7 PROJECT BENEFITS

This section of the EIS describes the expected benefits of the Project on a local, provincial, and federal level. These benefits enable BC Hydro, through the Project, to build relationships with Aboriginal groups, the public and local governments while ensuring that the Project remains cost-effective for BC Hydro ratepayers. The discussion of these benefits has been organized in this chapter as follows:

- Section 7.1 describes the financial benefits to ratepayers resulting from the cost-effective energy generated by the Project
- Section 7.2 describes the financial benefits to various levels of government, in the form of government revenues at the local, provincial, and federal level, generated by the Project
- Section 7.3 describes the economic benefits of the Project resulting from increased economic activity and job creation
- Section 7.4 describes the environmental, social, and sustainable development benefits of the Project. This includes the low greenhouse gas emission intensity of the energy produced, the role of the Project in integrating intermittent clean or renewable resources and in optimizing the hydroelectric potential of the Peace River, the role of the Project in increasing fish habitat and aquatic productivity in certain areas, in providing increased fishing opportunities and water-based recreational use and in providing improvements to public roads and to the reliability of the transmission system

7.1 Ratepayer Benefits

The EIS Guidelines state that the EIS is to include a description of the extent, distribution, and duration of the benefits of the Project, including the value of electricity generated.

This section provides a description of the benefit of cost-effective energy and dependable capacity to BC Hydro customers, and is structured as follows:

- Section 7.1.1 provides background information concerning BC Hydro's competitive electricity rates resulting from its Heritage hydroelectric system
- Section 7.1.2 provides a description of the energy and dependable capacity generation benefits from the Project
- Section 7.1.3 provides a description of the net ratepayer benefits arising from the Project

The EIS Guidelines also state that the EIS is to include a description of the initial capital construction cost and operating cost estimates for the Project, including a description of the methodology for developing cost estimates. This information is contained in Volume 1 Appendix F Project Benefits Supporting Documentation, Part 1 Project Cost Estimate.

7.1.1 Competitive BC Hydro Rates

Due to its Heritage hydro system, BC Hydro electricity is currently among the most competitively priced in North America, which helps reduce the utility component of the cost of living and provides a competitive advantage for businesses operating in B.C. Each year, BC Hydro participates in a Hydro-Québec comparison survey of average electricity prices for 12 Canadian utilities and 10 American utilities. The Hydro-Québec report provides the monthly bills, excluding taxes and non-utility levies, calculated for specific consumption points for four different customer segments: residential, small power, medium power, and large power. The average price is also calculated, for each customer segment and specific consumption point, by dividing the monthly bill by the amount of monthly energy consumption. For example, if an electric bill for 1,000 kWh was calculated to be a monthly amount of $50, the average price would be $50 divided by 1,000 kWh, or 5 cents/kWh.

The most recent completed rate comparison was undertaken in 2012 (BC Hydro 2012). Figure 7.1 shows a comparison of the rates in multiple North American cities. As shown, BC Hydro's rates for fiscal 2012 were identified as among the lowest in North America.

BC Hydro's competitive electricity rates result from its Heritage hydroelectric system. As described below in Section 7.1.3, while large hydroelectric generating facilities have relatively high initial capital costs, operating and maintenance costs are minimal when compared to other sources of electricity such as natural gas-fired generation:

- Comparing the cost of electricity with the initial investment of a hydropower generating station, the pay-back period is short relative to the economic life of the hydroelectric facility. As described in Volume 1 Section 5.5.2, natural gas-fired and wind generating facilities have shorter economic lives than large hydroelectric facilities.
- A hydroelectric generating station can produce electricity with minimal cost increases over the life of the facility. This contrasts with natural gas-fired plants where the price of natural gas fluctuates depending on what the market is doing.

For hydroelectric projects like the Project, a longer lifespan means not only are costs spread across a longer timeframe but also power generating equipment used at the hydroelectric facilities can often operate for long periods of time without needing major replacements or repairs.

7.1.2 Capacity and Energy Provided by the Project

The Project will provide needed, long-term, cost-effective dependable capacity and energy for as long as the project operates. Volume 1 Section 5.2 demonstrates that there is a need for the Project's energy and dependable capacity, while Volume 1 Section 5.5 shows that the Project is the most cost-effective way to meet the identified need.

7.1.2.1 Capacity

Capacity represents the instantaneous power output of a generating facility at any given time. As described in Volume 1 Section 5.2, BC Hydro plans its system to ensure that there is sufficient dependable capacity to meet customer needs, which represents the maximum generation output that can be reliably supplied coincident with system peak

load, taking into account the physical state and availability of the equipment and water or fuel constraints. The *Utilities Commission Act* service obligation discussed in Volume 1 Section 5.2 means that BC Hydro must make sure customer demand is met at the peak load every day.

The dependable capacity of the Project is established as part of the project design. The dependable capacity of the Project is 1,100 MW, as discussed in Section 4.3.1.4 in Volume 1 Section 4 Project Description. As described in Volume 1 Section 5.2, after BC Hydro implements Revelstoke Unit 6, there are limited dependable capacity resource options available to BC Hydro. Proceeding with the Project avoids dependable capacity resources such as natural gas-fired SCGTs and/or pumped storage facilities. Therefore, the long-term value of the Project's dependable capacity is the avoided cost of a SCGT (within the 93~~7~~% *Clean Energy Act* clean or renewable target) and/or pumped storage, which have unit capacity costs of between $89/kW-year up to $440/kW-year (refer to Table 5.38, Volume 1 Section 5). These capacity costs are reflected in the value of the avoided costs of energy presented in Section 7.1.2.3 below.

7.1.2.2 Energy

Energy represents the cumulative amount of electricity produced or consumed over a specific period of time. For the Project, the amount of energy that can be produced is driven by the water inflows into the proposed Project reservoir from the Peace Canyon generating station and from local tributaries.

To determine the average annual energy produced by the Project, BC Hydro modeled the BC Hydro generation and transmission system in HYSIM for 60 different water inflow scenarios, for portfolios (as defined in Volume 1 Section 5 Need for, Purpose of, and Alternatives to the Project) with the Project and without the Project. (Please see Volume 2 Section 11.4 Surface Water Regime for a more detailed discussion of the HYSIM model.)The difference between the annual energy in these two portfolios represents the energy contributed to the system by the Project.

Variability in weather conditions (most importantly, variability in precipitation amounts) will result in variability in the energy contributed by the Project from year to year. To quantify this variability in annual generation, the HYSIM analysis (Volume 2 Section 11.4 Surface Water Regime) calculated the energy contribution across the range of 60 water inflow scenarios. Table 7.1shows the average annual energy contributed by the Project, as well as the firm energy, which represents the average energy contributed in the worst three-year sequence of inflows out of the 60 water inflow scenarios.

Table 7.1 Annual Energy Contribution of the Project

Annual Energy Contribution	GWh
Average annual energy: Average annual energy contribution across all modelled inflow scenarios	5,100
Firm energy: Average annual energy contribution in worst three-year sequence of inflows	4,700

The timing of this energy generation throughout the year is also a key benefit to BC Hydro ratepayers, as generation can be timed to match customer demand. See Section 7.4.1 for further discussion.

Proceeding with the Project avoids higher cost clean or renewable intermittent resources (referred to as Available Resources in Volume 1 Section 5). The long-term value of the Project's 5,100 GWh/year of average energy is based on the avoided cost of alternative resources, and falls into the following range ($F2013):

- $135/MWh ($F2013), which is the adjusted weighted average price resulting from the most recent, broadly-based BC Hydro energy acquisition process, the Clean Power Call (about 3,000 GWh/year of firm energy)
- $131/MWh ($F2013), which is the adjusted weighted average price of the clean energy resources that make up the portfolios shown in Table 5.42, Volume 1 Section 5, based on pricing from the 2010 Resource Options Report

7.1.2.3 Combined Value of Site C Energy and Capacity

The long-term value of the Project's 5,100 GWh/year of average energy and 1,100 MW of dependable capacity can be valued through the avoided cost of a replacement portfolio of both energy and capacity resource options. The range of UECs for the replacement portfolios are:

- $163/MWh to $189/MWh, which is the unit energy cost for a portfolio with energy priced at the $135/MWh Clean Power Call adjusted weighted average price, plus capacity resources priced at the range provided in Section 7.1.2.1
- $156/MWh to $181/MWh, which is the adjusted unit energy cost range for the Clean Generation and the Clean + Thermal Generation portfolios (refer to Table 5.42, Volume 1 Section 5). This values energy at $131~~25~~/MWh based on information in the 2010 Resource Options Report (as per Section 7.1.2.2) and values capacity based on the range in Section 7.1.2.1.

7.1.3 Effect on Ratepayer Costs

Costs associated with generation projects are recovered from ratepayers based on the revenue requirements collected by BC Hydro, as regulated by the British Columbia Utilities Commission (BCUC). The addition to the total customer revenue requirement resulting from a hydroelectric project is generally composed of:

- Operations costs
- Financing costs (i.e., interest on debt associated with the project)
- Amortization of the project capital cost (depreciated over a period as determined by accounting principles and accepted by the BCUC)
- A regulated return on equity on the capital invested in the project

One of the benefits of the Project to BC Hydro ratepayers arises from the difference in ratepayer costs between different portfolios including the Project and portfolios where the Project is replaced by alternatives, as described in Volume 1 Section 5.5 Need for, Purpose of, and Alternatives to the Project. Based on the analysis in Volume 1 Section 5.5, the Project is expected to result in lower long-term costs to ratepayers than alternative resource options.

Figure 7.2 provides a directional depiction of the expected annual costs to ratepayers of the Project and a comparable block of either clean or clean plus thermal alternative resources.

- The Project's annual costs are calculated based on assumptions regarding the expected cost recovery from ratepayers. The manner of cost recovery is determined by the BCUC, and may therefore differ from these assumptions. Increases in the cost of service after Year 40 are due to significant sustaining capital requirements in these years.
- The cost of the portfolios of alternatives assume an annual payment schedule similar to the electricity purchase agreements (EPAs) signed under the Clean Power Call, which is the most recent BC Hydro power acquisition process, where costs increase at half of an agreed-upon inflation index (this results in a year-by-year decrease in the real dollar annual cost). The terms of future EPAs would be subject to commercial negotiations, and may therefore differ from these assumptions.

As shown by Figure 7.2, the Project consistently has a lower cost of service than the portfolios of alternative energy resources. This cost differential is smaller at the start of the operations period, as the financing costs for the Project are at their highest. As the project debt is repaid, financing costs decrease and the cost differential between portfolios increases. It should be noted that the average EPA term under the Clean Power Call was approximately 30 years (with the maximum being 40 years), and the price and volume of the replacement or renewal of EPAs after that point would be uncertain. Refer to Section 5.2.3 in Volume 1 Section 5 Need for, Purpose of, and Alternatives to the Project for additional detail.

An additional benefit of the Project is the lower uncertainty in the cost of energy paid by BC Hydro customers. The majority of the levelized cost of the Project is from construction and development costs, and thus would be fixed once construction of the Project is complete. Conversely, for a thermal resource such as a natural gas generating facility, a material portion of the costs are incurred during operations, and therefore energy costs are subject to market fluctuations in fuel prices. Table 7.2 demonstrates this difference by comparing the makeup in levelized unit energy cost (see Volume 1 Appendix F Project Benefits Supporting Documentation, Part 1 Project Cost Estimate for a description of the Project's unit energy cost) between the Project and a natural gas generating facility.

Table 7.2 Comparison of Unit Energy Cost Composition Between the Project and a Representative Combined-Cycle Gas Turbine

Component of Unit Energy Cost	Site C Clean Energy Project (%)	Sample Combined-Cycle Gas Turbine (%)
Construction and Development Costs	85	20
Operations Costs, Sustaining Capital, and Taxes	5	10
Fuel Costs (water rentals, natural gas)	10	70

NOTES:
All numbers rounded to nearest 5%
Capital cost information from Appendix 3 of BC Hydro's Resource Options Report (BC Hydro 2010)

Compared to natural gas generating facilities, the Project provides relative price certainty for ratepayers, and protects ratepayers from volatility in ongoing operating costs due to fluctuating fuel prices.

7.2 Taxpayer Benefits

This section describes the annual taxpayer benefits of the Project, including the following:

- Annual federal, B.C. provincial, municipal, and regional government revenues that will accrue during the construction and operation phases of the Project
- Annual federal and provincial gross domestic product (GDP) that will accrue during the construction and operations phases of the Project

This section is structured as follows:

- Section 7.2.1 provides a summary of the benefits to government revenues in the Northeast Development Region for the construction and operations periods
- Section 7.2.2 provides a summary of the benefits to provincial and federal government revenues for the construction and operations periods
- Section 7.2.3 summarizes these taxpayer benefits

7.2.1 Local Government Revenues

The Project will provide additional revenues to local governments during both the construction and operations periods. The major sources of this local government revenue are general taxation revenues, grants-in-lieu, and school taxes. Further details on the local government revenues effects assessment are provided in Volume 3 Section 16 Local Government Revenue.

7.2.1.1 Taxation Revenues

The key source of additional taxation revenues to local governments will be from incremental property taxes collected from new residents and businesses in local communities who are attracted by the opportunities presented by the construction of the Project. Based on the British Columbia Input-Output Model analysis, there would be a total of $40 million in direct, indirect, and induced incremental tax revenues resulting from the construction phase of the Project (Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats).

Table 7.3 Estimated Local Tax Revenues Derived from Project Expenditures During Construction

Year of Construction Phase	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Tax revenue from direct Project expenditures	0	1	1	1	1	1	0	0	0	5
Tax revenue from indirect and induced activity	1	3	4	5	6	6	5	3	1	35
Total	2	4	5	6	7	6	6	3	1	40

NOTES:
All values in $ million
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

There would be additional taxation revenues accruing to local governments during the operations phase of the project. However, grants-in-lieu (see below) replace the majority of traditional taxation revenues, and any remaining incremental revenues are expected to be non-material, given the low project operations costs. As a result, taxation revenues during the operations phase have not been included in the estimate of the Project's financial benefits.

7.2.1.2 Grants-in-Lieu of Taxes

BC Hydro's generating facilities are generally exempt from assessment and taxation, per B.C. Order-in-Council 2091/82. However, for most existing projects the Province has authorized BC Hydro to pay an annual grant-in-lieu of taxes to local communities during project operations. Whether this amount is paid is at the Province's sole discretion.

If the Province authorizes BC Hydro to pay grants-in-lieu for the Project, the estimated payment would be approximately $1,300,000 per year (in 2012 dollars) based on current rates. These rates are indexed to annual inflation in municipal tax revenues.

7.2.1.3 School Taxes

While BC Hydro generating facilities are generally exempt from assessment and taxation, this exemption does not extend to transmission assets. As a result, Project transmission assets such as transformers, circuit breakers, and the buildings that house them would be subject to school taxes.

The estimated school taxes on the Project transmission assets is approximately $800,000 per year (in 2012 dollars), but would depend on the actual assessed value of the assets once constructed. The school tax rate varies annually, but typically increases at the rate of inflation.

7.2.2 Provincial and Federal Government Revenues

The provincial and federal governments are expected to receive incremental revenues as a result of the Project during both construction and operations. The major sources of provincial government revenue are general taxation revenues, water rentals, and the Government return on equity. Federal government revenues are primarily from taxation revenues.

7.2.2.1 Taxation Revenues

During construction, these incremental revenues will come from taxes on a range of sources that would be associated with the Project, including provincial and federal income tax, net child benefits, net property tax, sales tax, fuel tax, health care premiums, payroll taxes, federal taxes, and net GST for B.C. families of various sizes and various incomes.

The British Columbia Input-Output Model(Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats) estimates that the provincial government would receive approximately $176 million in revenues from direct, indirect, and induced activities during the construction phase of the Project. Meanwhile, the federal government will collect an estimated $270 million over same period from direct, indirect, and induced activities.

Table 7.4 Estimated Provincial and Federal Tax Revenues Derived from Project Expenditures During Construction

Year of Construction Phase	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Provincial Revenue ($ million)										
Tax revenue from direct project expenditures	3	12	14	15	18	20	17	10	2	111
Tax revenue from indirect and induced activity	2	6	8	9	11	10	10	6	2	65
Total provincial tax revenue	6	18	22	24	29	30	27	16	4	176
Federal Revenue($ million)										
Tax revenue from direct project expenditures	5	17	21	22	26	38	33	18	4	185
Tax revenue from indirect and induced activity	3	9	11	13	15	12	12	7	2	84
Total	9	26	32	35	41	51	45	26	6	270

NOTE:

Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

During project operations, revenues would continue to accrue to the provincial government through water rentals and BC Hydro's regulated return on equity. These items are also included in the Project's unit energy cost (discussed in Volume 1 Appendix F Project Benefits Supporting Documentation, Part 1 Project Cost Estimate), either as direct costs (e.g., water rentals) or implicit in the discount rate (e.g., government dividend, via the return on equity).

7.2.2.2 Water Rentals

Water rentals are fees paid by BC Hydro and collected by the Water Stewardship division of the B.C. Ministry of Environment, as established by the *Water Act* and the *Financial Administration Act* (B.C. Reg. 204/88, O.C. 889/88). There are separate water rental charges based on energy output, authorized capacity, and water impounded for storage. In total, for all facilities, BC Hydro paid $346 million in water rentals to the Province for the fiscal year ending March 31, 2012.

Based on current water rates, the annual water rental revenues to the Provincial government associated with the Project are expected to be $41.2 million dollars in 2012 real dollars (BCMOE 2012). Water rentals are currently indexed to escalate at the rate of Canadian Price Index inflation and are therefore expected to stay constant on a real dollar basis.

7.2.2.3 Government Return on Equity and Dividend

The Project will provide incremental returns to the provincial government during operations through its contribution to BC Hydro's regulated return on equity and government dividend. Through Heritage Special Direction HC1, the province requires BC Hydro to make annual dividend payments to the province of 85% of BC Hydro's net income, as long as BC Hydro's debt-equity ratio, after deducting the payment, is not greater than 80:20.

BC Hydro's return on equity and dividend is based on all BC Hydro activities, and is not calculated on an individual basis for a project such as the Project. However, an approximation of the Project's contribution to the return on equity and dividend can be made to estimate the potential increase to government revenues.

The Project will represent a $7.9 billion capital investment held by BC Hydro at its in-service date. This initial capital investment will depreciate over time, although sustaining capital investment associated with asset rehabilitation or replacement will partially offset this depreciation.

BC Hydro collects a return on deemed equity, as established by Heritage Special Direction HC2 as 30% of its average asset/rate base. The return that BC Hydro collects on deemed equity is established by the BCUC on the basis of a comparison with the pre-tax rate of return earned by private utilities in B.C., and was 11.78% as of March 31, 2012.

For the Project, the incremental return on equity was estimated by taking 30% of the project's depreciated capital asset and calculating an 11.78% return on this amount. This analysis assumes that the sole effect on BC Hydro's return on equity is due to the increase in BC Hydro's capital asset base. Table 7.5 shows the approximate incremental return on equity and dividend for a selection of years throughout the life of the Project.

Table 7.5 Estimated Contribution of the Project to the Province of B.C.'s Return on Equity and Dividend (Selected Years)

Years from Project In-Service Date	Contribution to Return on Equity	Contribution to Dividend
1	220	185
5	190	160
10	160	135
25	95	80
50	35	30

NOTE:
All values in $ million, 2012 real dollars

7.2.2.4 Other Revenues

In addition to the above, the provincial and federal governments would also expect to receive incremental personal and corporate income tax revenues resulting from economic activity associated with project operations. However, these additional revenues are not expected to be material, given the low project operations costs, and have not been included in the estimate of the Project's financial benefits.

7.2.3 Summary of Taxpayer Benefits

A summary of the local, provincial and federal taxpayer benefits for the construction and operations phases of the Project are provided in Table 7.6.

Table 7.6 Estimated Government Revenues – Construction Period and Operations Period (Selected Years)

	Construction Period Total	Operations Period				
		Year 1	Year 5	Year 10	Year 25	Year 50
Local revenues	40	2	2	2	2	2
Provincial revenues	176	260	230	200	135	75
Federal revenues	270	0	0	0	0	0

NOTE:
All values in $ million, 2012 real dollars, rounded

7.3 Economic Benefits

This section describes the projected economic benefits of the Project, including:

- Estimated direct employment stated in number of person-years, to be created by major job category (e.g., labour, management, business services) during construction and operations
- Estimated indirect employment (i.e., employment in industries that supply goods and services used to produce an industry's output or to be consumed by individuals) and

induced employment (i.e., employment due to the spending and re-spending of directly and indirectly generated incomes in the broader economy) during construction and operation predicted by the British Columbia Input-Output Model developed and maintained by BC Stats (Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats)

- Predicted locality of direct and indirect hires
- Contractor supply services estimates, including the value of supply of service contracts expected for the Project's construction and operations phases

For definitions of direct, indirect, and induced effects, please see Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats.

This section also describes the economic benefits for Aboriginal groups, including:

- Employment
- Contracting and business development, including small and medium-sized enterprises
- Capacity-building initiatives

This section is structured as follows:

- Section 7.3.1 provides a description of spending on contractors and consultants for the construction period of the project
- Section 7.3.2 presents the employment benefits of the project through both the construction and operations phases
- Section 7.3.3 provides a description of the economic benefits that BC Hydro expects to provide to Aboriginal groups
- Section 7.3.4 provides a description of the economic benefits that BC Hydro expects to provide to communities local to the Project
- Section 7.3.5 provides a description of the economic benefits that BC Hydro expects to provide to B.C. Ministry of Transportation and Infrastructure (BC MoTI) through quarry expansion

7.3.1 Economic Development Benefits

7.3.1.1 Construction Phase

Construction of the Project will provide economic benefits at the local, provincial, and federal level, due to the purchase of goods and services for construction and the resulting increase in output from supplier industries, GDP, and household income.

The Project will provide benefits to a range of contractors and consultants supplying direct and indirect goods and services to the Project. The effects on economic development indicators for the construction period were estimated by providing cost estimates and supporting information to BC Stats for use in the British Columbia Input-Output Model (Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats). For the Northeast Development Region (NEDR), the increased output would be through the expansion of

existing businesses or the establishment of new ones, including branch and subsidiary operations of major suppliers who do not already have offices in the NEDR. In addition to the potential effects to direct suppliers, the Project is expected to increase GDP and household income in both the construction and operations phases.

The estimated magnitude of the effect on output, GDP, and household income at the regional and provincial level during construction is presented in Table 7.7. The majority of the effect on federal GDP will be due to the increase in B.C. provincial GDP; however, estimated imports from other provinces are provided in order to estimate the GDP increase in other provinces.

Table 7.7 Economic Development Benefits During Construction Period ($ million)

	Direct Suppliers	Other (Indirect) Suppliers	Induced Increase	Total Increase
Northeast Development Region				
GDP	35	52	45	132
Output	99	127	99	324
Household income	25	26	31	81
Provincial				
GDP	1,725	976	507	3,228
Output	1,429	774	814	3,016
Household income	1,294	648	291	2,232
Federal				
Imports from other provinces				580

NOTE:
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

It is expected that the Project would create opportunities for supplier industries and diversify the economic base of the NEDR during the construction period. Table 7.8 shows the change in dollars to the top five supplier industries of contracts associated with the Project during the construction phase. A more detailed table can be found in the BC Stats report in Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats.

Table 7.8 Estimated Increases in Output in Top Five Supplier Industries During Construction Phase

Supplier Industry	$ million
Finance, insurance, real estate, and renting and leasing	635
Manufacturing	190
Professional, scientific, and technical services	315
Wholesale trade	210
Operating, office, cafeteria, and laboratory supplies	205

NOTES:
The top five supplier industries represent approximately 52% of the total increase in supplier output
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

7.3.1.2 Operations Phase

Operations of the Project will provide economic benefits at the local, provincial, and federal level, due to the purchase of goods and services for operations and sustaining capital investment. These purchases will increase supplier industry output, GDP, and income.

The effects on output, GDP, and income for the operations period were estimated by providing cost estimates and supporting information to BC Stats for use in the British Columbia Input-Output Model, as was done for the construction phase. The estimated magnitude of the change to output, GDP, and household income at the regional and provincial level during construction is presented in Table 7.9. As discussed for the construction phase, the majority of the effect on federal GDP will be due to the increase in B.C. provincial GDP; however, estimated imports from other provinces are provided in order to estimate the GDP increase in other provinces.

Table 7.9 Average Annual Economic Development Benefits During Operations Phase ($ million Per Year)

	Direct Suppliers	Other Suppliers	Induced Increase	Total Increase
Northeast Development Region				
GDP	0.0	0.2	0.3	0.4
Output	0.2	0.4	0.5	1.1
Household income	0.0	0.0	0.2	0.3
Provincial (including Regional)				
GDP	2.9	1.5	2.6	7.0
Output	6.0	3.0	3.4	13.5
Household income	2.7	1.3	1.9	4.9
Federal				
Imports from other provinces				1.8

NOTES:
Values include both average annual increases from operations and maintenance, and levelized sustaining capital
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

Table 7.10 shows the dollar changes to the top five supplier industries of contracts associated with the Project during the operations phase. These increases are split between operations and maintenance and sustaining capital, due to the difference in the types of industries affected by these different operating period activities.

Table 7.10 Estimated Increases in Output in Top Five Supplier Industries During Operations Phase ($ million Per Year, Average)

Operations and Maintenance		Sustaining Capital Investment	
Increase in Supplier Industry Output		**Increase in Supplier Industry Output**	
Professional, scientific, and technical services	4.3	Finance, insurance, real estate, and renting and leasing	1.4
Finance, insurance, real estate, and renting and leasing	0.2	Transportation and warehousing	0.4
Operating, office, cafeteria, and laboratory supplies	0.9	Manufacturing	0.6
Retail trade	0.3	Wholesale trade	0.5
Travel and entertainment, advertising, and promotion	0.2	Professional, scientific, and technical services	0.4

NOTE:

Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

A more detailed table can be found in the BC Stats report in Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats.

<u>Business Engagement</u>

BC Hydro has been engaging with businesses in order to enable participation both prior to and during the construction of the Project. Please see Section 9.1.3.5 in Volume 1 Section 9 Information Distribution and Consultation for a description of these activities, which would continue through the construction period. In addition to these engagement activities, BC Hydro proposes to staff a procurement or economic development office in the NEDR.

BC Hydro has worked to engage local businesses with development work on the Project. To date, more than two dozen companies with local or regional offices are engaged with the Project, with a large number of additional vendors supplying goods and services to the Project.

Further information on ways in which BC Hydro is engaging local businesses can be found in Volume 1 Section 4 Appendix F Project Benefits Supporting Documentation, Part 2– Local Participation Strategies.

7.3.2 Employment Benefits

The Project is expected to provide employment benefits both prior to and during the construction and operations phases. This section describes the direct, indirect, and induced employment (as defined in Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats) resulting from

the Project for the period prior to and during the construction phase, as well as employment during the operations phase.

7.3.2.1 Prior to and During the Construction Phase

The Project would provide employment during the eight-year construction phase, and has been providing employment prior to and during the Environmental Assessment as well. Approximately 70% of the construction employment would involve trade occupations, 18% would involve contractor supervisors, and 11% would involve BC Hydro personnel. Of the trades occupations employment, 60% would be equipment operators, labourers, and truck drivers.

Table 7.11 Estimated Employment Provided by the Project Prior to Project In-Service Date

	Direct Jobs	Indirect and Induced Jobs	Total Employment
Prior to and during the Environmental Assessment	2,200	1,500	3,700
Construction Phase	10,200	19,100	29,300
Total Jobs to Project ISD	12,400	20,600	33,000

NOTES:
All values in person-years of employment
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

The locality of the construction employment can be estimated using the British Columbia Input-Output Model. Table 7.12 shows the component of the project employment expected to be provided in the NEDR.

Table 7.12 Estimated Employment During Construction in the Northeast Development Region

	Direct Jobs	Indirect and Induced Jobs	Total Employment
Construction Phase	1,600	2,300	3,900

NOTES:
All values in person-years of employment
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

In order to achieve this expected employment in the NEDR, BC Hydro has undertaken and will continue to undertake activities to engage labour not currently in the workforce. Details of these activities can be found in Section 7.3.4 as well as in Volume 1 Appendix F Project Benefits Supporting Documentation, Part 2 Local Participation Strategies.

7.3.2.2 Operating Period

The Project's operating labour requirements were estimated based on a comparison of existing BC Hydro facilities of a similar size. For plant operations and maintenance, BC Hydro estimates that the Project would require approximately 25 persons for

long-term employment, approximately 13 of whom would be located in the NEDR. These jobs are primarily composed of skilled trades, engineering, and management functions, with some supporting administrative and janitorial positions. Employment in supplier industries will result from positions related to environmental monitoring and mitigation activities, as well as other jobs related to equipment supply and other supporting activities.

Additional employment will result from major sustaining capital expenditures over the life of the Project. Sustaining capital investment occurs as project components require refurbishment or replacement, and is not expected to occur during the first 25 years of operations. When the sustaining capital investment does occur, the workforce required will depend on the magnitude and complexity of the work undertaken. For simplicity, employment associated with sustaining capital is presented as an average employment over the 100-year evaluation period in the BC Stats report in Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats. Actual employment will vary from year to year.

Table 7.13 Estimated Employment Provided by the Project After Project In-Service Date

	Direct Jobs	Indirect Jobs	Induced	Total Employment
Operations and Maintenance	25	51	12	88
Sustaining Capital (levelized)	33	20	20	73
Total employment after Project in-service date	58	71	33	161

NOTES:
All values in person-years per year
Source: Modified from Volume 3 Appendix A Economic Assessment Supporting Documentation, Part 2 Project Economic Impacts: BC Stats

It is expected that approximately 50% of the direct operations jobs on the Project will be located in the NEDR. Indirect and induced employment are expected to be similarly split evenly. Direct jobs associated with sustaining capital are expected to be more concentrated, with approximately 75% located in the NEDR. Indirect and induced jobs from sustaining capital investment would be expected to be more evenly split (i.e., 50% in the NEDR).

7.3.2.3 Tools for Engaging Local Labour

BC Hydro has, and would continue to, implement measures to increase the availability of local labour in recognition of the existing high local employment rate.

- BC Hydro donated $1 million to the Northern Lights College Foundation for skills and trades training for Aboriginal and non-Aboriginal students
- BC Hydro would build a daycare in the Fort St. John area early in the construction phase to support families wanting to participate in the local workforce
- BC Hydro's Project labour strategy is to seek to promote and maximize opportunities for local and regional hiring

BC Hydro is planning for approximately 15% of workers to live in local communities and commute daily to the work site. If additional workers are available, both locally and regionally, BC Hydro would be able accommodate this increase.

7.3.3 Economic Benefits to Aboriginal Groups

BC Hydro is committed to the advancement of economic opportunities for Aboriginal groups, both to build their capacity and to develop more sustainable long-term relationships. BC Hydro has an existing Aboriginal Contract and Procurement Policy that is intended to increase the involvement of First Nations in economic opportunities associated with BC Hydro's business activities by allowing certain procurement practices, including:

- Capacity-building initiatives, where BC Hydro provides funding or resources in order to provide training, improve skills, or increase business capacity in Aboriginal businesses
- Directed Aboriginal procurement, such as set-asides, restricted tendering, and single source negotiations
- The use of Aboriginal evaluation criteria in procurement packages. This provides an incentive for primary contractors to establish working relationships with First Nations groups, and increases the likelihood of Aboriginal participation in the construction contracts while maintaining a competitive environment that provides maximum benefits to ratepayers.
- The use of an Aboriginal business directory. BC Hydro's Aboriginal Business Directory is accessible by BC Hydro to suppliers and contractors, and enables BC Hydro to promote partnerships between non-Aboriginal, First Nations, and Aboriginal businesses in contract work for BC Hydro.

BC Hydro has sought to provide economic benefits and to support capacity-building opportunities for Aboriginal people during activities prior to and during the construction phase of the Project. Some highlights of these activities include:

- BC Hydro has been building Aboriginal business capacity through the use of directed procurement activities, both prior to and during the Environmental Assessment process on the Project. This directed procurement has been used on engineering investigations contractor work as well as environmental baseline and effects assessment studies.
- BC Hydro will contribute $1 million in funding to support trades and skills training bursaries at Northern Lights College, with 50% of the funding for bursaries to be dedicated to Aboriginal students
- In July 2011, BC Hydro entered into a three-year funding agreement with Northern Opportunities, a partnership of the school districts of Fort Nelson (SD #81), Peace River North (SD #60), and Peace River South (SD #59) along with Northern Lights College, local First Nations, and industry, as well as local communities, with the objective of providing young people with a seamless learning pathway from secondary school to post-secondary training, leading to career success. The program covers academic, trades, apprenticeship, and vocational programs, and is open to both Aboriginal and non-Aboriginal students.

- In December 2012, BC Hydro announced that it would contribute $100,000 to the North East Native Advancing Society in support of advancing North East Aboriginal Trades Training participants into trades training not currently offered by Northern Lights College for those trades that are of interest to BC Hydro for the Project, such as heavy duty equipment operators. The funding would be used to defray tuition and related costs for those students who are pursuing trades training.

For more details on the activities undertaken by BC Hydro to provide economic benefits to Aboriginal groups, see Volume 1 Appendix F Project Benefits Supporting Documentation, Part 2 Local Participation Strategies.

7.3.4 Economic Benefits to Local Communities

Local communities will receive benefits from:

- Employment opportunities (as discussed in Section 7.3.2)
- Economic development opportunities (as discussed in Section 7.3.1)
- Revenues to their local governments (as discussed in Section 7.2.1)

Specific business, skills, and employment initiatives that BC Hydro is undertaking to support the opportunities above include:

- Establishing a Business Liaison Program to keep the business community updated on the status of the project and to advise on future business opportunities (see Volume 1 Section 9.1.3.5)
- As noted in Section 7.3.3., BC Hydro will contribute $1 million in funding to support trades and skills training bursaries at Northern Lights College
- As noted in Section 7.3.3, BC Hydro entered into a three-year funding agreement in July 2011 with Northern Opportunities, a partnership of the school districts of Fort Nelson (SD #81), Peace River North (SD #60), and Peace River South (SD #59), along with Northern Lights College, local First Nations, and industry as well as local communities, with the objective of providing young people with a seamless learning pathway from secondary school to post-secondary training, leading to career success.

Communities will also benefit from project construction plans and proposed mitigation plans such as:

- **Improved Infrastructure:** As described in Section 4.3 in Volume 1 Section 4 Project Description, some of the roads upgraded and enhanced during the construction phase will be accessible to the public, in addition to the realigned segments of Highway 29. These enhanced and upgraded roads and highways would support the economic development of the communities in the NEDR in the long term, both during Project construction and after construction is complete. As a further example, the proposed Hudson's Hope shoreline protection, designed to protect the shoreline from the effects of erosion from the reservoir, will improve the stability of the slopes compared to their current condition, and will include a new walking trail.
- **Improved Tourism:** As part of its proposed mitigation plans, BC Hydro is also proposing funding for tourism improvements, including building a viewing site for

construction of the dam, providing enhancements to the W.A.C. Bennett Visitor Centre, and providing funding for other regional and local museums.

- **Affordable Housing:** To encourage workers to live locally, BC Hydro has committed to build approximately 50 new housing units in the City of Fort St. John, in cooperation with B.C. Housing; 40 of these units would be for use by BC Hydro's workforce and their families during construction and 10 would be for use by the community. After construction of the Project, all 50 housing units would be available as affordable housing in the community.

In addition to these benefits, BC Hydro is undergoing discussions with local and regional governments to pursue legacy initiatives that will provide additional economic and social benefits for local communities. Discussions are continuing with local and regional governments with a view to achieving benefits agreements.

Activities related to business and labour engagement are outlined in Sections 7.3.1 and 7.3.2, respectively. Additional initiatives to promote economic opportunities for northern communities are outlined below.

7.3.5 Economic Benefits from Quarry Expansion

West Pine and Wuthrich quarries would be expanded and the Portage Mountain quarry specifically developed for the Project, and available for production after the Project is constructed. A surplus of 2.9 million m^3 will be available for use by the B.C. Ministry of Transportation and Infrastructure and other potential users.

7.4 Environmental, Social and Sustainability Benefits

This section describes the environmental and sustainability benefits of the Project, including the ability of the Project to:

- Integrate clean or renewable generation resources such as wind and run-of-river hydro
- Generate electricity with a low amount of greenhouse gas emissions per unit of energy delivered
- Increase fish habitat and aquatic productivity in certain areas
- Provide increased fishing opportunities and water based access for a variety of boats
- Improve the safety of public roads and the reliability of the local transmission system

This section is structured as follows:

- Section 7.4.1 describes the manner in which the Project improves on the value of existing BC Hydro assets on the Peace River
- Section 7.4.2 describes the low greenhouse gas intensity of the electricity produced by the Project
- Section 7.4.3 describes the Project's potential increase in BC Hydro's ability to integrate additional intermittent clean resources such as wind and run-of-river hydro
- Section 7.4.4 describes the potential benefits to downstream infrastructure resulting from the improved control of flows provided by the Project

- Section 7.4.5 describes the potential benefits to fish habitat and aquatic productivity in certain areas
- Section 7.4.6 describes the potential benefits to outdoor recreation
- Section 7.4.7 describes the potential benefits to public roads and safety
- Section 7.4.8 describes the potential benefits to the local transmission system

7.4.1 Optimizing the Value of Existing BC Hydro Assets on the Peace River

A key benefit and competitive advantage of the Project is its location on the Peace River in British Columbia, downstream of the W.A.C. Bennett Dam and Peace Canyon Dam and their associated reservoirs, Williston and Dinosaur reservoirs, respectively. Williston Reservoir has a multi-year storage capacity; consequently, it has the capability to store water in wet years for use in dry years.

Electricity demand in British Columbia varies, with the highest seasonal demand in the winter, the highest weekly demand during the work week, and the highest daily demand during the daytime. As shown in Figure 7.3, water inflows to the BC Hydro reservoirs also vary, peaking in the spring with annual snowmelt and reaching a minimum in late winter. As part of normal operation of Williston Reservoir, water is stored during the high runoff and relatively low electricity price period from late April/May to early July, making water available to supplement the low runoff during the high demand and/or high price electricity period in summer and winter.

The Williston Reservoir can store three years of water inflow and enables BC Hydro to use water for generation when required for domestic demand. Flow from Williston Reservoir is regulated by the G.M. Shrum generating station. The regulated flow from G.M. Shrum and the natural flow enter Peace Canyon Dam's Dinosaur Reservoir. Outflow from Peace Canyon Dam is regulated by the Peace Canyon generating station. The flow into the Project's proposed reservoir would thus be regulated by the G.M. Shrum generating station and, to a lesser extent, the Peace Canyon generating station, to provide year-to-year shaping as well as seasonal and weekly shaping. In effect, this optimizes the value of the water stored behind W.A.C. Bennett Dam, as that water would be used for generation a third time after being run through turbines at the G.M. Shrum generating station and the Peace Canyon generating station.

This upstream regulation allows the Project to generate electricity to match the timing of BC Hydro customer demand without the need to establish another large multi-year storage reservoir similar to Williston Reservoir. As a result, the Project is able to produce approximately 35% of the energy produced by the G.M. Shrum generating station with 5% of the reservoir area.

7.4.2 Low Greenhouse Gas Emission Energy

All generation resources emit some greenhouse gas (GHG) emissions during their lifecycle. All facilities will have GHGs emissions associated with construction and operations. In addition, thermal resources such as natural gas and coal have additional GHG emissions associated with the operational combustion of hydrocarbons. One of the benefits of the energy that would be provided by the Project is its low GHG intensity, with GHG emissions per unit energy produced at levels comparable to other renewable

resources such as wind and run-of-river hydro, and substantially less than thermal generation resources.

BC Hydro has developed an estimate of GHG emissions associated with the Project, as discussed in Volume 2 Section 15 Greenhouse Gases. GHG emissions were modeled using the Intergovernmental Panel on Climate Change guidelines. The modeled emissions for the Project were then compared to those of other alternative generation options to determine if there are GHG reduction benefits to the selection of the Project over other alternatives.

In order to perform this comparison, BC Hydro used the GHG emissions per unit energy generated by the Project and by alternative generation options. This provides a relative comparison of the GHG emissions that would result in replacing the 5,100 GWh produced by the Project with 5,100 GWh of energy produced by other sources.

As shown in Table 7.14, results from GHG modeling found that, when compared to other forms of electricity generation, the Project would produce among the lowest GHG emissions per unit of energy produced. Over the next 100 years, the Project would produce the same or lower GHG emissions than all other options available in B.C. for the 5,100 GWh of annual energy generation from the Project.

Table 7.14 Emissions Intensity – Site C Clean Energy Project and Other Generation Options

Generating Facility Type	Range ($g\ CO_2e/kWh$)	Average ($g\ CO_2e/kWh$)
Site C Clean Energy Project [a]	N/A	~~7.8~~10.5
Canada Boreal Hydroelectric	8 – 60	36
Tropical Hydroelectric	1,750 – 2,700	2,150
Model Coal	959 – 1,042	1,000
Integrated Gasification Combined Cycle	763 – 833	798
Diesel	555 – 880	717
Natural Gas Combined Cycle	469 – 622	545
Solar Photovoltaic	13 – 104	58
Wind Turbines	7 – 22	14

NOTE:

[a] Reported Project emissions intensity is based on IPCC – Tier 3 Likely values from Volume 2 Appendix S Greenhouse Gases Technical Report

N/A – Not applicable

Source: Modified from Volume 2 Appendix S Greenhouse Gases Technical Report

As would be expected, the Project would produce less GHGs per gigawatt hour than fossil fuel sources such as natural gas, diesel, or coal. Emissions intensity from the Project is more than an order of magnitude lower than the lower emissions intensity from a thermal generation resource (i.e., natural gas combined cycle generation).

The estimates also suggest that the GHG emissions intensity from the Project would fall within the ranges expected for other renewable sources, such as wind, while outperforming solar photovoltaics.

The Project is in the lower range of GHG emissions intensity for hydroelectric facilities, as a result of the Project being located in a northern environment. Facilities constructed in northern (i.e., temperate and boreal) environments generally emit lower quantities of GHG emissions than tropical reservoirs (Volume 2 Appendix S Greenhouse Gases Technical Report). In addition, cold, deep, well-oxygenated systems emit a higher proportion of CO_2, which has a lower global warming potential than CH_4.

The Project also benefits from requiring a smaller reservoir and footprint than what would normally be required for a hydroelectric project to generate 5,100 GWh. This is a result of the benefit provided by the upstream storage in Williston and Dinosaur reservoirs.

As shown by the analysis of GHG emissions in Volume 2 Appendix S Greenhouse Gases Technical Report, the GHG emissions intensity from the Project will be as low as, or lower, than other generation alternatives. This will benefit the provincial and federal governments by contributing to meeting provincial and federal GHG reduction targets.

7.4.3 Integration of Clean or Renewable Resources

Many clean or renewable energy resources – such as wind or run-of-river hydro – are intermittent, as their generation varies with natural factors. In order to integrate these clean or renewable resources into the BC Hydro system and meet electricity demand, this variability must be backed up by dispatchable capacity. The Project provides additional clean and renewable dispatchable capacity to the BC Hydro system and increases the system's capability to integrate renewable resources such as run-of-river hydro and wind.

As described in Section Volume 1 Section 5.2, run-of-river hydroelectric projects do not have any material amounts of storage, meaning that their output varies with the natural flow in the river. Typically, run-of-river projects generate at full output during the spring and early summer when river flows are high as well as during periods of heavy rain. Generation drops during low flow periods. Refer to Figure 5.5 in Volume 1 Section 5.5.2.1, which shows the annual power output of a typical run-of-river project in the coastal region of B.C. The coastal region of B.C. includes projects in the Lower Mainland and Vancouver Island. Typically, projects in this region have a profile that has slightly more generation in the winter peak than those in the interior of B.C. This is a conservative view of the seasonal variability of run-of-river hydro resources and means that run-of-river projects in the interior of the Province may benefit even more from additional dispatchable capacity and reservoir storage. The output from run-of-river projects is less predictable outside of the spring freshet, which makes it difficult to operate to match demand.

As described in Volume 1 Section 5.2, due to natural variations in wind speed, wind power generation is highly variable in the short-term timescales of seconds to minutes, resulting in the need for additional highly responsive generation capacity reserves on the electric system to maintain system reliability and security. The natural variability in wind power generation also makes it difficult to forecast wind in the hour- to day-ahead time frame, resulting in the need to set aside system flexibility to address the potential for

wind generation to either under- or over-generate in this time frame. Figures 5.6 and Figure 5.7 in Volume 1 Section 5 of this EIS show sample BC Hydro load and wind generation variability from a sample eight-day period in June 2011 and January 2012, respectively.

7.4.3.1 Wind Integration Studies

BC Hydro has identified the integration of wind resources as having a potential effect on the BC Hydro system, and has therefore conducted additional analysis on potential limits to wind generation for the BC Hydro system. The cost associated with reserving system flexibility to integrate wind resources is reflected in the evaluation of alternatives to the Project in Volume 1 Section 5 Need for, Purpose of, and Alternatives to the Project.

Currently, there are three operational wind farms in the Peace Region of B.C. with a combined installed or nameplate capacity of about 380MW supplying BC Hydro's integrated system. Additional wind generation is expected to be added through existing electric purchase agreements with independent power producers. The effect of wind power generation on electric systems is an area of interest in the electric utility industry. Many wind integration studies have been undertaken, and the knowledge base of the effect of wind integration continues to grow. BC Hydro has reviewed many wind integration studies, utility practices, and regulatory agency proposals in the area of wind integration to inform the analysis of the effect of wind integration on the BC Hydro system. BC Hydro expects that the understanding of the issues surrounding the integration of wind resources will continue to evolve as BC Hydro gains more experience with the operation of wind resources in B.C.

A preliminary analysis has been completed to determine the amount that the Project would increase the maximum amount of wind power that can be integrated into the BC Hydro system without affecting the reliability and security of the system. The results of the analysis show that the wind integration limit could increase by up to 900 MW with the addition of the Project.

7.4.4 Improved Operational Control of Peace River Flows

Improved operational controls will result in two benefits downstream of the Project.

- Improved access to Taylor wells:

  The District of Taylor's water supply wells are located on a small island close to the left bank of the Peace River, just upstream of the confluence with the Pine River. In the past, District officials have requested low releases of water from Peace Canyon Dam so that they could access their wells for maintenance. However, there is currently no control over flows from the tributaries (primarily coming from the Halfway and Moberly rivers) between Peace Canyon and Taylor.

  With the Project, there would be a larger degree of control over the flows at the Taylor wells since the volume of flows originating from the tributaries between the Project and the wells would be regulated.

- Improved ability to manage risk of ice breakup flooding at the Town of Peace River:

  Flooding has occurred in the past at the Town of Peace River when the Smoky River ice cover breaks up dynamically before the ice cover on the Peace River has regressed downstream of the confluence of the two rivers. BC Hydro controls flow

releases from the W.A.C. Bennett and Peace Canyon dams in order to help manage ice breakup and minimize the risk of flooding. This is discussed in Section 11.7 Thermal and Ice Regime in Volume 2 Section 11 Environmental Background.

The Project would move the point of flow control between 10 and 12 hours closer to the Town of Peace River, providing a faster response time if a particular flow was required in the Peace River at this location to reduce the flooding risk.

7.4.5 Aquatic Productivity Benefits

The Project would result in the creation of a 9,300 hectare reservoir, which would result in an increase in fish habitat area compared to the current river environment. As discussed in Volume 2 Section 12.4.3 Effects Assessment – Operations – Change in Fish Habitat, the increase in fish habitat area is expected to be 3.3 fold.

This increase in fish habitat area and change from a river to a reservoir environment would be accompanied by an increase in certain areas of aquatic productivity.

- Increase in algal biomass both upstream (100-600% increase) and downstream (250% increase) of the dam
- Increase in secondary production in reservoir
- Increase in fish biomass both in the reservoir (200% increase) and downstream of the dam (20-40% increase). This increase will be net across all species – there will be different effects on different species, as discussed in Volume 2 Section 12.4.3 Effects Assessment – Operations – Change in Fish Habitat

7.4.6 Recreation and Tourism Benefits

Fishing opportunities during operations would be expected to increase over baseline conditions as the Site C reservoir would support increased boating and angling use, and would continue to support sport fish.

A positive effect on outdoor recreation is expected during operations after debris clearing and slope stability monitoring. Water-based recreation is expected to increase in the reservoir compared to the baseline conditions as a result of greater potential access by a variety of boats.

7.4.7 Improvements to Public Roads

The design for new construction and upgrades to public roads would be in accordance with applicable British Columbia and Canadian guidelines, codes, supplements, and technical circulars. Upgrades to the provincial and municipal public roads would improve upon existing conditions, and the benefits from road and highway infrastructure improvements completed as part of the Project would be realised into the future. As described in Volume 1 Sections 4.3.4 and 4.3.7, permanent road upgrades are planned on the following existing routes:

- **Realignment of Highway 29**: Realignment of nearly 30 km of existing highway at Lynx Creek, Dry Creek, Farrell Creek, Halfway River and Cache Creek, resulting in geometric and cross-section improvements. Existing issues along Highway 29, particularly at steep and curvilinear sections where the smaller tributaries to the Peace River are crossed by the highway, will be eliminated. At these crossings the

new bridges and highway approach realignments proposed would be constructed to a higher standard than the existing highway, reducing grades and 'flattening' the horizontal curves. As a result, drivers will benefit from travel time savings and road safety will be improved. In addition, the Province benefits from new road and bridge infrastructure.

- **Improvements to the North Bank Roads:**
  - Hard-surface 240 Road and the portion of 269 Road south of the intersection with 240 Road
  - Realign a portion of Old Fort Road south of 240 Road
  - Widen shoulders or add a path on 271 Road between Wuthrich Quarry and Highway 97
  - Potentially widen shoulders or add a path on Old Fort Road between Highway 97 and the realigned segment, and between the end of the realigned segment and the gravel pit entrance at km 5.5
  - Conduct intersection lighting calculations to determine if illumination is warranted and then, in collaboration with BCMoTI, consider installing intersection lighting

  As a result, drivers will benefit from improved driving conditions, road safety will be improved, and cyclists would benefit from wide shoulders or paths.

- **Upgrades to Jackfish Lake Road:**
  - The current network of unpaved resource roads would be upgraded to provide access to the dam site area during the first year of construction, including isolated widening and localized grading, and road base repairs along the 53 km of unpaved resource roads
  - Upgrade about 31 km of the unpaved portion of Jackfish Lake Road, including road base strengthening and hard surfacing, which may require the widening of some sections
  - Examine the feasibility of widening the shoulders along the first 30 km of Jackfish Lake Road to meet current BCMOTI rural collector standards, potentially including two 1.5 m wide paved shoulder

  As a result, drivers will benefit from improved driving conditions, road safety will be improved, and cyclists would benefit from wide shoulders.

- **Construct the Project access road**, a new permanent 33 km road alongside the existing transmission line corridor, extending northeast from the Jackfish Lake Road. While this would be a private road, others would be able to use it, potentially with safety-based restrictions. This may enable decommissioning of other resource roads in the vicinity and consolidate the road with the existing transmission corridor in this area. Benefits of the Project Access Road during construction including improved travel times for workers and deliveries to the dam site, and improved reliability and road safety relative to travelling to and from the dam site during construction on the existing PDR roads.

- **Improvements to Roads in the Hudson's Hope area:**
  - D.A. Thomas Road, which would provide improved vehicle access to the shoreline, berm and proposed day use recreation area and small craft boat launch
  - Construct a paved brake check before the grade on Canyon Drive, west of Hudson's Hope. Also explore opportunities for constructing, and install if feasible, either arrestor beds or runaway lanes, or both, on Canyon Drive above Hudson's Hope. Construction of the brake check and arrestor bed/runaway lane will improve road safety.

7.4.8 Transmission System Benefits

The Site C substation would include 500 kV to 138 kV step-down transformers to provide service to Fort St. John and Taylor, and allow for the removal of the 138 kV lines. The advantages of connecting Fort St. John and Taylor to the new Site C substation would be:

- Improvements in system reliability, as they would be connected to the transmission system at a much closer point
- Reduction in transmission system energy losses for the supply to Fort St. John and Taylor

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