, existing knowledge about the VC key indicators, and
4 the expected effectiveness of the mitigation. The residual environmental effect of habitat
5 alteration and fragmentation is significant if the effect could threaten extirpation of a key
6 indicator, or result in considerable reductions to habitats associated with a key indicator
7 that may in turn further elevate provincial or federal listings and cause the key indicator
8 to be a management concern. This means that species or ecosystems that are:

- 9 1. Currently provincially or federally designated as, or considered candidates for,
10 threatened or endangered status (e.g., provincially red-listed or SARA Schedule 1)
11 and have a residual effects Magnitude characterized as High, or
- 12 2. Currently a lower listing (e.g., provincially blue-listed or SARA Schedule 1 special
13 concern) and have a residual effects Magnitude characterized as High, which may
14 result in the key indicator being elevated to a threatened or endangered status
15 listing.

16 A number of rare plants and ecosystems are listed provincially but not federally. This
17 could be solely based on the delineation of jurisdictional boundaries, or may be a result
18 of provincial strategies for managing species and ecosystems at risk. So that both
19 provincial and federal decision-makers appreciate the full context of any significance
20 ranking, the determination of significance is provided for both federal and provincial
21 consideration.

22 **13.4.3 Determination of Significance of Residual Effects**

23 The available measures to mitigate the potential effects on rare plants and ecological
24 communities may not be fully effective. Therefore, the residual effect of the Project on
25 certain ecological communities and rare plants would be significant because the
26 sustainability of the regional population of these communities and plants, all of which are
27 of provincial management concern, would be threatened.

28 All of the rare plants and rare ecological communities occurring within the LAA are
29 provincially listed. None are federally listed. Table 13.18 provides a summary of
30 Potential Significant Residual Adverse Effects.

1 **Table 13.18 Summary of Assessment of Potential Significant Residual Adverse**
 2 **Effects**

Valued Component	Project Phase	Potential Effects	Key Mitigation Measures	Significance Analysis of Residual Effects (Summary Statement)
Vegetation and Ecological Communities	Construction	Habitat alteration and fragmentation	<ul style="list-style-type: none"> • Minimize project footprint • Establish Environmental Protection Zones to protect occurrences adjacent to construction sites • Maintain a spatial database of rare plant occurrences within LAA • Time, as feasible, construction activities to reduce effects to rare plants and sensitive and rare ecological communities • Follow approved work practices and environmental management plans • Maintain surface flow patterns • Manage invasive species within the Project activity zone • Translocate rare plants that would otherwise be lost due to the Project • Provide funding to existing suitable habitat enhancement projects or land purchase to protect areas under threat or in need of enhancement 	Significant

3 Of the provincially red-listed rare plant species that would be potentially affected,
 4 Drummond's thistle and little bluestem occur within the area that would be inundated by
 5 the reservoir. Within B.C., Drummond's thistle is known only from the Peace River area
 6 (see Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report, Part 1 Vegetation
 7 and Ecological Communities). Not all known occurrences within the LAA of both species
 8 will be lost if the Project is completed.

9 Blue-listed ecosystem communities with sizable losses include old and mature riparian
 10 and floodplain forests. While these communities will continue to persist downstream of
 11 the reservoir and in other areas removed from the LAA, there will be a reduced
 12 provincial representation of those habitats within the province. As such, the provincial
 13 status may be elevated from blue to red.

14 The federal government has an interest in preserving wetlands as habitat for wildlife,
 15 notably migratory birds and SARA-listed species, but the residual effect is not
 16 considered significant due to wetland loss, since the magnitude is not High and

1 numerous wetland complexes occur in upland forests and plateaus removed from the
2 Project.

3 **13.5 Cumulative Effects Assessment**

4 **13.5.1 Identification of Cumulative Effects**

5 With the Project likely to result in residual adverse effects to vegetation and ecological
6 communities, the potential cumulative effects of the Project have been assessed. The
7 cumulative effects assessment follows methods explained in Volume 2 Section 10
8 Effects Assessment Methodology and includes a review of projects and activities, the
9 residual effects of which may interact cumulatively with potential residual effects to
10 vegetation and ecological communities as a result of the Project.

11 **13.5.2 Description of Potential Cumulative Effects on VCs**

12 For each project or activity that could cumulatively contribute to habitat alteration and
13 fragmentation, an overview of the project or activity, project status, spatial and temporal
14 boundaries, and potential residual effects is provided below, based on the information
15 that is available. To generate the Future Case without the Project, foreseeable future
16 projects and activities are prioritized to assess how they may interact with the Baseline
17 Case. Projects recently constructed or operational (in the last few years) are included in
18 the summary, as their recent status would not be reflected in the habitat mapping that
19 was prepared for the assessment, or would yet to be fully incorporated in the provincial
20 and federal governments' current understanding of the status of the key indicators
21 associated with the VC. Many of the projects and activities listed below that occur within
22 the defined RAA are well removed from the LAA for which residual effects of the Project
23 are anticipated. The projects and activities have been included, as they may still remove
24 rare plants and terrestrial habitats that are the same as those affected by the Project.

25 Figure 13.2 shows the locations of all of the projects and activities occurring in the RAA
26 for which spatial information is available.

27 **Alliance Pipeline Sunrise Meter Station Relocation**

28 The project has been in operation since 2010 and involved the relocation of an existing
29 meter station to a new 50 m by 50 m site closer to Huron Energy's Sunrise Compressor
30 Station (TERA 2010), approximately 27 km northwest of Dawson Creek. The relocated
31 meter station was constructed to accommodate the receipt of natural gas originating in
32 the Sunrise producing area of northeastern B.C. The goal was to minimize natural gas
33 liquids dropping out from the rich incoming natural gas stream before reaching the
34 desired location.

35 One listed plant species was found within 5 km of the site: meadow willow (*Salix*
36 *petiolaris*). As outlined in the environmental assessment report (TERA 2010), residual
37 environmental effects for vegetation include the introduction and spread of weeds. Given
38 the location of this Project, a cumulative effect is not expected.

39 **Groundbirch East Receipt Meter Station**

40 The project, by NOVA Gas Transmission Ltd., has been in operation since 2011. It
41 involved the construction and operation of a new meter station approximately 45 km
42 west of Dawson Creek to provide an interconnect between Westcoast Energy Inc.'s

1 pipeline system – downstream of the Sunset Creek compressor station – and
2 Groundbirch Mainline (National Energy Board 2012).

3 Potential residual environmental effects identified were the introduction and spread of
4 weeds (National Energy Board 2012). Given the location of this Project, a cumulative
5 effect is not expected.

6 **Groundbirch Mainline**

7 NOVA Gas Transmission Ltd. operates a 24 km pipeline, of which 5 km parallels existing
8 rights-of-way and roads, and the remaining 19 km was newly cut (TERA 2010a). A
9 construction right-of-way of 39 m was required for the Project, with 20 m being a
10 permanent right-of-way and 19 m being temporary workspace. The pipeline is located
11 40 km northwest of Dawson Creek and 33 km southwest of Fort St. John. Construction
12 of the project was completed in 2012.

13 Identified Residual Effects on vegetation included:

- 14 • Alteration of wetland habitat and hydrologic function
- 15 • Alteration of water quality function in wetlands activities
- 16 • Potential reduction of wetland function in the event of a spill
- 17 • Loss or alteration of native vegetation
- 18 • Loss or alteration of local rare plant populations or a portion of a rare ecological
19 community
- 20 • Introduction and spread of invasive weeds
- 21 • Disturbance to vegetation from a spill and its associated clean-up and reclamation
22 (TERA 2010a)

23 Loss or alteration of native vegetation and loss or alteration of rare plant populations and
24 rare ecological communities may combine with those of the Project and result in a
25 cumulative effect.

26 **Moberly River Pipeline Replacement**

27 Westcoast Energy Inc. replaced a section of the Fort Nelson natural gas mainline, with
28 work finished in 2011. A 14 m long section of pipe became exposed due to southward
29 migration of the Moberly River along an outside bend at the pipeline crossing location.
30 The exposed section of pipe was replaced, and a new 50 m by 600 m right-of-way was
31 created adjacent to the northwest edge of the existing right-of-way, as well as additional
32 workspace to accommodate all equipment and machines used on the project.

33 No Environmental Assessment for this project could be located, but effects are expected
34 to be similar to other pipeline projects. Rare plant populations and rare ecological
35 communities may be affected. These may combine with those of the Project and result in
36 a cumulative effect.

37 **Provident Beatton River Replacement Project**

38 This project involved the replacement of portions of the approximately 53 km long Taylor
39 to Boundary Lake Pipeline, which carries sweet, high vapour pressure hydrocarbon
40 products from the city of Taylor to Boundary Lake, Alberta. A 36 km long section of the
41 pipeline required replacement to ensure safe and reliable operation. The majority of the

1 replacement work occurred within the existing right-of-way under operations and
2 maintenance activities; a new right-of-way – approximately 16 km long – was required
3 for the construction of a more suitable crossing of the Beatton River (National Energy
4 Board 2011).

5 Potential effects include the introduction and spread of non-native invasive species,
6 disturbance to vegetation due to spills or product releases, or a loss or alteration of
7 native vegetation, rare plants, riparian areas, and forested areas (National Energy
8 Board 2011). The project would cross two wetlands, and two listed rare plant species –
9 meadow arnica (*Arnica chamissonis*) and spike-oat (*Helictotrichon hookeri*) – were
10 observed on the proposed right-of-way. A cumulative effect is expected, as the Project is
11 would remove four occurrences of meadow arnica and three occurrences of spike-oat.

12 **Septimus Pipeline Project**

13 This project has been in operation since 2010 and involved the construction of 21 km of
14 a rich gas pipeline between the Septimus Gas Plant and Alliance Pipeline. The route
15 was within B.C.'s Agricultural Land Reserve and primarily traverses private cultivated
16 agricultural land and some forested land. The start of the pipeline is located
17 approximately 16 km directly south of Fort St. John.

18 No Environmental Assessment for this project could be located, but effects are expected
19 to be similar to other pipeline projects. Rare plant populations and rare ecological
20 communities may be effected and may combine with those of the Project and result in a
21 cumulative effect.

22 **Dawson Creek Processing Plant**

23 The project involves the construction and operation of a raw natural gas processing
24 facility 16 km west of Dawson Creek, and consists of a natural gas processing plant and
25 the associated access road, approximately 1 km of gas pipeline, a liquid handing loop,
26 and the acquisition of a segment of the Spectra Energy Midstream Bissette Pipeline. The
27 processing capacity of the Dawson Plant is to be installed in two phases. The initial
28 phase is complete and has been in operations since 2011. The second phase of this
29 project, which includes the installation of additional processing equipment, has a
30 planned in-service date of February 1, 2013.

31 Residual environmental effects on vegetation associated with construction and operation
32 include:

- 33 • Alteration of vegetation
- 34 • Loss or alteration of local rare plant populations
- 35 • Loss or alteration of a portion of a rare ecological community or wetland
- 36 • Introduction and propagation of weeds
- 37 • Disturbance of vegetation could occur as a result of an inadvertent spill or product
38 release (TERA 2010b)

39 Loss or alteration of native vegetation and loss or alteration of rare plant populations and
40 rare ecological communities may combine with those of the Project and result in a
41 cumulative effect.

1 **Transmission North 2011 Expansion Project**

2 The project provides incremental firm service from the outlet of the Fort Nelson
3 Processing Plant to a new point of interconnection between the Transmission North
4 system and NOVA Gas Transmission Ltd.'s Groundbirch Pipeline. The project was
5 comprised of two primary components in different locations. The first component
6 involved the installation of a new compressor unit, upgrades at existing stations, and the
7 construction of approximately 24 km of pipeline (Fort Nelson Mainline). The second
8 component involved the construction of a new pipeline and associated facilities,
9 construction of approximately 20 km of pipeline (Stewart Lake Pipeline), and the
10 construction of a new compressor station. The project was operational in 2011.

11 Residual effects to vegetation identified include loss of highly and very highly vulnerable
12 rare ecosystems and loss of wetlands, riparian areas, and old forest. These may
13 combine with those of the Project and result in a cumulative effect.

14 **Dokie Wind Project**

15 Preliminary modelled layout comprises 200 turbines of 1.5 MW each. Phase 1 of the
16 project (144 MW) has been operational since 2011. Phase 2 would include the
17 construction of the remaining towers, to produce 156 MW.

18 Residual effects on vegetation included loss of plant species, reduction in the availability
19 of key black huckleberry habitat, reduction in available wetland and riparian ecosystems
20 and old forest, and non-reversible reduction of rare ecosystem availability (Hélimax et
21 al. 2006). These may combine with those of the Project and result in a cumulative effect.

22 **Farrell Creek 88-I South Gas Plant Project**

23 Talisman Energy Inc. is proposing to construct and operate a natural gas processing
24 plant 25 km north of Hudson's Hope (Stantec Consulting Ltd. 2012). The proposed plant,
25 which will be adjacent to its existing Farrell Creek Central Production Facility (88-I Plant),
26 will remove water and natural gas liquids from the raw gas to meet the pipeline
27 requirements. The project is to be developed in two or more stages, and will eventually
28 build to a processing capacity of approximately 14 million m³/day.

29 No detailed analysis of effects is available, as this project is still in the application phase.
30 Possible effects on vegetation from this project are expected during the construction
31 stage and could include effects to rare plants and rare ecological communities (Stantec
32 Consulting Ltd. 2012). These losses may combine with those of the Project and result in
33 a cumulative effect.

34 **Wolverine Secure Landfill Project**

35 Tervita Corporation, formerly CCS Landfills Services, is proposing to develop a secure
36 landfill approximately 48 km northwest of Dawson Creek (CCS Corporation 2011). The
37 proposed location is on Crown land, and will accommodate industrial activities in
38 northeastern British Columbia. The project is currently in the Environmental Assessment
39 stage, with the goal of an Environmental Assessment Certificate to be issued in
40 March 2013.

41 For vegetation, some effects were noted, including disturbance and alterations to habitat
42 and displacement of native vegetation by introduction of new vegetation (CCS
43 Corporation 2011). A cumulative effect may occur.

1 **Dawson Creek/Chetwynd Area Transmission Project**

2 BC Hydro is planning to build a new substation 19 km east of Chetwynd, approximately
3 60 km of overhead transmission line from Sundance Substation to Bear Mountain
4 Terminal, expansion of existing substations, 12 km of transmission line from Bear
5 Mountain Terminal to Dawson Creek substation, and a passive reflector near Chetwynd
6 substation for communication purposes (BC Hydro 2011).

7 Residual effects identified to vegetation include:

- 8 • Alteration of ecosystems, including rare and sensitive ecosystems
9 • Vegetation removal and maintenance to a shrub/herb stage

10 Losses of rare and sensitive ecosystems may combine with those of the Project and
11 result in a cumulative effect.

12 **Transmission North 2012 Expansion Project**

13 This proposed pipeline is designed to provide incremental firm service from receipt
14 points along Westcoast's Fort Nelson Mainline and the NOVA Gas Transmission Ltd.
15 Groundbirch Pipeline (TERA 2011). The proposed 24 km route parallels the existing Fort
16 Nelson Mainline pipeline right-of-way for most of its length, with the exception of small
17 localized diversions at Mackie and Lynx creeks, to optimize the watercourse crossings.
18 In addition to the construction right-of-way, temporary workspace will also be required at
19 crossings, sidebends, log decks, and where grading is necessary.

20 Potential residual effects on vegetation identified include:

- 21 • Alteration of native vegetation
22 • Loss or alteration of rare plants or rare ecological communities
23 • Introduction and spread of invasive weeds
24 • Disturbance due to a spill, fire or association cleanup and reclamation (TERA 2011)

25 Losses of rare and sensitive ecosystems may combine with those of the Project and
26 result in a cumulative effect.

27 **Gething Coal Mine Project**

28 The project involves Canadian Dehua International Mines Group Inc. constructing a new
29 underground coal mine and on-site coal preparation plant approximately 25 km west of
30 Hudson's Hope (Rescan Environmental Services Ltd. 2006).

31 This project is currently in the Environmental Assessment stage. The estimated
32 construction start-up is 2013. Current status of the proposal is unknown, and no specific
33 residual effects are available for review. Possible cumulative effects on vegetation will be
34 the removal or change in vegetation and ecosystem communities.

35 **Carbon Creek Coal Mine**

36 This project involves the development of an open-pit surface and underground
37 metallurgical coal mine. The mine will be designed to achieve a production rate of
38 2.9 million tonnes of clean coal/year with an estimated mine life of 30 years (Rescan
39 Environmental Services Ltd. 2012). Currently, the project is in the environmental
40 assessment stage, with construction of project tentatively planned to begin in 2014 and
41 surface mine coal production beginning in same year.

1 The Project Description is available, but no residual effects have yet been identified.
2 Possible cumulative effects on vegetation will be the removal or change in vegetation
3 and ecosystem communities.

4 **Hackney Hills Wind Project**

5 The proposed wind power project is located west of Fort St. John and directly northwest
6 of Hudson's Hope (Aeolis Wind Power Corporation 2008). The wind farm will have an
7 estimated generation capacity of up to 1,000 MW, with the intent to sell electricity to
8 BC Hydro. The wind farm falls on Crown land and is surrounded by all-season petroleum
9 developments and forestry service roads.

10 Residual effects have not yet been identified. Possible effects to vegetation include loss
11 from the direct effects of clearing, disturbance, and effects to rare plants and
12 communities (Aeolis Wind Power Corporation 2008). These may interact with the effects
13 of the Project.

14 This project is currently in the pre-Application stage of the Environmental Assessment
15 process.

16 **Wartenbe Wind Energy Project**

17 The project site is located on Mount Wartenbe, southeast of Chetwynd. The project
18 originally received its Environmental Assessment Certificate in 2006, but subsequently
19 changed ownership. An application to extend the deadline of the certificate was
20 submitted in 2011, as construction had not commenced and the certificate was set to
21 expire. In 2012 the name of the holder of the Environmental Assessment Certificate was
22 changed. The preliminary modelled layout includes 47 turbines of 1.5 MW each.

23 Substantive project interactions were noted for wetlands and riparian ecosystems, and
24 loss of rare ecosystems (AXYS Environmental Consulting Ltd. 2006). The environmental
25 assessment concluded that cumulative effects on rare ecosystems would be significant
26 both with and without the project. These may combine with those of the Project and
27 result in a cumulative effect.

28 **Wildmare Wind Energy Project**

29 This project involves Finavera's construction of a 74 MW wind park, connector roads,
30 electrical connections, access roads, substation, operations centre, and an overhead
31 transmission line (Finavera Wind Energy Inc. 2011). It will be located 5 km west of
32 Chetwynd. The project is currently under review.

33 Residual effects identified include loss of rare plants, rare ecosystems and wetlands,
34 habitat fragmentation, soil disturbance and compaction, water quality degradation, and
35 introduction of exotic species (Finavera Wind Energy Inc. 2011). Losses of rare plants,
36 rare and sensitive ecosystems, and wetlands may combine with those of the Project and
37 result in a cumulative effect.

38 **General Oil and Gas Activities**

39 There are many oil and gas-related activities found throughout the northeast portion of
40 the province; collectively, there are a number of environmental effects that result from
41 the exploratory stage as well as the drilling and development stage. As new extraction
42 technologies become available, additional sites will be more attractive for exploration
43 and development. The timing and level of development will likely be set by market

1 prices, but recent plans for liquefied natural gas should continue interest in the regions
2 gas sector.

3 During exploration, activities that take place that may have adverse effects to vegetation
4 and ecosystem communities, include drilling exploration, construction of access roads,
5 and seismic exploration.

6 During the drilling/development phase, larger areas are required that involve the
7 construction of well pads, access roads, pipelines, and other ancillary facilities and the
8 drilling of wells. Habitat loss would be the largest effect, although indirect effects such as
9 associated dust, erosion, and the spread of invasive weeds could also occur.

10 According to information available, a total of 32 oil and gas facilities are approved or
11 under review within the RAA. Facilities are where water, hydrocarbon liquids or natural
12 gas are processed, measured, upgraded, or stored (Ministry of Labour – Citizens'
13 Services and Open Government 2012).

14 A total of 344 Pipeline projects (from 2004 to present) are approved within the RAA, with
15 another 23 under review. Linear length of pipeline, which was estimated from available
16 spatial information, totals 377 km within the RAA.

17 Petroleum Access Roads are applications for roads over any Crown land. A total of
18 1,422 approved or proposed access road applications are within the RAA, with a total
19 length of 823 km. In addition, there are 37 approved or proposed Petroleum
20 Development Road applications, totalling 163 km within the RAA. Petroleum
21 Development Roads applications are for construction, to apply for use of existing
22 non-status tenured roads over any Crown land, or to apply for use of non-status,
23 unencumbered existing access roads on Crown land.

24 Losses of rare plants, rare and sensitive ecosystems, and wetlands associated with
25 these activities may combine with those of the Project and result in a cumulative effect.

26 **General Forestry Activities**

27 A more detailed review of the forestry activities is provided in Section 21 Forestry.
28 Information provided in that section has been summarized below.

29 The RAA for vegetation and ecological communities overlaps portions of the Fort St.
30 John and Dawson Creek Timber Supply Areas, as well as Tree Farm Licence 48. The
31 current Timber Harvesting Land Base for all three areas combined is 2,152,127 ha. Of
32 this total area, the Annual Allowable Cut is presently set at 4,875,000 m³ of both
33 coniferous and deciduous forest. The government will be reviewing the amount cut and
34 possibly setting new limits for both Timber Supply Areas in the near future, and in 2017
35 for Tree Farm Licence 48.

36 Timber harvesting replaces mature forest with early seral stage plant communities. The
37 construction of logging roads for access provides opportunities for stream sedimentation
38 and habitat fragmentation. Roads also act as vectors for the persistence and spread of
39 invasive plants.

40 Losses of rare plants, rare and sensitive ecosystems, and effects to wetlands associated
41 with these activities may combine with those of the Project and result in a cumulative
42 effect.

1 **Land Tenures**

2 Over 11,000 ha have been identified within recent land tenure applications within the
3 RAA (Table 13.19). Commercial recreation tenure applications account for the largest
4 percentage of land use. Activities associated with commercial recreation include camps
5 for hunting and fishing, trail riding, cat skiing, heli-hiking, guided nature viewing, and
6 multiple other uses. The activities typically have considerably less disturbance,
7 compared to other industrial activities, but habitat alteration can still occur with habitat
8 loss, and indirect effects associated with the spread of invasive species may interact
9 with those of the Project and result in a cumulative effect.

10 **Table 13.19 Total Number of Land Tenure Applications Within the RAA**

Tenure Purpose	Number of Applications	Total Area (ha)
Agriculture	22	1,631
Commercial	1	< 1
Commercial recreation	17	9,411
Communication	3	1
Community	2	5
Energy production	8	9
Industrial	35	98
Institutional	1	< 1
Quarrying	18	293
Residential	3	1
Utility	24	43
Total	134	11,492

11 **Parks and Protected Areas**

12 The Peace River Boudreau Lake proposed protected area comprises a portion of the
13 south bank of the Peace River valley, Boudreau Lake, the lower Moberly River Valley,
14 and the islands near the confluences of the Moberly River and Maurice Creek with the
15 Peace River. The proposed protected area is 23,789.66,750 ha in size and partially
16 overlaps BC Hydro’s flood reserve for the Project ([Hillcrest Geographics 2012 Dawson
17 Creek LRMP, Inter-Agency Planning Team 1999](#)). The protected area has not been
18 officially established.

19 The protected area would be a positive effect and protect representative portions of the
20 BWBSmw biogeoclimatic subzone, including habitats for a number of rare species and
21 ecosystems.

22 **13.5.3 Cumulative Effects Mitigation Measures**

23 The projects summarized above will result in the alteration and fragmentation of habitats
24 through the conversion of natural habitats. These conversions are mostly long term or
25 even permanent. It is anticipated that the residual effects of the Project will act
26 cumulatively with the residual effects of these other project and activities.

27 Rare species recovery could be undertaken at the regional level collaboratively with
28 other projects. BC Hydro has limited authority to guide regional initiatives to support the
29 diversity and persistence of rare plant populations and rare and sensitive ecological
30 communities. This would be better guided by the provincial government.

1 **13.5.4 Characterization of Residual Cumulative Effects**

2 Past land use has shaped much of the region’s vegetation and ecological community
 3 composition. Many rare plants and ecological communities are currently under threat of
 4 loss and extirpation due to past and present land development (Baseline Case). Some of
 5 the listings are simply a result of the geographic distribution and provincial boundaries
 6 that restrict occurrences to a small portion of the province. In other instances,
 7 populations or habitats are simply unique and rare on the landscape (e.g., tufa seeps
 8 and marl fens).

9 In the future, many of the same activities associated with the Baseline Case will continue
 10 (e.g., forestry, and oil and gas development) and residual effects of habitat alteration and
 11 fragmentation are expected, regardless of the Project proceeding (Future Case without
 12 the Project). Most of these activities are removed from the Peace River valley, affecting
 13 areas of adjacent plateau and mountainous sites within the RAA. Some are within the
 14 LAA – notably forestry, and oil and gas, and some land tenure applications.

15 The majority of the Project disturbance is within the Peace River valley, affecting riparian
 16 habitats that are generally removed from most other developments (Project Case). Other
 17 Project components situated in upland areas removed from the Peace River (e.g., the
 18 transmission line and some quarry sites) may overlap with future projects and activities –
 19 especially with forestry, and oil and gas development. As such, the Project is likely to
 20 result in a residual cumulative effect. The characterization of the effect is listed below
 21 (Table 13.20).

22 **Table 13.20 Characterization of Residual Cumulative Effects**

Effects Criteria	Project Case
Direction	Negative
Magnitude	High
Geographic Extent	Regional
Duration	Permanent
Frequency	Continuous
Reversibility	Irreversible
Context	Low and High resilience
Level of Confidence	High
Probability	High

23 **13.5.5 Determination of Significance of Residual Cumulative Effects**

24 Due to past and continuing activities, and planned future projects and activities, the
 25 cumulative effect for the Project Case is considered significant – based on the
 26 expectation of a significant residual effect (see Section 13.4). The anticipated residual
 27 effects to vegetation and ecosystem communities from all other future projects and
 28 activities combined are also considered significant, even if the Project is not constructed.
 29 This occurs because effects associated with other projects and activities that involve
 30 road construction, forestry, land clearing are not fully mitigable, and the future loss of
 31 rare plants and rare and sensitive ecosystems is expected to further elevate provincial or
 32 federal listings.

1 **13.6 Monitoring and Follow-Up Programs**

2 The confidence in the characterization of the residual Project effect to rare plants was
 3 considered to be low. Although general predictions of adverse rare plant effects are
 4 sound, the specific disturbance responses for the rare plants in the LAA are unknown;
 5 the prediction of important habitats for rare plant occurrence is subject to limitations;
 6 certain mitigation measures – principally translocation – are considered experimental,
 7 and the success rate is difficult to predict; and distribution data within B.C. are
 8 incomplete for many of the affected rare plant taxa. As such, it is difficult to fully
 9 appreciate the scale of the effect to all rare plants that could be affected by the Project.

10 Rare plant translocation and understanding responses to disturbance will need to be
 11 monitored and reported to provide an understanding of success. Rare plants that will be
 12 lost would be good candidates for translocation, and species that persist in disturbed
 13 areas – e.g., the transmission line right-of-way – may be better suited for understanding
 14 tolerance to disturbance. The scope of the monitoring program should be discussed
 15 further with specialists to select candidate species, identify suitable sites, and further
 16 establish study design. The length of the monitoring program may be species specific,
 17 and would depend on observed early success rates (for translocation) or changes to
 18 adaptive mitigation strategies. At a minimum, the monitoring program should continue
 19 through the first 10 years of operations.

20 Follow-up will also be considered to document adequacy of habitat enhancement and
 21 possible compensation programs to document their progress in meeting expectations.
 22 Measuring success will be developed further with stakeholders but could include a
 23 measure of desired vegetation growth, persistence of rare plant occurrences, or the
 24 reduction in invasive species.

25 Follow-up programs are summarized in Table 13.21.

26 **Table 13.21 Follow-up Programs for Vegetation and Ecological Communities**

Project Phase	Monitoring Program Objective	Monitoring Program Frequency	Monitoring Program Duration
Operations	Rare plant translocation and understanding responses to disturbance will need to be monitored and reported to provide an understanding of success	Annually	Being after translocation and continue for first 10 years of operations
Operations	To document adequacy of habitat enhancement and possible compensation programs to document their progress in meeting expectations.	Annually	Dependent on habitat compensation programs established

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