

# PROJECT DESCRIPTION

## SITE C CLEAN ENERGY PROJECT

May 2011



## PREFACE

British Columbia Hydro and Power Authority (BC Hydro) proposes to develop a dam and hydroelectric generating station on the Peace River in northeast British Columbia (B.C.), referred to as the Site C Clean Energy Project (the “Project”). The Project would be the third dam and hydroelectric generating station on the Peace River in B.C., downstream of BC Hydro’s existing generating facilities at G.M. Shrum and Peace Canyon and the respective Williston and Dinosaur reservoirs.

The Project is subject to a federal environmental assessment and review process under the *Canadian Environmental Assessment Act* (CEAA). It is also subject to a provincial environmental assessment and review process under the B.C. *Environmental Assessment Act* (BCEAA). The *Canada-British Columbia Agreement for Environmental Assessment Cooperation* (2004) provides for a harmonized provincial and federal review when a project is subject to review pursuant to both BCEAA and CEAA.

BC Hydro is filing this Project Description Report with both the federal Canadian Environmental Assessment Agency (CEA Agency) and the British Columbia Environmental Assessment Office (BCEAO) to initiate the environmental assessment and review process for the Project.

Key steps in the environmental assessment and review process will involve the identification and evaluation of potential effects associated with the construction and operation of the Project, the development of recommended mitigation measures that may be used to avoid or minimize negative effects and the development of measures to enhance the positive effects of the Project. First Nations, members of the public, stakeholder groups and other interested parties have and will continue to be consulted and given the opportunity to provide input throughout the environmental assessment and review process.

Engineering work has been undertaken on the Project several times throughout its history. Preliminary design work was first done in the late 1970s, resulting in the original layout in 1981. Further engineering activities took place between 1989 and 1991.

In 2009, at the conclusion of the Project’s Stage 2 work, BC Hydro concluded that the historic design for Site C required optimization to meet current seismic, safety and environmental guidelines. This design optimization work was completed in late 2010. This Project Description Report reflects the upgraded Project design.

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# **1 General Project and Contact Information**

## **1.1 Purpose of the Project Description Report**

The proposed Site C Clean Energy Project (the “Project”) will be subject to a formal environmental assessment and review process pursuant to both the B.C. *Environmental Assessment Act* (BCEAA), and provisions of the *Canadian Environmental Assessment Act* (CEAA). The environmental assessment of the Project will be undertaken to satisfy the requirements of both Acts.

The scope and nature of the environment assessment processes can vary between projects depending on various factors. However, generally, there are three stages in an environmental assessment and review process – pre-application, application review, and decision.

- **Pre-Application Stage**

The purpose of the pre-application stage is to identify the information that must be submitted as part of the environmental assessment, and to prepare the environmental assessment application. The public, First Nations and regulatory agencies have an opportunity to provide input during this stage on what information they believe should be considered as part of the environmental assessment.

The Proponent, in this case British Columbia Hydro and Power Authority (BC Hydro), then prepares and submits the identified information. In British Columbia, this is referred to as an Environmental Assessment Certificate (EAC) Application. Under the federal process, this is referred to as an Environmental Impact Statement (EIS). For simplicity, the term EAC Application is used throughout this document and refers to the provincial EAC Application and the federal EIS document.

- **Application Review Stage**

The EAC Application (the Application) is then reviewed for completeness. Once the Application is accepted, it is subject to review by the regulatory agencies and involved First Nations. During this stage, the public is given the opportunity to provide feedback on the Application.

- **Decision Stage**

Based on the outcome of the application review stage, the appropriate federal and provincial authorities make a decision regarding whether the Project may proceed, and under what conditions it may proceed.

BC Hydro is filing this Project Description Report with both the federal Canadian Environmental Assessment Agency (CEA Agency) and the British Columbia Environmental Assessment Office (BCEAO) to initiate the Pre-Application Stage of the environmental assessment and review of the Project. The Project Description report is intended to provide technical information at an overview level to allow the CEA Agency and the BCEAO to determine whether the Project triggers an environmental assessment under CEAA and BCEAA, respectively. Detailed scoping of the environmental assessment occurs during the Pre-Application stage once the project has been accepted by the regulators. The public, First Nations and government have the opportunity to review the scoping document during this stage. A detailed description of the Project, environmental effects assessment and mitigation are addressed in the EAC Application.

The Project Description Report was prepared according to the guidance provided in the Major Projects Management Office (MPMO) guidance document, entitled “Guide to Preparing a Project Description Report for a Major Resources Project” (December 2008), and the BCEAO’s “Guidelines for Preparing a Project Description for an Environmental Assessment in British Columbia” (September 2008).

To provide background information to assist in the Pre-Application Stage, the Project Description Report:

- Provides general Project information and an overview of the rationale for the Project and alternatives to the Project
- Briefly describes the key components of the Project, construction and operational activities, an anticipated Project schedule, and estimated capital cost of the Project
- Provides an overview of the existing environmental and socio-economic setting, and land and water use in the vicinity of the Project
- Describes past and proposed engagement with First Nations, stakeholders and government agencies
- Provides a brief outline of the Project’s potential environmental effects and regulatory requirements

## **1.2 Introduction**

BC Hydro proposes to develop a dam and hydroelectric generating station on the Peace River in northeast British Columbia (B.C.), referred to as “the Project”. The Project would be the third dam and hydroelectric generating station on the Peace River in B.C., and would be located downstream

of BC Hydro's existing generating facilities at G.M. Shrum and Peace Canyon and respective Williston and Dinosaur reservoirs.

The Project would include the following major components:

- An earthfill dam, approximately 1,050 metres long and 60 metres high. A buttress of roller-compacted concrete to support the valley wall provides the foundation for the concrete structures and forms the south abutment of the earthfill dam.
- An up to 1,100-megawatt hydroelectric generating station with associated intake structures, penstocks and spillways
- An 83-kilometre-long reservoir
- Realignment of four sections of Highway 29 over a total distance of approximately 25 kilometres, and potential erosion protection in other locations
- Two 77-kilometre transmission lines that would, for the most part, follow an existing transmission line right-of-way between the proposed Site C generating station and the existing Peace Canyon switchyard

A more detailed description of the Project components is set out in Section 4.

The Project would generate up to 1,100 megawatts of capacity and an average of 5,100 gigawatt hours of electricity per year – enough energy to power more than 450,000 homes in B.C. The Project would be publicly owned and, when completed, would become one of BC Hydro's heritage assets<sup>1</sup> (i.e., a generation and storage asset). The Project requires significant capital investment with high up-front costs and low long-term operating costs, and would provide a clean and renewable source of firm, reliable and dependable electricity for more than 100 years.

The history of the Project dates back to the late 1950s when the potential for a third dam on the Peace River was first identified.

In the late 1970s, the Project was examined as a resource option, culminating in an application to the provincial government for an Energy Project Certificate in 1980. In 1981, the government referred the application to the British Columbia Utilities Commission (BCUC) for review. In 1983, the BCUC concluded that Site C was an acceptable project, but indicated that more work was required concerning the future demand for electricity and alternatives to the project.

Since the early 1980s, the demand for electricity in B.C. has increased significantly. This demand is forecast to continue to grow as B.C.'s population increases and the economy expands. In addition,

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<sup>1</sup> Heritage asset as defined by the B.C. *Clean Energy Act* is provided in Section 14: Glossary of Terms.

BC Hydro is researching and monitoring potential increases in demand due to the electrification of the transportation sector (including rail, ports and electric plug-in vehicles) and fuel switching.

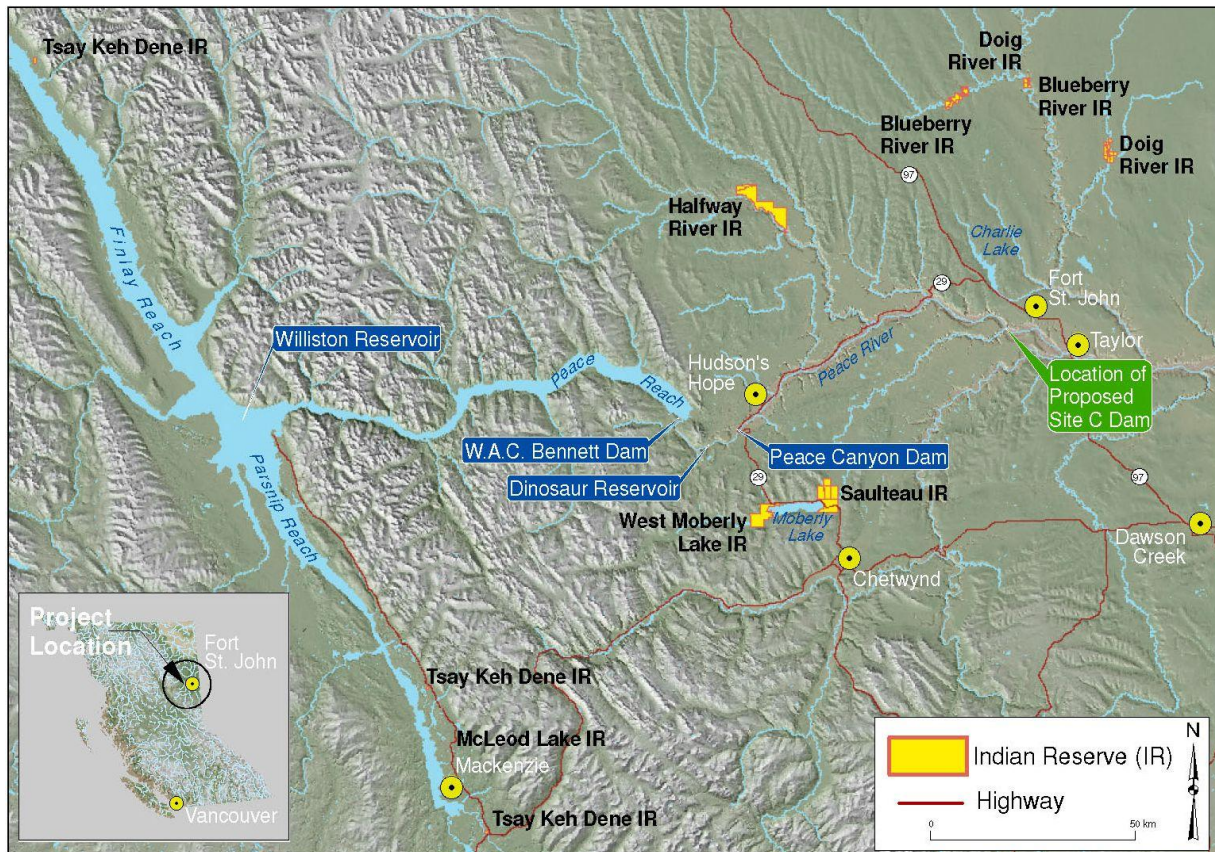
### **1.3 Project Location**

The Project dam and hydroelectric generating station would be located on the Peace River in northeast B.C., approximately seven kilometres southwest of Fort St. John (latitude and longitude of N 56°11'40.44", W 120°54'44.83", respectively).

Other municipalities in the vicinity of the Project include the District of Taylor (approximately 16 kilometres downstream), the District of Hudson's Hope (approximately 64 kilometres upstream), the District of Chetwynd (approximately 70 kilometres to the south), and the City of Dawson Creek (approximately 65 kilometres to the southeast). The dam, hydroelectric generating station and most of the reservoir would be within the Peace River Regional District. Further information on these communities is found in Sections 6 and 7.

First Nations in the vicinity of the Project include the Saulneau First Nation (approximately 60 kilometres southwest of the proposed dam site), the West Moberly First Nation (approximately 75 kilometres southwest of the proposed dam site), the Halfway River First Nation (approximately 67 kilometres northwest of the proposed dam site), the Blueberry River First Nations (approximately 58 kilometres north of the proposed dam site), and the Doig River First Nation (approximately 50 kilometres north of the proposed dam site). It is BC Hydro's understanding, based on consultations undertaken to date, that these First Nations exercise rights in and around the area of the proposed Site C reservoir. Further information on Aboriginal groups is found in Section 8.

The Site C Project location is shown in **Figure 1.1**.



1016-C14-B4750

**Figure 1.1 Project Location**

### 1.4 Proponent Information

BC Hydro is a Crown corporation owned by the Province of British Columbia; BC Hydro serves approximately 95 per cent of the province’s population (1.8 million customers) and is one of North America’s leading providers of clean, renewable energy.

Name of Corporation: BC Hydro  
 Address: 333 Dunsmuir Street  
 Vancouver, B.C. V6B 5R3

President and Chief  
 Executive Officer: David Cobb  
[david.cobb@bchydro.com](mailto:david.cobb@bchydro.com)

Principal Contact for Purposes of Environmental Assessment:

Danielle Melchior

Director, Site C Environmental Assessment/Regulatory

BC Hydro

Phone: 604 699-7344

Fax: 604 695-5290

Email: [danielle.melchior@bchydro.com](mailto:danielle.melchior@bchydro.com)

Company Website: [www.bchydro.com](http://www.bchydro.com)

Project Website: [www.bchydro.com/sitec](http://www.bchydro.com/sitec)

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## 2 Project Rationale and Benefits

This section of the report provides an overview of the purpose of and the need for the Project and potential benefits. It sets the legal and policy contexts that result from the British Columbia *Clean Energy Act* and how they apply to BC Hydro. It then describes the process by which BC Hydro undertakes its long-term electricity planning mandate through the determination of demand and supply options.

BC Hydro has a legal obligation to serve domestic electricity needs in its service area, which encompasses most of the province, as set out in Section 38 of the B.C. *Utilities Commission Act*. One of the tools BC Hydro uses to meet this obligation is long-term resource planning through Integrated Resource Plans (IRPs) to forecast and to analyze resource options to meet long-term customer demand. The Project is being proposed to provide a long-term, firm, reliable and cost-effective supply of electricity to BC Hydro customers, in a manner that optimizes the use of existing assets on the Peace River system and supports the integration of clean or renewable resources.

Key benefits of the proposed Project include:

- Average annual generation of about 5,100 gigawatt hours of energy that is more cost-effective electricity per gigawatt hour than other B.C.-based clean and renewable supply options. This is enough energy to power more than 450,000 homes in B.C.
- Generation of up to 1,100 megawatts of dependable hydroelectric capacity
- Provision of dispatchable generation with storage, allowing BC Hydro to respond to changing electrical system requirements and to support the integration of clean or renewable intermittent generating resources in B.C.
- A clean and renewable resource<sup>2</sup> that emits a small amount of greenhouse gas (GHG) emissions per unit output, when compared to fossil fuel generation
- Gain the benefits of water already stored in and regulated by the upstream Williston Reservoir
- Support for the legislated *Clean Energy Act* requirement that BC Hydro achieve electricity self-sufficiency by 2016 and each year after that, and secure 3,000 gigawatt hours per year of energy in addition to self-sufficiency (referred to as insurance energy) by 2020 and each year after that

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<sup>2</sup> Section 1 of the *Clean Energy Act* defines the term “clean or renewable” as follows: “clean or renewable means biomass, biogas, geothermal heat, hydro, solar, ocean, wind or any other prescribed resource”.



- Support for regional and provincial economic development and employment through the creation of 35,000 direct and indirect jobs during the development and construction stage

## **2.1        *Clean Energy Act***

In the B.C. government's 2010 *Clean Energy Act*, the Project is considered as an option to ensure that B.C. is able to meet its future electricity needs. The *Clean Energy Act* sets out a number of "British Columbia's energy objectives" that BC Hydro is to address in its IRP, and that BC Hydro's regulator, the British Columbia Utilities Commission, must consider and be guided by. The following objectives are relevant to the Project:

- Requires BC Hydro to achieve electricity self-sufficiency by 2016 and each year after, plus 3,000 gigawatt hours of insurance energy by 2020 and each year after
- Targets the acquisition of at least 66 per cent of BC Hydro's future incremental resource needs through conservation and efficiency improvements (referred to as Demand-Side Management or DSM) by 2020
- Requires BC Hydro to generate at least 93 per cent of the electricity in B.C. from clean or renewable resources, including large and small hydroelectric, solar, wind, ocean, geothermal, biogas, biomass and biogenic waste
- Disallows consideration of nuclear power
- Prohibits, with the exception of the proposed Project, future development of specified large-scale hydroelectric storage projects on river systems in B.C.
- Reinforces the B.C. government's legislated GHG reduction targets

## **2.2        *Energy Planning***

Under the *Clean Energy Act*, BC Hydro must prepare an IRP by early December 2011 for B.C. government review and approval that describes how BC Hydro proposes to meet future growth in provincial electricity demand over the next 20 years.

In the 2011 IRP, BC Hydro will project its demand requirements using its most recent Load Forecast less its planned Demand-Side Management, and compare this demand to committed supply capabilities to establish the potential demand/supply gap. The IRP also examines alternatives for filling the demand/supply gap. Of key importance, the 2011 IRP must describe BC Hydro's plans for achieving self-sufficiency and securing the 3,000 gigawatt hours of insurance energy, while

responding to the objective that 93 per cent of its generation originates from clean or renewable resources and acquiring cost-effective Demand-Side Management, while taking into account deliverability risk.

The IRP will update the information included in BC Hydro's last long-term plan, the 2008 Long-Term Acquisition Plan (LTAP). The 2008 LTAP provided an economic analysis of several energy options, including the proposed Project. The 2008 LTAP examined the costs and benefits of resource options such as run-of-river hydro, wind, natural gas, geothermal and biomass projects, as well as Site C, and included analysis of which options would provide value to BC Hydro customers.

The 2011 IRP will include an evaluation of the need for and comparisons to the Project and will consider various combinations of the Project and other energy options within a long-term context. As part of the 2011 IRP process, BC Hydro is currently analyzing potential future demand associated with a growing population, continued economic development, and potential electrification of transportation and other sectors of the B.C. economy. For example, BC Hydro is exploring future Demand-Side Management and is developing a province-wide inventory of potential electricity sources including wind, ocean (i.e., wave and tidal), natural gas, geothermal, bioenergy, run-of-river hydro, solar and others.

Following First Nations, public and stakeholder review of the draft 2011 IRP, BC Hydro will make any final amendments based on this input, and submit the final Plan by the beginning of December 2011 to the B.C. Ministry of Energy and Mines<sup>3</sup> for B.C. government review and decision. The results of the 2011 IRP will be described in the Site C Project EAC Application.

More information on BC Hydro's long-term planning process can be found on the following link:

[www.bchydro.com/planning\\_regulatory/long\\_term\\_electricity\\_planning.html](http://www.bchydro.com/planning_regulatory/long_term_electricity_planning.html)

## **2.3 Domestic Demand**

The information contained in this section is based on the most recent (2010) Load Forecast and committed supply information. The 2010 Load Forecast is derived largely from population, commercial and industrial demand forecasts.

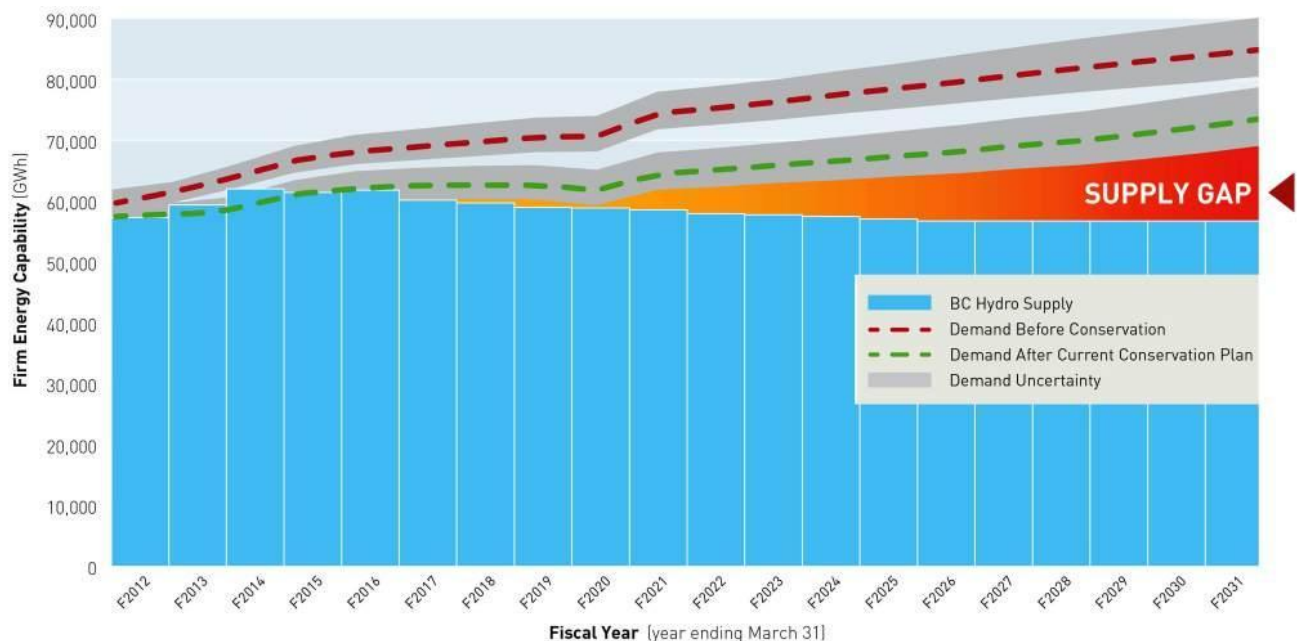
Over the next 20 years, B.C.'s population is expected to increase by more than one million people. BC Hydro forecasts that, in response to this growth and the anticipated increase in associated economic activity, the province's electricity demand will grow by approximately 40 per cent over the same time frame. While B.C.'s existing hydroelectric assets and committed contracts are extensive,

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<sup>3</sup> Refer to Section 15 for the list of relevant B.C. government ministries, their acronyms and the naming conventions.

it will not be possible to meet forecasted customer demand – including achieving electricity self-sufficiency and meeting the legislated requirement to secure 3,000 gigawatt hours per year of insurance by 2020 – using these committed resources alone.

This projected increase does not take into account BC Hydro’s planned Demand-Side Management, which are the first resources BC Hydro considers to meet its projected demand/supply gap beyond its committed resources. However, even with BC Hydro’s planned cost-effective Demand-Side Management and other long-term planning actions, including upgrades to existing hydroelectric assets and planned acquisitions, BC Hydro’s energy shortfall in 20 years is expected to be approximately 16,800 gigawatt hours per year (**Figure 2.1**). Thus, there is a need for new cost-effective energy such as that provided by the Project.



**Figure 2.1 BC Hydro’s Electricity Gap – Demand and Supply Outlook**

Several emerging demand trends, particularly those associated with the B.C. government’s interest and the public’s desire to reduce fossil fuel use and GHG emissions, may result in an even higher demand for electricity in B.C. For example, the B.C. government has legislated that a 33 per cent reduction in GHG emissions must be achieved by 2020, and it has also legislated a target to reduce the carbon intensity<sup>4</sup> of all passenger vehicles in B.C. by 10 per cent by 2020. Increased use of electric plug-in vehicles and other technologies will likely create additional demand for electricity. BC Hydro is monitoring these GHG-driven changes to legislation, regulation, policy, technology and

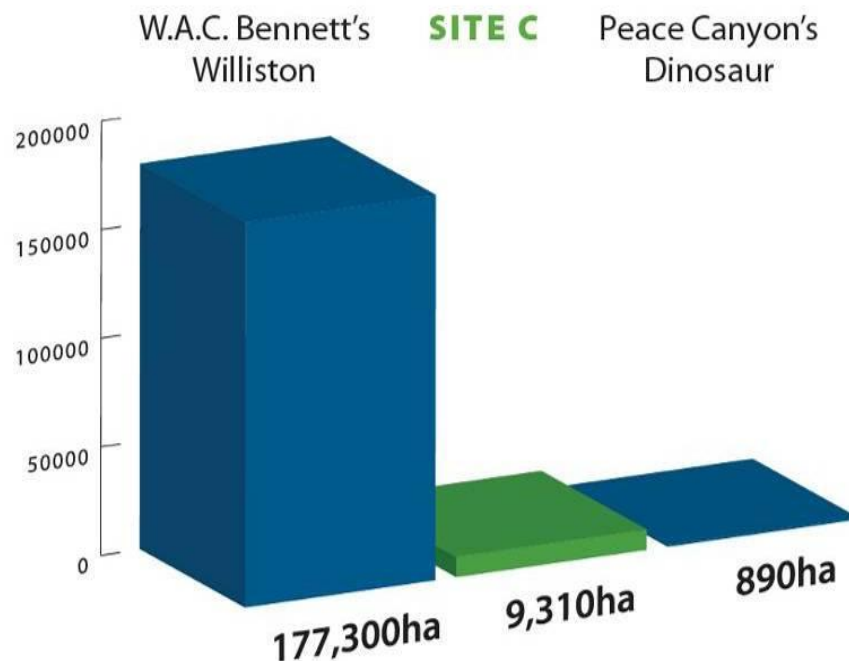
<sup>4</sup> Carbon intensity is defined as the amount of carbon by weight emitted per unit of energy consumed.

consumer trends. BC Hydro is also researching potential increases in electricity demand due to the electrification of the transportation sector (including rail, ports and electric plug-in vehicles) and fuel switching (e.g., increased use of electricity for residential space and water heating).

## 2.4 Optimization of Existing Resources

BC Hydro is currently planning to increase its yearly firm energy capability within its existing generation assets. For example, planned improvements at G.M. Shrum and Cheakamus generating stations are forecast to provide an additional 141 gigawatt hours per year by 2017. Additional firm energy will be required to meet all of BC Hydro's forecasted demand.

As the third dam and generating station on the Peace River, the proposed Project would gain significant efficiencies by taking advantage of water already stored in the Williston Reservoir upstream of the existing W.A.C. Bennett and Peace Canyon dams to generate electricity. If built, the Project would generate approximately 35 per cent of the energy produced at the W.A.C. Bennett Dam, with only five per cent of the reservoir area (**Figure 2.2**).



**Figure 2.2** Reservoir Area (ha)

BC Hydro is planning to increase capacity within its existing generation assets. For example, an additional 500 megawatts of capacity has recently been added to the Revelstoke generating station on the Columbia River, increasing its installed capacity to 2,480 megawatts. Two additional 500-megawatt units are also being added at the Mica generating station on the Columbia River. In April 2010, BC Hydro received Environmental Assessment Certificates for both these projects following a two-year review by the BCEAO. Additional work is planned for the G.M. Shrum generating station located at the W.A.C. Bennett Dam to improve its safety and reliability and to increase capacity of three of the existing 10 units from 275 megawatts to 305 megawatts (per unit).

## **2.5 Supporting the Integration of Renewable Resources**

To meet its future energy needs, B.C. will require electricity generated by a variety of clean or renewable resources, including wind and run-of-river hydro. Most clean or renewable resources, however, are intermittent sources of electricity, meaning they are not always available to generate electricity when required (e.g., when the wind is not blowing or the river is not flowing) and when they are producing electricity, their output can fluctuate significantly. Facilitation of the development of these clean or renewable energy resources in B.C. requires continued access to dependable, dispatchable electricity resources. A dependable resource is one that is consistently available to meet peak demand while a dispatchable resource allows for a rapid generation adjustment in response to changes in demand and intermittent generation. In addition to being dependable, large hydroelectric projects with storage, such as the Project, are dispatchable, allowing electricity generation to be increased or decreased in response to instantaneous changes in demand and intermittent generation. For example, when intermittent resources are producing electricity, generation from a large hydroelectric facility can be reduced and the water that accumulates behind the dam can be stored in the reservoir for later use. When intermittent generation resources are not producing electricity, generation from such a facility can be instantaneously increased to satisfy energy demand.

### 3 Project Alternatives

This section provides an overview of the current alternative supply options available to BC Hydro to satisfy its mandate to reliably serve domestic electricity needs in the province. Current supply alternatives and options are analyzed with consideration of resource quality (capacity, energy and reliability) and associated financial and environmental attributes.

The section also briefly describes current alternative means of delivering the Project and alternatives to the general arrangements of the dam and associated structures.<sup>5</sup>

#### 3.1 Alternatives to the Project

As part of its responsibility to meet its service obligations, BC Hydro is pursuing a variety of options consistent with the policy direction set out in the *Clean Energy Act*. BC Hydro plans to meet future demand through a combination of Demand-Side Management, buying more electricity from clean or renewable power projects (e.g., wind, run-of-river hydro), building more capacity through reinvestment in existing assets, and development of new resource options such as the Project.

The need for and costs of future electricity resources are continually changing. Analysis of the alternative strategies to meet expected demand while reflecting these uncertainties is performed as part of BC Hydro's long-term planning processes (currently the 2011 IRP analysis).

In the 2008 LTAP, BC Hydro evaluated multiple demand and thermal generation cost scenarios to determine whether the addition of the Project to the BC Hydro system was a preferred resource option. Based on the portfolio analysis, the Project was selected in over 95 per cent of the scenarios with a medium or high demand, as defined in the 2008 LTAP. The analysis in the 2008 LTAP indicates that, compared to alternative resources, the Project would provide a low-cost, reliable source of electricity resulting in economic benefits to customers.

The 2008 LTAP analysis will be updated and refined as part of BC Hydro's 2011 IRP, and will inform the analysis of alternatives to be presented in the EAC Application. The proposed Project and alternatives to the Project have been considered as part of these long-term planning processes.

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<sup>5</sup> Canadian Environmental Assessment Agency, "Policy Statement: Addressing 'Need for', 'Purpose of', 'Alternatives to' and 'Alternative Means' under the *Canadian Environmental Assessment Act*", November 2007, pages 2 and 3.

BC Hydro uses economic portfolio analysis to select resource alternatives based on technical, economic and environmental characteristics. Alternatives are compared based on the following key characteristics:

- **Resource Potential:** The approximate availability of various resources is evaluated. Only resource options that are considered technically and economically feasible and that are consistent with B.C. government policy and related legislative initiatives are evaluated.
- **Volume and Quality of Incremental Energy and Capacity:** Resources can be relied upon in multiple ways. Some can reliably deliver an amount of electricity (e.g., firm energy) over a given time period (e.g., one year), some can reliably deliver power (dependable capacity) at specific times during the year, and some can do both. In evaluating whether a resource can meet BC Hydro's electricity requirements, it is advantageous to identify projects that have a delivery profile that is similar to BC Hydro's typical demand profile (i.e., projects that can generate electricity when it is needed the most – for example, in cold winter months).
- **Price:** Price is a critical input into the models used to evaluate resource options. Scenarios evaluated in the 2008 LTAP that included the Project as a resource option evaluated four different capital cost alternatives for the Project.
- **Environmental and Social Impacts:** Consistent with the *Clean Energy Act* and GHG policies, GHG offset costs are translated into a potential future financial obligation for resource options. Other environmental and social effects are considered as part of the qualitative analysis of the resource options.

Physical characteristics of potential resource options (i.e., capacity, energy, reliability and dispatchability) that are being considered in the 2011 IRP are shown in **Table 3.1**. Please note that this table does not set out the cost and development uncertainties with respect to these potential resource options or whether development of these resource options is consistent with B.C. government policy.

**Table 3.1 B.C. Resource Options – Volume and Quality of Electricity\***

Potential Generation Resources	Dependable Generating Capacity (DGC) and Effective Load Carrying Capability (ELCC) Assumptions/Method of Determination	Firm Energy Assumptions/Method of Determination	Seasonality, Intermittency and Dispatchability
Biomass – Wood-based Municipal Solid Waste Biogas (Landfill)	DGC: 100% of installed capacity for all. 95% of installed capacity for biogas.	100% of average annual energy	Insignificant seasonality Insignificant intermittence Not dispatchable
Wind – onshore	ELCC: 21% of installed capacity – Review pending	100% average annual energy based on 2008 LTAP – Review pending	Seasonal Intermittent Not dispatchable
Wind – offshore	ELCC: 29% of installed capacity – Review pending	100% average annual energy based on 2008 LTAP – Review pending	Seasonal Intermittent Not dispatchable
Geothermal	DGC: 100% of installed capacity	100% average annual energy	Dispatchable
Run of River	ELCC: Weighted average of approximately 60% of the forecast average MW of potential in the December/January period	Region-specific factors applied to the average annual energy	Seasonal Intermittent Not dispatchable
Large Hydro (Site C)	DGC: 100% of installed capacity	87% average annual energy	Dispatchable with storage
Natural Gas-fired generation & Cogeneration	DGC: Varies between 90% to 98% of installed capacity	Based on 90% capacity factor for Combined Cycle Gas Turbine	Dispatchable
Coal-fired generation with Carbon Capture and Storage	DGC: 75% of installed capacity	100% average annual energy	Not dispatchable (base load)
Wave	ELCC: Assumed same ELCC as offshore wind	Assumed same as offshore wind	Seasonal Intermittent Not Dispatchable
Tidal	ELCC: 40% of installed capacity	100% average annual energy – Review pending	Predictable intermittence Not dispatchable
Large-scale Solar	ELCC: Assumed same ELCC as onshore wind	Assumed same as onshore wind	Seasonal Intermittent Not dispatchable

\*These assumptions will be further reviewed and refined in the 2011 Integrated Resource Plan

**Table 3.2** broadly outlines the environmental footprints of potential resource options.



**Table 3.2 B.C. Resource Options – Relative Environmental Attributes**

Resource Type	Environmental Impacts		
	Atmosphere	Land	Water (Fresh & Marine)
<b>Biomass: Wood-based, Biogas &amp; Municipal Solid Waste</b>	<p>Dependent upon fuel burned; possible local air impacts.</p> <p>Electricity generated from biogas and wood waste is considered to have net zero carbon dioxide emissions.</p> <p>GHG emissions from municipal solid waste must be offset.</p> <p>GHG emissions due to transportation-related activities.</p>	<p>Land impacts due to facility footprint and development/use of access roads and transmission rights-of-way, fuel harvest impacts.</p>	<p>Consumptive water use.</p>
<b>Wind: Onshore &amp; Offshore</b>	<p>Primarily construction-related impacts.</p>	<p>Visual impact of towers; typically located on ridges or coast.</p> <p>Land impacts due to access roads and transmission line rights-of-way.</p> <p>Potential impacts to wildlife associated with turbine operation.</p>	<p>Potential visual and navigational impacts as well as impacts on the ocean floor, and to mammals, birds, aquatic species, and fisheries at offshore sites.</p>
<b>Geothermal (conventional)</b>	<p>Some emissions during construction and possibly during operation (depending on geothermal source).</p> <p>Some sites may have minimal GHG emissions during operations.</p>	<p>Small land requirements for site. Land required for transmission and access roads.</p>	<p>May affect recreational use.</p>
<b>Run-of-River</b>	<p>Potential short-term construction-related impacts due to dust emissions.</p> <p>Short-term construction-related GHG impacts due to vehicle and equipment use.</p>	<p>Effects on wildlife habitat, traditional and recreational uses due to construction and development/use of access roads and transmission line rights-of-way.</p>	<p>Involves diversion of a portion of stream flow.</p> <p>May affect fish, fish habitat, navigation, and recreational use.</p> <p>Generally located in high gradient streams.</p>

Resource Type	Environmental Impacts		
	Atmosphere	Land	Water (Fresh & Marine)
<b>Large Hydro</b> (Site C)	Possible localized climatic changes (e.g., fog). Some GHG emissions related to reservoir development and construction, but these will be minimal in relation to the energy produced over the life of the Project.	Affects wildlife, traditional and recreational land use, agriculture, forestry. Project would expand cleared width along existing transmission line right-of-way.	Changes to aquatic environment and species due to conversion from riverine to reservoir setting. May affect flows immediately downstream of dam.
<b>Natural Gas</b>	Some local air emissions are controllable. GHG emissions must be offset.	Land impacts limited to facility, access and transmission line right-of-way footprint.	Consumptive water use.
<b>Coal</b> (carbon sequestered)	Air emissions (e.g., sulphur oxide, mercury) and other local air impacts. GHG emissions must be captured and sequestered (on- or off-site).	Land impacts due to facility footprint as well as mine, transportation infrastructure and transmission line right-of-way. Land impact due to infrastructure required for sequestration (e.g., possible pipeline, sequestration wells)	Consumptive water use and water quality impacts.
<b>Wave/Tidal</b>	Limited to construction-related emissions.	Land impacts due to facility footprint, access routes and transmission right-of-way.	May have an impact on local tide and current regime, as well as navigation and fishing. Possible impact on fish and/or mammal migrations.
<b>Large-scale Solar</b>	Limited to potential release of particulates during construction. Short-term construction-related impacts due to vehicle and equipment use.	Land impacts due to facility footprint, access routes and transmission line right-of-way.	Consumptive water use for some designs.

### 3.2 Alternative Means of Delivering the Project

As discussed in the Stage 1 and Stage 2 study reports (BC Hydro 2007b and 2009, respectively), five additional hydroelectric development sites were identified on the Peace River in the late 1950s. Sites A, B, C and D between Peace Canyon and Taylor were identified in 1958, based mainly on topographical considerations. Shortly thereafter, Site E was identified at a location just upstream of the Alberta border.

In the early 1970s, studies focused on dams at Sites C and E with the goal of developing the entire electric generation potential between Peace Canyon Dam and the Alberta border. By 1976, the focus of the engineering studies had shifted to concentrate on Site C. These studies of alternate sites culminated in 1978 with the selection of Site C as the preferred site.

From 2001 to 2006, several studies were undertaken to investigate alternate means of developing the hydroelectric potential of the Peace River between Peace Canyon Dam and Site C. During Stage 2, a comprehensive review of all previously identified alternates and any new alternates was undertaken using a consistent evaluation process. This review confirmed Site C as the preferred location for developing the hydroelectric potential downstream of Peace Canyon Dam.

### **3.3 Alternative General Arrangements**

Stage 2 studies concluded that a refined and updated design of the proposed Project was required. In 2010, optimization studies were carried out to evaluate different arrangements and dam types, resulting in the selection of a general arrangement which, based on current information, balances technical, environmental and social considerations, uncertainty and risk. This arrangement, described in more detail in Section 4, forms the basis for the Project Description Report and cost estimate.

## 4 Project Components and Activities

This section begins with an overview of the permanent physical components of the Project. It then describes temporary Project components and the various life-cycle phases of the Project including activities during construction, operations and decommissioning. The section concludes with summaries of the Project schedule.

The major permanent and temporary Project components and related activities are listed in **Table 4.1** and **Table 4.2**, respectively. The locations of the proposed Site C dam site and hydroelectric generating station, the reservoir and the two new transmission lines, along with the proposed primary access on the south side of the Peace River, are shown in **Figure 4.1**. The routes on existing petroleum development roads may differ from those shown in Figure 4.1. The locations of the Highway 29 realignments are shown in **Figure 4.4**.

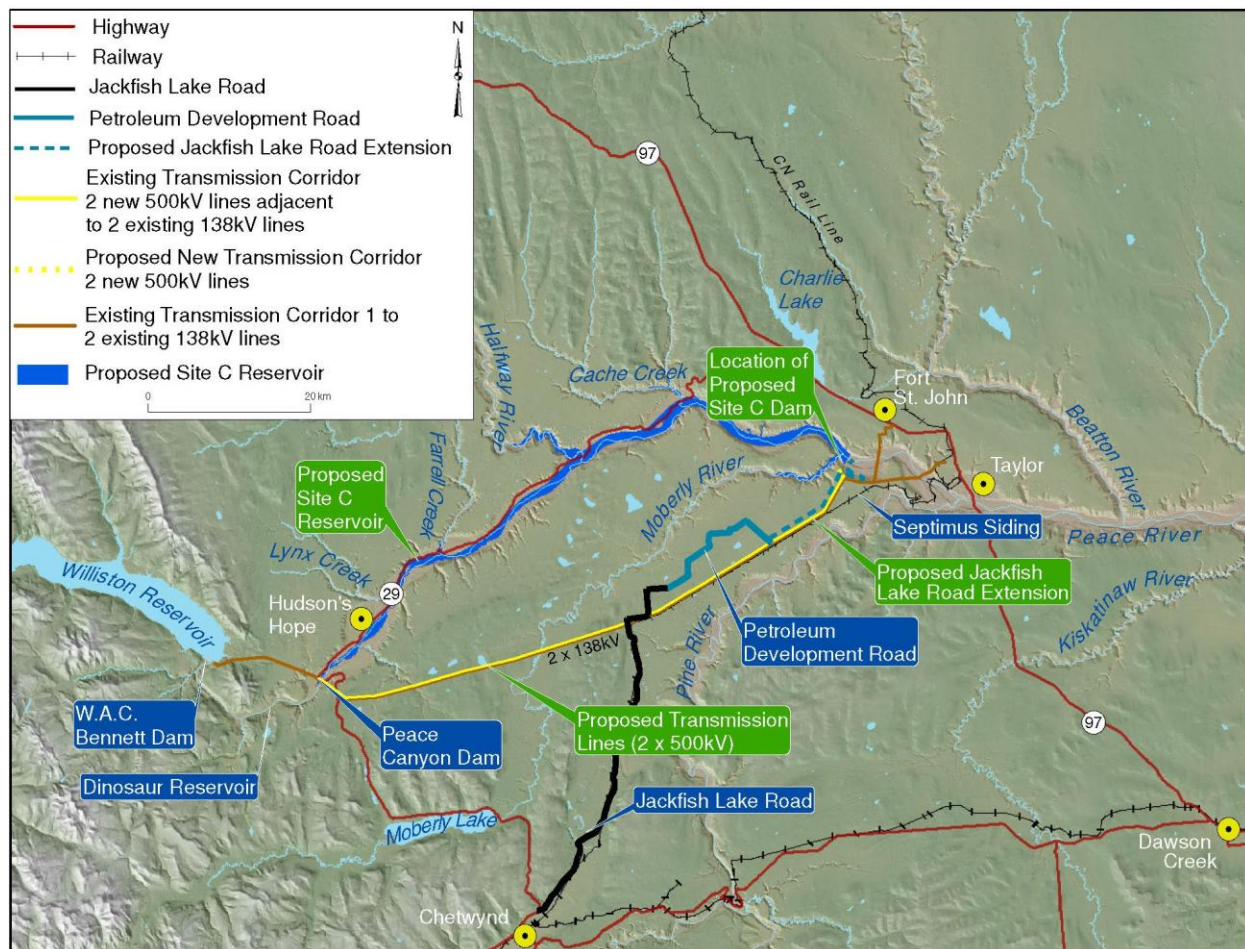
**Table 4.1 Permanent Project Components and Activities**

Main Component/Activities	Sub-components/Key Development Activities
Dam, Generating Station and Associated Structures	Earthfill dam
	Up to 1,100 MW six-unit generating station with vertical axis turbines
	Approach channel with concrete training walls to convey water from reservoir to power intakes and spillway
	Penstocks
	Power intakes
	Spillways
Reservoir	Access roads
	Clearing
	Filling
	Shoreline protection at Hudson's Hope
Transmission Line Connecting Site C to Peace Canyon	Three 500-kilovolt (kV) circuits connecting the generating station to the switchyard
	A 500 kV switchyard
	Two 500 kV Alternating Current lines, approximately 77 km in length connecting the switchyard to Peace Canyon Substation. Lines would be located along an existing right-of-way currently occupied by two 138 kV transmission lines and would require a widening of the right-of-way by approximately 35 metres.
	Access roads
Highway 29 Realignment	Realignment of four segments, including four new bridges
	Erosion protection of highway sections along the shore of the reservoir

**Table 4.2 Temporary Project Components and Activities**

Main Component/Activities	Sub-components/Key Development Activities
Temporary Project Components and Activities	Access roads from the north and south sides of the Peace River, temporary construction access bridge across the Peace River, and access roads at site between the various construction facilities and areas
	Worker housing at site*
	Offices at site
	Staging areas, storage facilities, workshops, aggregate processing, concrete batch plants, maintenance shops and other facilities required by contractors to support construction activities and assemble parts
	Construction of two cofferdams along each bank to confine the river to the main channel
	Construction of cofferdams and excavations to expose rock for the two diversion tunnels
	Surface and underground rock excavation for diversion tunnels
	Lining the diversion tunnels with concrete and constructing concrete inlet and outlet structures
	Construction of two cofferdams across the main river channel and diversion of the river through the diversion tunnels
	Excavations and relocation of excess soil and rock near dam site
	Excavations for construction materials
	Temporary access and transportation of construction materials from on-site areas and off-site areas by road and rail
	Access roads and laydown areas along the transmission line route as required for right-of-way clearing, construction of the towers, and stringing the lines

\*Worker Housing Plan, which may include some permanent facilities in the communities, will be developed.



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**Figure 4.1 Location of Proposed Site C Dam, Reservoir and Transmission Line**

The earthfill dam, spillway headworks, power intakes and associated training walls would comprise the main reservoir water-retaining structures. The general arrangement of these facilities is shown in **Figure 4.2**. A buttress of roller-compacted concrete (RCC) would support the valley wall, provide the foundation for the concrete structures, and form the south abutment of the earthfill dam.

These structures would be designed and constructed to international and Canadian standards to withstand the normal loads of the dam and reservoir, as well as loads resulting from extreme inflow events and earthquakes. In keeping with international standards, BC Hydro engaged an external Technical Advisory Board to review the general arrangement options that were considered for the Project. The Technical Advisory Board, comprised global experts in hydroelectric development, reviewed and provided feedback on BC Hydro's design choices for Site C.



**Figure 4.2 General Arrangement of Earthfill Dam and Concrete Structures**

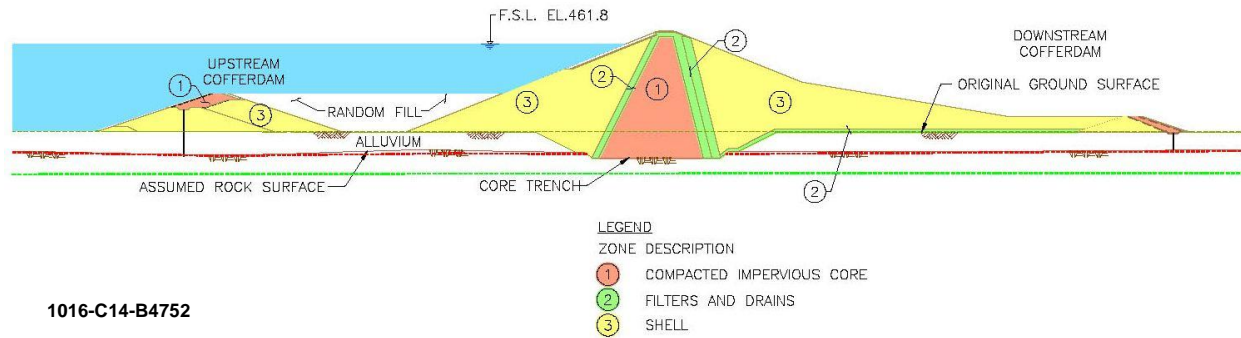
## **4.1 Permanent Project Components**

### **4.1.1 Dam and Generating Station Facilities**

#### **4.1.1.1 Earthfill Dam**

An earthfill dam has been recommended as the best technical design for the Site C location. The dam would have a central impervious core with outer shells of sands and gravel, as shown in **Figure 4.3**.

The earthfill dam would be approximately 1,050 metres in length. The dam crest (i.e., top of dam) would be at elevation 469.4 metres, approximately 60 metres above the present riverbed, providing for a freeboard of approximately eight metres above the maximum normal reservoir level at elevation 461.8 metres. The dam would have a crest width of approximately 10 metres.



**Figure 4.3 Construction Materials and Components for the Proposed Site C Dam**

The upstream and downstream cofferdams described in Section 4.3.1.2 would be incorporated into the earthfill dam. The space between the upstream cofferdam and the upstream shell of the dam would be filled with surplus materials from the excavations required to construct the Project structures. The upper part of the upstream face of the dam, and the upstream and downstream cofferdams, would be protected from wave erosion by coarse rock riprap on a bedding of fine rock.

The total volume of fill in the earthfill dam would be approximately 13.9 million cubic metres, of which 2.4 million cubic metres would be impervious fill.

#### 4.1.1.2 Hydroelectric Generating Facilities and Spillways

The hydroelectric generating facilities would consist of six generating units with a combined installed capacity of up to 1,100 megawatts. The six-unit generating station would be located adjacent to the spillways. Vertical axis turbines would be used. The generating station would consist of a reinforced concrete substructure and a structural steel superstructure clad with painted insulated metal siding.

The generating facilities and spillways would be located near the south bank of the Peace River and an approach channel would convey water from the reservoir around the end of the earthfill dam to the power intakes and spillways (**Figure 4.2**). The bottom of the approach channel would vary from 24 to 26 metres below the maximum normal reservoir level. Training walls, the power intakes and the spillway headworks would form the north side of the channel and retain the reservoir.

The power intakes would have operating gates and six large-diameter partially concrete-encased steel penstocks would be used to convey water from the approach channel to the generating station.

The spillway compartments would consist of a headworks structure with gates to control the discharges (water releases) from the reservoir, and a chute and stilling basin to dissipate the energy and minimize the erosion of the riverbed during large discharges. The spillways would have sufficient capacity to pass extreme upstream inflow events.



All discharges from the generating station and spillways would be conveyed into the river downstream of the dam. This area, known as the tailrace, would be protected from erosion by rock riprap.

Construction of the training walls, power intakes, spillways, and the generating station would require approximately 1.1 million cubic metres of concrete and 2.4 million cubic metres of roller-compacted concrete (i.e., concrete placed by trucks, spread by dozers and compacted by rollers).

#### **4.1.2 Reservoir**

The Project would create a reservoir that would be 83 kilometres long and, on average, two to three times the width of the current river. The extent of the inundation within the Peace River Valley in relation to existing water levels is shown in **Figure 4.4**. The reservoir would have a surface area of approximately 9,310 hectares and a volume of approximately 2,310 million cubic metres. Due to its ability to rely on the storage capability of the existing Williston Reservoir, the Site C hydroelectric facilities would be able to generate approximately 35 per cent of the energy produced by the G.M. Shrum generating station with just five per cent of the reservoir area.

#### **4.1.3 Transmission Line to Peace Canyon**

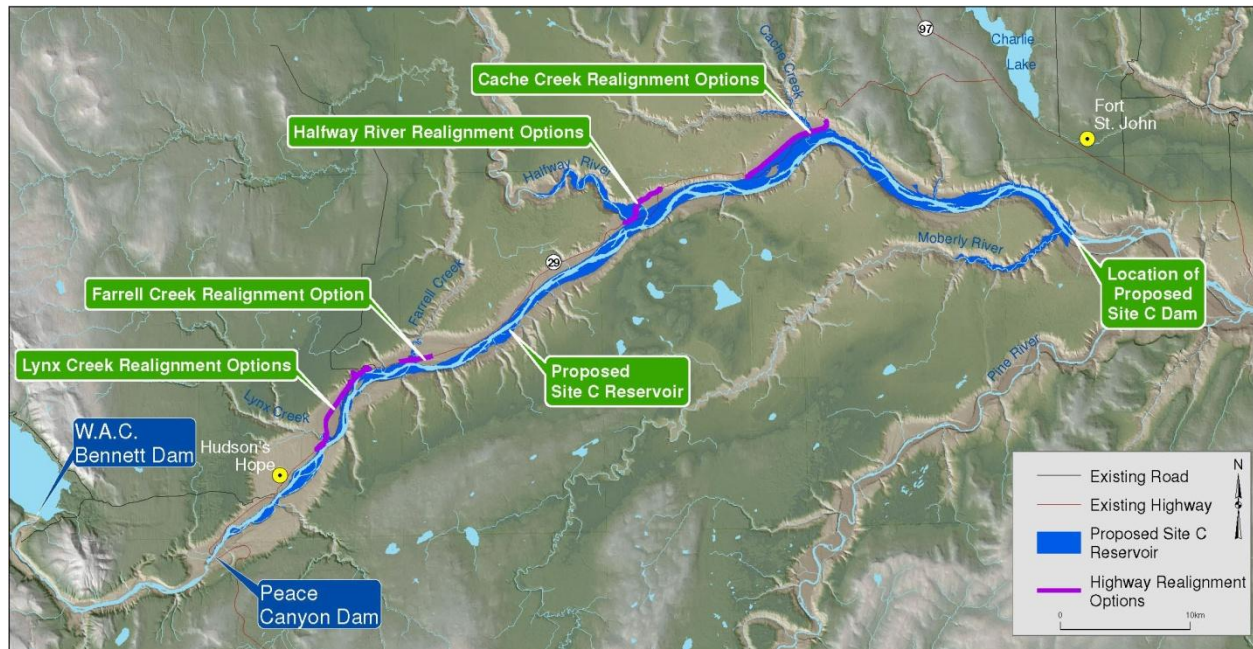
Two new 500-kilovolt Alternating Current transmission lines would connect the Site C switchyard to the existing Peace Canyon substation. These lines are proposed to be located along an existing right-of-way (**Figure 4.1**). This right-of-way is currently occupied by two 138-kilovolt transmission lines; the two new 500-kilovolt lines would be constructed alongside these lines, requiring a widening of the right-of-way by about 35 metres.

Access roads would be required for the construction and subsequent maintenance of the transmission line (see Section 4.2.4). During construction, laydown areas would be required along the transmission line route for the storage of materials and erection of components. Clearing will be required for the transmission lines. Some clearing would be required outside the right-of-way for danger tree management, access roads and laydown areas.

A switchyard at the Site C dam site would connect three 500-kilovolt lines from the generating station to the two new 500-kilovolt transmission lines to Peace Canyon. The switchyard would also have space to allow for additional local connections (e.g., Fort St. John) in the future.

#### **4.1.4 Highway 29 Realignment**

Four segments of Highway 29 would be inundated by the reservoir, resulting in the need to realign approximately 25 kilometres of the highway in the Cache Creek (Bear Flat), Halfway River, Farrell Creek and Lynx Creek areas (**Figure 4.4**).



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**Figure 4.4 Highway 29 Realignment Locations**

Realignment options (i.e., bridge plus causeway or bridge only) for each river crossing are provided in **Table 4.3**. Two general options have been identified for each segment. The first option is to construct a causeway combined with a shorter bridge. The second option is a longer bridge with no causeway. Realignment options will continue to be considered for each of the realignments in consultation with property owners, the B.C. Ministry of Transportation and Infrastructure (BCMOT), First Nations, and other stakeholders.

Some work may be required on additional sections of Highway 29 to improve alignment or address maintenance considerations. Erosion protection may be required on other sections of the highway that are adjacent to the proposed reservoir.

**Table 4.3 Highway 29 Creek Crossing Realignment Options (lengths approximate)**

Segment	Bridge Span + Causeway Option*	Bridge-Only Option*
Cache Creek	210 m + 230 m	410 m
Halfway River	320 m + 640 m	940 m
Farrell Creek	140 m + 145 m	265 m
Lynx Creek	90 m + 330 m	390 m

Source: KCBL and SNCL 2009

## **4.2 Temporary Project Components**

### **4.2.1 Construction Site Facilities**

Temporary facilities to support and undertake construction activities and assemble parts would be constructed at the Site C dam site on both sides of the Peace River, including, but not limited to:

- Offices
- Staging areas
- Workshops, labs and testing facilities
- Concrete batch plants
- Sites for relocation of surplus excavated materials
- Explosive storage
- Fuel storage and refuelling
- Electrical substations
- Utilities
- Safety, first aid and security
- Access roads and parking areas
- Storage facilities
- Aggregate and filter processing plants
- Fabrication shops
- Fully serviced worker housing
- Truck washing (including concrete trucks)
- Vehicle maintenance
- Power generators
- Fire protection
- Waste treatment and management

On the south bank of the river, craning facilities, storage and laydown areas would be developed adjacent to the Canadian National Rail Septimus Siding. The existing siding area would be expanded.

A natural gas feeder would likely be brought onto the site on the north bank of the river to service the site construction facilities. Electrical distribution lines connecting to the existing electrical grid would be brought to the work site to minimize the use of hydrocarbon-fuelled generation equipment on-site.

Access roads to various construction and reservoir preparation sites and the transmission line are discussed in Section 4.2.4.

### **4.2.2 Worker Housing**

Approximately 7,000 person-years of work would be required to complete construction of the Project, with the labour force peaking at approximately 1,700 in year five of construction.

In its base design from the 1980s, BC Hydro assumed that 75 per cent of the workers would be housed in two construction camps located close to the dam construction site, and that the remainder of the workers would either come from the local area or find accommodation off-site. Worker housing options are currently being reviewed and detailed worker housing plans will be developed during the environmental assessment process in consultation with local governments, First Nations and local stakeholders.

### 4.2.3 Excavations and Construction Materials

#### 4.2.3.1 Relocation of Surplus Excavation Materials

Approximately 34 million cubic metres of material (8 million cubic metres of rock and 26 million cubic metres of overburden) would be excavated during construction of the dam and associated structures. The north side of the valley, in the vicinity of the dam, would be excavated to provide a stable slope. Excavated sand and gravel would be incorporated into the shells of the dam, cofferdams, access roads and containment dikes, and used for processing for filters in the dam and for concrete aggregate (**Figure 4.3**).

Excavated bedrock, colluvium and glaciolacustrine silts and clays would be unsuitable for construction materials and would be relocated at site. **Table 4.4** shows the sources and destinations of relocated materials. The size and shape of these areas will depend on the final design and contractors' construction methods.

**Table 4.4 Sources and Destinations of Relocated Materials**

Source	Approximate Quantity (million cubic metres)	Destination
Downstream ends of diversion tunnels	1.4	North bank downstream of dam
Upstream ends of diversion tunnels and the lower part of north bank stabilization	7.7	North bank upstream of dam
Upper part of north bank stabilization	9.9	Dry gulley at top of slope
South bank	7.6	South bank upstream of dam

Materials relocated to areas near the river would be contained by dikes constructed from sand and gravel and protected from erosion by rock riprap. The excavated rock would be tested for acid rock drainage potential and any potentially acid-generating rock would be placed in areas lined and then capped with impervious materials. If necessary, crushed limestone would be added to the waste rock to neutralize potential acid generation. The bulk of the excavated rock would be relocated into areas upstream of the dam where they would be inundated by the reservoir, preventing any future oxidation of minerals in the rock and eliminating any potential acid rock drainage. Water treatment facilities would be installed to buffer the pH of any effluent from potentially acid-generating rock.

Reclamation plans would be developed as required.

#### 4.2.3.2 Borrow Areas and Quarries

The majority of construction materials required for construction of the earthfill dam are available in the vicinity of the Project. Approximately 3.3 million cubic metres of impervious material for the

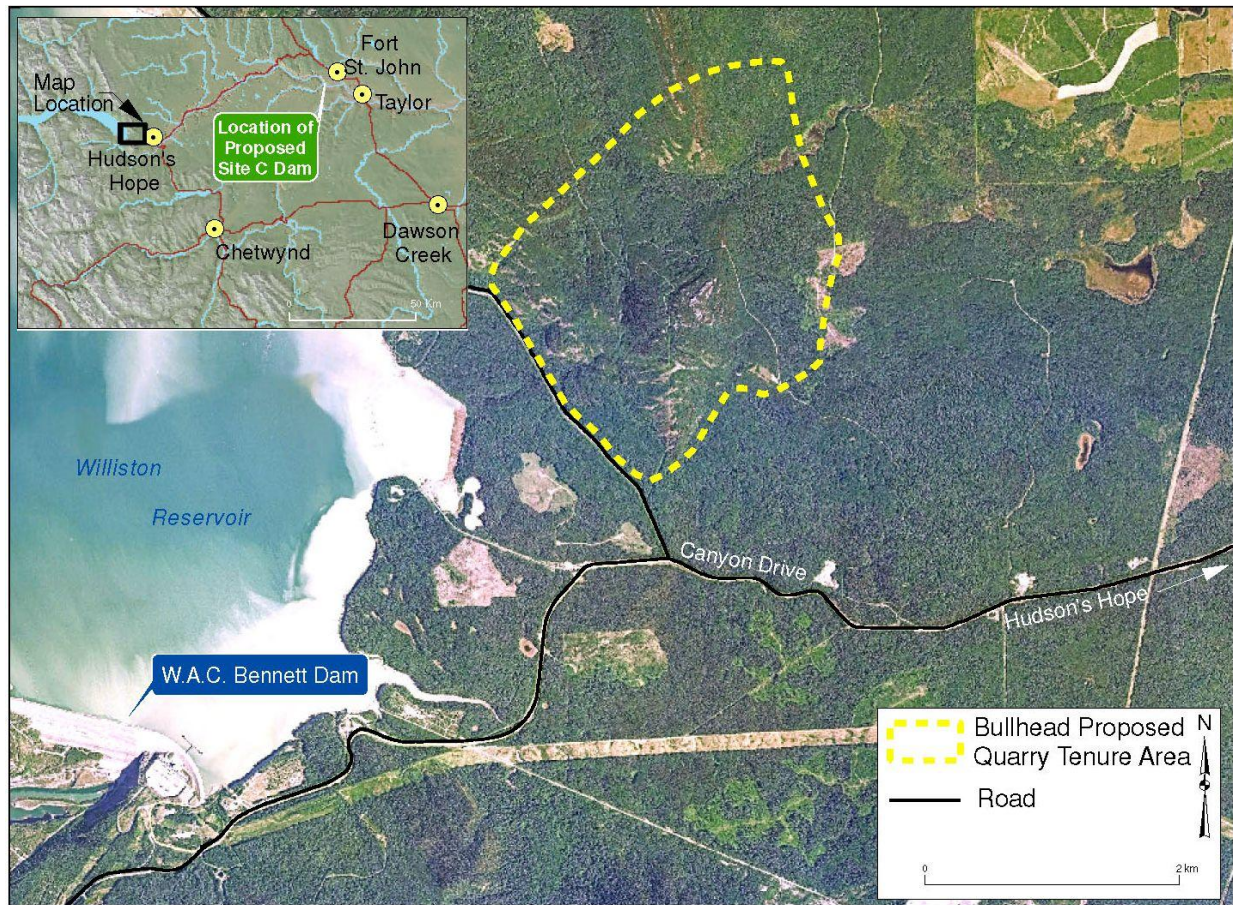
earthfill dam, cofferdams and approach channel lining could be sourced from deposits that have been identified north of the dam site. This material would be transported to site by truck or conveyor. Although the area(s) required for the excavation of the impervious fill would depend on the final design and the contractors' construction methods, it is expected to total from 30 to 50 hectares.

Coarse rock riprap would likely be imported from quarries in the vicinity of the Pine Pass area of the Rocky Mountains (**Figure 4.5**), and near the east end of Williston Reservoir (**Figure 4.6**). The quarry in the Pine Pass area will occupy a small portion of the proposed tenure area. The riprap would be transported to the site by road or rail. Approximately 805,000 cubic metres of riprap would be required for the approach channel lining, containment dikes, cofferdams, earthfill dam and tailrace.

Reclamation plans would be developed as required.



**Figure 4.5** Potential Source of Construction Material at West Pine Quarry Near Pine Pass

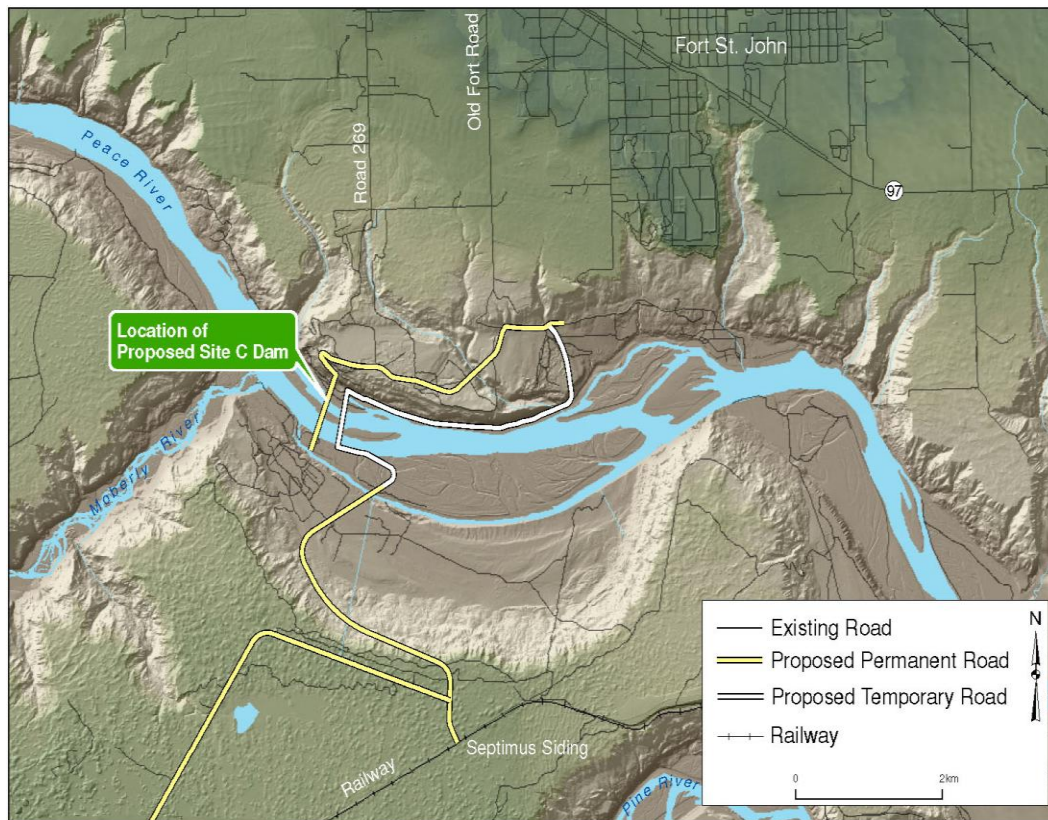


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**Figure 4.6 Potential Source of Construction Material Near the East End of Williston Reservoir**

#### 4.2.4 Access Roads

Access to the Site C dam site from Fort St. John and the Alaska Highway (Highway 97) would take place using existing municipal and provincial public roads. There would be access roads in the vicinity of the dam site and a temporary construction access bridge that would cross the Peace River immediately downstream of the dam. **Figure 4.7** shows the main permanent and temporary access roads to the site; however, many other access roads will be required to connect the site with temporary infrastructure, and a number of other temporary roads would be established within the dam site, connecting the various work areas and contractors' site facilities. These are currently being evaluated.



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**Figure 4.7** Currently Proposed Construction Access (additional access roads to the dam site on both the north and south sides of the river are being evaluated)

Existing road networks on the south bank of the Peace River include the partially paved Jackfish Lake Road and an unpaved network of rail, transmission, oil and gas, and forest service roads. Access to the site from the south would be via the Jackfish Lake Road and a new construction service road along the existing transmission line corridor (**Figure 4.1**). The dam site would be connected to the Canadian National Rail Septimus Siding by a new construction service road.

There is existing road access along most of the proposed route of the transmission lines as a result of construction and maintenance of the existing 138-kilovolt lines and other developments in the area. Some additional access may be required to individual structures and work sites.

Reservoir preparation activities would require the construction or upgrade of roads on both sides of the proposed reservoir and dam site. In addition, river and helicopter access would be required, depending on the clearing methods and terrain. As currently conceived, the roads would be decommissioned following clearing activities. However, the retention, deactivation or rehabilitation of specific access roads following reservoir preparation activities would be considered in consultation with responsible agencies, First Nations and others.

## **4.3 Construction Activities and Schedule**

Construction of the Project is expected to take seven years. The following section provides an overview of the schedule and activities associated with: 1) construction of the dam, generating facilities, associated structures and river diversion; 2) reservoir clearing, preparation, filling and commissioning; 3) commissioning of the generating station and completion of dam construction; 4) construction of the transmission lines; 5) the Highway 29 realignment; and 6) discharges and wastes during construction.

The durations provided in this section are not additive, as some of the activities will overlap. From the commencement of early works in fall 2013 (pending approval) to the start of operation of the first generating unit would be approximately 88 months. Project completion, including site cleanup, restoration and demobilization would be completed by the end of 2021.

### **4.3.1 Dam, Generating Facilities, Associated Structures and River Diversion**

#### **4.3.1.1 Temporary Project Components**

Pre-construction activities and construction of some of the temporary facilities would commence prior to dam construction. These activities would take approximately 23 months and include:

- Clearing of the dam site, reservoir area and transmission line routes
- Construction of access roads from the north bank, including connection to existing municipal roads
- Construction of the temporary construction access bridge over the Peace River at the downstream toe of the dam
- Construction of access roads on the south bank, including connections to the Septimus Siding and to Jackfish Lake Road
- Construction of worker housing on both banks

#### **4.3.1.2 River Diversion Activities**

The Peace River would be managed in the following two stages to allow for construction of the dam and generating facilities:

1. Cofferdams would be constructed along each edge of the main channel to confine the river to the main channel so that work could proceed on each bank in the dry, which would take approximately 36 months; and then



2. The river would then be diverted through diversion tunnels so that the dam could be constructed across the main river channel in the dry, which would take approximately 50 months.

The following work would be undertaken while the river was confined to the main channel:

- North bank:
  - construction of two concrete-lined diversion tunnels with inside diameters of approximately 9.8 metres and lengths of about 700 metres and 770 metres
  - excavation of foundations for the earthfill dam
  - construction of a portion of the earthfill dam
  - relocation of surplus excavated materials
- South bank:
  - excavation of foundations for the earthfill dam
  - excavation of foundations for the concrete structures
  - construction of a portion of the concrete structures
  - relocation of surplus excavated materials

During diversion with the river confined to the main channel, water levels at the upstream end of the dam site are expected to fluctuate over about 3.3 metres for the full range of licensed discharges from the Peace Canyon Dam compared to a current fluctuation of about 1.8 metres. During flood flows, the river level could rise about 2.7 metres above the current maximum level (i.e., the level that occurs when all four Peace Canyon generating units are at full discharge).

Once the diversion tunnels are completed, the Peace River would be diverted through the diversion tunnels. This would be accomplished by constructing a cofferdam across the river at the location of the upstream toe of the dam (see **Figure 4.3**). A second cofferdam would be constructed across the river at the downstream toe of the dam (see **Figure 4.3**). Water would then be pumped out of the area between the upstream and downstream cofferdams so that work on the dam could proceed in the dry.

With the river diverted through the diversion tunnels, water levels at the upstream end of the site would range by about 12.8 metres for the full range of licensed discharges from the Peace Canyon Dam. During floods, the river level could rise about 7.2 metres above the current maximum level.

With the river diverted through the tunnels, work would proceed on the earthfill dam and concrete structures (i.e., completion of the excavation and grouting of the foundations for the earthfill dam, construction of the earthfill dam, training walls, generating station, penstocks, power intakes and spillways, and installation of the first two generating units).

### **4.3.2 Reservoir Preparation and Filling**

Reservoir preparation activities such as clearing and removal of timber and vegetation, localized shoreline protection and preparation, habitat mitigation projects, and recreation site development would occur prior to filling the reservoir.

Clearing would occur in phased stages to allow a reservoir filling schedule compatible with the construction and commissioning schedule. In general, woody vegetation in the reservoir area below the maximum normal reservoir level is proposed to be cleared to a stump height of less than 30 centimetres.

Clearing at the dam site, transmission line right-of-way, access roads and reservoir would involve the harvesting of approximately 1,000,000 cubic metres of merchantable timber and the creation of about 550,000 cubic metres of waste vegetation. Disposal of this waste vegetation would be conducted in accordance with provincial and federal regulations and in a manner that minimizes air quality impacts. Alternatives to burning such as chipping, composting, reuse or conversion of waste to bioenergy would also be explored to minimize GHG and other emissions.

Reservoir filling would commence once the dam and associated structures have been completed to the stage that the reservoir could be safely impounded and controlled, and the spillway gates and power intake gates have been dry commissioned. Filling would likely take approximately two months, depending on inflows, and considerations for staged filling.

### **4.3.3 Commissioning of Generating Station and Completion of Dam Construction**

After reservoir filling, the generating units are expected to be tested and commissioned individually and would come into commercial operation at approximately two-month intervals. During commissioning, turbine discharges would be variable and intermittent during commissioning and the spillways would be used to maintain continuity of downstream flows.

Project commissioning completion would take approximately 12 months, and would include:

- Completion of construction activities
- Site reclamation

### **4.3.4 Transmission Lines**

Construction of the transmission lines would take approximately 25 months, and would involve developing an access plan, clearing the right-of-way, and constructing the transmission lines.

An access plan will be developed for the transmission line construction and maintenance. Where possible, pre-existing access roads will be used and a decommissioning plan will be developed. The

existing access roads would be used as the base for transmission line construction purposes. These roads and associated laydown areas would be sited as close to the transmission lines as possible.

The widened transmission right-of-way would be cleared to safeguard the new lines. Clearing methods would depend on the type of vegetation to be removed. Clearing specifications would be applied in accordance with standard transmission line development procedures.

Construction of the transmission lines would include:

- Distribution of components along the right-of-way
- Installation of foundations and guy anchors
- Assembly of towers and associated equipment
- Erection of towers
- Conductor pulling and tensioning equipment
- Installation of counterpoise
- Removal and reclamation of temporary access and cleanup and restoration of the right-of-way

#### **4.3.5 Highway 29 Realignment**

The Highway 29 realignment would take place prior to reservoir filling and would take approximately 28 months.

The construction sequence would likely be as follows:

- Construction of new bridges
- Construction and pavement of roads, including access to local roads and driveways
- Connections to existing highway
- Site reclamation

#### **4.3.6 Discharges and Wastes**

##### **4.3.6.1 Discharges**

The following types of discharges are typically produced during construction of a large-scale hydroelectric project:

- Dust emissions from drilling, road construction, equipment movement on dry roads, handling of aggregates, and concrete batch plants

- 
- Exhaust emissions (i.e., common air contaminants and GHGs) from mobile and stationary gasoline and diesel-powered equipment (e.g., light and heavy duty trucks, cranes, earthmovers, excavators, bulldozers, backhoes, compressors, generators)
  - Septic and grey water discharges from worker housing
  - Sediment-laden water from dewatering of excavation works
  - Noise from heavy equipment operation, drilling and blasting

Measures would be put in place to reduce and/or treat the various construction-generated discharges.

#### **4.3.6.2 Wastes**

Waste produced during construction and operation would be disposed of in accordance with applicable regulations, and would be reused and recycled where practical. For example, surplus excavated material suitable for landscaping (i.e., overburden soils) may be stockpiled and used for landscaping, site restoration and other potential mitigation opportunities. Excavated material suitable for use as engineering fill may be used for road construction, building foundations, or other similar purposes. Excavated material not suitable for either landscaping or engineering fill would be relocated within the Project site as appropriate. Wood waste would be partially recycled and non-recycled wood waste would be burnt, where permitted, and other options will be explored. Merchantable timber removed as part of reservoir, transmission line and/or road clearing would be available for use in forest products. Various means of disposal of non-merchantable timber and other vegetation cleared from the Project will be assessed in consultation with responsible agencies, First Nations and others.

#### **4.4 Dam and Reservoir Operations and Maintenance**

The Site C reservoir would be one of the most stable reservoirs in BC Hydro's system, with relatively little fluctuation in water levels. The maximum normal operating range for the Site C reservoir would be between 460.0 metres and 461.8 metres, with average reservoir fluctuations expected to be less than 1.8 metres throughout most of the year. In exceptional circumstances, such as extreme rainfall in the local unregulated tributaries, the proposed reservoir could rise above the maximum normal reservoir level for short periods of time. The reservoir could also be drawn down to lower levels for unusual system requirements or system emergencies.

The Site C dam would be operated, managed and monitored in accordance with Canadian and international dam safety practices. Similar to BC Hydro's other generating facilities on the Peace

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River, the Project would be operated to respond to provincial electricity demand. The final reservoir operations would be based on the results of additional engineering, environmental and socio-economic studies, as well as input provided during consultation with local communities and First Nations. The reservoir operations would require approval by the B.C. Comptroller of Water Rights as part of the water licensing process.

Typical operational discharges to the environment from the two existing Peace River generating stations are minimal. Oil loss to water and ground occurs from generators and transformers, but sump and containment systems are designed to capture most of this material for recycling via oil-water separators. Sulphur hexafluoride (SF6) is used in some equipment and can occasionally escape to the air. Discharges from the Project are expected to be similar to those of the two upstream generating stations and, in some areas, technological updates may improve emissions discharges to the environment.

#### **4.4.1 Facilities Maintenance**

Maintenance and inspection activities would include seasonal and non-seasonal activities. Seasonal inspection and maintenance of “water-to-wire” equipment (e.g., generators, turbines, penstocks, transformers) would generally be scheduled to coincide with maintenance outages for similar equipment at the G.M. Shrum and Peace Canyon generating stations. Typically, these maintenance outages would be scheduled to occur during periods of low energy demand (i.e., in the spring or fall).

Maintenance of non water-to-wire equipment (e.g., building HVAC systems, air compressors, cranes) would generally be scheduled to coincide with periods of high domestic energy demand, typically from late fall to early spring.

Maintenance of the spill discharge facilities (e.g., spillway operating gates) would generally be scheduled to occur after the freshet has subsided.

Non-seasonal maintenance would include activities such as daily, weekly and monthly inspection and maintenance of the earthfill dam, spill discharge facilities, intake head works, and equipment located in the generating station and switchyard.

A detailed Operations and Maintenance Plan would be developed. For example, the plan would establish monthly functional tests of the spillway operating gates and frequency of gate openings.

Transmission line maintenance activities would involve maintenance of the towers and right-of-way (e.g., vegetation management), access roads, and transmission facilities.

Following construction, the realigned sections of Highway 29 would be owned and operated by the BCMOT.

## 4.5 Decommissioning

BC Hydro expects that the Project would be operated for over 100 years, and decommissioning is not currently contemplated. Should a proposal be made to decommission and remove the Site C facilities, BC Hydro expects that an environmental effects assessment would be undertaken to determine areas of concern, and to plan decommissioning activities. According to current best practice, an Environmental Protection and Monitoring Plan would be developed for decommissioning to implement applicable precautionary measures for environmental protection and to restore the area to conditions deemed acceptable at the time of decommissioning. Further details on decommissioning would depend on regulations and best practice at the time of a decision to decommission.

## 4.6 Project Summary Schedule

BC Hydro has adopted a staged decision-making process for the Project. A staged process allows for multiple decision-making points during Project development and helps to control costs by focusing on deliverables and objectives at each stage. **Table 4.5** shows the major elements of the current Project schedule.

**Table 4.5 Anticipated Project Schedule**

Stage	Schedule
Stage 1: Review of Project Feasibility	Complete
Stage 2: Consultation and Technical Review	Complete
Stage 3: Environmental and Regulatory Review	2010–2013
• Project Description Report submitted	Spring 2011
• Environmental Assessment Certificate Application submitted	Late summer 2012
• Environmental Assessment Certificate Application Review Complete	Late summer 2013
Stage 4: Detailed Design and Procurement	2013
Stage 5: Construction	2014–2020
First generating units in service	2020
All units in service	2021

Proposed milestones for obtaining a federal environmental decision statement and a provincial EAC depend on the harmonized environmental assessment and review process requirements. Delays to these milestones would alter the Project schedule.

The durations provided in Section 4.3 are not additive, as some of the activities will overlap. From the commencement of early works in fall 2013 to the start of operation of the first generating unit

would be approximately 88 months. Project completion, including site cleanup, restoration and demobilization would be completed by the end of 2021.

#### **4.7 Project Costs**

Large hydro projects like Site C have a significant upfront capital cost, low operating costs, and a long life of more than 100 years.

The project cost for Site C has been updated to reflect the upgraded project design, and current market prices for labour, equipment and materials.

Site C would have an estimated capital cost of \$7.9 billion, and a cost per megawatt hour ranging from \$87 to \$95, based on a 5.5 to 6.0 per cent discount rate.

Based on the updated cost estimate, Site C would be among the most cost-effective resource options to help meet B.C.'s future electricity needs. In addition, Site C provides significant benefits not available from other resources, such as reliable capacity and flexibility.

## 5 Environmental Setting

This section provides an overview of the environmental setting in the vicinity of the Project. It begins by describing the attributes and features associated with the geography and geology of the region. It then summarizes hydrological conditions associated with surface water and stream flows, including existing water management as well as river ice formation, water quality and groundwater. The section then characterizes the current information on climate, air quality and noise. It concludes by providing an overview of the current baseline information on vegetation, wildlife and fish.

BC Hydro has collected much of the information summarized in this section during studies implemented prior to and during Stages 1 and 2 of the Project. During Stage 2, BC Hydro implemented a series of Technical Advisory Committees (TACs) and other opportunities to obtain input from First Nations and from provincial, federal and municipal government agencies on potential environmental and socio-economic issues and on additional information that would assist in assessing the potential effects of the Project on the biophysical and human environments. TACs were developed for greenhouse gas (GHG) emissions, wildlife, fish and aquatics, heritage, land and resource use, recreation and tourism, and community services and infrastructure. Input from these TACs informed the work undertaken in Stage 2 and the work that continues to be undertaken in preparation for the environmental assessment of the Project. A summary of each of the TAC processes is provided in the respective subsections.

BC Hydro is currently undertaking additional studies of baseline conditions. Study details are available on the Project website at [www.bchydro.com/sitec](http://www.bchydro.com/sitec).

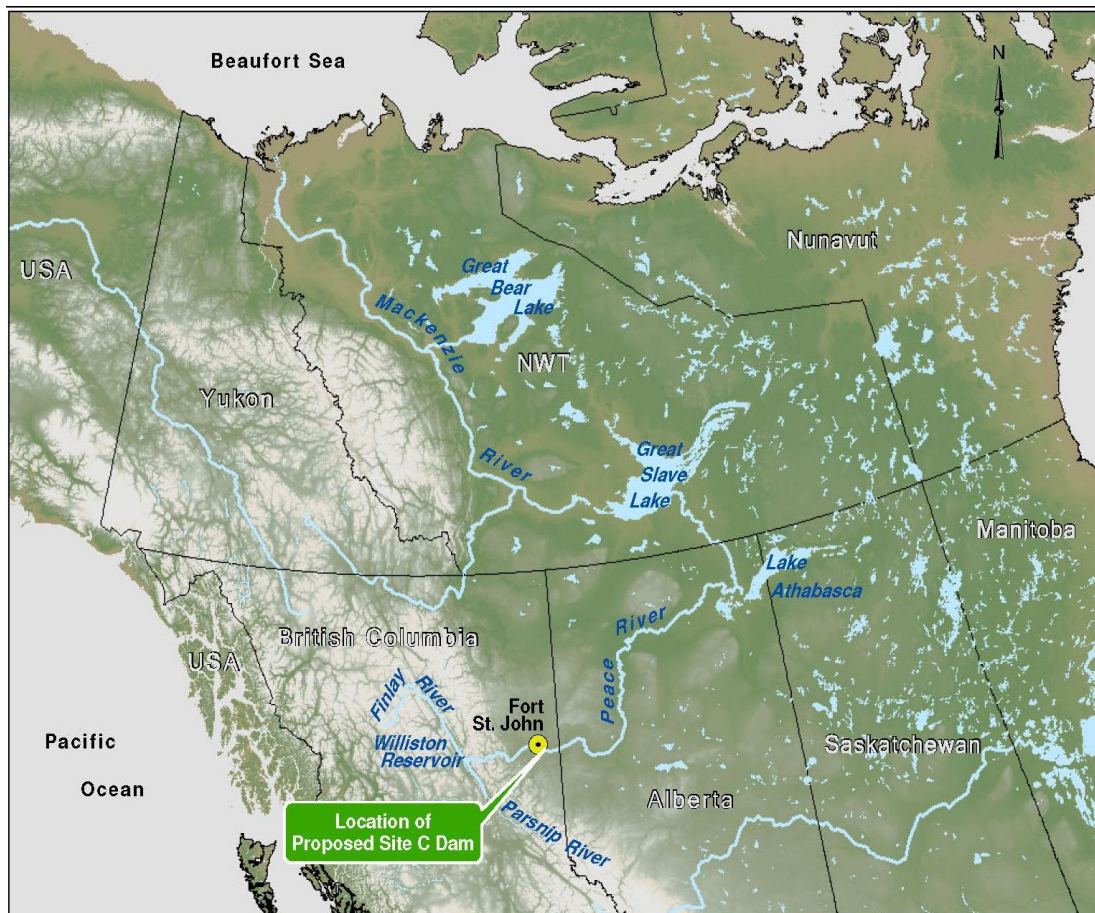
Following the submission of this Project Description Report, the Project will become a reviewable project under the B.C. *Environmental Assessment Act* and the *Canadian Environmental Assessment Act*. During the environmental assessment process, the environmental studies discussed in this section, along with socio-economic, heritage and health studies discussed in later sections, will be advanced from baseline work to an assessment of the effects of the Project, including measures to avoid or mitigate potential effects. This will include further opportunities for consultation and input by the public, stakeholders, Aboriginal groups and communities.

### 5.1 Landscape

The Peace River originates in the Rocky Mountain Trench in northeast B.C. at the confluence of the Finlay and Parsnip Rivers (now inundated by the Williston Reservoir) and flows through the Rocky Mountains from west to east. The Peace River then flows east through B.C. and northeast through Alberta to its confluence with the Rivière des Rochers, the main outlet of discharge from the Peace-Athabasca Delta and Lake Athabasca. Rivière des Rochers then flows north into the Slave River,



which then flows into Great Slave Lake in the Northwest Territories. From Great Slave Lake, the Mackenzie River flows northwest into the Beaufort Sea (**Figure 5.1**).



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**Figure 5.1 Peace River Flows from the Headwaters in B.C. to Discharge Point in the Northwest Territories**

The Project lies within the Alberta Plateau, which extends into northeast B.C. from Alberta, and is part of the Interior Plains Region. The Interior Plains Region is underlain by sedimentary bedrock of Cretaceous age composed of interbedded shales and sandstone near the surface. Bedding is flat-lying to gently dipping. Plateaus have developed on more resistant upland sandstone areas and most of the lowland areas are underlain by softer and more erodible interbedded shales and sandstone.

Uplands along the Peace River generally above a 700-metre elevation exhibit rolling topography. Benches lie at about 620 metres and have mounds and hollows with an overall flat topography, much of which has been cleared and is cultivated or improved for pasture. The benches and uplands are dissected by the Peace River and its tributaries, with the valley bottom lying at about 450 metres at Hudson's Hope, and at about 410 metres at the proposed dam site. The valley varies from up to

five kilometres wide where it is flat-bottomed with prominent terraces, to only about one kilometre wide with V-shaped and canyon-like forms (Thurber 1978).

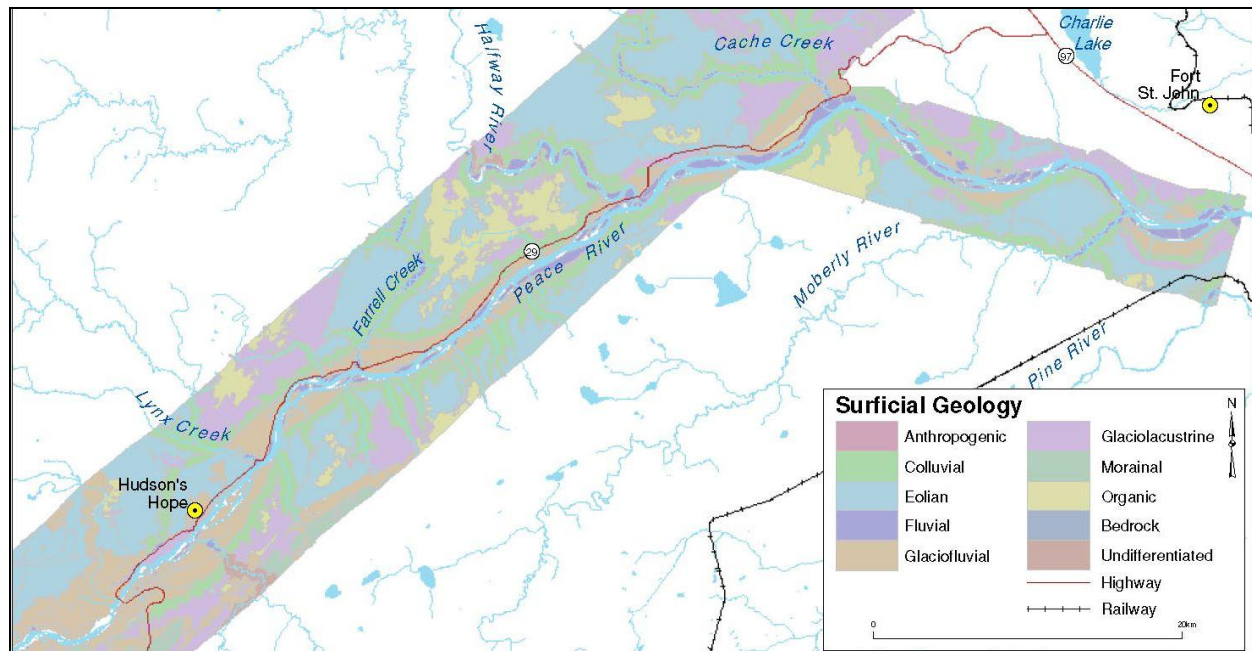
Prominent terraces occur at five major locations along the north bank of the Peace River upstream of the proposed dam site (Thurber 1978). Informal designations for these locations west to east are: Hudson's Hope Flat, Farrell Creek Flat, Attachie Flat, Bear Flat, and Jim Rose Prairie. These flats generally consist of multiple river terraces with elevations from 425 metres to 530 metres.

The Alberta plateau was glaciated during the Pleistocene epoch and periodically the glaciers blocked drainages forming glacial lakes in the older valleys (Mathews 1978). As a result, the Peace Valley was infilled with glacial deposits, including thick sequences of lake sediments.

De-glaciation and post-glacial erosion has deeply incised rivers and streams tributary to the Peace River, depositing deep glacier outwash and more recent river deposits in major valleys and tributaries, particularly near confluences (Mathews 1978).

The major soil landscapes that occur in the vicinity of the Project are shown in **Figure 5.2** and include (Green and Lord 1986):

- Steep sides of major river valleys entrenched into the plateau, dominated by young soils in slide debris derived from shale and glacial lake sediments (colluvial)
- Recent river deposits along the Peace River floodplain and near the confluences of its major tributaries, dominated by young soils formed in flood-deposited sediments (fluvial)
- Coarse-textured, well-drained glacial outwash deposits lying at somewhat higher elevations than the recent river deposits, along the margins of the Peace River and its major tributaries, with moderately well-developed soils (glaciofluvial)
- Gently undulating lowland clay plain with hummocky topography near the main river valley escarpments, dominated by mixed forest and grassland soils (glaciolacustrine)
- Broad, gently undulating glacial lake clay plains dominated by mixed forest soils in well-drained sites, imperfectly drained soils in lower areas, and organic soils mixed with wet mineral soils in poorly drained depressions (glaciolacustrine)
- Moderately sloping ridges composed of clayey till developed on sandstone, dominated by mixed forest and grassland soils (morainal)



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**Figure 5.2 Local Surficial Geology**

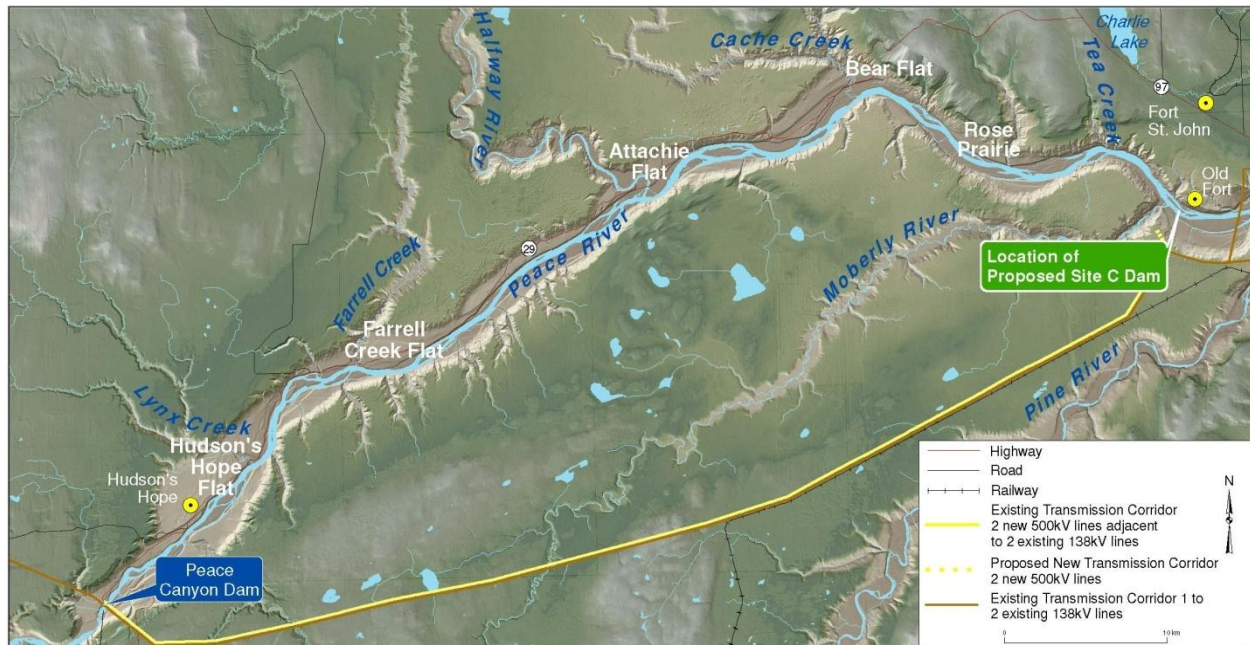
Landslide terrain includes long stretches of the valley walls that are entirely shaped and altered by multiple and overlapping lobes of slide debris and landslide scars (Thurber 1979). Major historic and prehistoric slides have occurred in the valley at Cache Creek, Attachie River, and Halfway River. The Attachie Slide, which occurred in May 1973, dammed the Peace River for about 10 hours before the river re-established itself through the slide area (Evans et al. 1996).

The proposed Site C dam and generating facilities are located in a section of the valley where the Peace River lies on the north edge of a buried valley, with a prominent river terrace on the south bank about 60 metres above river level. The top of the north bank lies at 580 metres, 170 metres above the river, and is a steeply eroded slope with glacial sediments overlying shale bedrock. Bedding planes, fractures, shears and joints have been investigated at the site. Each of these features has influenced the design of the dam and related structures.

## 5.2 Surface Water and Streamflow

### 5.2.1 Major Tributaries to the Peace River between Peace Canyon Dam and Site C

The major tributaries of the Peace River between the Peace Canyon Dam and the proposed Site C dam site are Lynx Creek, Farrell Creek, Halfway River, Cache Creek and the Moberly River (**Figure 5.3**). Summary information for the tributaries is provided in **Table 5.1**.



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**Figure 5.3 Major Tributaries to the Peace River between Peace Canyon Dam and Site C**

**Table 5.1 Summary Information for Tributaries Located between the Peace Canyon Dam and Site C**

Tributary	Watershed Area	Distance Upstream from Potential Site C Dam	Length of Tributary Potentially Inundated by Site C Reservoir	Mean Bankfull Channel Width in Inundated Area	Mean Bankfull Height in Inundated Area
	(km <sup>2</sup> )	(km)	(km)	(m)	(m)
Lynx Creek	307	73	0.8	11	0.4
Farrell Creek	620	63	2.5	26	1.8
Halfway River	9402	41	14	119	1.7
Cache Creek	899	25	8	21	0.6
Moberly River	1833	1.0	10	37	1.3

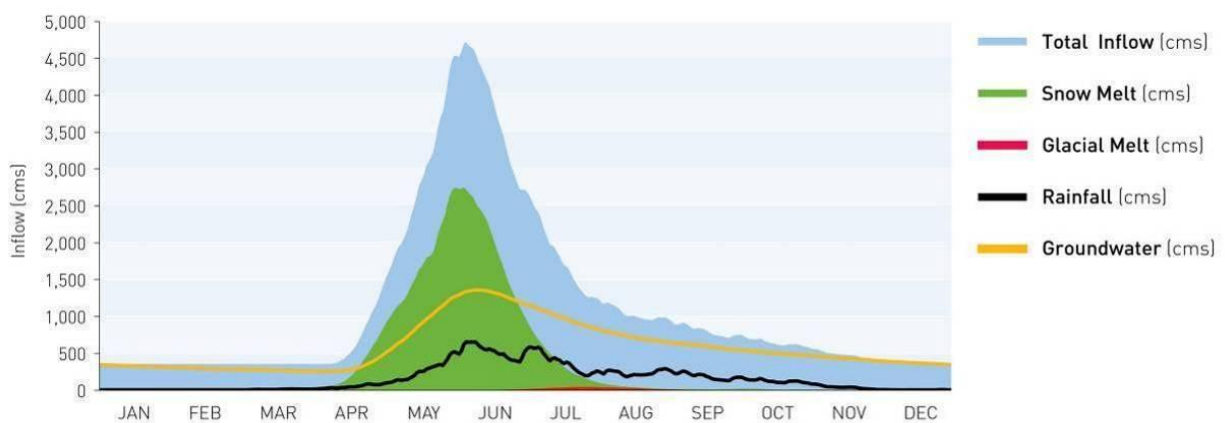
Source: AMEC and LGL 2008a and b

**5.2.2 Peace River Inflows**

The two major headwater tributaries to the Peace River, the Finlay and Parsnip rivers, originate in mountainous regions in the northwest and southwest corners of the Peace River basin (**Figure 5.1**). These rivers drain into Williston Reservoir, a T-shaped reservoir with a total surface area of about 1,770 square kilometres at full pool.

Mean annual inflow into the Williston Reservoir is approximately 1,135 cubic metres per second. Flows into Williston Reservoir are composed of, on average, 60 per cent snowmelt and 40 per cent rainfall. Since no significant glaciers feed the Williston Reservoir, glacial melt is not expected to be a significant component of the inflows.

The yearly runoff pattern into Williston Reservoir is characterized by low inflows during December through April and much higher inflows when the snow melts in late April through July. Heavy summer rains can create high inflows from June through July. Moderate inflows due to rainfall typically occur in August through November. Approximately 63 per cent of the inflow into Williston Reservoir occurs in the May through July period, with the peak inflow typically occurring due to snowmelt between mid-May and mid-June (**Figure 5.4**).



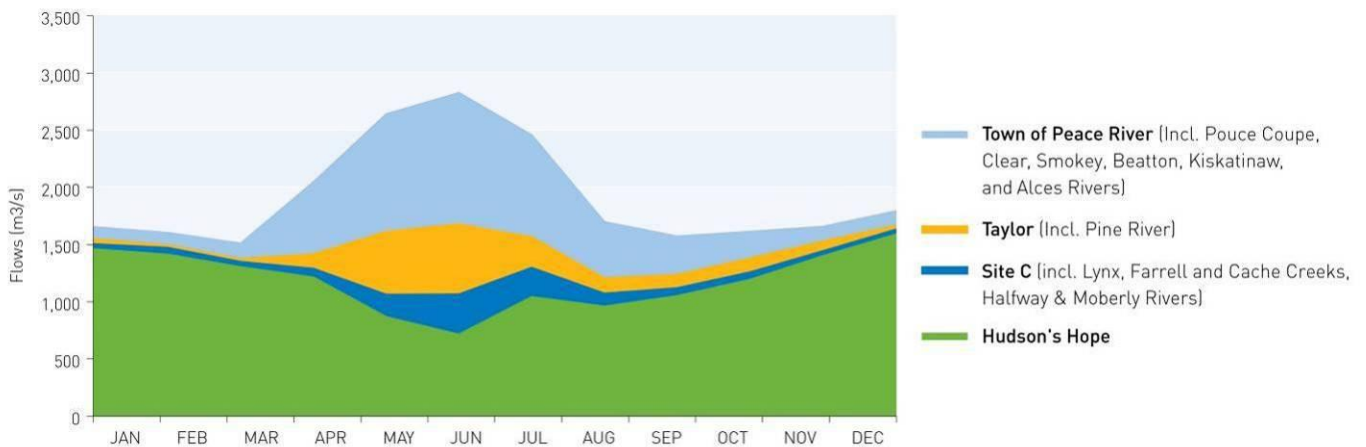
**Figure 5.4 Williston Inflow Partition**

About nine cubic metres per second of inflow is associated with local tributary inflow into Dinosaur Reservoir downstream of the W.A.C. Bennett Dam.

From Peace Canyon Dam, the Peace River flows east for approximately 148 kilometres toward the Alberta border, past the B.C. communities of Hudson's Hope, Fort St. John and Taylor. In this section, the river channel is generally confined at normal flow levels (i.e., less than 2,000 cubic metres per second). Between the B.C.-Alberta border and the town of Peace River, the river transitions from a complex and divided channel with many islands, gravel bars and side channels to a single, well-defined channel with few islands.

The relative contribution of flow from Peace Canyon to the total Peace River discharge decreases as water travels downstream due to the influence of inputs from other major tributaries, including the

Halfway, Pine, Smokey, Beatton, Kiskatinaw and Alces rivers. The annual distribution of the Peace Canyon and tributary discharges to the town of Peace River are illustrated in **Figure 5.5**.



**Figure 5.5 Mean Monthly Contribution of Flow Downstream of Peace Canyon Dam to the Town of Peace River**

The manner in which downstream river levels respond to changes in river flows varies at different points downstream of Peace Canyon Dam, depending on various factors, including the depth, width and slope of the river channel. In general, the river channel becomes wider and flatter with increasing distance downstream of Peace Canyon. These two-dimensional changes result in opposite effects:

- A wider river results in a decrease in the river level's response to flow changes. From Peace Canyon to the town of Peace River, the widening of the river dominates this effect and the water level range, due to changes in flows, decreases with distance downstream.
- A flatter river channel results in an increase in the river level response to flow changes. Downstream of the town of Peace River, at about Carcajou, and continuing on through Fort Vermilion and Peace Point, the flatter river channel slope causes a greater change in river levels with changes in flows.

### 5.2.3 Overview of BC Hydro's Existing Facilities on the Peace River

BC Hydro's existing facilities on the Peace River system have played a key role in B.C.'s integrated electrical system since the completion of the W.A.C. Bennett Dam and the G.M. Shrum generating station in 1968. The subsequent development of the Peace Canyon Dam and generating station, completed in 1980, increased this role. Influence on downstream flows is primarily governed by operations at G.M. Shrum.

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### **5.2.3.1 W.A.C. Bennett Dam, Williston Reservoir and G.M. Shrum Generating station**

The W.A.C. Bennett Dam is located on the Peace River approximately 168 kilometres upstream of the Alberta border. The 183-metre high earthfill dam impounds the Williston Reservoir. The T-shaped reservoir has an active storage volume of about  $39,500 \times 10^6$  cubic metres (multiple years of storage). The reservoir provides seasonal storage and regulates the contribution of runoff from upstream of the Bennett Dam. The reservoir level is higher in the late summer or early fall following the capture of freshet flows, and lower in the early spring after water is withdrawn from storage. Under normal operations, the maximum licensed reservoir level is about 672 metres. The minimum licensed reservoir level is about 642 metres. Annual operations within this range typically vary by less than 18 metres.

The G.M. Shrum generating station, located at the Bennett Dam, has 10 generating units with a generating capacity of 2,730 megawatts. The total discharge for power generation is licensed to 1,968 cubic metres per second. BC Hydro's current operations at G.M. Shrum and Peace Canyon generating stations are regulated by its water licences for storage and power diversion under the *Water Act* and by a *Water Act* Order (August 2007) that reflects the consensus recommendations of the Peace Water Use Plan (BC Hydro 2007a). Water discharged from the G.M. Shrum generating station or spilled at Bennett Dam flows directly into the Dinosaur Reservoir, discussed below.

### **5.2.3.2 Peace Canyon Dam, Dinosaur Reservoir, and Peace Canyon Generating Station**

The Peace Canyon Dam is located 20 kilometres downstream of the W.A.C. Bennett Dam near the town of Hudson's Hope. The 61-metre-high concrete dam impounds the Peace River to form Dinosaur Reservoir within the steep walls of the Peace Canyon. Dinosaur Reservoir has active storage of about  $49 \times 10^6$  cubic metres of water. Water discharged from the G.M. Shrum generating station or spilled at Bennett Dam flows directly into the Dinosaur Reservoir which, relative to Williston, has limited storage. Water levels in Dinosaur Reservoir fluctuate to a lesser degree than those in Williston Reservoir (e.g., three metres).

The Peace Canyon generating station has four generating units with a capacity of 694 megawatts. Total discharge for power generation is licensed to 1,982 cubic metres per second.

## **5.2.4 Water Management**

BC Hydro's existing Peace River projects are critical generation resources, allowing BC Hydro to rapidly respond to changes in the provincial integrated electricity system demands. The flexibility offered by Williston Reservoir's multi-year storage capability is used to match system generation to overall system electricity demand over periods ranging from minutes to years.

Operation of BC Hydro's existing facilities generally follows a pattern similar to that of domestic electricity use, with higher generation and water discharges in the winter, and lower generation and discharges in the spring. Discharges from existing facilities can be similarly higher in the daytime and lower at night. These are long-term historical patterns. However, for any particular day, there may be operational constraints or other issues that vary from these patterns as long as reservoir levels and power plant discharges remain within licence requirements.

At Peace Canyon, BC Hydro is permitted under its water licence to discharge water for the purpose of power up to 1,982 cubic metres per second through turbine generation. Under the *Water Act* Order, BC Hydro is also required to maintain, at all times, a minimum flow of 283 cubic metres per second for fisheries and riparian habitat, downstream water consumption, and recreational access. While this minimum flow may be provided by any combination of spill or turbine generation discharge, under normal operations it is provided solely by generation.

Spilling is the discharge of water that is not used for power generation. While infrequent, spills may occur when total project inflows exceed the licensed turbine discharge amounts at Bennett Dam and Peace Canyon. Operations during such an event are managed with additional due diligence associated with dam and facility safety, public safety, and environmental concerns. Both dams are designed to safely spill water, and spill releases can be part of normal and/or emergency operations and do not conflict with any licence requirements.

The risk of spill is an important consideration in BC Hydro's operations planning process since a spill represents lost energy production. Small spills may occur to maintain environmental flows during plant outages, to manage hydraulic imbalances between the G.M. Shrum and Peace Canyon generating stations to meet energy demands, or to accommodate routine maintenance such as gate testing. While less-frequent larger spills can occur when the Williston Reservoir is near full, the reservoir levels must be managed within licensed storage limits.

Over the past 40 years, eight spill events have occurred, with total project discharges greater than 1,982 cubic metres per second downstream of Peace Canyon Dam. Two of these events took place in the past 20 years (1996 and 2002). Small spills (i.e., spills involving a total discharge of less than 1,982 cubic metres per second) have no significant downstream effects relative to normal operational discharges within this range. Larger spills (i.e., spills involving a total discharge in excess of 1,982 cubic metres per second) may have both positive and negative effects relative to normal operations.

Communication about spill events at W.A.C. Bennett Dam or Peace Canyon Dam and associated environmental monitoring and reporting are conducted in accordance with the Peace Spill Protocol outlined in the Peace Water Use Plan (BC Hydro 2007a).



### **5.3 River Ice Formation**

Each year, ice forms on the Peace River, beginning in northern Alberta, and then progressing upstream. This ice cover affects water levels in the river and allows for the establishment of ice bridges at various river-crossing sites in Alberta.

The presence of a hydroelectric facility can change ice conditions, both upstream and downstream of the dam. Ice that forms in the river upstream of a dam is unable to move past the dam and will, instead, create ice cover accumulating upstream. This ice is not available for river ice cover accumulation downstream of the dam.

In any given year on the Peace River, there is approximately a 50 per cent chance that the Peace River ice front will extend into B.C. Although, historically, ice fronts have been observed as far upstream as the District of Taylor roughly 20 per cent of the time, this has not occurred since 1996 due to milder winter temperatures.

After the construction of G.M. Shrum and Peace Canyon generating stations, BC Hydro, the B.C. Ministry of Environment (BCMOE), and Alberta Environment created a Joint Task Force (of which they are all members) to manage the operation of the Peace River during ice periods. The Joint Task Force manages flood protection issues associated with river ice consolidation and breakup on the Peace River. The Joint Task Force agreed upon a set of procedures for the operation of G.M. Shrum and Peace Canyon generating stations during this time.

BC Hydro manages the flow regime from Peace Canyon Dam in the winter to reduce flood risk associated with ice jams near the town of Peace River. The Williston Reservoir provides ancillary protection for flood risk reduction by reducing the spring freshet flows.

If the Site C Project is approved, discharge temperatures during the winter may be slightly altered compared to the current state. As indicated, the Site C dam would also prevent ice from upstream of the dam accumulating downstream.

Water temperature and ice modelling for the proposed Site C reservoir and downstream Peace River will be conducted during the environmental assessment process to further refine BC Hydro's understanding of potential Project effects on ice formation within and downstream of the proposed reservoir.

### **5.4 Fluvial Geomorphology**

The major sources of sediment below the Peace Canyon Dam are the tributaries of the Peace River and natural erosion. Construction of the W.A.C. Bennett Dam and the Peace Canyon Dam did not

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appreciably affect the quantity of sediment delivered to the Peace River below the dams. However, construction of these two dams has had the following effects (Church 2005):

- The river's competence to transport bedload (mostly sand and gravel) has been reduced, so that the riverbed is aggrading and becoming finer-textured in some places, particularly near tributary confluences
- The width of the channel is decreasing as vegetation encroaches into marginal areas that are no longer inundated on a regular basis
- The lower reaches of some tributaries have aggraded and/or become laterally unstable due to the accumulation of bedload material at their mouths

## 5.5 Water Quality

BC Hydro has been collecting baseline water quality data from the Peace River, Peace River tributaries and Dinosaur Reservoir since 2005. Baseline water quality data reports can be found at the following link:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

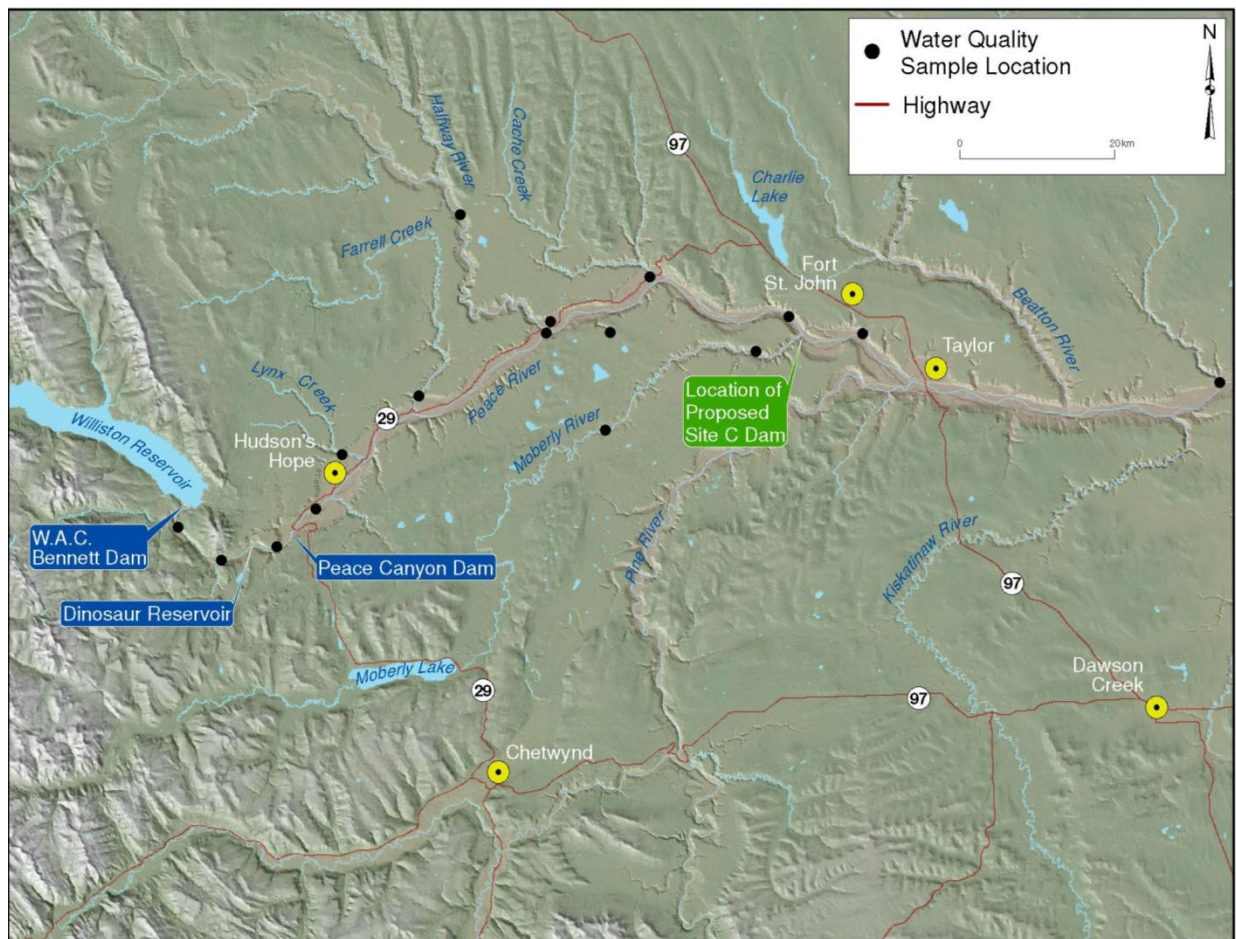
BC Hydro is currently conducting additional studies, and water quality data will be compiled and analyzed to inform the effects assessment.

Water quality sampling locations are shown in **Figure 5.6**. Water quality parameters measured during this program included: water temperature, turbidity, nutrients, metals, chlorophyll *a*, and organic carbon content. Total metals concentrations were also measured in vegetation, river sediments and soils, while fish tissue samples were analyzed for total mercury.

General program findings to date are summarized in the following sections.

### 5.5.1 Water Temperature

Peace River baseline water temperature data reflect the influence of both the Dinosaur Reservoir and tributary inflows. Compared to the tributaries, water temperatures in the Peace River tend to be cooler in the summer months and warmer in the winter months. In addition, late spring, summer and early fall mean monthly water temperatures were warmer in the tributaries compared to the Peace River, with highest tributary temperatures corresponding to decreasing spring runoff (**Table 5.2**).



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**Figure 5.6 Water Quality Sampling Locations**

**Table 5.2 Summary of Mean Daily Water Temperatures (degrees Celsius) from the Peace River and Tributary Sample Sites in 2008**

	Peace River Hudson's Hope	Farrell Creek	Peace River Upstream of Halfway River	Halfway River	Kiskatinaw River	Peace River Downstream Kiskatinaw River
May	4.0	9.5	6.4	9.3	11.2	7.5
June	7.5	16.6	11.1	11.2	17.2	13.4
July	10.3	19.3	12.3	15.3	19.9	14.8
August	11.5	17.5	12.4	14	18.3	14
September	11.7	11.9	12.1	10.9	12.3	12.4

Source: Golder 2009

Water temperatures in the Peace River also tend to fluctuate less than those in the tributaries. These fluctuations become more pronounced with distance downstream of the Peace Canyon Dam, reflecting the increasing influence of tributary inflows and solar heating.

During the water quality monitoring program, maximum mean daily temperatures in the tributaries ranged from 17.8 degrees Celsius in the Halfway River to a high of 25 degrees Celsius in the Kiskatinaw River. Instantaneous maximum daily tributary temperatures ranged from 18.9 degrees Celsius in the Halfway River to a high of 28.6 degrees Celsius in the Beatton River.

BC Hydro will use baseline water temperature data, collected from the Peace River and selected tributaries between the Peace Canyon Dam and the Alberta border since 2005, to predict future water temperatures in, and downstream of, the proposed Site C reservoir. This information will, in turn, inform the assessment of Project-related effects on fish species distribution and species composition. Additional water temperature and ice modelling for the proposed Site C reservoir and downstream Peace River will be conducted during the environmental assessment process to further refine BC Hydro's understanding of Project effects on ice formation within and downstream of the proposed reservoir.

### **5.5.2 Metals (in Water)**

Existing concentrations of certain total metals (i.e., aluminum, antimony, arsenic, cadmium, copper, iron, manganese, selenium, silver, thallium, vanadium and zinc) recorded in the Peace River and its tributaries currently exceed existing provincial and federal water quality guidelines for the protection of aquatic life, whereas concentrations of dissolved metals tended to be below detection limits. Total and dissolved levels of mercury in all water quality samples were below detection limits. Guideline exceedances of total metals were linked to total suspended solids levels and were particularly apparent at tributary sample sites during spring freshet conditions. The frequency of guideline exceedances for total metals increased with distance downstream of the Peace Canyon Dam, reflecting the accumulative influence of tributary inflows.

### **5.5.3 Suspended Sediment**

Based on water quality data, there are two distinct turbidity peaks in the Peace River associated with periods of peak runoff in the tributaries. The first major peak in turbidity occurs in April and is associated with inflows from smaller tributaries and initial spring snowmelt in low-lying areas. The second major peak, recorded in June, is associated with runoff from the larger Halfway and Moberly rivers. Turbidity can have limiting effects on fish species distribution and is also correlated with total suspended solids levels and downstream sediment transport.

#### **5.5.4 Other Environmental Analysis**

In addition to water quality data, BC Hydro has compiled baseline data that includes physical and chemical parameters analyzed in river sediment, soil, terrestrial vegetation, and fish tissue.

Key study findings included:

- Arsenic and nickel in sediment samples exceeded provincial and/or federal sediment quality guidelines at most sites, while cadmium, copper and iron exceeded these guidelines at a few sites
- Soils were of river origin and, while barium was the only metal to exceed provincial contaminated site regulations for park land use at more than one site, mercury was detected in two samples
- Very low levels of mercury were detected in vegetation samples
- Mercury levels in bull trout and mountain whitefish tissue ranged from 0.018 to 0.14 parts per million and from 0.014 to 0.086 parts per million, respectively. These levels are well below the 0.5 parts per million standard for total mercury established by Health Canada for commercially sold fish.

#### **5.6 Groundwater**

Groundwater extraction in the vicinity of the Project is primarily undertaken to provide domestic and agricultural water supplies and to support oil and gas operations. In general, groundwater flows towards the Peace River, which acts as a regional groundwater discharge point.

A groundwater quality baseline study will be conducted in Stage 3 with considerations for potential impacts associated with the filling of the Site C reservoir.

#### **5.7 Climate, Air Quality, Greenhouse Gas Emissions, and Noise**

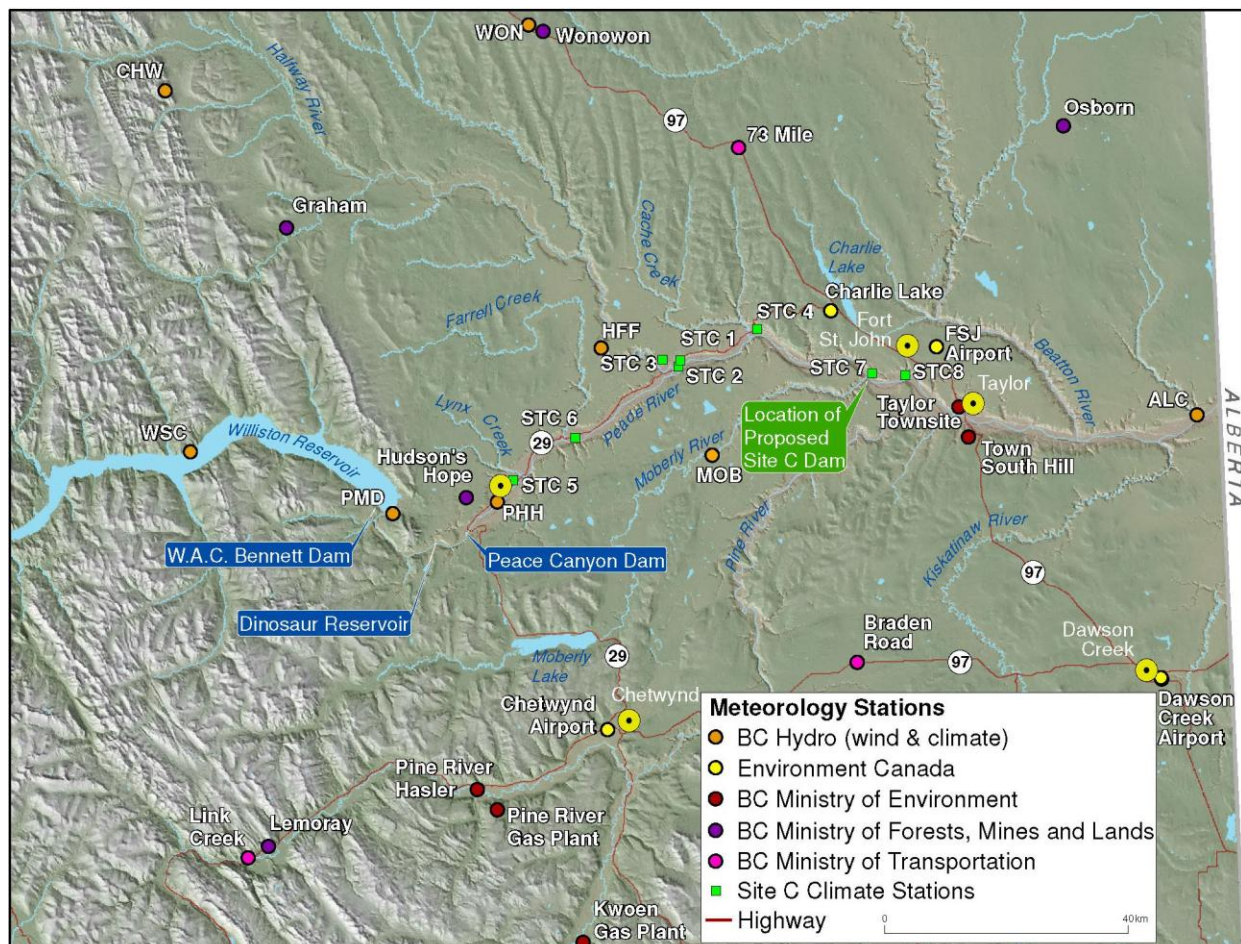
##### **5.7.1 Climate**

The climate of the Peace River Valley is continental and characterized by long, cold winters and short, warm, moist summers. The main flow of air is from the southwest. While very cold, dry masses of Arctic air dominate in winter, these are occasionally replaced by somewhat warmer and moister air from the west. Very warm air from the southern regions of the continent rarely penetrates to these latitudes (Environment Canada 2010).

Early spring generally has the lowest precipitation. Rainfall levels peak in summer and decrease to relatively low levels in fall and winter. Virtually all of the precipitation that occurs between November and March falls as snow.

Air temperatures at Fort St. John range from very cold in January to moderately warm in July. During winter, it is usual to have periods of Arctic weather with temperatures between -29 degrees Celsius and -40 degrees Celsius. The extreme minimum temperature recorded at Fort St. John is -47 degrees Celsius, while the extreme maximum temperature is 34 degrees Celsius. The lowest and highest average daily temperatures are -14 degrees Celsius in January and 16 degrees Celsius in July, respectively. In Fort St. John, winds are most frequently from the southwest (Environment Canada 2010).

Active meteorological stations in the region are operated by several parties, including Environment Canada, the B.C. Ministry of Environment (BCMOE)<sup>6</sup>, the B.C. Ministry of Forests, Mines and Lands, the BCMOT, and BC Hydro (Figure 5.7). A number of stations that previously recorded daily observations are no longer operational. Parameters measured at active stations are summarized in Table 5.3.



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**Figure 5.7 Active Climate and Wind Monitoring Stations in the Peace River Region**

<sup>6</sup> Refer to Section 15 for the list of relevant BC government ministries, their acronyms and the naming conventions.

**Table 5.3 Climate Parameters Measured by Agencies and BC Hydro**

Monitoring Station	Shortest Distance from Reservoir (km)	Period of Operation	Wind Speed	Wind Direction	Relative Humidity	Air Temperature	Ceiling Height	Barometric Pressure	Dew Point	Cloud Opacity	Solar Radiation	Cloud Amount	Precipitation	Snow on Ground	Net Radiation	Heat Flux	Soil Water Content	NO <sub>2</sub>	H <sub>2</sub> S/ SO <sub>2</sub>	Total Reduced Sulfur (TRS)		
Env Can	Dawson Creek Airport	69	1964 - Present	X	X	X	X	X	X	X	X	X	X	X								
	Fort St. John Airport	12	1953 - Present	X	X	X	X	X	X	X	X	X	X									
	Charlie Lake	13	1988 - Present			X	X					X	X									
	Chetwynd Airport	40	1982 - Present	X	X	X	X	X	X	X	X	X	X	X								
BCMOE	Fort St. John NP Cultural Centre	7	2001 - Present																		X	
	Kwoon Gas Plant	72	2002 - Present	X	X	X	X															
	Pine River Gas Plant	48	1993 - Present	X	X	X	X															
	Pine River Hasler	45	1999 - Present	X	X	X	X															
	Taylor South Hill	19	1998 - Present	X	X	X	X															
BCMOFML	Taylor Townsite	16	1996 - Present	X	X	X	X										X	X	X	X		
	Hudson's Hope	4	1986 - Present	X	X	X	X						X									
	Osborn	52	2009 - Present	X	X	X	X					X										
	Lemoray	125	1988 - Present	X	X	X	X					X										
	Graham	99	1979 - Present	X	X	X	X					X										
BCMOT	Wonowon	61	1990 - Present	X	X	X	X					X										
	73 Mile	31	2002 - Present	X	X	X	X	X	X	X	X	X	X									
	Braden Road	46	2002 - Present	X	X	X	X	X	X	X	X	X	X									
	Link Creek	67	2002 - Present	X	X	X	X	X	X	X	X	X	X									
BC Hydro	ALC (Peace River above Alces River)	54	2000 - Present	X	X	X				X												
	PHH (Peace River at Hudson's Hope)	0	2006 - Present			X																
	MOB (Moberly River at Fort St. John)	15	2000 - Present			X						X										
	HFF (Halfway River at Farrell Creek)	10	2000 - Present			X						X										
	CHW (Chowade Upper)	85	2000 - Present			X						X										
	PMD (GMS Hudson's Hope)	14	2000 - Present			X						X										
	WSC (Williston Lake at Schooler)	48	2000 - Present			X																
	WON (Wonowon)	63	2000 - Present			X																
	STC1 - Upper Attachie	0.2	2011 - Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	STC2 - Lower Attachie	0	2011 - Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	STC3 - Attachie Plateau	0.8	2011 - Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	STC4 - Bear Flat	0.1	2011 - Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	STC5 - Hudson's Hope	0.7	2011 - Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
STC6 - Farrell Creek	0.1	2009 - Present	X	X																		
STC7 - Site C	0.3	2011 - Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
STC8 - Old Fort	5	2011 - Present																			X	

Env Can – Environment Canada  
 BCMOE – B.C. Ministry of Environment  
 BCMOFML – B.C. Ministry of Forest, Mines and Land  
 BCMOT – B.C. Ministry of Transportation and Infrastructure

There are several meteorological stations in close proximity to the proposed Site C reservoir. The station at the North Peace Regional Airport (Fort St. John airport), located approximately seven kilometres east of Fort St. John, has the longest period of record (i.e., several decades).

During Stage 2, BC Hydro developed a climate monitoring program for the Peace River Valley, beginning with the installation of wind monitoring stations in early 2009. In 2010, all but one wind monitoring station were replaced with climate monitoring stations. The climate monitoring program records precipitation levels, wind speed and direction, air temperature, barometric pressure, humidity, solar radiation, and heat flux. These observations will be used to establish a pre-Project baseline of local climate data within the valley that will be incorporated into a regional climate model and a water temperature model. These models, in turn, will be used to predict the Project's effect on local climate conditions.

### **5.7.2 Air Quality**

The BCMOE operates a network of ambient air quality monitoring stations that record atmospheric levels of particulate matter less than 10 microns ( $PM_{10}$ ), particulate matter less than 2.5 microns ( $PM_{2.5}$ ), hydrogen sulphide, sulphur dioxide, total reduced sulphur, nitrogen dioxide, nitrogen oxide and ozone.

The closest ambient air quality monitoring stations to the Project are located in Fort St. John at the North Peace Cultural Centre, in Hudson's Hope, Taylor Townsite, Taylor South Hill, and at the Pine River Gas Plant and Pine River Hasler stations. Monitoring for most parameters began prior to 2000. Data completeness ranges from 75 per cent to 96 per cent for years in which station operations spanned the entire year.

The air quality station at the North Peace Cultural Centre measures particulate matter (both  $PM_{10}$  and  $PM_{2.5}$ ) and likely captures data that is representative of PM concentrations throughout Fort St. John. A station established for a few years (2003 to 2006) in Hudson's Hope measured both  $PM_{10}$  and  $PM_{2.5}$  and likely recorded data representative of PM concentrations in Hudson's Hope. Neither of the stations in Taylor, located on terraces within the Peace River Valley downstream of the Project, measures particulate matter levels. Ambient air quality data collected at the two Pine River stations, located more than 45 kilometres away, are not likely to be representative of air quality in the vicinity of the Project.

BC Hydro is currently implementing an air quality monitoring program to measure  $PM_{10}$  and  $PM_{2.5}$  baseline levels at stations located near the proposed dam site in Old Fort and within the Peace River Valley at Attachie Flat, midway between Fort St. John and Hudson's Hope.

### **5.7.3 Greenhouse Gas Emissions**

During Stage 1, BC Hydro identified the need for an estimate of GHG emissions associated with the Project. Current GHG emissions from the existing landscape in the vicinity of the Project are estimated to be approximately 4,900 tonnes per year, mainly as a result of agricultural activities. In the absence of the Project or any other land use change, this level of GHG emissions would be expected to continue.

During Stage 2, a preliminary GHG emissions estimate was developed. The estimate is made up of reservoir and land use change emissions based on the Intergovernmental Panel on Climate Change (IPCC) model guidelines, as well as construction-phase emissions based on preliminary estimates for quantities of fuel, electricity and materials required during Project development. The GHG Technical Advisory Committee (TAC) provided input and advice on the assumptions and modelling methods used by BC Hydro's consultant in developing a GHG emissions model for Site C. In



addition, the GHG TAC provided input on potential information needs for the environmental assessment and on GHG mitigation options at a high level.

Detailed modelling results can be found at the following link:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

These GHG estimates will be updated during the environmental assessment process to reflect any refinements to the Project plans.

#### **5.7.4 Noise**

Baseline noise levels in most areas surrounding the Project are typical of rural environments.

To characterize the baseline noise environment, BC Hydro will measure on-site noise levels at identified receptors and at existing sources of significant noise during the Project's environmental assessment. No previous noise monitoring has been conducted at these sites. BC Hydro will determine noise assessment criteria for identified noise receptors that could be affected by the Project, taking into account receptor susceptibility and response sensitivity to potential noise sources. This information will be used to inform the effects assessment.

### **5.8 Vegetation**

The Project is located within the Peace River Basin eco-region: a wide plain bordered by rolling uplands to the north and south, dissected by the Peace River and its tributaries (Demarchi 1996). The Project lies within one eco-section, the Peace Lowlands (PEL), and a single subzone variant, the moist, wet Boreal White and Black Spruce (BWBSmw1). The PEL is a large lowland that is deeply dissected by the Peace River and its tributaries (Demarchi 1996).

The BWBSmw1 variant covers the rolling plains that extend from near where the Rocky Mountains cross the Alberta border, north to near the Beatton River (DeLong et al. 1990). Within the BWBSmw1 variant, elevations range from 750 metres to 1,050 metres. Due to a history of frequent fires and other anthropogenic disturbances in most of the variant, trembling aspen (*Populus tremuloides*) is the dominant tree cover. The fire return interval is estimated to be 120 years (Canfor 2006). Balsam poplar (*Populus balsamifera* ssp.) occurs on wetter depressional sites and white spruce (*Picea glauca*) is present on moist to wetter sites with a limited fire history. Lodgepole pine (*Pinus contorta*) occurs as a seral species on drier and poorer sites. Black spruce (*Picea mariana*) forests, often with a minor component of tamarack (*Larix laricina*), are present on organic soils. Much of the original lowland habitat along the Peace River has been converted to cultivated crops (DeLong et al. 1990).

In 2006, BC Hydro completed Terrestrial Ecosystem Mapping (TEM) for an area lying between Hudson's Hope and the Alberta border. The TEM identified eight forested ecosystems, two forested

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wetlands, one floodplain, three non-forested wetlands, and one grassland ecosystem. BC Hydro is currently updating the TEM to reflect the revised ecosystem classifications presented in the new Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone, which is currently being published by the former Ministry of Natural Resource Operations.

As of March 2011, seven of the mapped ecosystems (scrub birch/water sedge; arctic rush – Nuttall’s alkaligrass – seablite; mat muhly – arctic rush – Nevada bluegrass; white spruce/red swamp currant/oak fern; white spruce/red swamp currant/tall bluebells; black spruce/common horsetail/peat-mosses; and spruces/red-osier dogwood [balsam poplar, black cottonwood]) are associated with ecological communities defined provincially as being “at risk”. During the environmental assessment, BC Hydro will reassess the occurrence of ecological communities “at risk” based on revised rankings and definitions for ecological communities “at risk” provided by the B.C. Conservation Data Centre (BCCDC).

During the environmental assessment, BC Hydro will also update the 1:50,000 biophysical mapping completed in the 1980s, using a combination of Vegetation Resource Inventory (VRI) data, Terrain Resources Information Management (TRIM), and current satellite imagery. Ecosystem units will also be updated to reflect changes in land use.

BC Hydro conducted baseline surveys for rare vascular plants, which identified 42 red- or blue-listed plants in the Peace River Valley and surrounding upland areas. A further 14 vascular plant species, which are currently unlisted by the BCCDC but are potentially rare and/or potentially previously undescribed, were also collected during these surveys and will be identified during the course of the environmental assessment. Non-vascular plants were identified and/or collected opportunistically during rare plant surveys.

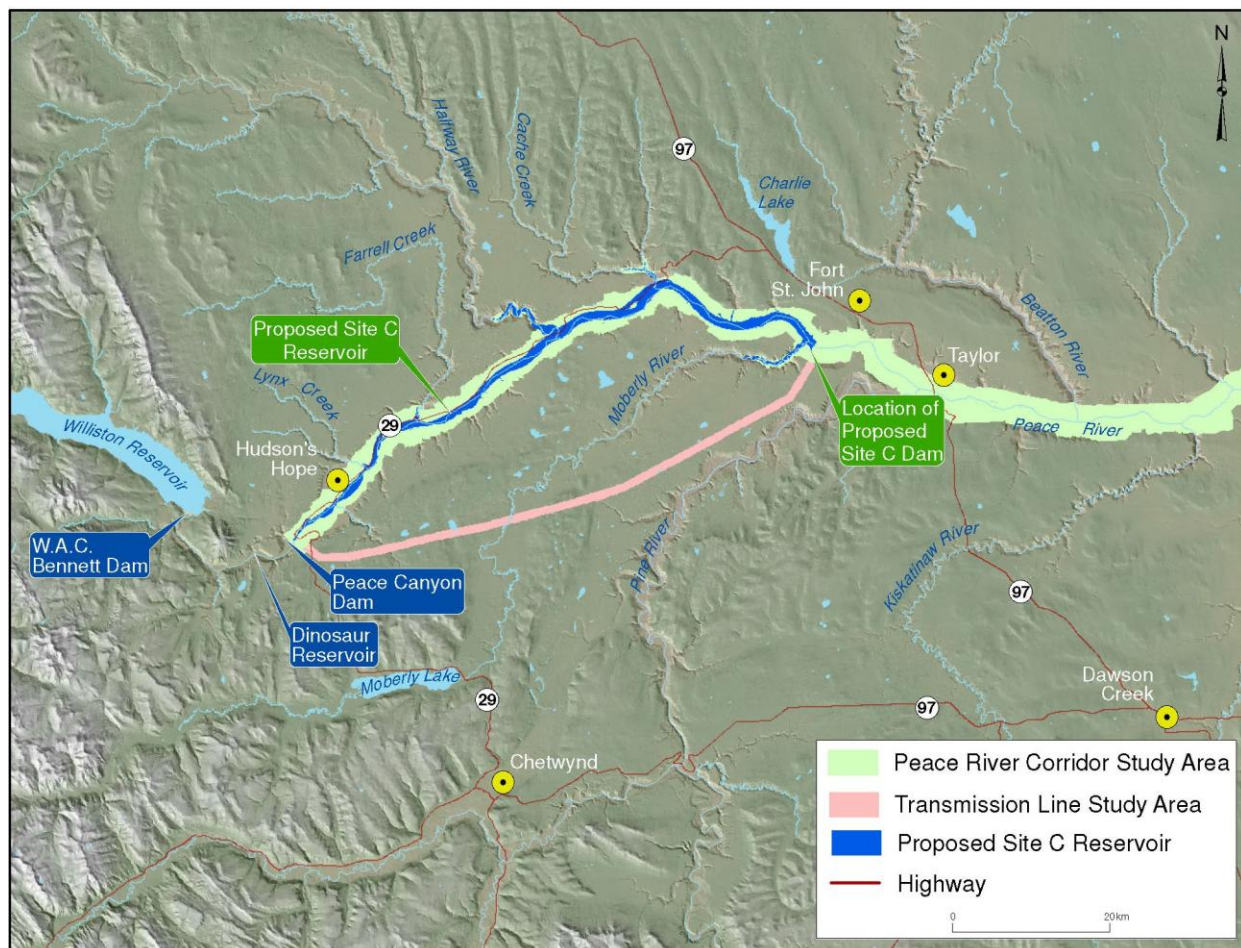
More detailed information on baseline vegetation studies conducted by BC Hydro can be found at the following link:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

## **5.9 Wildlife**

BC Hydro conducted baseline wildlife surveys in Stage 2 and is continuing to conduct surveys to identify wildlife presence and habitat use in the vicinity of the Project. Species groups surveyed include: butterflies and dragonflies, amphibians, waterfowl/shorebirds, raptors/herons, owls, songbirds, bats, furbearers and ungulates. BC Hydro used key tools, including the TEM and habitat suitability analysis, to inform the field surveys.

BC Hydro's wildlife surveys undertaken during Stage 2 augmented an existing multi-year baseline database. The boundaries for this work extended from Hudson's Hope to the Alberta border, encompassing the Peace River corridor (approximately 63,965 hectares) and the transmission line corridor (Figure 5.8). For the purposes of the Stage 2 wildlife surveys, the river corridor consisted of the entire Peace River Valley, including the floodplain and ascending slopes, extending approximately two kilometres on either side of the river. The transmission line survey area extended for 500 metres on either side of the centreline of the existing transmission line between Hudson's Hope and the proposed dam site. In 2010, BC Hydro extended the wildlife survey area beyond the Peace River Valley to allow for data collection in the surrounding region.



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**Figure 5.8 Stage 2 Wildlife Survey Areas along the Peace River from Peace Canyon Dam to the Alberta Border**

Stage 2 baseline survey results, by species group, are summarized in **Table 5.4**. **Table 5.5** provides risk status of listed wildlife species that occur in the surveyed area, their provincial and/or federal status, and the British Columbia Conservation Framework (BCCF) priority, where applicable.

Baseline wildlife reports can be found at the following link:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

The Blueberry River First Nations and municipal, provincial and federal government agencies provided input into a review of the Stage 2 wildlife program at the Wildlife Technical Advisory Committee (TAC). TAC meetings were held between September 2008 and March 2009. Participants provided input and advice regarding methods, timing, sampling and completeness of the baseline inventory data, including the need for regional scale information regarding habitat requirements and distribution of key species. A number of wildlife-specific issues were raised, including the potential effects of the Project on ungulates (i.e., mule deer, elk, moose and Stone sheep) and garter snake habitats within the potential reservoir area and the need to conduct species-specific surveys for birds at risk and of regional concern. In response to this feedback, BC Hydro added Stone sheep to ungulate surveys and initiated an ungulate and a fisher telemetry program. BC Hydro is currently evaluating the need for and preparing workplans, where necessary, to address other issues identified during these meetings in the Stage 3 wildlife program.

In response to this feedback from the TACs, BC Hydro initiated the ungulate monitoring program in January 2010 with the capture and outfitting of 20 moose, 30 mule deer, and 19 elk with GPS radio collars. These animals were captured between Hudson's Hope and the Alberta border. Collared animals are being followed for up to 24 months, with special attention being given to the documentation of birthing sites.

BC Hydro initiated a fisher telemetry study in November 2010. The study began with setting out capture stations, hair-sampling stations, and pre-baiting activities within the north and south sides of the Peace River between November and December 2010. Capture of individual fishers occurred between January and March 2011.

BC Hydro will be conducting surveys during Stage 3 for the following species in response to comments made by BCMOE and the Canadian Wildlife Service (CWS) during the wildlife TAC: northern goshawk, northern harrier, broad-winged hawk, short-eared owl, boreal owl, great grey owl, great horned owl, and conspicuous raptor nests. Swallow colony counts and surveys of songbirds (passerine), marsh birds, ruffed grouse, sharp-tailed grouse, woodpeckers and common nighthawk will also be conducted.

Bat and garter snake hibernacula studies and updating of beaver population estimates will also be undertaken in Stage 3.

**Table 5.4 Wildlife Surveys – Summary of Baseline Findings**

Indicator	Methods/Level of Effort	Results
<b>Amphibians</b>	<ul style="list-style-type: none"> <li>176.94 hours of survey time (2005, 2006, 2008)</li> </ul>	<ul style="list-style-type: none"> <li>The presence of five amphibian species (western toad, boreal chorus frog, wood frog, long-toed salamander) has been confirmed in the vicinity of the Project.</li> </ul>
<b>Bats</b>	<ul style="list-style-type: none"> <li>Mist net captures (269 net nights), radio-telemetry, detector surveys</li> </ul>	<ul style="list-style-type: none"> <li>The presence of seven species of bats (big brown, silver-haired, hoary, long-eared myotis, little brown myotis, northern myotis, long-legged myotis) has been confirmed in the vicinity of the Project. All seven species were confirmed to belong to breeding populations.</li> </ul>
<b>Beaver</b>	<ul style="list-style-type: none"> <li>Aerial food cache census, Hudson's Hope to the Alberta border</li> </ul>	<ul style="list-style-type: none"> <li>In 2005, 67 active beaver colonies were documented between Peace Canyon and the proposed dam site and an additional 75 active colonies were documented between the Moberly River and the Alberta border.</li> </ul>
<b>Butterflies and Dragonflies</b>	<ul style="list-style-type: none"> <li>Butterfly surveys were conducted at 788 sites</li> </ul>	<ul style="list-style-type: none"> <li>65 butterfly taxa have been documented in the vicinity of the Project for over three years.</li> <li>18 dragonfly species were documented in the vicinity of the Project in 2008.</li> </ul>
<b>Furbearers</b>	<ul style="list-style-type: none"> <li>Snow track surveys (2006)</li> <li>7 remote cameras (2006)</li> <li>41 hair snag stations (2009)</li> </ul>	<ul style="list-style-type: none"> <li>14 species of furbearer, excluding beaver, have been documented within the Peace River and surrounding plateau (snowshoe hare, red squirrel, Canada lynx, American marten, long-tailed weasel, ermine, common muskrat, fisher, northern river otter, red fox, wolverine, grey wolf, American mink, and coyote) have been documented within the Peace River and surrounding plateau.</li> <li>519 hair samples collected for DNA analysis. DNA analysis confirmed the presence of nine male fishers. DNA from one other fisher could not determine sex.</li> </ul>
<b>Owls</b>	<ul style="list-style-type: none"> <li>235.58 hours survey time (2005, 2006, 2008)</li> </ul>	<ul style="list-style-type: none"> <li>Eight species of owl (barred, great horned, great grey, boreal, northern saw-whet, long-eared northern pygmy) have been documented in the vicinity of the Project.</li> </ul>
<b>Raptors</b>	<ul style="list-style-type: none"> <li>Aerial surveys for large stick nests/heron colonies (2005, 2006 and 2008)</li> </ul>	<ul style="list-style-type: none"> <li>The number of active bald eagle nests along the river varies annually. The highest number documented was 25 in 2008 and the lowest was 17 in 2006.</li> <li>The estimated linear density of active bald eagle nests in the Peace River corridor is 10.6/100 km of shoreline.</li> <li>In addition to bald eagle, 11 other raptor species have been documented in the vicinity of the Project (American kestrel, broad-winged hawk, golden eagle, merlin, northern goshawk, northern harrier, osprey, peregrine falcon, red-tailed hawk, rough-legged hawk and sharp-shinned hawk).</li> </ul>
<b>Reptiles</b>	<ul style="list-style-type: none"> <li>Opportunistic observations (2005, 2006, 2008)</li> </ul>	<ul style="list-style-type: none"> <li>Common garter snakes and western terrestrial garter snakes have been documented near the Project.</li> </ul>

Indicator	Methods/Level of Effort	Results
<b>Songbirds</b>	<ul style="list-style-type: none"> <li>1,931 point counts stations (450+ hours of survey time) (2005–2008)</li> </ul>	<ul style="list-style-type: none"> <li>The three-year baseline database contains records of 116 passerine and upland game bird species.</li> </ul>
<b>Ungulates</b>	<ul style="list-style-type: none"> <li>47 blocks surveyed in February 2009</li> <li>12 sites surveyed for Stone sheep (2009): 39 pellet samples collected for DNA analysis</li> </ul>	<ul style="list-style-type: none"> <li>Ungulate winter counts documented 343 moose, 608 elk and 1,759 mule deer within the vicinity of the Project. Of these, 108 moose, 98 elk and 203 mule deer were within the potential reservoir area.</li> <li>Surveys for Stone sheep were conducted in habitats in and adjacent to the potential reservoir area. No sign of Stone sheep was observed. DNA analysis of collected pellets confirmed 27 samples from white-tailed deer and eight samples from mule deer. Five samples failed to produce results.</li> </ul>
<b>Waterfowl</b>	<ul style="list-style-type: none"> <li>425 surveys were conducted between 2005 and 2008</li> </ul>	<ul style="list-style-type: none"> <li>The three-year baseline database contains records of 61 waterfowl/water-associated birds.</li> </ul>

Source: BC Hydro Stage 2 Wildlife Reports

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

**Table 5.5 Wildlife Species at Risk Status in the Vicinity of the Project**

English Name	Scientific Name	Species Group	COSEWIC Status*	SARA Schedule	B.C. Status	CWS*	BCCF**
Western Grebe	<i>Aechmophorus occidentalis</i>	Bird			Red		1
Le Conte's Sparrow	<i>Ammodramus leconteii</i>	Bird			Blue	M	4
Nelson's Sharp-tailed Sparrow	<i>Ammodramus nelsoni</i>	Bird	NAR		Red	H	2
Great Blue Heron	<i>Ardea herodias</i>	Bird			Blue		2
Short-eared Owl	<i>Asio flammeus</i>	Bird	SC	3	Blue	H	2
Upland Sandpiper	<i>Bartramia longicauda</i>	Bird			Red		1
American Bittern	<i>Botaurus lentiginosus</i>	Bird			Blue		2
Broad-winged Hawk	<i>Buteo platypterus</i>	Bird			Blue		4
Common Nighthawk	<i>Chordeiles minor</i>	Bird	T	1	Yellow		2
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Bird	T	1	Blue	H	2
Yellow Rail	<i>Coturnicops noveboracensis</i>	Bird	SC	1	Red		1
Bay-breasted Warbler	<i>Dendroica castanea</i>	Bird			Red	H	2
Cape May Warbler	<i>Dendroica tigrina</i>	Bird			Red	M	2

English Name	Scientific Name	Species Group	COSEWIC Status*	SARA Schedule	B.C. Status	CWS*	BCCF**
Black-throated Green Warbler	<i>Dendroica virens</i>	Bird			Blue	H	1
Canada Warbler	<i>Wilsonia canadensis</i>	Bird	T	1	Blue	H	2
Rusty Blackbird	<i>Euphagus carolinus</i>	Bird	SC	1	Blue	H	2
Barn Swallow	<i>Hirundo rustica</i>	Bird			Blue	M	2
California Gull	<i>Larus californicus</i>	Bird			Blue		4
Surf Scoter	<i>Melanitta perspicillata</i>	Bird			Blue		
Connecticut warbler	<i>Oporornis agilis</i>	Bird			Red	M	2
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	Bird	NAR		Blue		2
Fisher	<i>Martes pennanti</i>	Mammal			Blue		2
Northern myotis	<i>Myotis septentrionalis</i>	Mammal			Blue		2
Western toad	<i>Anaxyrus boreas</i>	Amphibian	SC	1	Yellow		2
Arctic skipper, <i>mandan</i> subspecies	<i>Carterocephalus palaemon mandan</i>	Butterfly			Blue		4
Common woodnymph, <i>nephele</i> ssp.	<i>Cercyonis pegala nephele</i>	Butterfly			Blue		4
Common ringlet, <i>benjamini</i> ssp.	<i>Coenonympha tullia benjamini</i>	Butterfly			Blue		4
Assiniboine skipper	<i>Hesperia assiniboia</i>	Butterfly			Red		3
Bronze copper	<i>Lycaena hyllus</i>	Butterfly			Blue		4
Alberta Arctic	<i>Oeneis alberta</i>	Butterfly			Red		3
Uhler's Arctic	<i>Oeneis uhleri</i>	Butterfly			Blue		4
Old-world Swallowtail, <i>pikei</i> subspecies	<i>Papilio machaon pikei</i>	Butterfly			Blue		3
Tawny crescent	<i>Phyciodes batesii</i>	Butterfly			Blue		4
Arctic blue, <i>lacustris</i> ssp.	<i>Plebejus glandon lacustris</i>	Butterfly			Blue		4
Striped hairstreak	<i>Satyrium liparops</i>	Butterfly			Red		3
Coral hairstreak, <i>titus</i> ssp.	<i>Satyrium titus titus</i>	Butterfly			Red		3
Aphrodite fritillary, <i>manitoba</i> ssp.	<i>Speyeria aphrodite manitoba</i>	Butterfly			Blue		4

English Name	Scientific Name	Species Group	COSEWIC Status*	SARA Schedule	B.C. Status	CWS*	BCCF**
Great spangled fritillary, <i>pseudocarpenteri</i> ssp.	<i>Speyeria cybele pseudocarpenteri</i>	Butterfly			Red		3

\* Priority Region 6

\*\*Priority as of June 2010,

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

SARA – Species at Risk Act

CWS – Canadian Wildlife Service

BCCF – British Columbia Conservation Framework

NAR=not at risk, SC=special concern, T=threatened, H=high, M=medium, S=stewardship

Red=species that are likely to become endangered if limiting factors are not reversed, Blue=species whose characteristics make them particularly sensitive to human activities or natural events.

Source: BCMOE 2010a. [www.env.gov.bc.ca/conservationframework/](http://www.env.gov.bc.ca/conservationframework/); BCMOE 2010b. <http://www.env.gov.bc.ca/atrisk/red-blue.htm>; EDI 2007

Types of wildlife habitat identified within the surveyed areas include:

- Cultivated and cleared lands used as a food source and cover for wildlife, particularly ungulates and birds
- Steep sloped south aspect ungulate winter range used by mule deer, elk and moose
- Riverine stop-over habitat for waterfowl and shorebirds
- Wetlands and back-channels stop-over and breeding habitat for ducks, songbirds and amphibians
- Low elevation riparian and floodplain forests, used by moose in winter and many other species in summer
- Upland forests used by a wide variety of species

The latter habitat type consists of seral deciduous dominated forests, mixed forests, and coniferous-dominated forests. Late stage or old-growth trees occur on older or more stable islands in the Peace River, downstream of the Peace Canyon Dam.

Portions of the steep (>25 per cent), warm-aspect (135°–285°) slopes in the vicinity of the Project are designated ungulate winter ranges and provide critical winter habitat for moose, elk and mule deer. During the environmental assessment, BC Hydro will quantify the areal extent of Project-related habitat losses in these winter ranges and assess potential effects.

## 5.10 Fish Communities and Migration

During Stage 2, BC Hydro expanded on earlier baseline aquatic and fisheries studies.



The Fish and Aquatics TAC consisted of representatives from the federal, provincial and municipal government as well as the Blueberry River First Nations. The Fish and Aquatics TAC met four times between September 2008 and March 2009. The goal of the Fish and Aquatics TAC was for representatives to provide input to help BC Hydro develop an information base that would support a possible future environmental review process. Key meeting topics included background information and issue sharing, effects mechanisms, data gaps and study requirements, and potential mitigation and enhancement options. The Fish and Aquatics TAC emphasized the importance of management objectives as a means of assisting a future environmental assessment. During the TAC, the regional office of the BCMOE committed to establishing regional management objectives for the Project.

BC Hydro is continuing to conduct studies to develop an understanding of baseline conditions of fish communities and individual species life histories, habitat utilization, and seasonal movements in the Peace River and its tributaries. Ongoing work will provide further information regarding species genetic diversity, aquatic productivity, and the behaviour of methyl mercury for the purposes of the Project's environmental assessment. BC Hydro is currently evaluating the need for additional work and, where necessary, is preparing work plans to address further issues identified during the Fish and Aquatics TAC meetings.

Some of the program findings to date are summarized below. Existing baseline fish reports can be found at:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

### 5.10.1 Fish Communities

The Peace River and tributaries support a diverse fish community that includes cold clear water and cool turbid water sportfish, suckers, minnows, and sculpins. Of the 32 fish species identified, none are listed as endangered, threatened or of special concern under Schedule 1 of the federal *Species at Risk Act*, or are being considered for official listing under Schedule 2 or 3 of the Act, which can be viewed at ([www.sararegistry.gc.ca/sar/listing/default\\_e.cfm](http://www.sararegistry.gc.ca/sar/listing/default_e.cfm); 9 April, 2009).

**Table 5.6** lists the fish species by groups based on their size, designation as sportfish or non-sportfish, and provincial conservation status. Four of the 32 species are identified by the BCCDC as species of concern, including blue-listed bull trout, goldeye and northern pearl dace, and red-listed spottail shiner.

**Table 5.6 Existing Fish Species Recorded in the Vicinity of the Project and their Provincial Status**

Category	Group	Species		Provincial Status <sup>a</sup>
		Common Name	Latin Name	
Large-fish	Sportfish (cold/clear water)	Arctic grayling	<i>Thymallus arcticus</i>	Yellow
		Bull trout	<i>Salvelinus confluentus</i>	Blue

Category	Group	Common Name	Species Latin Name	Provincial Status <sup>a</sup>
		Kokanee	<i>Oncorhynchus nerka</i>	Yellow
		Lake whitefish	<i>Coregonus clupeaformis</i>	Yellow
		Lake trout	<i>Salvelinus namaycush</i>	Yellow
		Mountain whitefish	<i>Prosopium williamsoni</i>	Yellow
		Rainbow trout	<i>Oncorhynchus mykiss</i>	Yellow
		Pygmy whitefish	<i>Prosopium coulteri</i>	Yellow
		Brook trout	<i>Salvelinus fontinalis</i>	Exotic
	Sportfish (cool/turbid water)	Burbot	<i>Lota lota</i>	Yellow
		Goldeye	<i>Hiodon alosoides</i>	Blue
		Northern pike	<i>Esox lucius</i>	Yellow
		Yellow perch	<i>Perca flavescens</i>	Unknown
		Walleye	<i>Sander vitreus</i>	Yellow
	Suckers	Largescale sucker	<i>Catostomus macrocheilus</i>	Yellow
		Longnose sucker	<i>Catostomus catostomus</i>	Yellow
		White sucker	<i>Catostomus commersoni</i>	Yellow
Small fish	Minnnows/ Sticklebacks/ Trout-perch	Brook stickleback	<i>Culea inconstans</i>	Yellow
		Finescale dace	<i>Chrosomus neogaeus</i>	Yellow
		Flathead chub	<i>Platygobio gracilis</i>	Yellow
		Longnose dace	<i>Rhinichthys cataractae</i>	Yellow
		Lake chub	<i>Couesius plumbeus</i>	Yellow
		Northern pikeminnow	<i>Ptychocheilus oregonensis</i>	Yellow
		Northern redbelly dace	<i>Phoxinus eos</i>	Blue
		Peamouth	<i>Mylcheilus caurinus</i>	Yellow
		Pearl dace	<i>Margariscus margarita</i>	Blue
		Redside shiner	<i>Richardsonius balteatus</i>	Yellow
		Spottail shiner	<i>Notropis hudsonius</i>	Red
		Trout-perch	<i>Percopsis omiscomaycus</i>	Yellow
	Sculpins	Prickly sculpin	<i>Cottus asper</i>	Yellow
		Slimy sculpin	<i>Cottus cognatus</i>	Yellow
		Spoonhead sculpin	<i>Cottus ricei</i>	Yellow

<sup>a</sup> Red – Indigenous species or subspecies that have been or are candidates for Extirpated, Endangered or Threatened status.  
Blue – Indigenous species or subspecies considered to be of Special Concern.  
Yellow – Species that are apparently secure and not at risk of extinction.  
Unknown – Designation highlights species where more inventory and/or data gathering is needed.  
Exotic – Species that have been moved beyond their natural range as a result of human activity.  
Status – <http://a100.gov.bc.ca/pub/eswp/>; 21 March 2011.

Source: NHC and Mainstream 2010

The structure of fish communities in the Peace River undergoes a gradual shift from a cold clear water sportfish community dominated by mountain whitefish in upstream areas to a more diverse cool turbid water fish community downstream of the Pine River confluence, the latter of which is more tolerant of elevated water temperatures and high sediment levels. The fish community structure is shown in **Table 5.7**.

### Sportfish

Fourteen fish species have recreational and food value and are designated as sportfish. This group includes nine species that inhabit cold clear water environments generally located upstream of the Pine River, and five species that inhabit cool turbid water environments generally located downstream of the Pine River and into Alberta.

Of the cold clear water sportfish species, Arctic grayling, bull trout, mountain whitefish and rainbow trout are widely distributed, with core areas for the first three species extending downstream from the Peace Canyon Dam to the Pine River confluence. Mountain whitefish is the only cold clear water species with a population that extends beyond this point, downstream into Alberta. The distribution of the five remaining cold clear water species is restricted to upstream of the Site C dam. Pygmy whitefish and brook trout are incidental species, while kokanee, lake whitefish, and lake trout, although more abundant, are adapted to lake/reservoir rather than riverine habitats. This is an important consideration, given the changes that will occur on the Peace River following Project development (i.e., conversion of riverine habitat to reservoir habitat).

Six of the nine cold clear water sportfish populations are maintained, at least in part, by recruitment from the upstream reservoirs, and two populations are maintained entirely by natural recruitment from tributaries. The Halfway River system is a major spawning and rearing area for bull trout, while the Moberly River is likely the major spawning and early rearing area for Arctic grayling. Mountain whitefish are maintained by recruitment from both tributaries and the mainstem Peace River.

In contrast to the cold clear water sportfish, the five cool turbid water sportfish populations are found primarily downstream of the Pine River and distributions of all five populations extend downstream into Alberta. None are maintained by recruitment from entrainment and most have sources of natural recruitment from locations downstream of the Project site. Only two populations, burbot and northern pike, may be maintained, in part, by recruitment from the Moberly River. The blue-listed goldeye is found seasonally in the Peace River and is thought to migrate upstream from Alberta in spring after spawning and return to downstream overwintering areas in fall.

### Suckers

Core areas for longnose sucker and largescale sucker populations are bisected by Site C, while the core area for the white sucker population is located downstream of the Beatton River confluence. Longnose sucker and white sucker populations extend downstream into Alberta while the largescale sucker population resides entirely within B.C. All three populations are maintained by natural recruitment from tributaries located upstream and downstream of the Project. The suckers group has

an ecological value to the fish community. This is particularly true downstream of the Project area where this group dominates the fish community in terms of abundance and biomass.

### Minnows

The minnow group consists of 12 species, including 10 true minnows (family Cyprinidae), and two species typically grouped within this category – brook stickleback (family Gasterosteidae) and trout-perch (family Percopsidae). Fish in this group are typically small (<150 millimetres long) and provide food for larger fish species. Core areas of most minnow populations are located either in tributaries or in the Peace River downstream of the proposed dam site. Many populations are largely restricted to, and complete all of their life requisites, in tributaries. Longnose dace is the single population in this group that has a core distribution that includes the Peace River mainstem upstream of the proposed dam site.

Ten of the 12 species of minnows have extended distributions downstream into Alberta, suggesting a strong tolerance to higher temperatures and turbidity; however, northern pikeminnow are generally found upstream of the proposed dam site. Peamouth, the other species that does not extend downstream into Alberta, is considered scarce. Most minnow populations are maintained by natural recruitment; only peamouth is maintained, in part, by recruitment from entrainment.

The BCCDC blue-listed northern pearl dace are distributed throughout the eastern portion of the Peace River drainage in B.C. Low numbers of pearl dace have been observed in association with side channel and tributary habitats.

### Sculpins

The sculpin group also consists of small-bodied fish. It includes three species, prickly sculpin, slimy sculpin, and spoonhead sculpin. Sculpins reside in tributaries as well as the mainstem Peace River. The core area of prickly sculpin habitat is located primarily upstream of the dam site, while slimy sculpin is widely distributed and extends downstream into Alberta. While spoonhead sculpin does occur upstream of the dam site, its populations are primarily located downstream into Alberta. Like minnows, all populations in the sculpin group rely on tributaries for natural recruitment and to complete all their life requisites.

## **5.10.2 Fish Migration**

BC Hydro conducted a fish movement and tracking study in Stage 2 to develop a further understanding of key fish species movements and the seasonal variation of these movements in the Peace River, in its tributaries and in the vicinity of the Project. To date, BC Hydro has radio tagged and tracked 442 adult fish (mountain whitefish, Arctic grayling, rainbow trout, walleye and bull trout) in the Peace River system and has monitored their seasonal movements using a network of fixed-

station receivers and aerial overflights. The Stage 2 tracking information supplements the results of BCMOE tracking studies conducted in 1996 to 1999, where 76 Halfway River bull trout and 49 Arctic grayling were radio tagged and tracked (AMEC and LGL 2010). Data collected will be used to inform the environmental effects assessment.

**Table 5.7 Distribution of Large-Fish Populations in the Vicinity of the Project**



Source: NHC and Mainstream 2010

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## 6 Land and Water Use

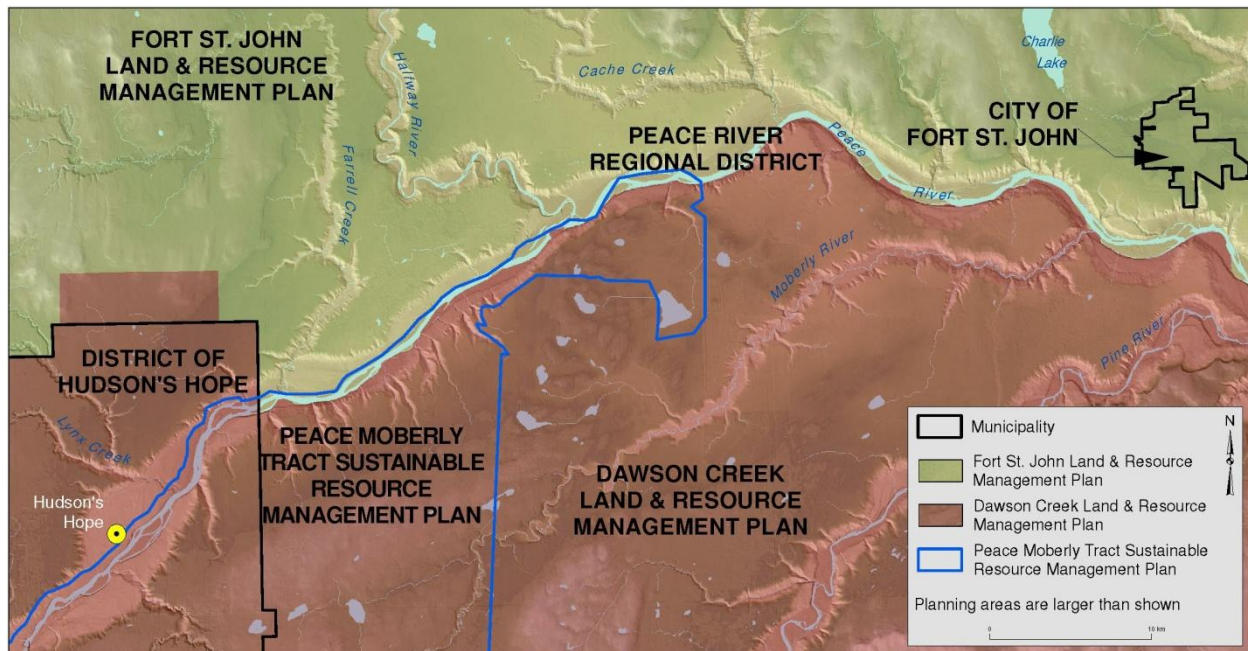
This section of the report provides an overview of the current use of land and water resources.

Similar to the objectives of the other Technical Advisory Committee (TAC) processes, the Land and Resources TAC and the Recreation/Tourism TAC provided an opportunity for input from municipal and provincial governments, regional districts and the Blueberry River First Nations to focus on potential approaches for assessing land and resource use, and recreation and tourism opportunities. For example, TAC participants reviewed the recreational use study that was underway, and discussed how the Project might influence the supply and quality of recreation and tourism opportunities, as well as the demand for those opportunities. The Recreation/Tourism TAC also discussed preliminary mitigation concepts related to recreation use. For other land and resource subject areas, some of the key themes heard were loss, alteration or conversion of land from current uses (such as forestry and agriculture), alienation of resources (such as forest or aggregate resources within the proposed reservoir area), changes to transportation infrastructure and subsequent changes to resource access, effects on local and regional government development or planning, and consideration of cumulative effects with other land use activities.

Information from these TACs is being considered and will inform the environmental assessment. Land and water use information will be updated and assessed during the environmental assessment.

### 6.1 Land Use

The Project is situated within the Peace River Regional District (PRRD) in an area that comprises largely provincial Crown land, BC Hydro-owned fee simple land, and privately held fee simple land. In general terms, most of the fee simple parcels are located on the north bank of the river, while most provincial Crown land is situated on the south bank of the river. The north bank of the Peace River is situated within the Fort St. John Land and Resource Management Plan (LRMP) area. The south bank of the river is located within the Dawson Creek LRMP and the Peace Moberly Tract Sustainable Resource Management Plan areas (**Figure 6.1**).



1016-C14-B4763

**Figure 6.1 Regional and Municipal District, and Land and Resource Management Plan Boundaries in the Vicinity of the Project**

While there are no federal lands or Indian Reserve (IR) lands located in the immediate vicinity of the Project, the area is covered by Treaty 8 First Nations. As a result of consultations undertaken to date, BC Hydro understands that parts of the Project area are used by some Treaty 8 First Nations for traditional activities such as hunting, fishing, trapping and gathering, and that there may also be sites of cultural interest, such as burial sites, camping sites, and places for gatherings or ceremonial activities within the Project area. BC Hydro is working with First Nations to identify their use of the land base through Traditional Land Use Studies and other means to help inform the communities, the environmental assessment process, and the Crown's consultation obligations. Additional information on First Nations Engagement can be found in Section 8.

During the 1970s and early 1980s, BC Hydro actively purchased properties in the Peace River Valley that could be affected by the Project of which most were acquired between 1977 and 1981.

Based on recommendations from the BCUC in the early 1980s, and in an effort to minimize the disruption of the local real estate market, BC Hydro introduced the Passive Property Acquisition Program. Under this program, potentially affected landowners have been able to voluntarily sell their property to BC Hydro, should they be interested. The property is purchased by BC Hydro based on an independent appraisal of the property and upon reaching a negotiated agreement with the owner. Property owners have the opportunity to lease back the property that they have sold to BC Hydro.



Of the land currently owned by BC Hydro in the vicinity of the Project, 93 per cent has been leased either to the former property owners or to residents in the Project area. As part of this program, all owners who have sold land to BC Hydro in relation to the Project have the right to repurchase the property, at the original price paid, if the Project is abandoned.

The Passive Property Acquisition Program remains in effect and BC Hydro continues to respond to requests from landowners who are interested in selling their property. Since the beginning of Stage 2, BC Hydro has purchased six residential properties under this Program, as well as one industrial property.

During Stage 2, BC Hydro developed updated mapping of the lands that would be inundated by the proposed Site C reservoir. Based on this mapping, it is estimated that the surface area of the reservoir would cover approximately 9,310 hectares, comprising 5,340 hectares of inundated land and 3,970 hectares that are currently occupied by the river.

Of the 5,340 hectares, 81 per cent consists of Crown land (4,318 hectares), including unclassified land and road allowances (**Table 6.1**). A further 12 per cent is owned by BC Hydro (approximately 666 hectares) and seven per cent of the inundated land is privately owned land (approximately 356 hectares) as of February 1, 2011. The areas are based on the maximum normal operating discharge from Peace Canyon and an estimated average annual flow from the Halfway River resulting in a surface area of the reservoir at a level of 461.8 metres.

**Table 6.1 Crown Land and Privately Owned Land Potentially Affected by Inundation of the Site C Reservoir**

	Potential Area of Inundation (hectares)	Percentage of Total Inundated Land Area
Crown land (includes unclassified land and road allowances)	4,318	81%
BC Hydro-owned land	666	12%
Private land	356	7%
<b>Inundated Land Area</b>	<b>5,340</b>	<b>100%</b>
<b>Inundated River Area</b>	<b>3,970</b>	
<b>Total Reservoir Area</b>	<b>9,310</b>	

Note – the shoreline erosion area of the reservoir will be defined during the environmental assessment.

Prior to construction activities or inundation of the reservoir, BC Hydro will need to purchase the remaining privately owned land in the proposed reservoir area in fee simple, and acquire tenure to Crown lands otherwise affected by the Project. BC Hydro is currently also continuing to define

potential impacts to private property from activities such as sourcing construction materials, reservoir impact lines, shoreline protection, Highway 29 realignment, access roads and the transmission line.

### 6.1.1 Agricultural Land Use

Agricultural lands and activities in the Peace River Valley are primarily concentrated on the north bank of the Peace River between Hudson's Hope and the B.C./Alberta border. Much of this land is included in the Agricultural Land Reserve (ALR).

Agricultural land can be characterized in a number of different ways, including according to its soil capability and agricultural capability, the nature and extent to which it is cultivated or supports range and grazing tenures, and its ALR zoning. **Table 6.2** shows the classification of land from previous agricultural studies. According to this data, of the 5,340 hectares of land that would be inundated by the Site C reservoir, there are 2,928 hectares of Class 1–3 agricultural land. Further studies will update and refine the agricultural land classification using current criteria.

**Table 6.2 Site C Reservoir – Agriculture Land Capability Class and Percentage of Valley Total**

<b>Agricultural Land Capability by Class</b>			
	<b>Peace River Valley (Peace Canyon to Alberta Border) (1979)</b>	<b>Site C Reservoir: (1982)</b>	<b>Site C Reservoir as a Percentage of the Valley</b>
<b>Class of Agricultural Land</b>	<b>(Hectares)</b>	<b>(Hectares)</b>	<b>%</b>
1 Optimum potential, full range of crops	2,464	106	4.3%
2 Wide range of crops, some restrictions	12,502	2,215	17.7%
3 Wide range under good management	1,765	607	34.4%
4 Restricted range, several limitations	2,116	162	7.7%
5 Perennial forage crops, severe limitations	932	358	38.4%
6 Natural rangeland, no cultivation	3,212	3	0.1%
7 No agricultural capability	2,656	68	2.6%
<b>Sub total (Class 1–3)</b>	<b>16,731</b>	<b>2,928</b>	<b>17.5%</b>
<b>Sub total (Class 1–5)</b>	<b>19,779</b>	<b>3,448</b>	<b>17.4%</b>
<b>Total</b>	<b>25,647</b>	<b>3,519</b>	<b>15.2%</b>

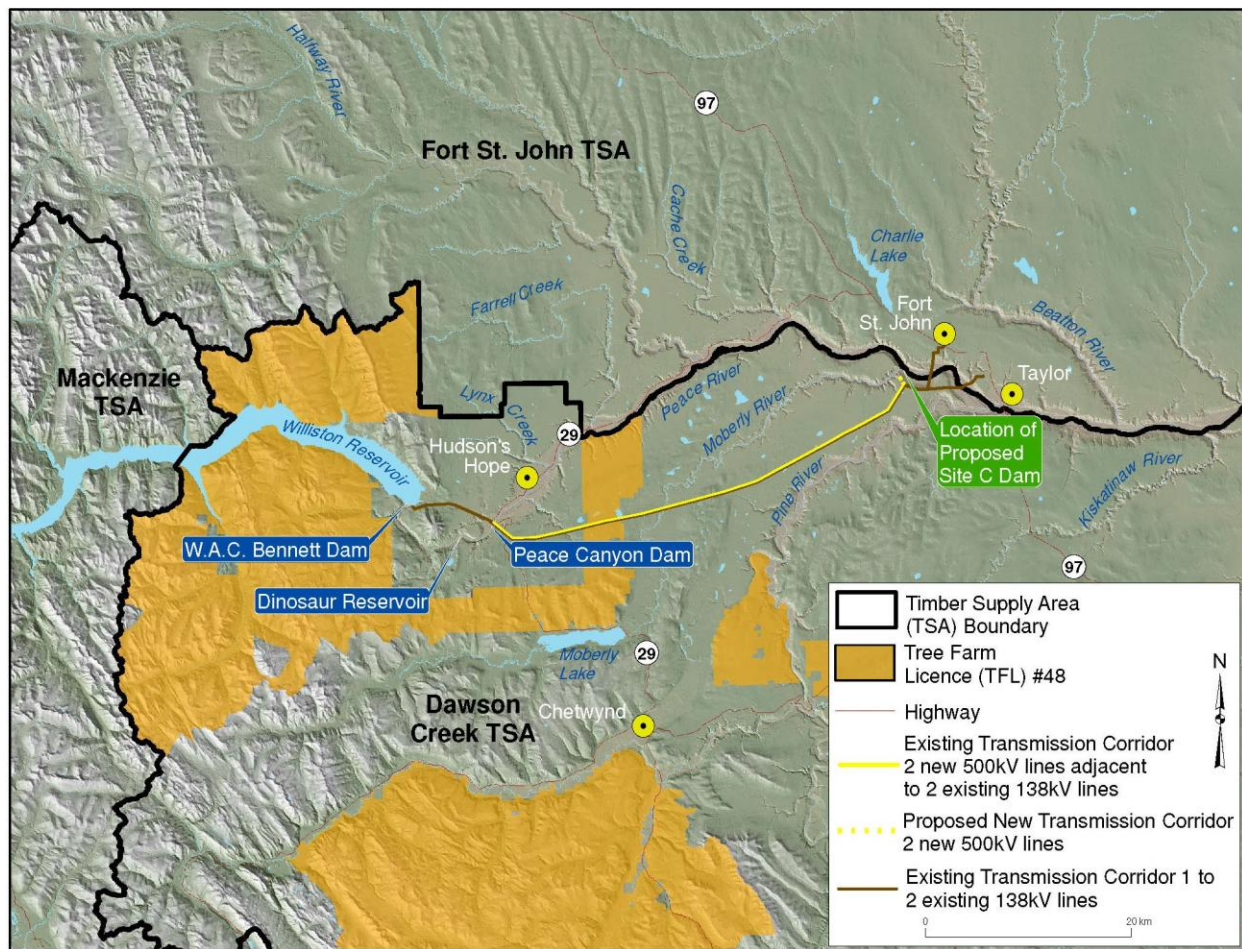
Source: Canadian Bio Resources Ltd. 1979; Pottinger 1982.

Based on recent mapping and air photograph analysis, approximately 750 hectares of land within the potential reservoir area is or has been under cultivation. Typical agricultural land uses include ranching, grazing, and forage and seed crops. Historically, there has also been some market gardening (food production) for local markets, particularly in Taylor downstream of the proposed

dam site. BC Hydro is undertaking an agricultural assessment to assess the effect of the Project on agricultural land, land use and the economy.

### 6.1.2 Forestry

The Site C Project area is within the Fort St. John and Dawson Creek Timber Supply Areas (TSAs) and one Tree Farm Licence (TFL). Both TSAs are in the Peace Forest District. The Dawson Creek TSA would be affected on its northern margin by the reservoir and also by the proposed transmission line right-of-way. The Fort St. John TSA abuts the Dawson Creek TSA along the south bank of the river and would be affected on its southern margin by the reservoir. TFL 48 consists of five discrete supply blocks. A small amount of TFL 48 would be affected by the transmission line right-of-way (**Figure 6.2**).



**Figure 6.2 Timber Supply Areas and Tree Farm Licences in the Vicinity of the Project**

Forested Crown land that is economic and available for timber harvesting is referred to as the timber harvesting land base (THLB). The size and characteristics of the forest located on the THLB in each

of the management units (i.e., the two TSAs and one TFL) are key factors in determining the long-term sustainable harvest level, as well as the current allowable annual cut (AAC). The Dawson Creek TSA, the Fort St. John TSA and TFL 48 occupy approximately 7.6 million hectares. **Table 6.3** shows the currently estimated areas and volumes of timber that would be cleared for the Project by land ownership. The approximately 6,000 hectares of Project clearing areas represent less than one per cent of each management unit.

**Table 6.3 Timber Areas and Volumes Estimated to be Cleared by Type of Land Ownership**

Land Ownership	Merchantable Conifer Volume (m <sup>3</sup> )	Merchantable Deciduous Volume (m <sup>3</sup> )	Estimated Waste Wood Volume (m <sup>3</sup> )	Forested Area (ha)	Non-Treed (NCC) Area (ha)	Total Clearing Area (ha)
Crown	346,316	536,837	503,555	4,478	1,227	5,705
BC Hydro	757	4,944	4,665	48	13	61
BC Hydro – Leased	6,256	29,760	26,234	255	76	331
Private	0	0	0	0	0	0
<b>Total</b>	<b>353,329</b>	<b>571,541</b>	<b>534,454</b>	<b>4,781</b>	<b>1,316</b>	<b>6,097</b>

Source: Industrial Forest Services Ltd. 2009

BC Hydro will develop a clearing and harvesting plan in consideration of the interests of tenure holders, First Nations, and stakeholders during the environmental assessment.

### 6.1.3 Oil and Gas

Northeast B.C. accounts for nearly all of the oil and gas activity in the province and is the second-largest natural gas producing region in Canada. Although minor in comparison to the overall area of oil and gas activity, some oil and gas tenures and facilities are located in the vicinity of the Project. Recent analysis shows eight wells and three oil and gas facilities near the Project. The three oil and gas facilities include two testing stations and a water injection site. Pipeline rights-of-way or permits intersect with the Project at 14 separate points, totalling 7.6 hectares and involving five energy companies.

### 6.1.4 Mining and Minerals

Northeast B.C. also has a long association with mineral exploration and mining, notably coal, and the region has seen the development of several major mines in recent years, including the Bullmoose and Quintette properties in Tumbler Ridge. The Peace River corridor has coal development potential and currently hosts active aggregate pits. Apart from coal and aggregate

activity, the potential related to metallic and industrial minerals appears limited. There are no operating metal mines or industrial mineral sites in the vicinity of the Project.

### **6.1.5 Recreation**

The Peace River Valley provides recreational opportunities to both residents and tourists. In 2008 and 2009, BC Hydro conducted a recreational use study to identify the most common recreation activities throughout the year. Between April and September, recreation use focused mainly on camping, jet boating, and fishing. From September through October, most recreational users use the area for hunting. Very low numbers of users were identified in the winter months.

A survey of existing recreational use sites identified camping areas located along the Peace and Pine rivers between the Peace Canyon Dam and the B.C.-Alberta border. Including the Pine River, four public campgrounds, 12 primitive maintained campsites, and a further 13 primitive unmaintained campsites were identified and mapped. There are also two private campgrounds in the Hudson's Hope area and one private campground in the Bear Flat area. Near Taylor, a municipal campground and amenities operate at Peace Island Park.

The Peace River corridor is a scenic resource with heritage value that is important for residents and as a tourism destination. Although relatively few tourists actually use the river valley recreation opportunities as compared to residents, the scenic resource in combination with regional campsites and attractions creates a regional tourism destination.

### **6.1.6 Fishing**

People fish throughout the Peace River and its tributaries. During the 2008 and 2009 recreational use study, 622 anglers were surveyed during 291 interviews. In addition to collecting recreational use information, these interviews included a creel survey between the Peace Canyon Dam and the B.C./Alberta border for the purpose of estimating angler effort and catch information for input to the fisheries assessment. Twelve per cent of angling effort occurred in the relatively small stratum from Peace Canyon Dam to Hudson's Hope, 40 per cent occurred from Hudson's Hope to the proposed Site C dam site, 23 per cent between Site C dam site and the Alberta border, and 25 per cent took place in the Pine River watershed.

For all river strata, angling effort was dominated by shore-based activity. This was especially true between the Peace Canyon Dam and Hudson's Hope (83 per cent shore-based). In the other three areas, 61 per cent, 66 per cent, and 72 per cent of angling activity was shore-based, respectively (LGL 2010).

### **6.1.7 Hunting**

The provincial government manages game species and public hunting opportunities through a variety of management tools, including hunting seasons, licensing regulations of various types, and permits. People usually hunt from late August to late November for most species. Bag or harvest limits in Region 7B (Peace) are one for most ungulates, a combined limit of two for deer, one for cougar, two for black bear, three for wolf, and none for coyote. Bag limits for birds range from three for sharp-tailed grouse to 10 for spruce grouse and ruffed grouse (BC Ministry of Natural Resources Operations 2010).

Almost all of the area was recently designated for an Agricultural Zone Hunt for elk, white-tailed deer and mule deer, which has increased hunting opportunities in the region in recent years. There are no-hunting and restricted-hunting zones in the vicinity of the Project, at Farrell Creek (firearms using shot only), and on the upper Halfway River.

Deer, moose, elk and black bear accounted for 99 per cent of the 2,680 animals harvested in the general vicinity of the Project in 2005, and 97 per cent of the 4,575 animals taken in the region. The proportion of elk in the local harvest has increased considerably since 1996. The types of birds that are harvested include grouse, ptarmigan, duck, geese and snipe.

### **6.1.8 Guiding**

Registered guiding activity is administered by the B.C. Ministry of Forests, Lands and Natural Resource Operations (BCMOFLN). There are 86 registered guide outfitters in Region 7 (northeast), 29 of which are registered in the Peace sub-region. Of these, four guide outfitter territories would intersect with the Project, representing less than one per cent of their total licensed area.

### **6.1.9 Trapping**

Fourteen registered traplines are located in the vicinity of the Project. In four cases, approximately three to five per cent of the trapline area is located in the vicinity of the Project. For the remaining 10, less than three per cent of the trapline areas fall within the vicinity of the Project. Trapping activity within each trapline will contribute to the effects assessment.

With the exception of Treaty 8 First Nations members, who do not need a licence to operate a trapline for personal use, trapping activity is registered and administered by the BCMOFLN. Individual traplines typically cover a large area.

### **6.1.10 Parks and Other Protected Areas**

Nine provincial parks and six municipal parks are located in the Peace region, one of which, Alwin Holland Municipal Park in Hudson's Hope, would be affected by the Project. A new protected area,

Peace River Boudreau Lakes, was recommended by the 1999 Dawson Creek and 1997 Fort St. John LRMP processes; however, it has not been formally designated. There are five regional parks in the area, one of which, Blackfoot Regional Park, is on the Peace River, downstream near the B.C./Alberta border.

### 6.1.11 Heritage and Culture

BC Hydro has conducted heritage resource studies near the Project since the mid-1970s. Cultural heritage resource studies have also been conducted for transportation, forestry, and oil and gas projects, and for government agencies.

As of October 2008, 115 pre-Contact archaeological sites have been documented in the vicinity of the Project as defined by the proposed reservoir area, dam site, transmission line right-of-way, and possible highway realignments. Over 95 per cent of the pre-Contact archaeological sites near the Project are lithic sites (stone tools or flakes of stone associated with making of tools). These include lithic scatters (sites with two or more stone artifacts) and isolated finds (single stone artifacts). Less frequently found site types include cultural depressions, comprising human-made pits that may have been used for food storage (cache pits), cooking (roasting pits), or habitation (house pits). In most cases, these original functions could not be determined at the time that the sites were recorded. Other types of sites include trails, human-made mounds of unknown function, burial places, and sites where only butchered animal bones were observed.

Within a one-kilometre buffer around the proposed reservoir, there are a further 149 recorded pre-Contact sites (**Table 6.4**).

**Table 6.4 Number of Pre-Contact Archaeological Sites by Project Component<sup>7</sup>**

Project Component	Number of Sites
Reservoir	83
Construction Facilities Area	10
Transmission Line Corridor	3
Road Realignment	31
One-kilometre Reservoir Buffer	149

Source: Arcas 2009

As of October 2008, 35 historic heritage sites had been identified near the Project, including trappers' cabins, gravesites and early homesteads. Two of these are sites of early fur trade posts, which were extensively researched and excavated by archaeologists in the 1980s. The fur trade era posts consist of buried archaeological remains.

<sup>7</sup> The total is less than the sum of each area because 11 sites are counted twice in the breakdown, due to their situation within two project components (e.g., reservoir and road realignment).

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During the Heritage and Archaeology Technical Advisory Committee (TAC), discussions took place about potential effects to archaeology sites (pre-contact), heritage or historic sites, and paleontology sites. BC Hydro shared draft results and maps from a heritage resources data gap analysis to help inform these discussions, and the TAC discussed the regulatory requirements for heritage studies, as well as some of the practical considerations, such as use of an archaeological potential model, for carrying out a heritage resources assessment in a large study area. For all types of sites, the main themes in terms of potential Project effects included loss of or alteration to the condition or integrity of a site, spiritual values of a site, or future access to sites as appropriate for various uses (such as for future research, social or traditional purposes, or tourism) (Arcas 2009).

BC Hydro is currently conducting a Heritage Impact Assessment in accordance with the B.C. *Heritage Conservation Act*.

### **6.1.12 Paleontology**

Fossils of interest in the vicinity of the Project include invertebrates, vertebrates and plants, as well as microfossils. Marine shales are rich in invertebrates, especially ammonites and bivalves, many of which are important in regional correlation and relative dating of strata. With one exception, vertebrate remains have not been reported as yet from bedrock strata near the Project. The exception is the “Fish-Scale Marker”, a prominent layer of fish scales that is widespread in Cretaceous strata.

Non-marine rocks have potential for the discovery of dinosaur and other skeletal material as well as footprint trackways. Significant trackways have been found in slightly older formations to the west in the Peace River Canyon.

Marine shales have potential for the discovery of fish and marine reptile fossils, as these have been found elsewhere in the region. Plant fossils have been documented in or close to the Project area.

Pre-glacial Quaternary fossils near the Project area include a mammoth tusk found in 1966 during construction of the W.A.C. Bennett Dam, and bison remains recovered from gravels beneath till at the Osterio Gravel Pit near Taylor. Fossilized rodent and rabbit bones have also been recovered from a mudflow deposit at Bear Flat.

Early post-glacial (Late Pleistocene) vertebrate fossils are widespread in the Peace region. The fauna from these deposits is dominated by bison, but also includes wapiti and horse (Arcas 2009).

BC Hydro is undertaking a paleontology resources assessment as a component of the heritage study program.



## **6.2 Water Use**

### **6.2.1 Peace Water Use Plan**

Current non-consumptive water use by BC Hydro existing hydroelectric facilities on the Peace River is governed by BC Hydro's water licences, including evaluation and recommendations from the Peace Water Use Plan (WUP). The Peace WUP was developed for existing projects on the Peace River through a consultative planning process that involved participants such as government agencies, First Nations, local citizens, and other interest groups in B.C.

The B.C. Comptroller of Water Rights reviewed the WUP under the provisions of B.C.'s *Water Act*, and involved Fisheries and Oceans Canada (DFO), other provincial agencies, First Nations, and holders of water licences who might be affected by the plans. In August 2007, the WUP was accepted by the B.C. Comptroller of Water Rights, approved by Cabinet, and is subsequently being implemented by BC Hydro (BC Hydro 2007a).

Both operational and non-operational programs are being implemented by BC Hydro. Operational requirements relate to the management of reservoir levels or flows. Non-operational programs include physical works and scientific studies to evaluate the effectiveness of the flow management requirements. The WUP, terms of reference for the field monitoring programs, and subsequent reports are available on BC Hydro's website at:

[www.bchydro.com/planning\\_regulatory/water\\_use\\_planning/northern\\_interior.html](http://www.bchydro.com/planning_regulatory/water_use_planning/northern_interior.html)

### **6.2.2 Water Licences**

As of 2010, the provincial Water Licence registry for the Peace River identified 25 active water licences (under the *Water Act*) from the W.A.C. Bennett Dam to the District of Taylor. These consumptive use licensees include several municipalities that draw community water supplies from the river or from aquifers adjacent to or below the Peace River, as well as individual residents and farmers.

Other consumptive uses in the Water Licence registry include industrial cooling and fire protection at Spectra Energy in Taylor, dust control for the BCMOT, and landowner withdrawals for domestic and agricultural irrigation use.

Additional water allocations outside of those identified in the Water Licence registry may be granted under other arrangements or authorities. In northeast B.C., the oil and gas sector uses water for activities ranging from routine drilling to advanced stimulation techniques. The use of water in drilling and servicing a well is vital to many oilfield practices. Some of the main water use activities include, but are not limited to, hydraulic fracturing, drilling and completion of an oil or gas well, rig wash

water, coolant for internal combustion engines on rigs, compressors, and other equipment, and for sanitary purposes.

The B.C. Oil and Gas Commission identifies numerous ways for the oil and gas industry in B.C. to access water (BCOGC 2010), including:

- BCMOE long-term surface water licences
- Water source wells
- Section 8 Short Term Water Licence
- Produced water as a by-product of oil and gas production
- Municipal or city water reserves
- Private landowners

## 7 Socio-Economic Setting

This section provides an overview of the socio-economic setting in the vicinity of the Project. It describes currently available information related to population, employment and income, as well as information related to housing, transportation and community services based on the most recent available data. This dataset will be updated during the environmental assessment.

During the Community Services and Infrastructure Technical Advisory Committee (TAC), BC Hydro was provided with input from municipal and provincial governments and the Blueberry River First Nations about various topics, issues and potential approaches for assessing effects on community services and infrastructure. For example, TAC discussions included the need to consider local labour market effects, options for the location and size of worker housing, Project needs, and support for community services (e.g., education, health and recreation) and infrastructure (e.g., sewer, water and waste), the lead time that local and provincial governments need to plan for and implement programs, and regional solid waste management capacity. This information is currently being considered to inform the environmental assessment.

### 7.1 Population, Employment and Income

The communities located in closest proximity to the Project include Fort St. John, Taylor, Hudson's Hope, and the Peace River Regional District (PRRD) – Electoral Area C<sup>8</sup>. In 2006, the combined population of these communities along with nearby Chetwynd and Dawson Creek was 26,681, compared to a total regional population of 59,330 (**Table 7.1**).

First Nations communities located in the vicinity of the Project include the Saulteau First Nation, West Moberly First Nation, Halfway River First Nation, Blueberry River First Nations, and Doig River First Nation. As of March 2010, the total population of these First Nations was approximately 2,000, half of whom live on-reserve.

The communities nearest the dam site accounted for about 55 per cent of the total labour force in the PRRD (**Table 7.2**). Area boundaries of PRRD are shown in **Figure 7.1**. The participation rate of the employment-age population in the labour force within the PRRD was high, and above the provincial average. If the unemployment rate remains relatively low in northeast B.C., it may constrain the availability of local labour for the Project.

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<sup>8</sup> PRRD – Electoral District C includes the rural lands outside of the municipalities of Taylor and Fort St. John on the north side of the Peace River.

**Table 7.1 Census Population, 1986 to 2010: Select Communities in the Vicinity of the Project and B.C.**

	1986 <sup>2</sup>	1996 <sup>1</sup>	2006 <sup>1</sup>	2010 <sup>1</sup>
<b>Select Community Populations</b>				
City of Fort St. John	13,355	15,683	17,933	19,873
District of Taylor	711	1,075	1,386	1,497
PRRD – Electoral Area C <sup>3</sup>	n/a	5,251	6,350	n/a
District of Hudson's Hope	1,158	1,163	1,012	1,056
District of Chetwynd	2,774	3,112	2,722	2,714
City of Dawson Creek	10,544	11,579	11,094	11,860
<b>Regional and Provincial Population</b>				
Local Study Area Peace River Regional District	57,278	58,769	59,330	63,368
Northern Rockies Regional District	n/a	6,116	6,298	6,209
British Columbia	2,889,207	3,874,317	4,243,580	4,530,960

\* Peace River – Liard Regional District

<sup>1</sup> BC Stats 2009 & 2011a, sub-provincial estimates <http://www.bcstats.gov.bc.ca/data/pop/pop/estspop.asp>

<sup>2</sup> Stats Canada 1988. [http://www.bcstats.gov.bc.ca/data/dd/handout/hist\\_cen.pdf](http://www.bcstats.gov.bc.ca/data/dd/handout/hist_cen.pdf)

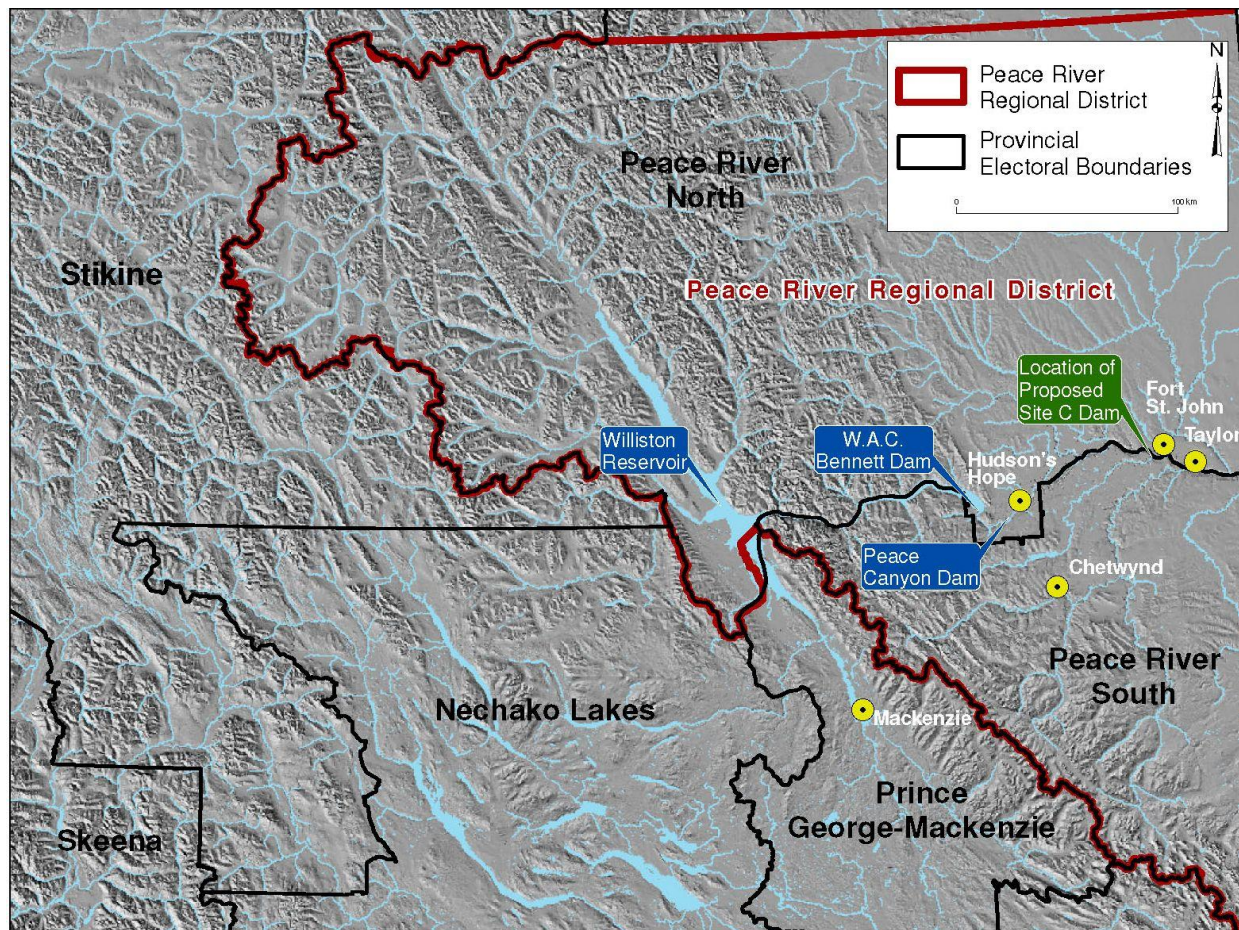
<sup>3</sup> BC Stats Census Profiles 2001 and 2006 Census (BC Stats 2003, 2010)

**Table 7.2 Labour Market Statistics, 2006**

Area	Labour Force (persons)	Employed (persons)	Unemployed (persons)	Participation Rate (%)	Unemployment Rate (%)
Peace River Regional District	34,405	32,530	1,875	76.2	5.4
Regional area (northeast B.C.) <sup>1</sup>	35,300	34,000	-	69.2	-
B.C.	-	-	-	65.6	6.0
City of Fort St. John	10,875	10,345	530	80.5	4.9
District of Taylor	860	840	15	83.9	1.7
PRRD – Electoral Area C	3,975	3,825	145	79.9	3.6

Source: Stats Canada 2006 & BC Stats 2011b

<sup>1</sup> Statistics Canada Labour Market Survey



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**Figure 7.1 Regional District and Electoral Boundaries in Northeast British Columbia in the Vicinity of the Project**

At the regional level, average income across all occupations in 2006 was higher than the provincial average (**Table 7.3**). The proportion of the workforce employed full-time, however, was very similar to the provincial average.

**Table 7.3 Employment Income, Northeast B.C. and B.C., 2006**

Industry	Northeast B.C.	B.C.
Average employment income	40,090	34,978
Total employment income (millions)	1,940	–
% of workforce that worked the full year	47.5%	46.5%

Source: Stats Canada 2006

During the construction period, direct Site C jobs would include:

- Labourers
- Carpenters
- Machinists
- Ironworkers
- Cement Masons
- Administration (surveyors, technologists, office personnel)
- BC Hydro management and engineering staff
- Safety personnel
- Electrical workers
- Operating engineers
- Welders
- Pipefitters
- Painters
- Contactors' supervisory staff
- Environmental monitors
- Other

During operations, the Project will likely be dispatched remotely, similar to the Peace Canyon Generating Station upstream. However, new operations and maintenance jobs would be required on site, including:

- Electrical workers
- Safety personnel
- Administration
- Engineers
- Environmental Monitoring

## **7.2 Housing, Transportation and Community Services**

### **7.2.1 Housing**

The Peace River region had 21,945 residential dwellings in 2006 (not including reserve housing), of which 5,575 were rental units (**Table 7.4**). Regionally, approximately 75 per cent of the dwelling stock was owned by residents; however, in Fort St. John, Chetwynd, and Dawson Creek, rental units accounted for almost 50 per cent of the housing stock.

**Table 7.4 Peace River Region – Housing Stock and Ownership, 2006**

	Owned Dwellings	Rented Dwellings	Total Dwellings
<b>North Peace</b>			
Fort St. John	4,335	2,545	6,780
Hudson's Hope	335	90	425
Taylor	395	125	525
Electoral Area B	1,385	205	1,635
Electoral Area C	2,160	155	2,315
<i>Total North Peace</i>	8,610	3,120	11,680
<b>South Peace</b>			
Chetwynd	640	385	1,025
Dawson Creek	3,060	1,590	4,650
Pouce Coupe	255	35	290
Tumbler Ridge	850	195	1,045
Peace Area D	1,905	160	2,065
Peace Area E	1,050	90	1,145
<i>Total South Peace</i>	7,760	2,455	10,220
<b>Total Area</b>	<b>16,370</b>	<b>5,575</b>	<b>21,945</b>

Source: Stats Canada 2006

Residential housing start data appears to indicate that the local housing market responds to population increases and new demand, although there appears to be a lag between population and actual construction activity. The net in-migration of over 2,000 people that occurred in 2005 reversed a seven-year period of net out-migrations and stimulated a 67 per cent increase in residential housing starts in 2006 and a further 50 per cent increase in 2007 (**Table 7.5**).

**Table 7.5 Residential Housing Starts, 2003–2007**

Community	2003	2004	2005	2006	2007
Fort St. John	204	125	153	256	382
Dawson Creek	29	38	40	67	138

Source: BC Stats and Canada Mortgage and Housing Corporation 2010

## 7.2.2 Transportation

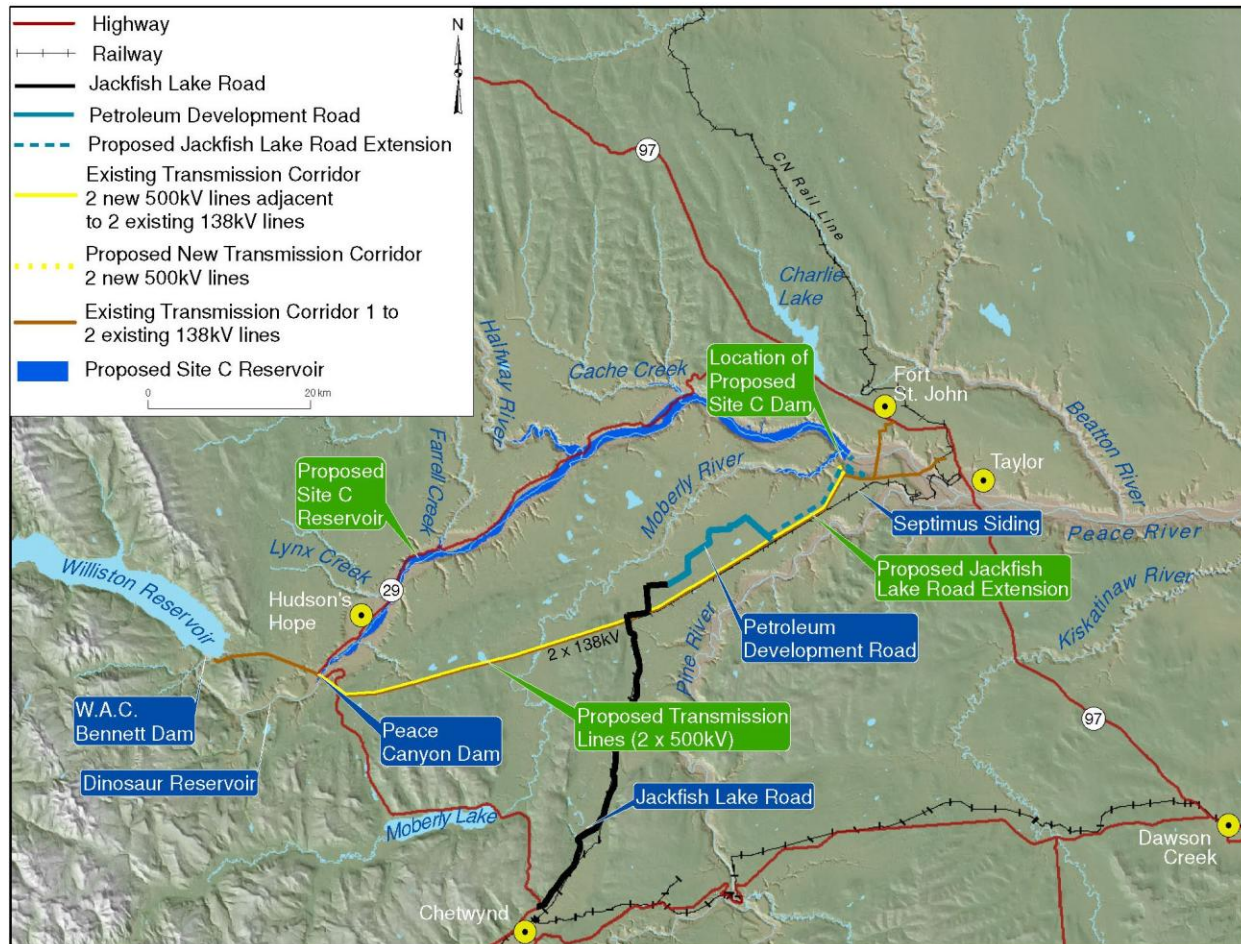
### 7.2.2.1 Highways and Roads

The primary highway corridor is the north-south Alaska Highway/Highway 97 (**Figure 7.2**), including the Peace River bridge crossing at Taylor. The highway supports local, commercial and industrial traffic, as well as through travel between northern B.C., the Yukon Territory, Alaska and points south. Much of the regional road network branches off the Alaska Highway and, in turn, supports a complex network of regional and local roads, as well as petroleum development and forest service roads.

On the north side of the Peace River, Highway 29 joins the Alaska Highway approximately 10 kilometres northwest of Fort St. John, and is the main corridor linking Hudson's Hope with Chetwynd to the south and Fort St. John to the east. Heading west from the Alaska Highway, Highway 29 serves several subdivisions and farms in its first 5.5 kilometres. Beyond this, the road links local petroleum development and forest service roads, and serves agricultural properties and smaller residential parcels along its entire length. Although Highway 29 was recently resurfaced, few changes have been made to its original alignment. As indicated, four sections of the Highway 29 descend into the Peace River Valley and would be inundated by the Project, requiring realignment.

On the south side of the Peace River, Jackfish Lake Road originates just north of Chetwynd (**Figure 7.2**). Jackfish Lake Road is 57 kilometres long and ends approximately 10 kilometres from the south bank of the Peace River and the proposed Site C dam site. The road, sections of which are privately maintained, provides access for the agriculture, forestry, and oil and gas sectors that are active in the area north of Chetwynd and south of the Peace River. Although Jackfish Lake Road provides ground access to a number of petroleum development roads, companies also tend to rely on helicopter access to this area due to the four-hour drive from Fort St. John.





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**Figure 7.2 Primary Highway and Road Corridors in the Vicinity of the Project**

### 7.2.2.2 Rail Transportation

Canadian National Railway provides freight service to Fort St. John. The main users are the agriculture, forestry, and oil and gas industries. The rail system is integrated with the North American rail network, and with deep sea ports for international transshipment. The Canadian National railway Septimus Siding is located on the south bank of the Project area, approximately 4 kilometres southeast from the proposed dam site (**Figure 7.2**).

### 7.2.2.3 Air Transportation

There are scheduled air services into both Fort St. John and Dawson Creek.

The North Peace Regional Airport is located approximately seven kilometres east of Fort St. John. Since 1997, the airport has been owned by the North Peace Airport Society, and is currently operated by North Peace Airport Services, a wholly owned subsidiary of YVR Airport Services Ltd.

The North Peace Regional Airport is open daily and has two runways that can accept planes as large as a Boeing 737.

Commercial, charter and private aircrafts use the North Peace Regional Airport. In 2011, two commercial airlines, Air Canada and Central Mountain Air, operated scheduled services between Fort St. John and Vancouver, Prince George, Edmonton and Calgary. Between 1996 and 2006, total annual commercial aircraft movements have been cyclical, with between approximately 19,000 and 27,000 per year, with peaks in 1998, 2001, 2005 and 2006. Total passenger numbers through the period 2002 to 2007 have risen annually, from 79,924 in 2002 to 119,314 in 2007. Without consideration of the Site C Project, the forecast is for continued passenger growth at 2.5 per cent annually until 2016, 2 per cent from 2017 to 2021 and at 1.5 per cent annually until 2032.

Central Mountain Air and Swanberg Air offers scheduled flight services into Dawson Creek. A number of other communities in the region, such as Hudson's Hope, Chetwynd and Mackenzie, operate airports that provide landing strips for small aircraft or helicopters. A number of service providers are available to provide charter flight services, both fixed wing and helicopter, throughout the region (Pryde Schropp McComb 2008).

### 7.2.3 Community Services

Northern Health is responsible for delivery of health care across northern B.C., providing services such as acute care, mental health, public health, addictions, and home and community care services. **Table 7.6** shows health care facilities in northeast B.C. as of 2008.

**Table 7.6 Local Health Care Facilities by Community, 2010**

Area	Facilities
Fort St. John	<ul style="list-style-type: none"> <li>• Fort St. John Hospital and Health Centre</li> <li>• Fort St. John Health Unit</li> <li>• North Peace Care Centre (long-term care)</li> </ul>
Hudson's Hope	<ul style="list-style-type: none"> <li>• Hudson's Hope Health Centre</li> </ul>
Chetwynd	<ul style="list-style-type: none"> <li>• Chetwynd Hospital &amp; Health Centre</li> <li>• Chetwynd Health Unit</li> </ul>
Dawson Creek and Pouce Coupe	<ul style="list-style-type: none"> <li>• Dawson Creek and District Hospital</li> <li>• Dawson Creek Health Unit</li> <li>• Rotary Manor (long-term care)</li> <li>• Peace River Haven (Pouce Coupe)</li> </ul>

Source: Northern Health 2010

### **7.2.3.1 Acute and Emergency Care**

The Dawson Creek and Fort St. John hospitals operate as integrated facilities within the Northeast Health District.

The Fort St. John Hospital and Health Centre is an acute care and obstetric hospital with 45 acute care beds, extensive out-patient and in-patient services, and an emergency room. A new regional hospital is under construction in Fort St. John that will have 55 acute care beds, an Intensive Care Unit (ICU), maternity wards, two operating rooms, an expanded emergency room, an endoscopy suite, and an adjacent 123-bed residential care facility.

The Dawson Creek and District Hospital has 31 acute care beds and an 11-bed obstetric ward, as well as a 15-bed regional psychiatric ward and basic in-patient and outpatient services, including 24/7 emergency coverage.

### **7.2.3.2 Public and Community Health Services**

Public health nursing provides a range of health services to individuals, families, groups and communities in homes, schools, and health unit and community settings. The Fort St. John Health Unit provides community health services to Fort St. John, Taylor, Hudson's Hope and the surrounding areas. The Dawson Creek Health Unit services Dawson Creek and the surrounding area. Chetwynd has its own health unit, which services that community. Mental health and addiction services can be accessed in each of Fort St. John, Dawson Creek and Chetwynd.

### **7.2.3.3 General Practitioners and Dentists**

General practitioners and dentists are an important part of overall health care delivery in the region. There were 37 general practitioners in Fort St. John in 2008, up from 33 in 2005.

In Dawson Creek, there were 24 general practitioners in 2008, down from 27 family doctors in 2005. Chetwynd had four general practitioners in 2008, down from five in 2005. Some physicians travel to provide services throughout the region.

The College of Dental Surgeons lists eight dentists in Fort St. John and seven dentists in Dawson Creek. Throughout the Northeast region, there are additional specialist dental services available on a limited basis from travelling specialists. Chetwynd has one resident dentist, while Hudson's Hope, Taylor and rural area residents must travel to the larger centres for dental service (College of Dental Surgeons of British Columbia 2011). Like many northern communities, there is a shortage of dentists in the region.

### 7.2.3.4 Emergency Services (Police, Fire and Ambulance)

Communities in the region are served by both dedicated emergency services as well as those shared with their neighbouring communities.

Residents within the region receive police services from RCMP provincial forces and RCMP municipal forces. Municipal forces provide services to communities with populations of over 5,000 persons. The Fort St. John RCMP detachment, which has a full-time staff of 60 with an additional three auxiliary constables, is responsible for Fort St. John and Taylor and the surrounding areas. The Dawson Creek detachment serves the areas of the South Peace (**Table 7.7**).

**Table 7.7 Authorized Police Statistics by Jurisdiction, 2006**

Policing Jurisdiction		2006 Population	Police Strength	CCC Offences <sup>a</sup>	Crime Rate <sup>b</sup>	Case Load <sup>c</sup>
Chetwynd	Provincial	6,337	9	1,023	161	114
Dawson Creek	Municipal	11,615	22	2,291	197	104
Dawson Creek	Provincial	8,862	4	363	41	91
Fort St. John	Municipal	18,270	28	3,795	208	136
Fort St. John	Provincial	14,334	10	846	59	85
Hudson's Hope	Provincial	1,661	3	58	35	19
Tumbler Ridge	Provincial	2,698	5	503	186	101

Source: BC Ministry of Public Safety 2007

<sup>a</sup> CCC (Canada Criminal Code) offences include property, personal and other offences, excluding traffic offences.

<sup>b</sup> Crime rate is the number of Criminal Code offences per 1,000 resident populations.

<sup>c</sup> Case load is the number of Criminal Code offences per authorized police strength.

Courthouses located in Fort St. John and Dawson Creek provide access to Provincial and Supreme Court services.

Fire services are provided in the larger communities by both staff and volunteer firefighters, while smaller communities are served largely by volunteer firefighters. Outside residential areas served by municipal fire departments, the B.C. Forest Service provides fire services out of the Prince George Fire Centre. Dispatch services for 911 are served by Fort St. John and Dawson Creek for the North and South Peace, respectively.

Ambulance resources, funded through the provincial government, are located throughout the Regional District, including those already mentioned, to provide coverage for the entire region. In addition to the vehicle service, the region is integrated with the provincial service to provide access to helicopters and fixed-wing aircraft for medical evacuations.

#### **7.2.3.5 Education Services**

Elementary and secondary enrolment is driven by population, in particular the local school-age population. In the 2010/2011 school year, total enrolment in School Districts 59 (Peace River South) and 60 (Peace River North) was 4,063 and 5873, respectively (B.C. Ministry of Education 2011a and 2011b).

Northern Lights College and the University of Northern B.C. provide local access to post-secondary education services. The two main campuses in the region are located in Dawson Creek and Fort St. John. In 2007/2008, total enrolment at the two campuses was 10,300 including 8,900 part-time students and 1,400 full-time students.

#### **7.2.3.6 Other Community Services**

Other community services include operation and management of recreation facilities and solid waste, water and sewer (storm and sanitary) line infrastructure, and water and sewage plant and treatment facilities. In general, the demand for these services is directly related to the number of residents in each community. Each community oversees its own service levels.

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## 8 Aboriginal Engagement

This section describes the engagement and consultation with Aboriginal groups undertaken to date and planned as the Project moves forward. A map of Aboriginal groups engaged during Stage 2 and proposed for ongoing engagement in Stage 3 provides a visual overview of the geographic scope of BC Hydro's engagement activities (**Figure 8.1**). As well, feedback from engagement during Stage 2 is summarized to illustrate the general nature of issues and interests identified by Aboriginal groups to date.

More details on BC Hydro's engagement with Aboriginal groups in Stage 2 can be found at:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

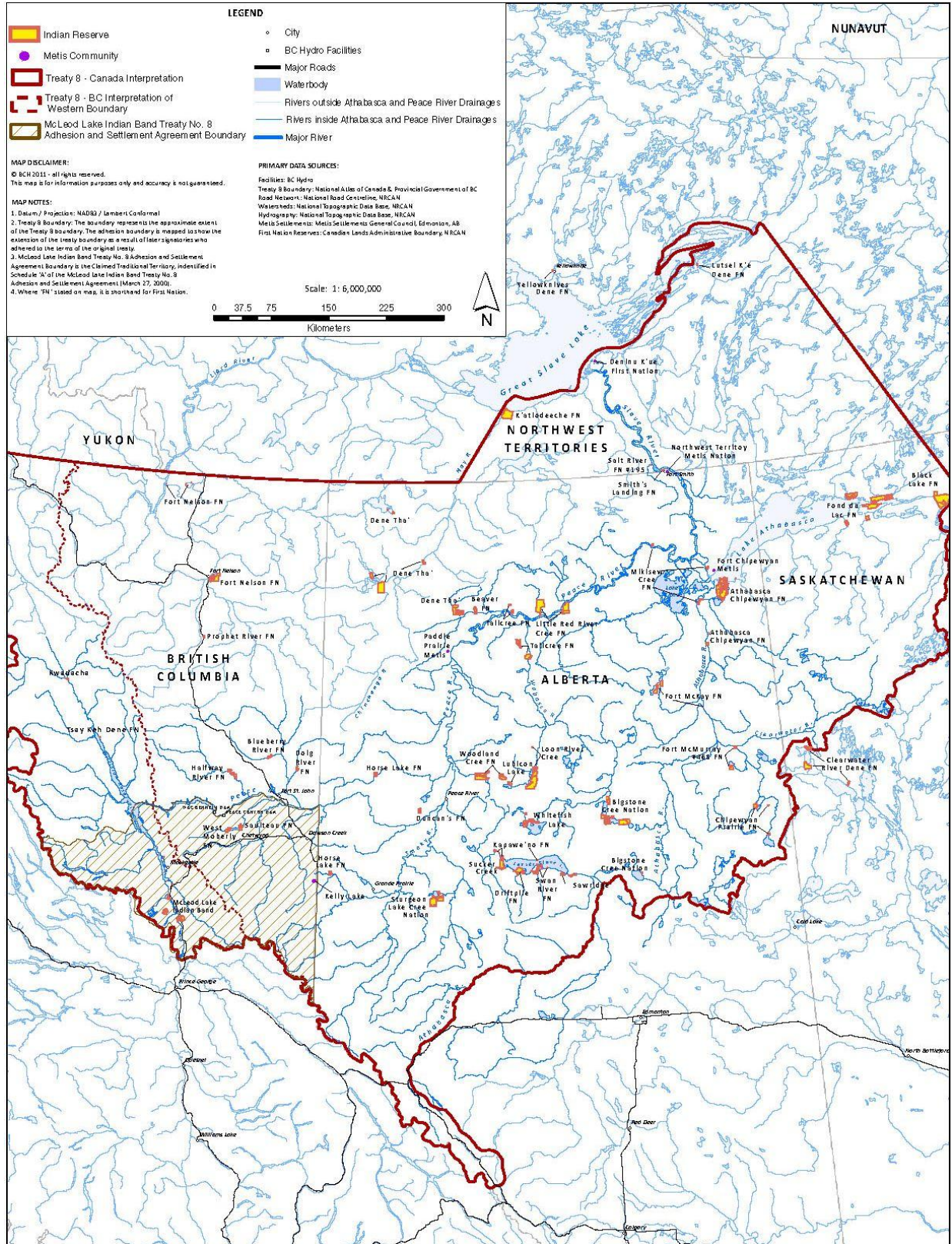
### 8.1 First Nations and Métis

The Project and its associated infrastructure and activities are proposed to be located on land covered by Treaty 8.

Treaty 8 was originally signed in 1899, with several First Nations and other First Nations adhering to Treaty 8 after that date and up to 2000. Treaty 8 covers approximately 840,000 square kilometres of northeastern B.C., northern Alberta, northwestern Saskatchewan and a portion of the Northwest Territories. Of the 39 Treaty 8 First Nations, 22 are located in Alberta, eight are in B.C., six are in the Northwest Territories, and three are in Saskatchewan (**Figure 8.1**). While some Treaty 8 First Nations have historical and contemporary ties with one another, they represent several different cultures and traditions.

Prior to initiating any consultation or engagement activities, preparatory work was undertaken to identify the Aboriginal groups that may have an interest in the Project. BC Hydro reviewed publicly available information and drew upon internal resources to determine the Aboriginal groups that may exercise traditional practices in the Peace River watershed and other potentially affected areas outside the watershed. BC Hydro has been inclusive in its approach to Aboriginal engagement.

During Stage 2, BC Hydro initiated consultation with all Treaty 8 First Nations except for the K'atlodeeche First Nation in the Northwest Territories and the Black Lake, Fond du Lac, and Clearwater River Dene Treaty 8 First Nations in Saskatchewan. These First Nations were not initially contacted due to the remoteness of their location relative to the Project. Engagement also took place with the Kwadacha and Tsay Keh Dene First Nations located at the northern end of the Williston Reservoir and with the Kelly Lake Métis Settlement Society, the Fort Chipewyan Métis Association,



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Figure 8.1 Map of First Nations Traditional Territories

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the Northwest Territory Métis Nation and the Paddle Prairie Métis Settlement. In total, 41 Aboriginal groups were engaged to varying degrees regarding the Project during Stage 2 (**Table 8.1**).

Following the B.C. government's announcement to advance the Project to Stage 3, BC Hydro took the additional step of contacting the four remaining Treaty 8 First Nations to advise them of the government's announcement and to provide information about the Project.

The scope of engagement with Aboriginal groups varied depending on the level and nature of effects that are anticipated, and on the Aboriginal community's interest.

Introductory letters, along with copies of the report, *Summary: Stage 1 Review of Project Feasibility* (BC Hydro 2007b) were sent to all Aboriginal groups identified in **Table 8.1**. Introductory and follow-up meetings were then completed with 21 Aboriginal groups, in some cases representing more than one First Nation. Based on these initial meetings, eight consultation agreements representing 13 First Nations were negotiated to facilitate more in-depth consultation. Three of these agreements were negotiated with Treaty 8 First Nations in B.C., while the remaining five agreements were negotiated with Treaty 8 First Nations located along the Peace River in Alberta. BC Hydro indicated that it was available throughout Stage 2 to meet with any Aboriginal group interested in the Project. In total, BC Hydro conducted over 140 meetings with Aboriginal groups during Stage 2.

BC Hydro sought input from Treaty 8 First Nations with strong interests in the Project on a wide range of studies related to the environment, archaeology, socio-economic conditions, and land use. As previously described, BC Hydro established Technical Advisory Committees (TACs) to bring together First Nations and local, provincial and federal government agencies and regulators to discuss key program areas including fish, wildlife, heritage, GHGs, recreation and tourism, land and resource use, and community services and infrastructure. These TACs offered First Nation participants an opportunity to learn about the Project, review historic and recent studies, explore potential issues and effects, and provide BC Hydro with early input on potential issues, data gaps, and assessment methodologies. While all B.C. Treaty 8 First Nations were invited to participate, only the Blueberry River First Nations participated in the TAC process. A separate technical advisory review process was established for the Council of Western Treaty 8 Chiefs.



**Table 8.1 Aboriginal Groups Engaged in Stage 2 Regarding the Project**

	<b>British Columbia</b>	<b>Alberta</b>	<b>Northwest Territories</b>
<b>Treaty 8</b>	Council of Western Treaty 8 Chiefs*, **, *** • Doig River • Fort Nelson • Halfway River • Prophet River • Saulteau • West Moberly Blueberry River*, **, *** McLeod Lake*, **, ***	Athabasca Chipewyan* Beaver* Bigstone Cree Nation Chipewyan Prairie Dene Tha' *, ** Driftpile Duncan's*, **, *** Fort McKay Fort McMurray #468 Horse Lake*, **, *** Kapawe'no Little Red River Cree*, ** Loon River Cree Lubicon Lake Mikisew Cree* Sawridge Sturgeon Lake Cree Sucker Creek Swan River Tallcree*, ** Whitefish Lake Woodland Cree	Deninu K'ue* Lutsel K'e Dene Salt River* Smith's Landing* Yellowknives Dene First Nation*
<b>B.C. Non-Treaty</b>	Kwadacha* Tsay Keh Dene*		
<b>Métis</b>	Kelly Lake*	Paddle Prairie* Fort Chipewyan Métis Association*	Northwest Territory Métis Nation*

\* denotes Aboriginal groups that BC Hydro met with in Stage 2

\*\* denotes Aboriginal groups with Stage 2 Consultation Agreements

\*\*\* denotes Aboriginal groups with which BC Hydro initiated discussions regarding the collection and use of traditional knowledge and land use information in Stage 2

Members from some First Nations also participated as field survey participants in Stage 2, where they assisted in fish and wildlife field programs, weed mapping, and knapweed control. During the 2010 field season, BC Hydro trained 53 Aboriginal people as archaeological assistants. Twenty-four of these individuals were subsequently employed to support the 2010 field component of the heritage program, which is intended to continue in 2011. First Nation participants were able to observe field studies first-hand and share traditional knowledge if they wished to, while benefiting directly from employment, training, and capacity-building opportunities. During Stage 2, BC Hydro also made efforts to increase opportunities for First Nation owned businesses to participate in Site C related activities.

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## 8.2 Key Comments and Concerns Expressed

In addition to the specific issues identified below, three common concerns and interests were raised by Aboriginal groups engaged during Stage 2:

- Grievances related to past BC Hydro projects
- Cumulative effects of past and current projects on the region, including those from other industry sectors (e.g., oil and gas, mining)
- Short- and long-term employment and economic opportunities related to the Project

### 8.2.1 British Columbia

In B.C., Aboriginal groups engaged during Stage 2 expressed concern about the Project's potential effects on cultural and heritage resources and on land and water where treaty rights to hunt, fish and trap may be exercised. The following section summarizes the issues raised.

#### Wildlife

Treaty 8 First Nations consulted raised questions about the winter feeding habitat, migration patterns, and ungulate calving grounds in areas that would be inundated by the proposed reservoir. There is also a concern that the Project may increase access to traditional hunting areas. All Aboriginal groups engaged in B.C. emphasized the importance of attempting to incorporate traditional knowledge in studies undertaken by BC Hydro on fish and wildlife.

#### Fish and Water

Issues related to fish focused on the distribution, abundance, habitat, and spawning migration for fish species in the Peace River and its tributaries. Treaty 8 First Nations expressed concern about potential effects of the Project through the creation of the reservoir (i.e., habitat loss, reservoir level fluctuation and methyl mercury accumulation) and chemical contamination of waterbodies that could result from inundating sections of Highway 29, leaching of construction materials, and water discharge from the Fort St. John landfill.

#### Cultural Heritage

Issues related to culture and heritage are of importance to Treaty 8 First Nations. The potential inundation of important places where communities meet and practice traditional activities such as hunting and gathering (particularly medicinal plants) and the loss of burial sites and artifacts are of particular concern.

### Other Issues

As residents of the Peace region, B.C. Treaty 8 First Nations also expressed concerns similar to those expressed by some members of the broader community about the Project. These include energy conservation strategies, the exploration of alternative energy sources, impacts on existing transportation corridors and patterns (e.g., highway realignment and potential public use of the construction access bridge) and the socio-economic effects of introducing a large workforce in the region during construction.

#### **8.2.2 Alberta and the Northwest Territories**

Issues related to fish and hydrology (i.e., water temperature, flows, and quality) are of concern to Aboriginal groups downstream in Alberta and the Northwest Territories. In communities where people rely on the Peace River for transportation and food sources, even minor fluctuations in the water regime are of interest. Aboriginal groups living around the Peace-Athabasca Delta continue to raise concerns related to the original construction of the W.A.C. Bennett Dam and its perceived effect on the hydrology, wildlife and their traditional way of life.

#### **8.3 Traditional Knowledge and Use by Aboriginal Groups**

Aboriginal people have a unique understanding, perspective and knowledge of the land and environment that can contribute important information to ongoing environmental and archaeological studies, analyses of environmental effects, and the development of mitigation strategies. In Stage 2, BC Hydro initiated discussions with some B.C. and Alberta Treaty 8 First Nations on the collection and use of traditional knowledge to support consultation and the environmental assessment and regulatory process (**Table 8.1**). Five agreements representing eight First Nations have been concluded to date with the related studies underway or nearing completion.

#### **8.4 Ongoing and Proposed Aboriginal Consultation**

BC Hydro is committed to ongoing dialogue with all Aboriginal groups engaged during Stage 2, as well as any others expressing interest in the Project. Aboriginal engagement will be guided by the information gathered during the Stage 2 Aboriginal engagement process, ongoing environmental and engineering studies, and continued consultation with the Aboriginal groups in question. BC Hydro will work with Aboriginal groups to develop consultation and engagement processes to meet the diverse interests of Aboriginal groups and the requirements of the regulatory process.

BC Hydro will seek to negotiate Consultation Agreements with those Treaty 8 First Nations located along the Peace and Slave Rivers in B.C., Alberta and the Northwest Territories where Project-related effects may be experienced. These agreements will aim to address a range of consultation

activities, which may include: First Nation input into relevant environmental studies; participation in the environmental assessment process; discussions regarding the avoidance, mitigation and accommodation, where appropriate, for Project-related effects on First Nations rights; and the identification of economic and capacity building opportunities resulting from the Project.

Aboriginal groups not expected to be affected by the Project will continue to receive notification of key Project milestones. BC Hydro will continue to engage with these Aboriginal groups on issues of interest.

## **8.5 Activities**

Once the Site C environmental assessment and review process is established, the Aboriginal engagement process will be refined to meet the Crown's duty to consult and all regulatory requirements.

## **9 Stakeholder Consultation**

This section of the report describes the current and proposed consultation activities with stakeholders and the public. While this section provides an overview of the findings from the consultation process and activities during Stage 2, further detail, including all Stage 2 consultation summary reports, consultation documents and meeting notes are available at:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

Building on the extensive consultation done in Stage 2, this section also describes the ongoing and planned consultation activities with the public, regional and local governments, regional and provincial business groups, property owners, the Province of Alberta, and the Northwest Territories during Stage 3.

### **9.1 Key Stakeholders**

The public and stakeholder consultation program during Stage 2 was designed to be multi-phased and offer many opportunities for public and stakeholder input through a variety of consultation methods.

Public notice of consultation was broad and encouraged participation of stakeholders and communities at open houses and stakeholder meetings or by web, email, fax and phone. Stakeholders who participated during Stage 2 consultations for the Project included, among others:

- Members of the public
- Property owners
- Neighbourhood and community organizations
- Local and regional governments
- Business associations and organizations
- Sustainability groups
- Environmental groups
- Tourism organizations
- Transportation groups
- BC Hydro ratepayers

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- Industry groups (e.g., construction, mining, forestry, energy, the Joint Industry Electricity Steering Committee [JIESC], independent power producers, and others)
  - First Responders (police, fire, ambulance)

## **9.2 Consultation Activities with Stakeholders: Stage 2**

BC Hydro has consulted with stakeholders over the years since the Project was first seriously considered in 1977. In 2006, through the BC Hydro Integrated Electricity Plan (IEP) process, the Project was raised in the context of available future supply options. The 2006 IEP process included regional and provincial consultation regarding a number of potential resource options, including discussion of the Project.

In February 2007, the provincial government's *BC Energy Plan* directed the Province and BC Hydro to enter into initial discussions with First Nations, the Province of Alberta, and communities to discuss the Project to facilitate communications regarding the Project and the processes being followed.

BC Hydro conducted three rounds of public and stakeholder consultation regarding the Project between December 2007 and December 2008. The consultation included Pre-Consultation, which asked local, regional and provincial stakeholders how they wanted to be consulted and about what topics, followed by two rounds of Project Definition Consultation on key impacts, benefits and features of the Project.

BC Hydro involved the public and stakeholders on designing the consultation process during Stage 2. Stakeholder feedback from Pre-Consultation directly informed the consultation methods, as well as the topics of consultation during the two subsequent rounds of Project Definition Consultation.

There were many ways to participate in Stage 2 public consultation, including:

- Attending open houses (held in communities in the Peace region as such Fort St. John, Taylor, Hudson's Hope, Dawson Creek/Pouce Coupe, Fort Nelson, Tumbler Ridge/Chetwynd, Mackenzie, and Prince George, as well as an open house in Vancouver)
- Attending stakeholders meetings (held in communities in the Peace region such as Fort St. John, Taylor, Hudson's Hope, Dawson Creek/Pouce Coupe, Fort Nelson, Tumbler Ridge/Chetwynd, Mackenzie, Prince George, as well as in the Lower Mainland and on Vancouver Island)
- Completing feedback forms (online or in person)
- Mailing, faxing or emailing written submissions

- Calling the Site C toll-free information line
- Visiting the Site C website: [www.bchydro.com/sitec](http://www.bchydro.com/sitec)
- Visiting the Fort St. John or Hudson's Hope Community Consultation Offices

Public notice of consultation opportunities included 105 advertisements in 16 newspapers, radio advertisements on 11 stations in northern B.C., and thousands of notification emails and phone calls to stakeholders, as well as notices posted on the Project's website. In addition, 21,000 mailers were sent to households in the Peace River region, prior to the first and second rounds of consultation. Public notice also included a bill insert to 1.3 million BC Hydro residential customers prior to the second round of Project Definition Consultation in October 2008.

Many hundreds of people participated in 121 meetings over the three rounds of consultation, including 103 stakeholder meetings and 18 open houses. **Table 9.1** provides an overview of participation.

**Table 9.1 Participation in Stage 2 Public and Stakeholder Defined Consultation Periods**

Pre-Consultation (December 4, 2007 – February 15, 2008)	Project Definition Consultation, Round 1 (May 1 – June 30, 2008)	Project Definition Consultation, Round 2 (October 1 – December 3, 2008)
• 687 total participants	• 936 total participants	• 909 total participants
• 400 participants attended 48 stakeholder meetings	• 284 participants attended 29 stakeholder meetings	• 358 participants attended 26 stakeholder meetings
• 56 people attended a public meeting and open house in Hudson's Hope	• 380 people attended 10 open houses	• 326 people attended 7 open houses
• 305 feedback forms returned (67 online, 238 hardcopy)	• 224 feedback forms returned (76 online, 148 hardcopy)	• 345 feedback forms returned (177 online, 168 hardcopy)
• 31 submissions (fax, email, phone and mail)	• 22 submissions (fax, email, phone and mail)	• 72 submissions (fax, email, phone and mail)
• 200 visits to Fort St. John Community Consultation Office	• 250 visits to Fort St. John Community Consultation Office	• 153 visits to Fort St. John and Hudson's Hope Community Consultation Offices

Note: Some participants attended meetings in each of the three rounds of consultation.

Source: BC Hydro Stage 2 report:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

### **9.2.1 Community Relations Activities**

In addition to three rounds of public consultation during Stage 2, BC Hydro also implemented several other communications and community relations initiatives, as described below.

#### Fort St. John and Hudson's Hope Community Consultation Offices

BC Hydro opened a community consultation office in Fort St. John on January 7, 2008. Subsequently, in response to stakeholder requests, a community consultation office was opened in Hudson's Hope on October 7, 2008. The community consultation offices provide a place where people can get information about the Project, ask questions and submit feedback forms. During the three rounds of consultation, there were more than 600 visits to the community consultation offices.

#### Field Studies Communications Program

As part of Stage 2, BC Hydro conducted environmental, socio-economic and engineering field studies on and around the Peace River, between the Williston Reservoir and the British Columbia/Alberta border. Several field studies originally contemplated for later dates were prioritized to Stage 2 in response to feedback received from stakeholders in early rounds of consultation.

BC Hydro produced a series of information sheets to notify residents of the timing of field studies in the area and to provide information about the scope and nature of the studies. All field studies information sheets were made available at [www.bchydro.com/sitec](http://www.bchydro.com/sitec).

#### Public Inquiry Program

BC Hydro established a public inquiry-response program to provide timely, accurate information in response to requests for information regarding the Project. Inquiries could be made through a toll-free information line, by fax, by email, and in person at the community consultation offices. As of November 2010, responses have been provided to more than 2,200 inquiries.

#### Project Website: [www.bchydro.com/sitec](http://www.bchydro.com/sitec)

BC Hydro established a comprehensive website dedicated to this Project. The website includes current descriptions of project plans and studies, a number of project environmental and engineering reports (including the full Stage 2 report plus its 35 appended reports) as well as links to historical reports on the Project. The website also included contact information, information about business opportunities on the Project and an opportunity to provide direct input and ask questions via email.



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### Property Owner Consultation

Since December 2007, as part of the Stage 2 consultation and technical review program, BC Hydro has been meeting with owners whose properties could be impacted by the Project. In late 2008 and early 2009, BC Hydro met individually with potentially affected property owners to discuss the realignment options for sections of Highway 29 that would be needed if the Project proceeds. The purpose of this consultation was to provide information, gather further input from property owners, determine owner preferences in terms of possible highway realignment options and hear property owner concerns.

## **9.3 Key Comments from Stakeholders and the Public: Stage 2**

### **9.3.1 Pre-Consultation (December 4, 2007 – February 15, 2008)**

Three key themes identified during Pre-Consultation included:

- Questions and concerns regarding potential local effects
- An interest in how and when the Project would be compared to energy alternatives
- An interest in the consultation process and in participating in the subsequent Project Definition Consultation

Public input during Pre-Consultation also informed specific consultation methods undertaken during Project Definition Consultation. For example, Peace region participants expressed a higher degree of interest in open houses than provincial participants (82 per cent versus 38 per cent). As a result of this feedback, a number of open houses were held in the Peace region, as well as a number of stakeholder meetings.

BC Hydro opened the community consultation office in Hudson's Hope based on feedback received from the community. Pre-Consultation also informed BC Hydro that mail was rated highly by Peace region participants as a public notification method. As a result, prior to both rounds of Project Definition Consultation, BC Hydro sent 21,000 mailers to Peace region households to advise them about consultation opportunities.

Public input during Pre-Consultation informed the topics of consultation during both rounds of Project Definition Consultation. Some of the topics raised most often during Pre-Consultation included elements of project design, recreation, infrastructure, local effects, land uses, and community benefits. As a result, BC Hydro included as many of these topics as possible in the subsequent rounds of consultation.

### **9.3.2 Project Definition Consultation, Round 1 (May 1 – June 30, 2008)**

Results from Project Definition Consultation, Round 1 – including feedback forms, stakeholder meetings and open houses – showed that participants had a strong interest in socio-economic and environmental issues associated with the Project. In addition, participants commented on the process being used by BC Hydro to evaluate the Project. Some specific findings are outlined below.

- Participants expressed a strong interest in avoiding or mitigating local effects, particularly potential socio-economic effects associated with an influx of construction workers
- When asked to rate the importance of community and provincial benefits, participants gave the highest importance to low-emission energy, dependable energy, and potential local community benefits associated with the Project, particularly upgrades to transportation infrastructure, parks and health facilities
- Environmental concerns such as effects on air quality, water and land were raised, and were generally deemed more important than factors such as dependable and low-cost electricity
- Participants were interested in the multi-staged evaluation and consultation process, and the BC Hydro and government decision-making processes and timelines

### **9.3.3 Project Definition Consultation, Round 2 (October 1 – December 3, 2008)**

- Overall, 57 per cent of consultation participants “strongly” or “somewhat” agreed with pursuing Site C if conservation, upgrading existing equipment, and investing in new sources were insufficient to meet the electricity needs of B.C.
- Sixty-nine per cent of provincial consultation participants agreed with this, while in the Peace region, consultation participants were evenly split on their level of agreement (47 per cent agreed and 47 per cent disagreed)
- Consistent with input from Pre-Consultation and Project Definition Consultation, Round 1, participants had a strong interest in avoiding or mitigating local effects, particularly effects to water, air and land. Mitigating effects to fish and aquatic habitats and wildlife and terrestrial habitats were also consistently important to participants.
- Participants in Project Definition Consultation, Round 2, were also interested in and supported potential local and provincial benefits, including business contracting and training opportunities for local workers, public use of the generating station access bridge and other road improvements, additional city infrastructure such as water and sewer, and recreation opportunities such as campgrounds, RV parks, boat launches and marinas

- Participants showed a desire for BC Hydro to continue reviewing alternatives to the Project, most notably the further promotion of conservation, as well as other electricity generation options

There were some protests during Project Definition Consultation, Round 2. Between seven and 15 people attended stakeholder meetings in Hudson's Hope, Dawson Creek and Fort St. John to protest. In addition, between 10 and 25 people attended open houses in Dawson Creek/Pouce Coupe and Fort St. John to protest.

### **Consideration of Feedback from Stage 2 Consultations**

In Stage 2, BC Hydro reviewed and considered input received from the public and stakeholders during Stage 2 public consultations – along with technical and financial input – to refine features of the Project and the scope and nature of environmental and other studies. A consideration memo showing how feedback was considered was prepared and is available on the BC Hydro website: [www.bchydro.com/sitec](http://www.bchydro.com/sitec)

Consultation summary reports, which are available at [www.bchydro.com/sitec](http://www.bchydro.com/sitec), document additional information such as public notification, consultation discussion guides, and meeting notes of open houses and stakeholder meetings.

## **9.4 Ongoing and Proposed Stakeholder Engagement/Consultation Activities: Stage 3**

### **9.4.1 Stage 3 Public and Stakeholder Consultation**

A comprehensive consultation program is a key component of Stage 3: Environmental and Regulatory Review and will build on the consultation undertaken in Stage 2. In addition to the public comment periods that will take place as part of the independent environmental review process, BC Hydro is conducting additional public consultation on a range of topics for project planning and completing the environmental assessment process.

While consultation in Stage 2 focused on characterizing existing conditions, consultation in Stage 3 will generally, although not exclusively, focus on gathering public and stakeholder input about Project effects and on plans for avoiding and mitigating these effects. The process will include six streams of consultation with the public, communities and property owners. Interprovincial discussions with the Province of Alberta and the Northwest Territories will be led by the Province of B.C., with BC Hydro supporting those discussions.

Stage 3 consultation streams include:

- Regional and Local Government Liaison

- Property Owner Liaison and Consultation
- Environmental Assessment Public Comment Period (Timing and scope to be determined by regulators)
- Environmental Assessment Certificate (EAC) Application Public Comment Period (Timing and scope to be determined by regulators)
- Local Area Consultations on specific topics (i.e., Hudson's Hope Shoreline Protection)
- Preliminary Design Consultation

#### **9.4.1.1 Regional and Local Government Liaison**

BC Hydro will continue to engage key municipal and regional government stakeholders to keep them up to date on the status of the Project, and to consult on issues related to their jurisdiction.

Two streams of liaison with regional and local government are currently being led by BC Hydro:

- The **Regional and Local Government Liaison Committee** is an information-sharing committee that provides a regular forum for BC Hydro and elected officials to share information and discuss community interests, issues and benefits related to the Project. Regional and Local Government Liaison Committee meetings started in June 2010 and will continue through Stage 3.
- **Local Government Technical Engagement** is complementary to the Regional and Local Government Liaison Committee and establishes regular contact between the Project team and key municipal staff, including Chief Administrative Officers and Directors of Planning and Engineering. This engagement, which will facilitate the sharing of accurate technical information as well as identifying and discussing issues, is available to municipal staff as project planning proceeds. Local Government Technical Engagement meetings started in June 2010 and will continue through Stage 3.

In addition to the ongoing two-way information exchange, BC Hydro will seek specific information and input from these two groups during the public and stakeholder consultation periods (i.e., Environmental Assessment Public Comment Periods, Pre-Consultation, Local Area Consultation and Preliminary Design Consultation for Stage 3). During these periods, members of the committees will be asked to provide specific feedback on consultation topics.

#### **9.4.1.2 Property Owner Liaison and Consultation**

Following up on property owner consultation held in Stage 2, BC Hydro will continue to liaise directly with property owners during Stage 3 on topics that affect those owners.

Property Owner Liaison will be implemented as a separate stream of work from public and stakeholder consultation, reflecting the need to engage property owners directly regarding their private interests, which may be different from public interests expressed in public and stakeholder consultation.

In addition to bringing potentially affected property owners together with BC Hydro Project staff on a regular basis, property owners will be included as a key stakeholder group during the public and stakeholder consultation periods (i.e., Environmental Assessment Public Comment Periods, Pre-Consultation, Local Area Consultation and Preliminary Design Consultation for Stage 3).

#### **9.4.1.3 Environmental Assessment – Public Comment Periods**

BC Hydro will meet or exceed environmental requirements for public participation during the environmental assessment process as defined by legislation, regulation and government directives. The regulatory review process will be confirmed by provincial and federal governments in the near future.

Two public comment periods are expected to be held as part of the environmental assessment process:

- **Pre-Application Stage - Environmental Assessment Public Comment Period** – Presents the draft Application Information Requirements (or a terms of reference which would also address information needs required by the federal process, i.e., EIS guidelines) to the public for comment. Input is used to define the scope of studies to be completed and to inform what information will be included in the EAC application.
- **Application Review Stage - EAC Application Public Comment Period** – Focuses on gathering public feedback on environmental effects-assessment, including mitigation of potential effects and proposed commitments and assurances from the proponent.

The scope and structure of the public comment periods are defined by the regulators and will be more fully defined when the process has been confirmed by the provincial and federal governments.

Generally, feedback is gathered online, through written submission, open houses, and by any other means as directed by the regulators. In the event that a panel review is required, BC Hydro would update Stage 3 consultation plans to reflect this process.

#### **9.4.1.4 Additional Public and Stakeholder Consultation**

In addition to Regional and Local Government and Property Owner Liaison, and the public comment periods defined by the environmental assessment process, BC Hydro will hold additional rounds of public and stakeholder consultation during Stage 3.

##### **Local Area Consultations**

BC Hydro will conduct area-specific consultations where local issues arise. For example, a consultation to gather local input about proposed shoreline protection measures will be held specifically with the community of Hudson's Hope. Consultation methods may include a public open house, stakeholder meetings, and a discussion paper and feedback form.

##### **Preliminary Design Consultation**

Preliminary Design Consultation will focus on gathering stakeholder and public input on a range of topics for project planning and the EAC Application. Preliminary Design Consultation results will be included in the EAC Application. This reinforces the strength and thoroughness of BC Hydro's consultation program, which offers the public numerous opportunities to provide input on a range of issues. Consultation methods will include public open houses, stakeholder meetings, online materials, and an online discussion guide and feedback form.

Building on knowledge obtained during the two rounds of Project Definition Consultation conducted in Stage 2, possible topics requiring further input by stakeholders and the public during the Preliminary Design consultation may include, but not be limited to:

- Agriculture
- Climate
- Community benefits
- Fish and wildlife
- Heritage
- Highway 29 realignment
- Impact lines
- Recreation
- Worker housing

### **9.4.2 Community Relations**

In Stage 2, BC Hydro developed a comprehensive Community Relations Program that will continue in Stage 3. Community relations are ongoing two-way communications, distinct from public consultation, and provides information to local, regional and provincial stakeholders and facilitates effective and timely response to their inquiries. As part of the Community Relations Program, there is extensive information about the Project available to the public.

The ongoing Community Relations Program includes the following:

- Project website ([www.bchydro.com/sitec](http://www.bchydro.com/sitec))
- Community Consultation Offices in Fort St. John and Hudson's Hope
- Inquiry-Response Program
- Field Study Communications
- Presentations and meetings with stakeholders and community groups
- Business Liaison

Community Relations in Stage 3 will complement the public consultation program, and will be a key forum for notification of consultation opportunities. The program will also provide another avenue for stakeholders and the public to ask questions or provide comments regarding the Project outside of formal consultation periods.

### **9.4.3 Consultation Methods, Notification and Reporting**

Stage 3 consultation will include multiple opportunities to provide input over several years. The following consultation methods will be used, and individual consultation plans will be appended to this plan to show consultation methods.

#### **Consultation Methods**

- Community Consultation Offices, Fort St. John and Hudson's Hope
- Consultation Backgrounder (Pre-Consultation)
- Consultation Discussion Guides and Feedback Forms
- Environmental Assessment Fact Sheets
- Display Boards
- Website
- Online Feedback Form

- Computer Simulation of Project Features
- Public Open Houses
- Stakeholder Meetings
- Local Government Meetings
- Property Owner Meetings
- Qualitative/Quantitative Attitude Research

### **Notification**

- Newspaper Insert/Radio Ads
- Email to Stage 2 Participants
- BC Hydro Bill Inserts
- Web Promotion
- Project Updates

### **Reporting**

- Consultation Summary Reports
- Consideration Memos

#### **9.4.4 How Input Will be Used**

A Consultation Summary Report will be prepared at the conclusion of each defined period of Project-led consultation (e.g., Pre-Consultation, Preliminary Design Consultation, Local Area Consultation, etc.).

Consideration Memos will be prepared by BC Hydro, indicating how input has been considered for utilization in project requirements, including engineering and environmental mitigation plans. There will be an overarching report summarizing all consultation feedback at the end of Stage 3.

Public and stakeholder input from each defined consultation period will be used as outlined below.

- Input from the DAIR Public Comment period will be used to define the scope of the studies and what information will be included in the EAC Application
- Input from Preliminary Design Consultation and Local Area Consultation will be included in the EAC Application. This will help refine project scope and design, and gather feedback regarding draft preliminary effects assessment and mitigation plans.



- Input from the EAC Application Public Comment period will gather public feedback on the effects assessment and mitigation plans and contribute to the Table of Commitments and Assurances as part of the Environmental Assessment process

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## 10 Government Agency Engagement

This section provides a brief overview of engagement activities that have been conducted with government agencies to date, and those that are planned during the Site C environmental assessment and review process.

BC Hydro engagement with government agencies to date has been primarily through the Technical Advisory Committees (TACs). As indicated, TACs were established to engage First Nations and local, provincial and federal government agencies and regulators. Participants were provided with an opportunity to review and comment on the proposed Terms of Reference for the TAC process.

As described in previous sections of the report, BC Hydro established seven TACs to solicit input from local, provincial and federal governments, and First Nations. The objectives of the TAC meetings were to identify potential environmental and socio-economic issues, including data gaps, recommendations for further baseline studies, review of effects mechanisms and assessment methodologies, and potential mitigation options. Separate TACs were established for key program areas, including fish and aquatics, wildlife and plants, heritage, GHGs, recreation and tourism, land and resource use, and community services and infrastructure topics.

The specific topics of discussion in each TAC varied according to the nature of the issue, the information available and the participants; however, each TAC addressed the following general topics:

- Sharing of historical, recent and ongoing research efforts and general information about the project components
- Scoping and identification of potential Project-related effects
- Identifying potential effects and benefits of the Project
- Identifying information requirements and review of proposed study programs
- Considering and evaluating preliminary mitigation options, where sufficient information was available
- Identifying potential data gaps and effects assessment methodologies

Feedback from participants was incorporated into ongoing and future studies (e.g., wildlife and fish studies described in sections 5.9 and 5.10, respectively).

A total of 22 TAC meetings were held, with each TAC meeting between three to five times from September 2008 to March 2009. TAC participants included representation from the following First Nations and government agencies, dependent on the TAC subject area:

### Federal Government Agencies

- Fisheries and Oceans Canada – various branches
- Environment Canada – Canadian Wildlife Service
- Transport Canada – Navigable Waters Protection

### Provincial Government Agencies

- B.C. Ministry of Environment – various branches
- B.C. Ministry of Forests and Range – Peace region
- B.C. Ministry of Public Safety and Solicitor General – Provincial Emergency Planning
- B.C. Ministry of Transportation and Infrastructure – Peace region
- B.C. Ministry of Tourism, Culture and the Arts – Archaeology Branch
- B.C. Ministry of Tourism, Culture and the Arts – Recreation, Sites & Trails Branch
- B.C. Agricultural Land Commission (first meeting only)
- B.C. Ministry of Agriculture and Lands – Integrated Land Management Bureau (first meeting only)

### Local Governments

- Peace River Regional District
- District of Taylor
- City of Fort St. John
- District of Chetwynd
- District of Hudson's Hope

### First Nations

- Blueberry River First Nations

As indicated in Section 8, the Council of Western Treaty 8 Chiefs participated in a separate technical advisory review process at their request.

### Consultation with the Province of Alberta and the Northwest Territories

In addition to consulting with communities and Aboriginal groups, the *BC Energy Plan* also indicated that the Province and BC Hydro needed to consult with the Province of Alberta. Subsequently, the

provincial government provided direction to include the Northwest Territories in interprovincial consultation. BC Hydro has played a supporting role to these initial discussions, as it is the provincial government that takes the lead on any interprovincial consultation involving other governments and agencies.

#### Continued Agency Engagement

Agency engagement will continue during the environmental assessment process and will be defined and led by the regulatory agencies. BC Hydro will work with agencies to meet the various milestones and deliverables required for the environmental assessment process to meet regulatory requirements. BC Hydro is continuing to engage with provincial, federal and local governments to identify issues and, on a discipline-specific basis, to review baseline studies in light of environmental assessment regulatory process requirements.

## 11 Preliminary Synopsis of Project Effects

This section of the report provides a preliminary high level summary of potential environmental, social, economic, heritage and health effects associated with the construction and operation of the Project. This summary of potential effects is included in this Project Description Report in accordance with federal Major Project Management Office guidelines for developing a Project Description Report.

During the environmental assessment process, environmental, socio-economic, heritage and health studies will be advanced from baseline work to effects assessment, including measures to avoid or mitigate potential effects. This will include further opportunities for consultation and input by the public, stakeholders, Aboriginal groups and communities. The Project footprint and its zone of influence, as well as the local and regional study area boundaries, will be defined in detail during the environmental assessment process.

### 11.1 Overview of Project Components

Section 4 describes the Project components and infrastructure. In summary, the Project scope consists of:

- Construction, operation and maintenance of an earthfill dam, generating station and switchyard at a site located on the Peace River, seven kilometres southwest of Fort St. John
- Clearing and creating an 83-kilometre-long reservoir
- Construction, operation and maintenance of 77 kilometres of two new 500-kilovolt transmission lines
- Development, use and reclamation of off-site quarries and borrow areas
- Realignment of sections of Highway 29 over a distance of approximately 25 kilometres
- Construction of a temporary access bridge across the Peace River that will be removed following construction of the dam, and upgrading and development of new temporary and permanent access roads near the dam site

Information collected and analyzed during earlier investigations undertaken in support of the Project, particularly in the late 1970s to early 1980s and in the early 1990s, provided a foundation for the detailed assessments currently being conducted in Stage 3. Furthermore, work undertaken during Stage 2, including engineering and environmental field studies, and engagement with Aboriginal

groups, stakeholders and government agencies, has provided a general understanding of the Project's potential effects and will also inform the environmental assessment.

## **11.2 Overview of Potential Project-Related Effects**

An overview of the potential effects of the Project components and activities on environmental, social, economic, heritage and health resources includes:

- The dam will create a barrier to the current free flow of water in this section of the Peace River. It may change the water quality (e.g., temperature, sediment transport) downstream, and will affect fish passage, fish species composition, entrainment and mortality.
- The creation of the reservoir will cause the inundation of the Peace River and Halfway and Moberly rivers, and adjacent land between the Peace Canyon Dam and the Site C dam. It will increase the risk of erosion, landslides, and groundwater levels in areas adjacent to the shoreline, and may result in the loss of wildlife habitat, species distribution and possible changes in wildlife population dynamics.
- Construction and operations may affect GHG emissions, air quality, climate change and noise levels.
- Construction of temporary facilities, excavation of construction materials, two new transmission lines and highway realignment has the potential to affect wildlife habitat and loss of vegetation.
- These activities have the potential to affect social and economic conditions in the region, including possible changes to Aboriginal ways of life, private landowners, agriculture, recreation and tourism, employment, transportation and infrastructure.

## **11.3 Summary of Potential Environmental Effects**

The following section provides a summary of potential environmental effects, which will be investigated in more detail during the environmental assessment.

### **11.3.1 Reservoir Creation**

The creation of the new reservoir would result in the partial inundation of the Peace River, tributaries and floodplain lands between the Peace Canyon Dam and the proposed Site C dam. At maximum normal reservoir level of 461.8 metres, the reservoir would inundate approximately 5,340 hectares of land and about 3,970 hectares of river. In terms of the inundated land area, approximately 81 per cent consists of Crown land (4,318 hectares), including unclassified land and road allowances, and 12 per cent is owned by BC Hydro (approximately 666 hectares). Seven per cent of the inundated land is privately owned land (approximately 356 hectares) as of February 1, 2011.

The reservoir would increase the water level immediately behind the dam by approximately 52 metres. The Moberly River and the Halfway River would be backwatered for 10 kilometres and 14 kilometres upstream of their confluence with the Peace River, respectively. On the north side of the Peace River, realignment of four sections of Highway 29 away from the inundation zone, and the need for erosion protection measures along other sections of the highway, would result in the potential for further effects on land and water resources.

During the environmental assessment, the potential effects of reservoir creation with respect to impact lines based on the physical processes of shoreline stability, erosion, increased groundwater levels, and landslide-generated waves would be identified and evaluated. The location of the impact lines will define the Project footprint and effects, with potential implications for land use zoning, property and land use, and the Project's land and/or easement requirements. Five separate impact lines are defined as follows:

1. Inundation Impact Line – the boundary beyond which the land adjacent to the reservoir is not expected to be inundated as a result of the creation or normal operation of the reservoir; includes an allowance for the passage of floods and for wind effects
2. Stability Impact Line – the boundary beyond which the land use adjacent to the reservoir is not expected to be affected by landslides resulting from the creation or normal operation of the reservoir
3. Erosion Impact Line – the boundary beyond which land use adjacent to the reservoir is not expected to be affected by progressive shoreline erosion and regression as a result of the creation or normal operation of the reservoir
4. Groundwater Impact Line – the boundary beyond which land use is not expected to be affected by changes in groundwater due to the creation or normal operation of the reservoir
5. Landslide-Generated Wave Impact Line – the boundary beyond which land use adjacent to the reservoir is not expected to be affected by waves generated by a landslide into the reservoir. The dam will be designed to safely accommodate the largest possible wave that could be created by a landslide into the reservoir.

### **11.3.2 Hudson's Hope Shoreline Protection**

The slopes along the Peace River downstream of Hudson's Hope comprise both erodible material and more resistant bedrock. Reservoir inundation would result in a change in groundwater conditions that, when coupled with the effects of beaching from erosion, would cause some shoreline regression. As a result, shoreline protection options are being evaluated to protect portions of the shoreline near Hudson's Hope. Additional consultation and assessment will be conducted

during the environmental assessment regarding the detailed design features and extent of these potential shoreline protection measures.

### **11.3.3 Hydrology and Water Quality**

The Project would create a barrier to the free flow of the Peace River below the Peace Canyon Dam. Potential hydrological effects would be associated with reservoir filling, and changes in flow levels and timing, water temperature and sediment transport.

Since generation operations of Site C would generally be in hydraulic balance (i.e., the outflows will equal the inflows) with the upstream plants at G.M. Shrum and Peace Canyon Dam, the flow regime downstream of the Project would not be appreciably altered. As the release point of water at Site C would be 83 kilometres downstream of Peace Canyon Dam, daily flow variations would occur about 10 to 12 hours earlier than they do at present.

The intake of water from the reservoir through the Site C generating station has the potential to change seasonal temperatures in the river downstream of the Project. Any increase or decrease in river temperature would be greatest immediately downstream of the Project and would be attenuated with increasing distance downstream due to contributions of flow from tributaries and groundwater. A change in the seasonal temperatures of downstream flows could, in turn, affect the timing and extent of ice formation on the Peace River downstream of the Project. An increase in winter water temperatures would be expected to decrease the overall extent and duration of ice, whereas a decrease in winter temperatures would increase the extent and duration of ice. The potential effects of the Project on temperature and ice regime downstream are being evaluated during the environmental assessment.

At present, most of the sediment that enters the Peace River below the Peace Canyon Dam originates from tributaries located downstream of the Project, such as the Pine River and the Beaton River. While the Project would prevent the downstream recruitment of sediment inputs from the inundated section of the Peace River, it would not affect the sediment contribution of these tributaries to the lower river. Therefore, it is considered unlikely that the Project would have a measurable effect on either downstream sediment load or mobilization of riverbed materials. BC Hydro is currently conducting additional studies to refine the understanding of sediment transport mechanisms under normal operations, during flood events and/or during potential routine testing of the Site C spillway.

### **11.3.4 Groundwater**

The impoundment of the river behind the proposed dam is expected to raise the river from less than one metre at the Peace Canyon Dam to approximately 52 metres at Site C. Depending on the depth



and location of water wells in the vicinity of the Peace River, it is likely that this increase in river level will affect the quantity and/or quality of water drawn from these wells. With regard to water quantity, it is expected that water levels in the wells would rise, resulting in additional drawdown capacity and volume. BC Hydro is currently initiating baseline groundwater studies, and a screening assessment to identify the potential for contaminated soils within the proposed inundated area. An evaluation of Project effects on groundwater quality and quantity will be conducted during the environmental assessment.

### **11.3.5 Local Climate**

The replacement of a river with a reservoir may result in localized changes to climatic variables, such as temperature or humidity, in the area adjacent to the Site C reservoir. Since the surface area of the reservoir would be relatively small, any such changes would occur within the limits of the valley walls.

BC Hydro has installed climate stations in the valley to continue to collect baseline climate data. The data will be used to model weather patterns to identify the potential magnitude and direction of the Project's effects on local climate variables, if any. If modelling predicts notable changes in local climate, BC Hydro will undertake further analyses to identify and evaluate the potential for related effects on agriculture, transportation and other types of land use. These investigations are being conducted as part of the environmental assessment.

### **11.3.6 Air Quality**

Due to emissions associated with the operation of heavy machinery and the burning of organic debris, the Project may have a localized, temporary effect on air quality during the construction period. Any such effects will be similar to those associated with any large-scale construction project where the predominant activity involves the movement of large volumes of rock and other heavy materials.

Shoreline erosion can be a source of fugitive dust emissions when coupled with wind velocities that may be high enough to entrain sediments into the air. Although approximately three square kilometres of shoreline would be exposed when the reservoir level is at its lowest, due to the relatively small reservoir drawdown anticipated during operations, the Project is not expected to be a large source of such emissions. BC Hydro is currently collecting baseline measurements of air contaminant criteria used to assess the potential effects of dry reservoirs on air quality, including Total Suspended Particulate (TSP), particulate matter less than 10 microns (PM<sub>10</sub>) and particulate matter less than 2.5 microns (PM<sub>2.5</sub>), in the vicinity of the Project. This data will be used to identify and evaluate Project-related effects on air quality during the environmental assessment.

### 11.3.7 Greenhouse Gas Emissions

Construction and operation of the Project would result in relatively low levels of greenhouse gas (GHG) emissions per gigawatt hour, compared to the levels produced by other forms of electricity generation (**Table 11.1**).

**Table 11.1 Emissions Intensity (Tonnes of GHG/GWh) Ranges and Average Values for Renewable Generation Projects and Technologies**

Technology Type	Data Source	Emission Intensity Average (and Range)
Site C Hydro reservoir and construction	BC Hydro construction emissions estimate and IPCC Tier 3 model	10
Wuskwatim Hydro (Manitoba)	Pembina Institute 2003	4
Wind	World Energy Council 2004	14 (7–22)
Geothermal	Hondo 2005	15
Solar photovoltaics	World Energy Council 2004	48 (43–55)

The GHG emissions estimate for Site C is based on the conservative Tier 3 reservoir scenario plus a high estimate for construction activities and materials. As single projects, ranges are not available for Wuskwatim Hydro or geothermal. Ranges for wind and solar are based on several projects in each category (International Rivers Network 2006).

Current GHG emissions in the vicinity of the Project are estimated to be approximately 4,900 tonnes per year, mainly as a result of agricultural activities. In the absence of the Project or any other land use change, this level of GHG emissions would be expected to continue.

These GHG estimates will be updated during the environmental assessment as necessary to reflect refinements to Project plans.

### 11.3.8 Wildlife and Vegetation

Wildlife is abundant in and surrounding the Peace River Valley, although somewhat constrained by land uses such as agriculture, highways, and oil and gas exploration and development.

The impoundment of water behind the Site C dam would result in some loss of habitat, for example, for hoofed mammals such as elk, deer and moose and for fur-bearing animals such as fisher, birds, beaver and marten. In particular, the Project would result in the loss of lowland riparian habitat within the inundated area. Between the Peace Canyon Dam and the proposed Site C dam, the existing river, with its associated islands, shallow water areas, riparian areas and back channels, would be converted into a reservoir with deeper water.

BC Hydro conducted baseline wildlife studies in Stage 2 and is currently continuing with these and additional studies. These studies will inform the effects of the Project on animal movements,

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distribution, density, breeding and birthing areas, survival and mortality. The assessment will also evaluate the potential for changes in wildlife species composition within and adjacent to the Project and identify mitigation options, including those to be considered during detailed design.

### **11.3.9 Aquatic Life, Fish and Fish Habitat**

The development of the Site C dam would affect fish populations and fish habitat in the Peace River and its tributaries located between the Peace Canyon Dam and the Site C dam. Based on observations in other reservoirs, changes to aquatic habitat caused by impoundment of the river may cause a shift in species composition, abundance and distribution. These potential changes will be assessed through modelling, using baseline data collected during Stage 1, 2 and 3, and information from other reservoirs during the environmental assessment.

The operation of the Site C dam would result in the entrainment of fish from the reservoir over the spillway or through the turbines, which will also result in fish mortality. Entrainment and mortality will be assessed during spillway and turbine optimization and final design. Although spills of water over the spillway are expected to be infrequent, such discharges could result in elevated levels of total dissolved gas immediately downstream of the dam; potential total dissolved gas issues will also be assessed during spillway final design. Mitigation options to address potential effects will be identified and evaluated during the environmental assessment and incorporated into engineering design, as appropriate.

Water diversion works during construction and the presence of the dam would affect the upstream and downstream passage of fish species. Mitigation options for fish passage will be evaluated during the environmental assessment, and those that are predicted to be effective and practicable will be considered during detailed design.

Other potential downstream effects (e.g., temperature, turbidity, discharge and ice) will be assessed through modelling and baseline data during the environmental assessment.

## **11.4 Summary of Potential Heritage Effects**

It is anticipated that heritage and cultural resources in the vicinity of the Project may be affected as a result of activities associated with excavation, construction and road building, as well as inundation of the river, tributaries and land during reservoir filling and operation, and destabilization and ongoing erosion of the reservoir banks.

B.C.'s archaeological resources are protected under the *Heritage Conservation Act*. In accordance with the Act, archaeological sites may not be destroyed, excavated or altered without a permit. BC Hydro is currently conducting a heritage assessment and will identify archaeological,

paleontological, historical, and cultural resources in the vicinity of the Project. Appropriate mitigation plans will be developed based on the resources present and the nature of disturbances associated with Project construction and operation.

## **11.5 Summary of Potential Social and Economic (Socio-Economic) Effects**

Due to the increase in population and associated economic activity during construction, the Project would have both beneficial and adverse effects on local communities. The increase in population associated with the construction workforce would place additional demand on local services such as schools, health services and community services. In addition, the Project itself would require services and infrastructure during construction. As part of the environmental assessment, Project effects will be identified and mitigation measures that may be used to offset adverse effects, such as transportation management and provision of support to local community services, will be considered. BC Hydro will work with communities to develop options to mitigate potential effects.

### **11.5.1 First Nation Activities**

Based upon consultations undertaken to date, it is understood that the Project and surrounding lands and waters may be used by some Treaty 8 First Nations for traditional activities such as hunting, fishing, trapping and gathering, and may also include areas of cultural significance where burial grounds and sites for camping and ceremonial activities may be located. Aboriginal communities in the vicinity of the Project have been invited to provide input to the environmental assessment regarding the use and importance of potentially affected lands and waters. As described in Section 8, BC Hydro is consulting with Aboriginal groups and, where possible, is seeking traditional knowledge information. BC Hydro is currently discussing the documentation of such information through Traditional Land Use Studies with some Aboriginal groups. Traditional knowledge will be incorporated into studies and effects assessment, where available and applicable.

### **11.5.2 Property**

Reservoir creation would result in the inundation of privately owned lands, lands previously purchased by BC Hydro and provincial Crown lands. Prior to inundation, BC Hydro would purchase potentially directly affected private lands and/or rights on those lands and also would acquire land rights to Crown lands. Potential land effects on local residents include the effects on private land holdings, leased BC Hydro-owned lands and tenure on Crown land where there are land-based residential and economic activities. The effects may be due to inundation, shoreline erosion and instability, realignment of Highway 29, access roads and lands required for construction materials. During consultation and environmental assessment, BC Hydro will put forward a range of measures to minimize disruption to residents and land use.

### **11.5.3 Agriculture**

Agriculture in the Peace River valley is primarily focused on ranching, grazing and forage and seed crop production while cattle ranching is the prime livestock focus. Potential agricultural effects of the Project may include inundation of farming operations adjacent to the reservoir, fragmentation of agricultural land parcels, disruption of access routes, loss of land associated with realignment of Highway 29, effects of changes to the local climate on agricultural activities, and effects from construction activities.

Some of the potentially affected land is contained within the Agricultural Land Reserve (ALR), a provincially regulated zone in which agriculture is the priority use, farming is encouraged and non-farm uses are restricted. During the environmental assessment, BC Hydro will evaluate the potential effects on agricultural land use and identify mitigation options. BC Hydro will also engage the Agricultural Land Commission (ALC) in discussions regarding the applicable process with respect to ALR lands affected by the Project.

### **11.5.4 Recreation and Tourism**

Tourism and recreation would be affected during construction of the Project's physical works and by the partial inundation of the Peace River, tributaries and floodplain lands between the Peace Canyon Dam and the proposed Site C Dam. Boating, camping, hiking, hunting, and wildlife- and nature-viewing in these areas are popular activities for residents and tourists. The increase in reservoir shoreline would allow existing activities, such as beach use, boating and picnicking, to continue. Although reservoir creation would eliminate certain river-based activities, this loss could be offset by new opportunities for reservoir-based recreation.

BC Hydro is conducting baseline studies to gather additional information that will be used to inform the environmental assessment. Mitigation options such as provision on new boat launches and/or recreation sites will be identified and evaluated during the environmental assessment.

### **11.5.5 Employment**

The Project would require an estimated 7,000 person-years of direct construction employment during the seven-year construction period, resulting in an increase in the number of jobs and business opportunities available in the vicinity of the Project. The size, distribution and characteristics of the existing local population and workforce will influence the number of workers who migrate to the area to work on the Project. During construction, in-migrating workers will require temporary accommodation, either in town or near the work site, for themselves and possibly their families.

While growth in the local and regional population is forecast to continue, temporary and permanent changes in population induced by the Project could affect the demand for community services and infrastructure. Key topics to be addressed during the environmental assessment will include those related to temporary or permanent Project-induced changes in the size, distribution and characteristics of local and regional populations, with particular focus on housing, transportation, the delivery of health, emergency and community services, and the adequacy of associated infrastructure.

#### **11.5.6 Transportation**

As previously described, the Project would involve several major road components, including realignment of four segments of Highway 29, construction of a temporary construction access bridge across the Peace River for access from Fort St. John to the south bank of the dam and generating station construction site, and development of permanent and temporary access roads in the general vicinity of the construction site. In addition, a number of temporary roads would be required for construction-related activities, including but not limited to access for tree and vegetation clearing in the reservoir and along the transmission line right-of-way. The effects of Project construction and operation on the physical transportation infrastructure of the surrounding area and the use of this infrastructure will be investigated during the environmental assessment. Included within the engineering studies associated with the road infrastructure component of the Project, traffic impact analyses will be carried out for all corridors directly or indirectly impacted by the activities associated with the Project. In consultation with key stakeholders, the studies will be used to develop traffic management plans to minimize the effects for road users and adjacent areas.

#### **11.5.7 Navigation**

There are no known commercial uses of the Peace River in the vicinity of the Project. Project-related effects on recreational water uses and tourism activities are described in Section 11.5.4. River navigational issues will be evaluated during the environmental assessment and mitigation measures will be identified, as appropriate.

### **11.6 Summary of Potential Human Health Effects**

The potential for Project-related impacts to effect human health will be assessed during the environmental assessment. For example, BC Hydro is currently conducting a study that will define baseline methyl mercury conditions, assess aquatic food chain links, and predict methyl mercury levels in fish in the Site C reservoir.

Since the Project would have a relatively small reservoir with a short average residence time for water (i.e., about 22 days) compared with that of larger reservoirs (e.g., multiple years for Williston

Reservoir), decaying vegetation and soil would not come into contact with large volumes of standing water, thus reducing the potential for methyl mercury production and bioaccumulation.

Mitigation options to reduce the amount or duration of methyl mercury accumulation are being explored and could include clearing of the reservoir and removal of any non-merchantable timber and vegetation prior to filling to reduce the volume of organic matter in the reservoir at the time of inundation to minimize potential effects.

At this time, significant human health effects are not anticipated as a result of construction or operation of the Project.

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## 12 Potential Regulatory Approvals and Permits

The Project will require an environmental assessment under the British Columbia *Environmental Assessment Act* (BCEAA). The Project exceeds the thresholds under the Reviewable Projects Regulation as the Project will:

- Have an installed energy generating capacity greater than 50 megawatts
- Require two 500-kilovolt transmission lines with more than 40 kilometres of new right-of-way
- Require a new or expanded sand/gravel pit and quarry

The Project will also trigger *Canadian Environmental Assessment Act* (CEAA) due to the requirements for approvals under the federal *Fisheries Act* and *Navigable Waters Protection Act*. Since the threshold of 200 megawatts of installed energy generating capacity will be exceeded, a comprehensive (rather than a screening level) study will be required.

The BCEAA and CEAA environmental assessment process can be harmonized according to the Canada-B.C. Agreement for Environmental Assessment Cooperation (2004) and the operational procedures developed for implementation of the Agreement (dated 2008). The intent of a harmonized process is to facilitate efficiencies in agency, First Nations and stakeholder consultations, and in the review of environmental effects. Further changes to the federal environmental assessment process and the role of the CEA Agency were identified in Budget 2010 and gazetted in August 2010. The implication of these changes and their potential effects on the environmental assessment process for the Project remains to be determined by the regulators.

A large number of federal, provincial and municipal permits and approvals will be required during the investigative, construction and operational phases of the Project. Key potential permits and approvals are provided in **Table 12.1**. The table does not provide an exhaustive list and additional permits will be required and identified as the Project proceeds through the regulatory process.



**Table 12.1 Key Potential Permits and Approvals Required during the Investigation, Construction and Operational Phases of the Project**

Act	Regulation or Section	Permit Name	Permit Purpose/Objective	Permitting Authority
<b>Federal</b>				
<i>Fisheries Act</i>	Sections 35(2), 29, 32, 26	Authorization for Works or Undertakings Affecting Fish Habitat	Necessary when a project will result in the “harmful alteration, disruption or destruction of fish habitat”, the unduly obstruction of fish passage, or the introduction of deleterious substances	Fisheries and Oceans Canada
<i>Navigable Waters Protection Act</i>	Section 5	Application for Approval	Necessary when a project will affect the navigation of waterways	Transport Canada
<i>The Explosives Act</i>	Section 7(1)	Temporary Factory, Storage, and Transportation Licences	Necessary when explosives are used, stored and transported in construction activities that are of short duration. Such sites must be supported by existing licensed base factories.	Natural Resources Canada
<i>Species at Risk Act</i>	Section 32	Approval of Compliance	May not be necessary, as the <i>Species at Risk Act</i> (SARA) does not apply to provincial Crown land, but B.C.’s implementation of the SARA is endorsed by the Canada-British Columbia Agreement on Species at Risk. The SARA does apply to federally regulated aquatic species and migratory birds. Habitat requirements and levels of harm to species at risk must be considered before authorization of construction and operation can be granted.	Environment Canada
<b>Provincial</b>				
<i>Environmental Management Act</i>	Waste Discharge Regulation	Waste Discharge Permit	Necessary if wastes to be discharged to air, land or water at any point in the Project	Ministry of Environment
	Contaminated Sites Regulation (CSR)	Contaminated Soil Relocation Permit	Necessary if soil or sediment is being moved and exceeds the “trigger value” as set out by the CSR	
	Spill Reporting Regulation		Any spill of a hazardous substance must be reported to the Provincial Emergency Program (PEP)	

Act	Regulation or Section	Permit Name	Permit Purpose/Objective	Permitting Authority
<i>Forest Act</i>	Section 47.4	Occupant Licence to Cut	Necessary if timber will be cut or harvested from Crown land during land clearing, construction or modification of roads/trails or construction improvements	Ministry of Forests, Lands and Natural Resource Operations
<i>Heritage Conservation Act</i>	Section 12/14	Heritage Inspection/Investigation or Alteration permit	Allows investigation where ground disturbance in a heritage site will take place	Ministry of Forests, Lands and Natural Resource Operations
		Archaeological or Heritage Site Conservation Permit	Necessary when a project is located at or near an archaeological/historic site	
		Archaeological Overview Assessment	Necessary where First Nations rights or title issues exist at or in the project vicinity	
<i>Land Act</i>	Section 14, 39, 40	Temporary Land Use Permit	Authorization for site investigation on Crown land and low-impact activities; no construction or improvements	Ministry of Forests, Lands and Natural Resource Operations
		Licence of Occupation	To carry out activities outlined in the water licence on Crown land; non-exclusive access; allows activities such as construction of access and structures	
		Statutory Right-of-Way	Issued to authorize use of Crown land for transportation, communication, energy production and utility development and when transmission line crosses Crown land	
<i>Mines Act</i>	Section 10	Aggregate Mine Permit	Operation of high volume borrow areas and quarries	Ministry of Energy and Mines
<i>Water Act</i>	Section 9	Notification or Application for Approval	For works or specific changes in and about a stream	Ministry of Forests, Lands and Natural Resource Operations
	Section 7(g)	Conditional Water Licence	Necessary for use, storage, inundation, and diversion rights of water from streams	
<i>Wildlife Act</i>	Section 19(1)	Wildlife Act Permit	Conditionally makes any offence under the <i>Wildlife Act</i> permissible	Ministry of Environment – Permit Authorization Service Bureau

Act	Regulation or Section	Permit Name	Permit Purpose/Objective	Permitting Authority
<b>Regional/Municipal</b>				
<i>Local Government Act</i>		Land Use/Zoning Approval	Necessary to ensure the project does not contravene any local zoning bylaws	Peace River Regional District
		Building Permit and Setback Requirements	Necessary for any buildings or structures associated with the project that are within the Peace River Regional District	
Local By-laws			As identified	Local Government
<i>B.C. Fish Protection Act</i>	Riparian Area Regulations (RAR)	Impact Benefit Agreements; Economic Benefit Agreements; Capacity Funding Agreement	Local government could require these agreements depending on bylaws enacted through RAR	Local Government

## 13 References and Supporting Documentation

Documents and sources of information referenced directly in the Project Description Report are listed in Section 13.1 below.

Supporting documentation, listed in Section 13.2 Supporting Documentation, provides more detailed information on some topics that were summarized or described in general terms in the Project Description Report. These include all Stage 2 reports which can be found at the following link:

[www.bchydro.com/planning\\_regulatory/site\\_c/document\\_centre/stage\\_2\\_reports.html](http://www.bchydro.com/planning_regulatory/site_c/document_centre/stage_2_reports.html)

A list of other reference websites is also provided.

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## 14 Glossary of Terms

<b>Active Storage</b>	The volume of water between the maximum and minimum licensed reservoir levels, as defined by our storage water licences to support the purpose of power. Active Storage will be the difference between Total Storage and Inactive Storage. Active Storage can be significantly less than Total Storage for some reservoirs (e.g., Dinosaur Reservoir).
<b>Aggrading</b>	To fill and raise the level, or streambed, by deposition of sediment.
<b>Alluvial/Alluvium</b>	Sedimentary soils or deposits formed by flowing water.
<b>Annual Allowable Cut</b>	The amount of wood permitted to be harvested within a one-year period to ensure the sustainability and productivity of forests.
<b>Bedload</b>	Material that is transported along the bed of a river by the water flowing in the river.
<b>Bioaccumulation</b>	Accumulation of chemicals in the tissue of organisms through any route, including respiration, ingestion or direct contact with contaminated water, sediment and pore water in the sediment.
<b>BC Energy Plan</b>	An energy policy document released by the B.C. government in February 2007.
<b>Capacity</b>	The highest level of electricity that a utility or resource can produce at any one time. Capacity is measured in megawatts (MW).
<b>Carbon Intensity</b>	The amount of carbon by weight emitted per unit of energy consumed.
<b>Cofferdam</b>	A temporary dam or barrier used to divert a river or to enclose an area during construction to enable underwater foundations to be built in the dry.
<b>Colluvium</b>	Loose deposits of earth and rock debris accumulated through the action of rainwash or gravity at the base of a gently sloping cliff or slope.

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<b>Concrete Structure</b>	The component(s) constructed out of concrete. Typical components include the spillway, spillway headworks, stilling basin, generating station sub-structure, and power intakes.
<b>Demand-Side Management</b>	A rate, measure, action or program undertaken: (a) to conserve energy or promote energy efficiency; (b) to reduce the energy demand a public utility must serve; or (c) to shift the use of energy to periods of lower demand, but does not include: (d) a rate, measure, action or program, the main purpose of which is to encourage a switch from the use of one kind of energy to another such that the switch would increase greenhouse gas emissions in British Columbia, or (e) any rate, measure, action or program prescribed.
<b>Dependable Generating Capacity</b>	<p>The amount of megawatts a plant can reliably produce when required, assuming all units are in service. Factors external to the plant affect its dependable capacity. For example, streamflow conditions can restrict the dependable capacity of hydro plants and fuel supply constraints can impact thermal plant dependable capacity. Planned and forced outage rates are not included.</p> <p>Also, for the purpose of Resource Option estimates: the capacity a plant can reliably deliver for the duration of time in which it is required. The dependable capacity used in the annual resource balance is the maximum capacity that a plant/unit can reliably provide for 3 hours in the peak load period of weekday during the continuous two weeks of cold weather.</p>
<b>Dispatchable</b>	A supply- or demand-side resource whose output can be controlled to respond to short-term variations in <i>load</i> or <i>resource</i> balance due to weather changes, unit outages, market price changes, and non-power considerations.
<b>Drawdown</b>	Lowering the water levels in a reservoir by discharging more water than is entering it.
<b>Effective Load Carrying Capability</b>	The maximum peak load that a generating unit or system of units can reliably supply such that the <i>Loss of Load Expectation</i> will be no greater than one day in 10 years

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<b>Electrical Grid</b>	A synchronized transmission network that delivers electricity from generating stations to local distribution facilities
<b>Energy</b>	The total amount of electricity that a utility or resource supplies during a particular time period. Typically measured in gigawatt hours (GWh).
<b>Fill</b>	Earth materials with specific properties that are used for construction, for example for roads, highways and dams.
<b>Firm Energy</b>	Energy produced by a project on an assured basis over a defined period of time.
<b>Floodplain</b>	An area of land that supports floodplain plant species and is (a) adjacent to a stream that may be subject to temporary, frequent or seasonal inundation, or (b) within a boundary that is indicated by the visible high water mark
<b>Turbine</b>	Used to generate electricity. A turbine is a fixed blade reaction-type turbine and is based on radial water flow.
<b>Gate Testing</b>	Periodic functional tests performed on the spill gates to verify they operate as designed and to verify their availability for spill events.
<b>Generating Station</b>	The component of a hydroelectric power plant where the generators and turbines are housed and where power is produced by the action of the water acting on the turbines.
<b>Geomorphology</b>	Physical configuration of the river channel in relation to surrounding topography and geology.
<b>Gigawatt (GW)</b>	One billion watts or one million kilowatts.
<b>Gigawatt Hour (GWh)</b>	Unit of energy equal to one billion watt hours, or one million kilowatt hours (an amount of electric energy that will serve about 100 residential customers in B.C. for one year).
<b>Glaciolacustrine</b>	Pertaining to lakes fed by melting glaciers, or to the deposits forming therein.

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<b>Heritage Asset</b>	<p>As defined in the B.C. <i>Clean Energy Act</i>:</p> <ul style="list-style-type: none"><li>(a) any equipment or facilities for the transmission or distribution of electricity in respect of which, on the date on which this Act receives First Reading in the Legislative Assembly, a certificate of public convenience and necessity has been granted, or has been deemed to have been granted, to the authority or the transmission corporation under the <i>Utilities Commission Act</i>,</li><li>(b) generation and storage assets identified in Schedule 1 of this Act, and</li><li>(c) equipment and facilities that are for the transmission or distribution of electricity and that are identified in Schedule 1 of this Act.</li></ul>
<b>Hydrology</b>	<p>The science of the properties, distribution and effects of water on a planet's surface, in the soil and underlying rocks, and in the atmosphere.</p>
<b>Impact Lines</b>	<p>Boundary beyond which usage of lands adjacent to a reservoir are not expected to be affected by the creation or normal operation of the reservoir.</p>
<b>Impervious Material</b>	<p>Material that has low water permeability, used for the core of an earthfill dam.</p>
<b>Insurance Energy</b>	<p>Insurance energy means the 3,000 gigawatt hours of energy in addition to the amount of electricity required to meet BC Hydro's electricity supply obligations that BC Hydro must hold the rights to by the year 2020 and each year after.</p>
<b>Integrated Resource Plan</b>	<p>BC Hydro's long-term electricity planning required under the B.C. <i>Clean Energy Act</i>.</p>
<b>Interbedded Shales</b>	<p>Interbedded – alternating layers of rock with different properties such as grain size.</p> <p>Shales – fine grained sedimentary rock composed of clay and silt sized particles</p>

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<b>Intermittent</b>	An electric generator that is not <i>dispatchable</i> and cannot store its fuel source
<b>Kilowatt (kW)</b>	A unit of electric power equal to 1,000 watts.
<b>Kilowatt Hour (kWh)</b>	The amount of electricity a power plant generates or a customer uses over a period of time is measured in kilowatt hours, a unit of electrical energy equivalent to one kilowatt of power used for one hour. One kilowatt hour is equal to 1,000 watt hours, equivalent to the energy consumed by a 100-watt bulb burning for 10 hours. An average household will use 800 to 1,300 kWh per month depending upon geographical area.
<b>Lacustrine</b>	Originating from a lake environment.
<b>Landslide Terrain</b>	Area of irregular or hummocky topography created by slope movement.
<b>Laydown Areas</b>	Designated locations at a construction site where the components or equipment needed during the construction of a facility are offloaded and stored temporarily until required. These locations are usually large flat areas that are easily accessible by both transportation and construction equipment. Pre-assembly of some components prior to their installation or use may also be carried out at these locations.
<b>Licensed Minimum Reservoir Level</b>	Defined under a provincial <i>Water Act</i> storage licence for the purpose of power. Temporary operations below this range may be required for maintenance or dam safety.
<b>Licensed Maximum Reservoir Level</b>	Defined under a provincial <i>Water Act</i> storage licence for the purpose of power. This represents the upper level the project could indefinitely store water. Temporary operations above this range may be required for maintenance or dam safety when routing high flows.
<b>Load</b>	The amount of electricity required by a customer or group of customers.

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<b>Load Forecast</b>	The expected <i>load</i> requirements that an <i>electricity system</i> will have to meet in future years.
<b>Long-Term Acquisition Plan</b>	BC Hydro's previous long-term energy planning process, now superseded by the Integrated Resource Plan
<b>Long-Term Sustainable Harvest Level</b>	A harvest level that can be maintained indefinitely, given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
<b>Loss of Load Expectation</b>	The sum, over a year, of the probability of not meeting the peak loads on all days.
<b>Maximum Normal Reservoir Level</b>	Normal maximum operation elevation of the reservoir in the forebay of the dam.
<b>Normal Operating Range</b>	The difference between the normal maximum and normal minimum water levels for the purpose of power. This is the range that the reservoir is used over the course of normal operations. Operations above or below this range may be required for maintenance or dam safety reasons such as routing high inflows. Normal operating ranges on BC Hydro's reservoir may change throughout the year to accommodate seasonal inflow planning or other temporal-based interests such as recreation or fisheries objectives. Normal Operating Range, however, will always be equal to or less than the Licensed Operating Range.
<b>Megawatt (MW)</b>	A unit of electrical production capacity. One million watts or 1,000 kilowatts.
<b>Megawatt Hour (MWh)</b>	One million watt hours of electrical energy. A unit of electrical energy that equals one megawatt of power used for one hour.
<b>Methyl mercury</b>	An organic form of mercury, created from metallic or elemental mercury by bacteria in sediments, which is easily absorbed into the living tissue of aquatic organisms and is not easily eliminated. It bioaccumulates in organisms at the top of food chains, such as humans.

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<b>Minimum Flow</b>	The lowest flow release from all release structures in a dam and hydroelectric generating station.
<b>Old Growth</b>	Old, structurally complex stands comprising mainly shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition and patchy under stories typical; under stories may include tree species uncommon in the canopy, because of inherent limitations of these species under the given conditions; time since disturbance generally > 140 years.
<b>Outage</b>	A term used to describe when a piece of equipment has been taken out of service for planned or unplanned maintenance or repairs.
<b>Overburden</b>	The layer of natural materials that overlie bedrock. Typical materials would include soil, sand, granular deposits, and glacial lacustrine materials.
<b>Passive Property Acquisition Plan</b>	BC Hydro's program that gives property owners whose property is potentially impacted by the Project the voluntary option of selling their property to BC Hydro before the project has obtained regulatory approval. Upon receipt in writing from an owner that they wish to sell to BC Hydro, BC Hydro will, on a property-by-property basis, assess whether the property is potentially impacted by the project. Where appropriate, BC Hydro will initiate the process for acquiring the land. Property owners will be given the opportunity to lease back the property they sell to BC Hydro at market rental value until it is required for the project. Consistent with a previous commitment by BC Hydro, and a recommendation of the British Columbia Utilities Commission, all property owners will have the right to repurchase the property they sell to BC Hydro at the price paid by BC Hydro if the project is abandoned.

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<b>Particulate Matter</b>	A complex mixture of extremely small particles and liquid droplets. It is made up of a number of components, including acids, organic chemicals, metals, and soil or dust particles.
<b>Penstock</b>	A closed conduit or pipe used to convey water under pressure from the power intakes to the turbines of a hydroelectric power plant.
<b>Power Intakes</b>	The concrete structure that is used to channel or direct the flow of water into the penstocks of a hydroelectric power plant. Gates or valves, used to stop the flow of water to facilitate maintenance or for an emergency, are usually located in this structure.
<b>Pre-Consultation</b>	Pre-Consultation was held from December 4, 2007 through February 15, 2008 and was the first round of consultation held in Stage 2. The purpose of Pre-Consultation was to inform the design of the next two formal rounds of Project Definition Consultation during Stage 2 by asking participants how they want to be consulted and about what topics.
<b>Project Definition Consultation</b>	Project Definition Consultation took place in 2008 over two rounds of consultations during Stage 2. The purpose of Project Definition Consultation was to seek participant input into key topics related to the Project.
<b>Discharge Capacities</b>	Flow of water in cubic metres per second ( $m^3/s$ ) that a turbine discharges when operating at its maximum capacity
<b>Regional Groundwater Discharge Point</b>	Point where groundwater daylights to surface.
<b>Reliable Electricity</b>	A measure of the adequacy and security of electricity service. Adequacy refers to the ability to satisfy load demand and system operational constraints. Security refers to the project's ability to respond to transient disturbances in the system.
<b>Renewable Energy</b>	Biomass, biogas, geothermal heat, hydro, solar, ocean, wind or any other prescribed resource (as defined in the B.C. <i>Clean Energy Act</i> ).

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<b>Reservoir</b>	An artificial lake used to collect and store water, such as for community water supply, irrigation or electricity generation.
<b>Riverine</b>	Relating to or resembling a river.
<b>Run-of-River Hydro</b>	Hydroelectric power generation at the rate of inflow without change as a result of storage in a reservoir.
<b>Salmonids</b>	Of, belonging to, or characteristic of the family Salmonidae, such as salmon, trout and whitefish.
<b>Seasonality</b>	A positive link between seasonal (winter/spring/summer/fall) weather patterns and a resource type's fuel source. For example, most Run-of-River resource options have seasonal water inflow characteristics in that significant inflows occur in the spring freshet period following winter snowmelt. Run-of-River projects do not have fuel storage and therefore generate with a corresponding seasonal profile.
<b>Sedimentary Bedrock</b>	Rock that is formed by the deposition of mineral or organic particles in water or on the Earth's surface by water, wind, mass movements, or glaciers.
<b>Seral Species</b>	Plant species of early, middle and late successional plant communities. The term is often used in a narrower sense in forest management to describe the dominant conifer vegetation that follows major disturbance episodes.
<b>Spillway</b>	A structure used to provide an efficient, controlled and safe means of releasing (spilling) water inflows that exceed the design capacity of the dam/reservoir. A spill can be forced, such as when there is not enough storage capability in the reservoir and the inflows exceed turbine discharge capacity, or planned as part of normal non-power release requirements.
<b>Spillway headworks</b>	The structure that is used to channel or direct the flow of water into the spillway. The spillway gates are usually located in this structure.

<b>Stage 1</b>	Review of Project Feasibility. During this initial stage, existing studies and historical information related to engineering, costs, environment and land, consultation and First Nations were reviewed. At the completion of Stage 1, BC Hydro determined that the Project was feasible and recommended to the provincial government that it be moved forward to the next stage.
<b>Stage 2</b>	Consultation and Technical Review. Stage 2 commenced in fall of 2007. Activities included extensive consultations with the public, stakeholders, communities, Aboriginal groups and property owners, as well as early discussions with the Province of Alberta and the Northwest Territories. The stage included the initiation of field studies to better understand current conditions related to the physical, biological and socio-economic environment, and to gather engineering and technical information regarding the design, construction and operation of the potential Project.
<b>Stage 3</b>	Environmental Assessment and Regulatory Review Stage. The Project is currently in Stage 3. Biological, physical and socio-economic baseline studies will continue. Engagement with Aboriginal groups, the public, agencies and communities will continue. Baselines studies will inform the effects assessment. An EAC Application will be submitted to the regulatory agencies for review. A decision will be made to move the Project forward to the next stage.
<b>Stilling Basin</b>	A basin, constructed at the outlet of a spillway, designed to dissipate the energy of fast-flowing water from a spill event and to help protect the riverbed from erosion.
<b>Storage</b>	The volume available in a reservoir to hold water for power generation or flood control.
<b>Sulphur Hexafluoride</b>	An inorganic, colourless, odourless, non-toxic and non-flammable gas. Used as a gaseous dielectric medium in the electrical industry.

<b>Switchyard</b>	A designated area at a power plant (hydroelectric, thermal, wind, etc.) containing the switching facilities and equipment needed for the purposes of connecting the power plant to the transmission system.
<b>Tailrace</b>	The area of the river immediately downstream of the generating station into which the water from the turbines is discharged.
<b>Thermal Generation</b>	A power plant that converts heat energy into electrical energy. The heat needed for thermal generation can be produced from a number of sources such as coal, oil, gas or nuclear fuel, and can drive the turbine directly, or can drive the turbine indirectly by first heating water into steam, which, in turn, is then used to drive the turbine.
<b>Total Dissolved Gas</b>	Measure of dissolved gas pressure in water where prolonged exposure to high levels may harm aquatic life.
<b>Total Suspended Particulate</b>	The quantity of solid particles in a gas or exhaust stream. Any finely divided material (solid or liquid) that is airborne with a diameter smaller than a few hundred micrometres.
<b>Total Suspended Solids</b>	Small particles of solid materials in water that cause cloudiness or turbidity.
<b>Turbidity</b>	The cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in air.
<b>Peak Demand</b>	Peak demand, peak load or on-peak are periods in which electrical power is expected to be produced for sustained periods at a significantly higher than average supply level. Peaks can fluctuate on seasonal, monthly or daily cycles. For example, in British Columbia, the winter peak periods occur on the coldest days of winter at breakfast and/or dinner time.

**Water-to-Wire Equipment**

Equipment in a generating station used directly in the production of electricity, such as generators, turbines, circuit breakers, penstocks, intake operating gates, and unit transformers. Inspection and maintenance of this equipment generally requires a generating unit to be taken out of service. Generating station equipment not used directly in the production of electricity includes cranes, building lighting and heating, air compressors, spillway operating gates, etc.

**Watt (W)**

A scientific unit of measurement of electrical power used to describe the rate of energy consumption of an electrical appliance. One watt is the power equal to one joule of energy per second; 750 watts is equivalent to one horsepower. Watts equal voltage times amperage.

**Watt Hour (Wh)**

The basic unit of measurement for consumption of electrical energy; equal to the wattage multiplied by the time in hours; the quantity of energy used when one watt is used for one hour.

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## 15 List of Acronyms & Abbreviations

AAC	Allowable Annual Cut
ALR	Agricultural Land Reserve
ALC	Agricultural Land Commission
B.C.	British Columbia
BCCF	British Columbia Conservation Framework
BC Hydro	BC Hydro and Power Authority
BCEAA	British Columbia <i>Environmental Assessment Act</i>
BCEAO	British Columbia Environmental Assessment Office
BCCDC	British Columbia Conservation Data Centre
BCMOEM	British Columbia Ministry of Energy and Mines (includes reference to the former B.C. Ministry of Forests, Mines and Land)
BCMOE	British Columbia Ministry of Environment
BCMOF	British Columbia Ministry of Forests (now the BCMOFLN)
BCMOFLN	British Columbia Ministry of Forests, Lands and Natural Resource Operations (includes any reference to the former B.C. Ministries of Forests and Range, Agriculture and Lands, and Natural Resource Operations)
BCMOT	British Columbia Ministry of Transportation and Infrastructure (formerly the B.C. Ministry of Transportation and Highways)
BCUC	British Columbia Utilities Commission
BWBSmw1	Boreal White and Black Spruce
CEA Agency	Canadian Environmental Assessment Agency
CEAA	<i>Canadian Environmental Assessment Act</i>
m <sup>3</sup> /s or cms	cubic metres per second
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DAIR	Draft Application Information Requirements

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DGC	Dependable Generating Capacity
EAC	Environmental Assessment Certificate
EIS	Environmental Impact Statement
ELCC	Effective Load Carrying Capability
DFO	Fisheries and Oceans Canada
DSM	Demand-Side Management
GHG	greenhouse gas
GWh	Gigawatt hour
GWh/yr	Gigawatt hour per year
ha	hectare
ICU	Intensive Care Unit
IEP	Integrated Electricity Plan
IPCC	Intergovernmental Panel on Climate Change
IR	Indian Reserve
IRP	Integrated Resource Plan
JIESC	Joint Industry Electricity Steering Committee
LRMP	Land and Resource Management Plan
LTAP	Long-Term Acquisition Plan
km	kilometre
kV	kilovolt
m	metre
MW	Megawatt
MW/hr	Megawatt per hour
NCC	Non-commercial Cover
PEL	Peace Lowlands
PEP	Provincial Emergency Program

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PM	Particulate Matter
PRRD	Peace River Regional District
RAR	Riparian Area Regulations
RCC	Roller-Compacted Concrete
SARA	<i>Species at Risk Act</i>
SF6	Sulphur hexafluoride
TAC	Technical Advisory Committee
TEM	Terrestrial Ecosystem Mapping
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TRIM	Terrain Resources Information Management
TSA	Timber Supply Area
TSP	Total Suspended Particulate
VRI	Vegetation Resource Inventory
WUP	Water Use Plan