



**Report Title:** Site C Environmental Impact Statement

**Issuer:** BC Hydro and Power Authority, System Engineering Division

**Date:** July 1980

**NOTE TO READER:**

**THE FOLLOWING REPORT IS MORE THAN TWO DECADES OLD. INFORMATION CONTAINED IN THIS REPORT MAY BE OUT OF DATE AND BC HYDRO MAKES NO STATEMENT ABOUT ITS ACCURACY OR COMPLETENESS. USE OF THIS REPORT AND/OR ITS CONTENTS IS AT THE USER'S OWN RISK.**

**During Stage 2 of the Site C Project, studies are underway to update many of the historical studies and information known about the project.**

**The potential Site C project, as originally conceived, will be updated to reflect current information and to incorporate new ideas brought forward by communities, First Nations, regulatory agencies and stakeholders. Today's approach to Site C will consider environmental concerns, impacts to land, and opportunities for community benefits, and will update design, financial and technical work.**

## SECTION 8.0 - RECREATION

### CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
8.1	INTRODUCTION	8 - 1
8.2	REGIONAL RECREATION RESOURCES	8 - 1
8.3	LOCAL FEATURES AND USE	8 - 3
8.4	RECREATION RESOURCES WITH THE DEVELOPMENT	8 - 4
8.5	RECREATION MANAGEMENT WITH THE DEVELOPMENT	8 - 5

### TABLES

<u>Table No.</u>		
8-1	Annual Use (User-days) of Recreational Waterbodies in the Peace River Region by Local Residents	8 - 2
8-2	Projected Recreational Use (User-days) of Site C Reservoir Area	8 - 6

### FIGURES

<u>Figure No.</u>	
8-1	Appearance of Reservoir at Bear Flat
8-2	Appearance of Reservoir at Attachie

## SECTION 8.0 - RECREATION

### 8.1 INTRODUCTION

Much of the recreation impact analysis was based upon projections of future patterns of recreational use and anticipated changes in use patterns that would occur due to the Site C development. Anticipated demands for recreation at Site C were based on population growth projections, current regional recreation development plans and the expected pattern of use of waterbodies in the surrounding region.

As part of the study a questionnaire was mailed to approximately 25 percent of the households in Fort St. John and Dawson Creek. About 10 percent of the households in Fort St. John and 8 percent in Dawson Creek returned the questionnaire (551 in all). This survey provided a basis for projecting user-days for various recreational activities. Comments by respondents gave some insight into why people use the Peace River valley for recreation and how this use would be affected by the proposed development.

### 8.2 REGIONAL RECREATION RESOURCES

The lower Peace River has a predominance of Class 4 (CLI) recreation capability which is relatively attractive by comparison to rivers such as the North Thompson and Nass. The Kootenay and Fraser rivers have sections with higher capability while the Skeena and Columbia rivers are quite variable in their capability by comparison to the Peace River.

Table 8-1 provides a breakdown of the annual use of rivers and lakes by local residents from the results of the household survey. The Peace River alone attracts 47 percent of the recreational use of rivers and 25 percent of the use of rivers and lakes combined. Although the relative importance of the Peace River as a recreation

TABLE 8-1

ANNUAL USE (USER-DAYS) OF RECREATIONAL WATERBODIES  
IN THE PEACE RIVER REGION BY LOCAL RESIDENTS<sup>1</sup>

River	Use	Percent of Total	Lake	Use	Percent of Total
Peace	24 195	47	Charlie	15 328	34
Pine	6 160	12	Williston	11 560	26
Kistatinaw	5 980	12	Moberly	9 968	22
Moberly	4 320	8	Hart	1 547	4
Halfway	3 236	6	Corp	1 497	3
Beaton	2 699	5	Bear	1 322	3
Sukunka	2 198	4	McLeod	1 029	2
Murray	2 012	4	One Island	955	2
Parsnip	609	1	Gwillam	660	1
Prophet	<u>335</u>	1	Other	<u>1 021</u>	2
TOTALS	51 744			44 887	

<sup>1</sup> Based upon household survey conducted in Fort St. John and Dawson Creek.

## 8.2 REGIONAL RECREATION RESOURCES - (Cont'd)

resource may have been somewhat exaggerated by respondents, its high rank is considered valid. The lower Peace River is used primarily because of its nearness to Fort St. John and Dawson Creek and its scenic beauty.

The lack of developed access and camping facilities appear to be the main deterrents to more intensive use of the Peace River. The municipality of Hudson Hope and service clubs have participated in the development of Alwin Holland Park. The River Rats Association have improved a few camping sites for boaters along the river. The B.C. Parks Branch and Forest Service have not developed any major facilities but the Parks Branch has provided a boat launching ramp at Taylor. One or two private businesses provide river boating, camping and fishing.

## 8.3 LOCAL FEATURES AND USE

The scenic qualities of the Peace River valley are considered to be of provincial significance. These qualities are most frequently viewed from Highway No. 29 at Bear Flats, Attachie and near Farrell Creek. In addition to aesthetic values the amount of riverbank land that is suitable for camping or picnicking far exceeds the present demand. Much of the attractiveness for recreation is due to varied patterns of islands, channels and vegetation in the floodplain.

Household and field surveys provided an estimate of the annual recreational use by activity of the Peace River valley upstream of Site C. Fishing, boating, sightseeing, camping and picnicking were recorded as the most frequent activities. Fishing accounted for about one-third of all recreational use.

Several opportunities exist to improve recreational facilities for people arriving by automobile or boat at specific locations along the river. These could include: a picnic area overlooking the

### 8.3 LOCAL FEATURES AND USE - (Cont'd)

Halfway River; expanded day-use and river access at Cache Creek; improved boat launching at Hudson Hope; and expanded camping at Alwin Holland Park near Hudson Hope.

Various recreational activities by residents and non-residents are expected to increase by 2 to 4 percent per year in the near future in response to regional population growth and changes in per capita participation rates. Yearly recreational use of the valley between the Moberly River and Hudson Hope could reach as much as 77,000 user-days by 1996 without the proposed hydroelectric development.

### 8.4 RECREATION RESOURCES WITH THE DEVELOPMENT

The projected attractiveness of the reservoir shoreline was evaluated at half-mile intervals. Several sites with relatively high values would be distributed along the new shoreline. On the north shore, the most attractive locations would be near Wilder Creek, Bear Flats, the Halfway River, Farrell Creek, Lynx Creek and Alwin Holland Park. On the south shore they would be located across from Wilder Creek and at river Miles 58, 68 and 71.

The projected appearance of the Site C reservoir was analyzed at vantage points for Highway No. 29 since it is from there that most people would view the reservoir. The reservoir would be closer to the highway than the river is at present and the water surface would be visible for some 35 km (22 mi) as compared to 16 km (10 mi) at present.

The reservoir level was projected on panoramic photos taken at vantage points along the highway. Views overlooking Bear Flat and Attachie are shown in Figs. 8-1 and 8-2. Visually, the reservoir would be a dramatic element in the landscape but would lack much of the variety of the present watercourse. Flooding islands and small channels would cause the greatest loss of attractiveness.

#### 8.4 RECREATION RESOURCES WITH THE DEVELOPMENT - (Cont'd)

Though there would be a net loss of attractive shoreline, there would be adequate shoreline on the reservoir for beaching boats and picnicking. The recreation capability ratings along the Moberly and Halfway arms of the reservoir would be lower than at present.

The reservoir is expected to attract similar numbers of people from the surrounding areas as compared to the river but the relative importance of recreation activities would change. General boating, fishing and camping would be more popular; hunting could decline somewhat in popularity depending on game management practices. More people are likely to use the reservoir for canoeing because one way travel down river would not be necessary. The opportunity for specialized river boating would be lost. Debris could hamper boating in the initial years of operation.

The Site C damsite, with development of an interpretative program, could become a popular and informative site for tourists and nearby residents.

#### 8.5 RECREATION MANAGEMENT WITH THE DEVELOPMENT

Increased public access to the water would be a significant benefit to recreationists. There would be at least four areas on the north shore of the reservoir suitable for campground, picnic, boat launching or day-use facilities. These would be near Cache Creek, overlooking the Halfway River and at Farrell Creek and Lynx Creek. Land use planning studies would be required after reservoir filling to determine the optimal location and layout of facilities.

Recreational activities would attract additional use over and above that which would normally occur on the river or reservoir. Table 8-2 summarizes projections of future recreational use on and around the proposed reservoir and at campground and day-use facilities that could be developed.

8.5 RECREATION MANAGEMENT WITH THE DEVELOPMENT - (Cont'd)

Perhaps the most practical approach to financing future recreational facilities on the reservoir would be through a long-term development fund. Money could then be spent as the recreational capability and actual use of the reservoir becomes better known.

TABLE 8-2  
PROJECTED RECREATIONAL USE (USER-DAYS)  
OF SITE C RESERVOIR AREA<sup>1</sup>

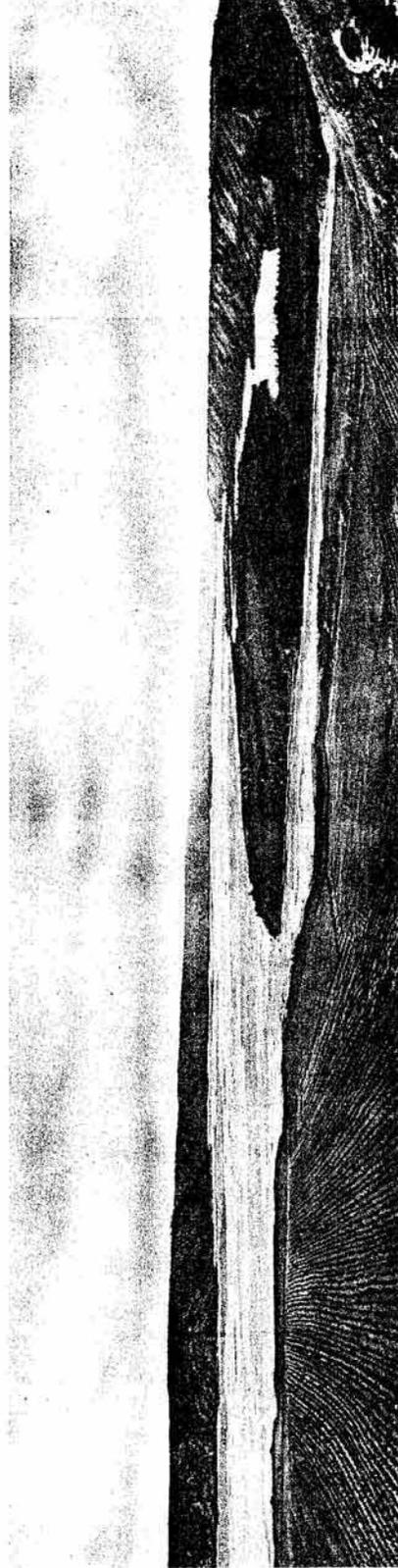
Year	Use without Site C Devel.	Use with Site C Devel.	Additional Use due to Facilities <sup>2</sup>	
			Campground	Day-Use
1976	36 300	36 300	-	-
1981	48 600	50 000	-	-
1986	50 700	36 000	-	-
1988	53 700	45 400	23 700	25 900
1991	58 200	48 100	23 500	34 500
1996	71 300	55 000	24 100	38 400

<sup>1</sup> Regional population growth based upon slow regional development scenario used in economics study.

<sup>2</sup> Assuming full development of recreational facilities at four locations.



Present view looking south from Highway 29.



Projected appearance of reservoir surface.

APPEARANCE OF RESERVOIR  
AT BEAR FLAT



Present view looking south from Highway 29.



Projected appearance of reservoir surface.

APPEARANCE OF RESERVOIR  
AT ATTACHE

SECTION 9.0 - FORESTRY

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
9.1	REGIONAL FOREST RESOURCES	9 - 1
9.2	LOCAL FOREST RESOURCE	9 - 2
9.3	LOGGING AND CLEARING	9 - 4

TABLES

<u>Table No.</u>		
9-1	Forested Areas and Coniferous Timber Volumes Affected by the Site C Development	9 - 3
9-2	Effects of Site C Development on Forest Productivity by Management Units	9 - 4
9-3	Manpower and Machinery Requirements for Logging and Clearing of Site C Reservoir	9 - 7

## SECTION 9.0 - FORESTRY

### 9.1 REGIONAL FOREST RESOURCES

Forests of the region\* are part of British Columbia's Boreal Forest and consist primarily of white spruce, balsam poplar, lodgepole pine and aspen. Forest management units in the region are: the Dawson Creek Special Sale Area (SSA) and the Fontas, Blueberry, Sikanni, Wapiti, Moberly and Peace Public Sustained Yield Units (PSYU). The Dawson Creek Special Sale Area is presently being considered for PSYU status by the B.C. Forest Service and has a preliminary allowable annual cut. Spruce and pine have a commercial value and are harvested. Deciduous species are normally left due to the lack of a market.

Logging activity is concentrated to the north, west and south of Site C. Mills at Fort St. John and Taylor haul logs from over 160 km (100 mi) at a cost of \$18 to \$19 per cunit; it takes about 1400 m<sup>3</sup> (500 cunits) per day to supply one of these mills. Sawmills in the region are:

Peace Wood Products at Taylor  
Swanson Lumber at Fort St. John  
Northwest Wood Preserves at Dawson Creek  
Chetwynd Forest Products at Chetwynd  
Canadian Forest Products at Chetwynd

Logging and milling operations employ approximately 1400 people on a full or part-time basis. These mills utilize a combined regional quota of 484,500 cunits per year plus an additional 70,000 cunits that are awarded as short-term timber sales. Sawmills are primarily dimension softwood lumber producers whose product is shipped by rail to U.S. markets.

---

\* For purposes of the forestry analysis the region was considered to be the area within a radius of 160 km (100 mi) of Fort St. John.

## 9.1 REGIONAL FOREST RESOURCES - (Cont'd)

These volumes contrast to those for the Prince George district where in 1976 over 4 million cunits of merchantable timber were harvested, and for the province as a whole in which over 24 million cunits were harvested.

At present levels of annual allowable cut no PSYU is expected to have a shortage of coniferous volume during the present rotation. Also by the end of this rotation, many of the deciduous stands will become dominated by coniferous species.

## 9.2 LOCAL FOREST RESOURCE

Table 5-1 summarizes the forested areas and coniferous timber volumes that would be directly affected by the Site C development. Areas affected were determined by a grid count method and cross-checked with total areas determined in the land use study component. Volumes were calculated using standard aerial photo interpretation and cruising methods. In this inventory stands containing more than 28 m<sup>3</sup> (10 cunits) per acre of coniferous volume were considered merchantable.

The affected areas lie entirely within the Dawson Creek SSA and Peace PSYU. A total of 96 750 cunits of merchantable coniferous volume would need to be cleared for the reservoir and Highway No. 29 relocation.

Forest productivity has been assessed using mean annual increments (MAI) - specifically the per acre volume yield at culmination age divided by that age. Culmination age is the age when MAI reaches a maximum and under intensive forest management is frequently adopted as the rotation age for the stand. Table 9-2 summarizes annual allowable cuts (AAC) and MAI lost due to the Site C development for the two management units involved.

TABLE 9-1

FORESTED AREAS AND CONIFEROUS TIMBER VOLUMES AFFECTED BY THE SITE C DEVELOPMENT<sup>1</sup>

	Dawson Creek SSA		Peace PSYU		Total
	Land Area (arce)	Coniferous Volume (cunit)	Land Area (arce)	Coniferous Volume (cunit)	
<b>Merchantable Timber</b>					
Reservoir Damsite	1752	81 807	595	14 386	96 193
Highway 29 relocation	<u>13</u>	<u>557</u>	-	-	<u>557</u>
Sub Totals	1765	82 364	595	14 386	96 750
<b>Non-merchantable Timber</b>					
Reservoir Damsite <sup>2</sup>	5657	-	539	-	6196
Highway 29 relocation	<u>813</u>	-	-	-	<u>813</u>
Sub Totals	6551	-	539	-	7090
<b>All Productive Forest Lands</b>					
Reservoir Damsite	7409	81 807	1134	14 386	96 193
Highway 29 relocation	<u>813</u>	<u>557</u>	-	-	<u>557</u>
TOTALS	8316	82 364	1134	14 386	96 750

<sup>1</sup> Volumes calculated to close utilization standards - trees 7.1-inch DBH and over, 12-inch stump height, 4-inch top and deductions for decay, waste and breakage. Transmission line effects are considered in a separate report by Thurber Consultants Ltd.

<sup>2</sup> Current planning of facilities at the damsite indicates that less than 700 ac would need to be cleared.

9.1 REGIONAL FOREST RESOURCES - (Cont'd)

TABLE 9-2

EFFECTS OF SITE C DEVELOPMENT ON FOREST  
PRODUCTIVITY BY MANAGEMENT UNITS

Management Unit	Allowable Annual Cut (cunits)	Committed Cut (cunits)	MAI lost by Site C Development (cunits)	MAI as Percent of AAC
Dawson Creek SSA	270 000	70 000	2539	0.9
Peace PSYU	<u>252 603</u>	<u>116 720</u>	<u>418</u>	<u>0.2</u>
TOTALS	522 603	186 720	2957	0.6

9.3 LOGGING AND CLEARING

There are several reasons for the absence of logging in the reservoir area to date. Access to merchantable timber is severely limited by steep unstable banks, river channels and lack of primary access to the south side of the Peace River. Ice bridges are not feasible. Of the proposed reservoir area, less than one-fifth is stocked with merchantable timber and much of this is scattered in small patches posing access problems.

Two basic approaches to logging the reservoir were considered. First, stands that could be reached by logging trucks could, upon logging and decking, be transported directly to mills over access roads and highways. Second, stands that could not be easily reached by truck could be felled and skidded to the Peace River. These logs would be floated down the river to a dewatering point from which they could be trucked to mills. River driving of logs was considered a lesser threat to fish habitats than causeway construction to islands.

### 9.3 LOGGING AND CLEARING - (Cont'd)

For cost estimating purposes it was assumed logging would be performed to B.C. Forest Service close utilization standards. Clearing of the entire reservoir, piling and burning of debris and stump removal in specific areas with recreational potential would cost about \$9 million in 1980 dollars. Estimated manpower and machinery requirements for logging and clearing the reservoir are given in Table 9-3. Total man-years and machine-years would be about 130 and 35 respectively. In addition it is estimated that up to \$1 million would need to be spent in the first 2 years following flooding to clean up floating debris that was not burned during clearing operations.

TABLE 9-3

MANPOWER AND MACHINERY REQUIREMENTS FOR LOGGING AND CLEARING OF SITE C RESERVOIR

	Years of Development								Total	Remarks	
	1	2	3	4	5	6	7	8			
Logging											
Man-months <sup>1</sup>		226	123		1					350	Logging done in freezing weather in years 2 and 3
Machine-months		42	19							61	
Clearing											
Man-months	55	123	159	139	135	120	23	31	785	Allowance for cleanup in years 7 and 8	
Machine-months	13	35	67	68	11	8	11	213	213		
Supervisor											
Man-months	20	51	59	35	31	23	7	11	237	Allowance for cleanup in years 7 and 8	
Transportation											
Man-months		43	71	20					134	River drive in year 3; balance in year 4. Accessible area hauled as logged	
Machine-months		43	71	20					134		
TOTAL											
Man-months	75	443	412	194	167	143	30	42	1506		
Machine-months	13	120	157	88	11	-	8	11	408		

<sup>1</sup> Labour man-months include machine operator.

SECTION 9.0 - FORESTRY

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
9.1	REGIONAL FOREST RESOURCES	9 - 1
9.2	LOCAL FOREST RESOURCE	9 - 2
9.3	LOGGING AND CLEARING	9 - 4

TABLES

<u>Table No.</u>		
9-1	Forested Areas and Coniferous Timber Volumes Affected by the Site C Development	9 - 3
9-2	Effects of Site C Development on Forest Productivity by Management Units	9 - 4
9-3	Manpower and Machinery Requirements for Logging and Clearing of Site C Reservoir	9 - 7

## SECTION 9.0 - FORESTRY

### 9.1 REGIONAL FOREST RESOURCES

Forests of the region\* are part of British Columbia's Boreal Forest and consist primarily of white spruce, balsam poplar, lodgepole pine and aspen. Forest management units in the region are: the Dawson Creek Special Sale Area (SSA) and the Fontas, Blueberry, Sikanni, Wapiti, Moberly and Peace Public Sustained Yield Units (PSYU). The Dawson Creek Special Sale Area is presently being considered for PSYU status by the B.C. Forest Service and has a preliminary allowable annual cut. Spruce and pine have a commercial value and are harvested. Deciduous species are normally left due to the lack of a market.

Logging activity is concentrated to the north, west and south of Site C. Mills at Fort St. John and Taylor haul logs from over 160 km (100 mi) at a cost of \$18 to \$19 per cunit; it takes about 1400 m<sup>3</sup> (500 cunits) per day to supply one of these mills. Sawmills in the region are:

Peace Wood Products at Taylor  
Swanson Lumber at Fort St. John  
Northwest Wood Preserves at Dawson Creek  
Chetwynd Forest Products at Chetwynd  
Canadian Forest Products at Chetwynd

Logging and milling operations employ approximately 1400 people on a full or part-time basis. These mills utilize a combined regional quota of 484,500 cunits per year plus an additional 70,000 cunits that are awarded as short-term timber sales. Sawmills are primarily dimension softwood lumber producers whose product is shipped by rail to U.S. markets.

---

\* For purposes of the forestry analysis the region was considered to be the area within a radius of 160 km (100 mi) of Fort St. John.

## 9.1 REGIONAL FOREST RESOURCES - (Cont'd)

These volumes contrast to those for the Prince George district where in 1976 over 4 million cunits of merchantable timber were harvested, and for the province as a whole in which over 24 million cunits were harvested.

At present levels of annual allowable cut no PSYU is expected to have a shortage of coniferous volume during the present rotation. Also by the end of this rotation, many of the deciduous stands will become dominated by coniferous species.

## 9.2 LOCAL FOREST RESOURCE

Table 5-1 summarizes the forested areas and coniferous timber volumes that would be directly affected by the Site C development. Areas affected were determined by a grid count method and cross-checked with total areas determined in the land use study component. Volumes were calculated using standard aerial photo interpretation and cruising methods. In this inventory stands containing more than 28 m<sup>3</sup> (10 cunits) per acre of coniferous volume were considered merchantable.

The affected areas lie entirely within the Dawson Creek SSA and Peace PSYU. A total of 96 750 cunits of merchantable coniferous volume would need to be cleared for the reservoir and Highway No. 29 relocation.

Forest productivity has been assessed using mean annual increments (MAI) - specifically the per acre volume yield at culmination age divided by that age. Culmination age is the age when MAI reaches a maximum and under intensive forest management is frequently adopted as the rotation age for the stand. Table 9-2 summarizes annual allowable cuts (AAC) and MAI lost due to the Site C development for the two management units involved.

TABLE 9-1

FORESTED AREAS AND CONIFEROUS TIMBER VOLUMES AFFECTED BY THE SITE C DEVELOPMENT<sup>1</sup>

	Dawson Creek SSA		Peace PSYU		Total
	Land Area (arce)	Coniferous Volume (cunit)	Land Area (arce)	Coniferous Volume (cunit)	
<b>Merchantable Timber</b>					
Reservoir Damsite	1752	81 807	595	14 386	96 193
Highway 29 relocation	<u>13</u>	<u>557</u>	<u>13</u>	<u>-</u>	<u>557</u>
Sub Totals	1765	82 364	595	14 386	96 750
<b>Non-merchantable Timber</b>					
Reservoir Damsite <sup>2</sup>	5657	-	539	-	-
Highway 29 relocation	<u>813</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Sub Totals	6551	-	539	-	-
<b>All Productive Forest Lands</b>					
Reservoir Damsite	7409	81 807	1134	14 386	96 193
Highway 29 relocation	<u>813</u>	<u>557</u>	<u>-</u>	<u>-</u>	<u>557</u>
TOTALS	8316	82 364	1134	14 386	96 750

<sup>1</sup> Volumes calculated to close utilization standards - trees 7.1-inch DBH and over, 12-inch stump height, 4-inch top and deductions for decay, waste and breakage. Transmission line effects are considered in a separate report by Thurber Consultants Ltd.

<sup>2</sup> Current planning of facilities at the damsite indicates that less than 700 ac would need to be cleared.

9.1 REGIONAL FOREST RESOURCES - (Cont'd)

TABLE 9-2

EFFECTS OF SITE C DEVELOPMENT ON FOREST  
PRODUCTIVITY BY MANAGEMENT UNITS

Management Unit	Allowable Annual Cut (cunits)	Committed Cut (cunits)	MAI lost by Site C Development (cunits)	MAI as Percent of AAC
Dawson Creek SSA	270 000	70 000	2539	0.9
Peace PSYU	<u>252 603</u>	<u>116 720</u>	<u>418</u>	<u>0.2</u>
TOTALS	522 603	186 720	2957	0.6

9.3 LOGGING AND CLEARING

There are several reasons for the absence of logging in the reservoir area to date. Access to merchantable timber is severely limited by steep unstable banks, river channels and lack of primary access to the south side of the Peace River. Ice bridges are not feasible. Of the proposed reservoir area, less than one-fifth is stocked with merchantable timber and much of this is scattered in small patches posing access problems.

Two basic approaches to logging the reservoir were considered. First, stands that could be reached by logging trucks could, upon logging and decking, be transported directly to mills over access roads and highways. Second, stands that could not be easily reached by truck could be felled and skidded to the Peace River. These logs would be floated down the river to a dewatering point from which they could be trucked to mills. River driving of logs was considered a lesser threat to fish habitats than causeway construction to islands.

9.3 LOGGING AND CLEARING - (Cont'd)

For cost estimating purposes it was assumed logging would be performed to B.C. Forest Service close utilization standards. Clearing of the entire reservoir, piling and burning of debris and stump removal in specific areas with recreational potential would cost about \$9 million in 1980 dollars. Estimated manpower and machinery requirements for logging and clearing the reservoir are given in Table 9-3. Total man-years and machine-years would be about 130 and 35 respectively. In addition it is estimated that up to \$1 million would need to be spent in the first 2 years following flooding to clean up floating debris that was not burned during clearing operations.

TABLE 9-3

MANPOWER AND MACHINERY REQUIREMENTS FOR LOGGING AND CLEARING OF SITE C RESERVOIR

	Years of Development								Total	Remarks	
	1	2	3	4	5	6	7	8			
Logging											
Man-months <sup>1</sup>		226	123		1					350	Logging done in freezing weather in years 2 and 3
Machine-months		42	19							61	
Clearing											
Man-months	55	123	159	139	135	120	23	31	785	Allowance for cleanup in years 7 and 8	
Machine-months	13	35	67	68	11		8	11	213		
Supervisor											
Man-months	20	51	59	35	31	23	7	11	237	Allowance for cleanup in years 7 and 8	
Transportation											
Man-months		43	71		20				134	River drive in year 3; balance in year 4. Accessible area hauled as logged	
Machine-months		43	71	20					134		
TOTAL											
Man-months	75	443	412	194	167	143	30	42	1506		
Machine-months	13	120	157	88	11	-	8	11	408		

<sup>1</sup> Labour man-months include machine operator.

SECTION 10.0 - WILDLIFE

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
10.1	INTRODUCTION	10 - 1
10.2	REGIONAL WILDLIFE RESOURCES	10 - 1
10.3	LOCAL WILDLIFE RESOURCES	
	(a) Ungulates	10 - 2
	(b) Other Mammals	10 - 3
	(c) Birds	10 - 3
	(d) Resource Use	10 - 4
10.4	DIRECT IMPACTS ON WILDLIFE RESOURCES	10 - 5
10.5	SECONDARY IMPACTS	10 - 5
10.6	MITIGATION, COMPENSATION AND ENHANCEMENT	10 - 7

## SECTION 10.0 - WILDLIFE

### 10.1 INTRODUCTION

The impact assessment of wildlife resources was based upon studies in 1974 to 1976 throughout the lower Peace River valley and in November 1976 to July 1977 within a more confined Site C study area. Approximately 500 habitat units were differentiated on aerial photos by vegetation and landform; 385 of these units were surveyed in the field.

Wildlife inventories included: winter aerial surveys of ungulates, pellet counts, track counts, beaver den surveys, small mammal trapping, waterfowl surveys, ruffed grouse observations and bird sightings.

The main source of information on terrestrial fur-bearers was trapline catch data obtained from B.C. Fish and Wildlife Branch. Wildlife status and utilization were discussed with game management personnel and local residents.

### 10.2 REGIONAL WILDLIFE RESOURCES

The Peace River region provides a significant proportion of British Columbia's moose, wolf and sharp-tailed grouse harvest. Although only 6.5 percent of the provincial area, it provides over 20 percent of the moose harvest in B.C.

Wildlife Management Units 7-32, 7-34 and 7-35 are estimated to contain 4000 to 8000 moose, of which about 1000 are taken annually by hunters. Deer are more restricted in distribution and abundance, and numbers fluctuate greatly over a period of years. A single herd of elk occurs in the region - about 55 animals in the Moberly River area. Over 90 percent of the area of these management units has CLI Class 3

## 10.2 REGIONAL WILDLIFE RESOURCES - (Cont'd)

or better ungulate habitat and the river valleys are rated particularly high. Hunting provides about 26,000 person-days of recreation per season.

These units encompass parts of three guiding territories and several traplines. Squirrels dominate trapline catches in numbers, but lynx produce most income. Recent catches have been worth about \$7.00/km<sup>2</sup> of land area trapped (\$18.00 per sq mi).

The Peace River and tributary valleys have supported about 2.1 moose and 1.8 deer per square kilometre in recent winters (5.4 moose and 4.7 deer per sq mi). Higher populations, particularly deer, have been reached in past years.

## 10.3 LOCAL WILDLIFE RESOURCES

A total of 13 habitat types were identified within the Site C "impact area"\*. Cottonwood or cottonwood-spruce on floodplains occupy the largest area, followed by aspen forest, mixed spruce-birch-poplar forest and dense spruce woods. The present watercourse below El. 1515 ft has about 400 km (250 mi) of "edge" between aquatic (river channel) and terrestrial (upland) habitats.

### (a) Ungulates

Moose frequent the impact area year round, but its most important use is for wintering and calving. It was estimated that up to 110 moose may occur at any one time in the winter and up to 500 individual moose may utilize the area at some time during the course of a year.

---

\* The "impact area" as used in the wildlife study includes all land and watercourses that would be flooded, altered by construction, or fall within active slide areas around the reservoir, and amounts to some 10,240 ha (25,600 ac).

### 10.3 LOCAL WILDLIFE RESOURCES - (Cont'd)

Deer stay mostly above the proposed full supply level in winter, but are widespread on the floodplain in summer, where they utilize islands during the fawning and post-fawning period. Not more than 25 percent of the present population, or 100 to 125 deer are believed to utilize habitats in the impact area at one season or another.

Elk in the Moberly River valley make little use of areas below El. 1515 ft but considerable winter use of slopes just above this elevation.

#### (b) Other Mammals

Beaver are more abundant along the Peace River than on the tributaries, primarily due to the lower gradient and velocity of the Peace. A minimum of 30 to 40 colonies totalling 150 to 200 animals is estimated for the impact area.

Weasels are the most abundant (100 to 300) mustelids in the area, followed by marten, fisher and mink. Wolverine and otter are rare. Impact area habitats are estimated to support about 15 coyotes, 10 lynx, up to 6000 snowshoe hares, 500 to 1000 red squirrels and 10 black bears. About 25 wolves with territories largely outside the impact area sometimes enter it.

Small mammal populations are numerically dominated by deer mice. Total small mammal densities appear to be very high in forested floodplain habitat.

#### (c) Birds

Fairly large numbers of ducks, mostly dabblers, migrate along the Peace River in spring, but few stay to nest. No more than 27 different broods per year were seen in the impact area

### 10.3 LOCAL WILDLIFE RESOURCES - (Cont'd)

during 1974-1977. No more than 50 duck broods per year are probably produced in the entire impact area. Most broods seen were mallard or common goldeneye.

About 50 mated pairs of Canada geese were tallied in the impact area in spring, but only 12 or 13 broods were located. The only common breeding shore-birds were spotted sandpipers and killdeers. An estimated 400 pairs of sandpipers, and 40 of killdeers, nest along the shores below El. 1515 ft.

Ruffed grouse are the only abundant upland game bird. During 1975-1977, populations in the impact area were estimated at 1000 in spring and 3000 in fall.

Common or abundant nesting raptors are the American kestrel, red-tailed hawk, great-horned owl and merlin. Less common to rare nesters include the bald eagle (3 nest sites), sharp-shinned hawk, marsh hawk, goshawk and barred owl. One peregrine was seen, but the species is not believed to nest in the area.

Songbird densities were estimated to be 300 to 550 breeding territories per square kilometre (115-210 per sq mi). Spring populations of 25,000 to 40,000 birds were estimated for the area below full supply level.

#### (d) Resource Use

An estimated 750 to 1000 person-days per year of hunting presently occurs in the impact area. The potential may be higher considering the surplus of ruffed grouse. Most trapping activity takes place on uplands away from the impact area. At most, 33 pelts per year worth \$650 at 1976-77 prices might be taken in the impact area.

### 10.3 LOCAL WILDLIFE RESOURCES - (Cont'd)

Non-consumptive use of wildlife (e.g. viewing and photographing) occurs to a minor degree but its intensity could not be measured in this study.

### 10.4 DIRECT IMPACTS ON WILDLIFE RESOURCES

The most significant Site C impact would be permanent loss of wildlife productivity in the flooded area. Flooding would result in permanent loss of a diverse array of productive natural and modified valley-complex plant communities. Length of shoreline, and therefore the edge between aquatic and upland habitat, would be reduced by 130 km (81 mi). Regional mammal population could be reduced by the following numbers: 125 to 250 moose; up to 250 mule deer; 15 to 20 beaver colonies; up to 230 weasels; 45 to 70 marten; 2 fisher; 10 to 15 coyotes; 2 to 8 lynx; up to 4500 snowshoe hares; 400 to 800 red squirrels; and 10 black bears. Those wolf and elk populations ranging into the reservoir area might be reduced by up to 10 percent due to the slight reduction in available habitat.

Duck production should not be appreciably altered, but the current (rather low) level of Canada goose production could be reduced still further. Nesting killdeers and spotted sandpipers may be reduced by 50 to 75 percent. Average populations of 1000 ruffed grouse in spring and 3000 in summer would be lost. Several breeding territories of raptorial birds, including 3 bald eagle nest sites, would be inundated.

The reservoir should continue to be used by beaver, some waterfowl and shorebirds, though in diminished numbers. Use by loons, grebes, diving ducks and perhaps gulls should increase. The reservoir should be more suitable for ospreys and otters than is the river in that area. Moose may be able to resume cross-valley winter movements in winters when ice cover is complete, but in milder winters thin ice could be a hazard to animals.

#### 10.4 DIRECT IMPACTS ON WILDLIFE RESOURCES - (Cont'd)

Wildlife-population increases on adjacent lands caused by displacement from the reservoir area should be short-lived. Little or no damage due to over-use of adjacent ranges is expected. Displaced game and fur animals could probably be taken by local hunters and trappers without any special regulations or extended seasons.

Formation of fog along the reservoir in winter could reduce the insulative value of south facing slopes used by wintering ungulates, however, this potential impact cannot be quantified.

Only about 100 ha (250 ac) of productive wildlife habitat would be lost to Highway No. 29 relocations. This impact would be insignificant.

About 280 ha (700 ac) of terrestrial habitats would be lost or altered by dam construction activities. If the entire area is permanently lost, wildlife population losses might average 8 percent of those described for the reservoir. However, long-term impact should be much less if disturbed lands are revegetated.

The permanent loss of wildlife habitat due to slumping or erosion above full supply level would be small relative to that due to flooding. The maximum amount of terrestrial habitat affected by erosion is expected to be 8 to 9 percent of that below full supply level. Loss of habitat due to erosion of southwest-facing slopes could be critical to wintering ungulates. Beaver, mink, waterfowl, shorebirds and bald eagles would not be affected by erosion.

#### 10.5 SECONDARY IMPACTS

Other impacts would include hunting activity by construction workforces, construction noise and disturbance, and greater access to areas where a wilderness hunting experience may now be had. It should

#### 10.5 SECONDARY IMPACTS - (Cont'd)

be possible to keep these effects to an acceptable level. Any increase in agricultural land clearing stimulated by the Site C development would cause additional losses to wildlife habitat.

The project would reduce potential hunting recreation in the region by up to 3500 person-days per year. Loss of productive area in guide-outfitter territories would be insignificant, but new access to the Moberly River area could result in competition from unguided hunters. Maximum loss of land from any of eight traplines bordering the impact area would be 6 percent. Most losses would be smaller. In addition most trapping activity is currently on uplands away from the impact area.

Three species which have been included on lists of rare and endangered species have been recorded in the area - bald eagle, peregrine falcon and northern Rocky Mountain cougar. Only the bald eagle would be directly affected, but this species is abundant elsewhere in B.C.

When the significance of wildlife impacts is viewed in local, regional and provincial context, losses are largely insignificant at the provincial level, and low at the regional level. Local significance of the impacts is moderate-to-high.

#### 10.6 MITIGATION, COMPENSATION AND ENHANCEMENT

A few mitigation and compensation measures have been studied but they would not significantly reduce the loss of wildlife populations caused by the development. Compensation is possible by waterfowl habitat improvement around the reservoir; ungulate habitat management on adjacent lands; and long-term dedication of existing wildlands to wildlife production. Management of adjacent uplands to increase ungulate production appears to be a possible compensation measure.

SECTION 11.0 - WATER QUALITY AND USE

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
11.1	PRESENT WATER QUALITY AND USE	11 - 1
11.2	RESERVOIR WATER QUALITY	11 - 3
11.3	USE OF RESERVOIR WATER	11 - 4

TABLES

<u>Table No.</u>		
11-1	Typical Water Quality Values in Lower Peace River System	11 - 2

## SECTION 11.0 - WATER QUALITY AND USE

### 11.1 PRESENT WATER QUALITY AND USE

Water quality in the Lower Peace River is determined by the quality of water released from Williston Lake and that of tributary inflows. Inflows from the Halfway and Moberly rivers contribute up to 20 percent of the spring flow of the Peace River at Site C. Surface water temperatures in the Peace River range from 1°C in winter to a maximum of 12°C at Hudson Hope and 15°C at Taylor in late summer. Table 7-1 summarizes typical water quality parameters for Williston Lake and at Hudson Hope and Taylor.

The municipality of Hudson Hope obtains its water supply from the Peace River. At times in the winter when the river is near freezing natural spring water near the municipal pumphouse is used as an alternative source. Some 825 single family dwellings are connected to the supply system.

The village of Taylor uses water from the Peace River downstream of Site C. Present use is about 3 million Imperial gallons per month. Nearby Pacific Petroleum Ltd. pumps some 36 million Imperial gallons per day as cooling and plant process water. The heated water is returned to the river via treatment basins.

Both Hudson Hope and Fort St. John have sewage lagoons for waste water treatment. There is no direct outfall from the Hudson Hope system although lagoons are close to the Peace River and there may be some seepage into the watercourse. The Fort St. John system discharges approximately 900,000 Imperial gallons per day of chlorinated effluent into the Peace River downstream of Site C between May and November.

TABLE 11-1

TYPICAL WATER QUALITY VALUES IN LOWER PEACE RIVER SYSTEM<sup>1</sup>

Location	Season	Turbidity JTU	Total Phosphorous ug/L	Total Dissolved Nitrogen ug/L	Total Hardness ug/L	Total Iron ug/L
Williston Lake	Fall	less than 1	less than 5	160	86	7
Hudson Hope	Spring	less than 1	16	-	94	27
	Fall	less than 1	21	-	88	-
Taylor	Spring	20-120	40-89	175	93	233-366
	Fall	3	17-34	147-185	85-91	87-250

<sup>1</sup> Data Sources: B.C. Research, Limnological Studies of Williston Lake and Environment Canada Water Management Service.

### 11.1 PRESENT WATER QUALITY AND USE - (Cont'd)

Minor use is made of spring and river water near the shoreline for irrigation and livestock watering.

### 11.2 RESERVOIR WATER QUALITY

Any changes in water quality within the reservoir would depend on reservoir configuration, water circulation patterns, tributary inflows and nature of climatic influences. The flushing rate, or average time taken for water to pass through the reservoir, would be only 18 days. This rate contrasts with 2.2 years for Williston Lake. In the period May through August, water is expected to warm up by 4 to 5<sup>o</sup>C as it passes through the reservoir. Maximum temperatures of 13.5<sup>o</sup>C could be reached at Site C as compared to 10.5<sup>o</sup> at present. Shallow bays and backwaters with somewhat warmer water would occur as they do at present along the river.

Suspended sediment would settle in the tributary arms and the main reservoir but during periods of high surface runoff, turbid zones would be apparent in the reservoir downstream of the Halfway River, Cache Creek and Moberly River.

The largest contribution of nitrogen and phosphorous to waters of the Peace River appears to be from natural erosion and leaching of land. This input is not expected to change due to the proposed reservoir except for a minor increase in initial leaching of flooded land.

No significant oxygen depletion is expected to occur in the reservoir and dissolved oxygen levels would reflect those of water released from Williston Lake (8 mg/l for July to September).

### 11.3 USE OF RESERVOIR WATER

In general, the potential for water supply should be favourable throughout the reservoir. Water quality at Hudson Hope would be unchanged by reservoir development and the water would continue to be acceptable for municipal use.

The other existing water intakes on the river are downstream of Site C at Taylor. Water quality at this location is influenced by inflows from the Pine River; however, there would be less suspended sediment in the mainstream than at present. Water temperatures below the dam in the late summer would be a few degrees warmer than at present.

There appears to be no limitation to release of treated effluents into the reservoir provided such discharges are carefully designed to provide adequate flushing and dilution within their immediate zone of influence.

SECTION 12.0 - FISHERIES

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
12.1	INTRODUCTION	12 - 1
12.2	REGIONAL FISH RESOURCES	12 - 1
12.3	LOCAL FISH RESOURCES	12 - 2
12.4	EFFECTS OF THE DEVELOPMENT	12 - 4
12.5	MANAGEMENT OF THE PROPOSED RESERVOIR	12 - 5

## SECTION 12.0 - FISHERIES

### 12.1 INTRODUCTION

Field studies of aquatic resources were conducted in the Site C area at various times throughout 1974 and 1975, in the fall of 1976 and in the spring and early summer of 1977. Physio-chemical data was gathered on water quality, temperature, stream habitats and littoral zones. Biological analysis involved collection of fish by a variety of methods, tagging, dissection and measurements. The presence of ripe and spent fish or of fertilized eggs on substrate was used as an indication of spawning areas.

Anglers, boaters and other recreationists encountered in the field during May, June and July of 1977 were asked questions about their use and enjoyment of the Peace River fishery. A creel survey was also conducted in June and July (total creel 536). A questionnaire completed by 15 members of the Peace River Rats Association provided additional information on recreational use of fish resources.

During the course of the study information and opinions were gathered from members of the B.C. Fish and Wildlife Branch at Fort St. John, Prince George, Vancouver and Victoria.

### 12.2 REGIONAL FISH RESOURCES

The completion of the W.A.C. Bennett Dam in 1967 and creation of Williston Lake dramatically altered fishery resources and utilization patterns in the region. Since that time Williston Lake has developed an excellent sport fishery and has potential for a commercial fishery. In contrast to historic conditions, discharge of the W.A.C. Bennett Dam provides the lower Peace River with a source of clear, high quality water. The clear water and fish food organisms

## 12.2 REGIONAL FISH RESOURCES - (Cont'd)

passing through the dam has altered aquatic habitats downstream. This apparently has resulted in significant increases in cold-water sport fish populations (mainly rainbow trout and Arctic grayling) in tail-water and downstream areas. This new fishery resource was heavily utilized by anglers during the period from 1973 to 1975 but in more recent years, because of changes in access (i.e. construction of the Site One dam which virtually blocked upstream boat travel, and the placement of a locked gate on the road into the W.A.C. Bennett Dam tailwater area), sport fish utilization has declined. With the filling of the Site One reservoir, access to the better fishing sports may be re-established.

Changes in the flow characteristics of the river, caused by construction of the Site One dam, apparently resulted in the delay and blockage of upstream migrations of local fish species. As a result, sport fish (primarily mountain whitefish, Arctic grayling and rainbow trout) have congregated just below the construction site. Heavy angling pressure by local residents and construction workers has occurred and a sport fishery has developed. Information on the quality of fishing at Site One has spread rapidly and now residents of nearby communities (Dawson Creek, Chetwynd, Fort St. John) are also utilizing the resource. The ability of this fishery to sustain itself at present levels of utilization is not known.

In recent years Charlie Lake has developed into an important sport fishery for northern pike and yellow walleye. A local fish derby is held annually. This resource is particularly important because of its easy access and proximity to Fort St. John.

## 12.3 LOCAL FISH RESOURCES

At present, mountain whitefish appear to be the most abundant sport fish in the Site C area. Other sport fish species in decreasing order of abundance are Arctic grayling, rainbow trout, Dolly Varden,

### 12.3 LOCAL FISH RESOURCES - (Cont'd)

northern pike and yellow walleye. Longnose and largescale suckers are the most abundant non-game fish.

The lower sections of Maurice Creek and Lynx Creek were the only locations in the study area identified as being used for spawning by rainbow trout from the Peace River; however, this utilization appears to be very limited. Resident stream populations of rainbow trout are present in Brenot Creek, the upper part of Farrell Creek and in the Halfway River system. Tagging studies indicate there is a spawning migration of rainbow trout into the Site One area. Upon completion of the Site One dam, this migration would be blocked; recruitment of the young rainbow trout from the Site One area into the Site C reservoir would also be blocked by the Site One dam except for passage through the turbines.

Arctic grayling are known to spawn in Maurice Creek, Lynx Creek, Farrell Creek and the Moberly River. They also likely spawn in the Halfway River system and possibly in the mainstem Peace River. Mountain whitefish spawn in the Moberly River, the Halfway River and in the mainstem Peace River. Suckers appear to spawn in most tributaries. No information is available concerning spawning areas for Dolly Varden; however, spawning likely occurs in the upper part of the Halfway River system and possibly to a very limited extent in Maurice Creek.

In general the chironomids and the mayfly, Rhithrogena, were the most important benthic organisms in the standing crop during the study period, though the latter was significant only in those areas with suitable rocky substrate. The Chironomidae were found in high numbers at almost all the sites. The Peace River mainstem showed the highest standing crops of benthic fauna, possibly because it offered more diverse substrate habitats.

### 12.3 LOCAL FISH RESOURCES - (Cont'd)

The sport fishery in the Peace River in the study area is considered by anglers to be good. Most of the angling occurs upstream of the Halfway River, with the majority of angling pressure concentrated just downstream of the Site One construction site. Mountain whitefish were the prominent species in the creel of anglers fishing near the construction site. An estimated 10,552 man-days per year of angling (exclusive of construction workers at the Site One dam) occur in the study area.

### 12.4 EFFECTS OF THE DEVELOPMENT

The main effects upon fisheries of the Site C development would be the alteration of the present riverine system into a reservoir and the blockage of upstream movements of fish by a Site C dam. The impoundment would greatly increase the amount of habitat available to aquatic organisms and fish.

The long-term production of phytoplankton and zooplankton would increase after impoundment by comparison to the present river; phytoplankton would probably be dominated by diatoms, zooplankton by calanoid copepods. The benthic invertebrate fauna of the reservoir would likely be dominated by standing-water organisms, such as members of Oligochaeta and Chironomidae. Fish species adapted to reservoir conditions would make use of these flood organisms.

Northern pike populations are expected to increase in the reservoir in response to growths of aquatic vegetation in shallow littoral areas around the reservoir. Mountain whitefish and Arctic grayling numbers are expected to remain high or increase slightly. Dolly Varden numbers may also increase slightly. Dolly Varden numbers may also increase provided they can withstand angling pressure. Rainbow trout populations are expected to be low in the reservoir because of the very limited spawning habitat available for them in the Site C

#### 12.4 EFFECTS OF THE DEVELOPMENT - (Cont'd)

area. However, if recruitment of young trout from upstream impoundments is significant rainbow trout populations in the Site C reservoir would be affected accordingly. Very little potential rainbow trout spawning habitat would exist in the Site C area.

Because of the small number of yellow walleye in the Site C area it is doubtful that a self-sustaining population would be trapped in the reservoir.

#### 12.5 MANAGEMENT OF THE PROPOSED RESERVOIR

The development of sport fishery for the Site C reservoir would be dependent on fish species composition and abundance, and fishing opportunities elsewhere in the region. With intensive management, including possible stocking or habitat improvement, a good sport fishery could develop. Because of the proximity of the Site C reservoir to Fort St. John and Hudson Hope, the reservoir could be heavily used by anglers from these centres if angling quality were good.

The management of the fishery resource in the Site C reservoir would be the responsibility of the B.C. Fish and Wildlife Branch. Practical management options would centre around rainbow trout or yellow walleye; however, the utilization of other less known salmonid species such as Kokanee may be possible.

SECTION 13.0 - HERITAGE SITES

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
13.1	INTRODUCTION	13 - 1
13.2	KNOWN HERITAGE SITES	13 - 1
13.3	HISTORICAL FEATURES	13 - 2
13.4	DISTURBANCE OF HERITAGE SITES	13 - 3
13.5	MITIGATION AND COMPENSATION OPTIONS	13 - 4

FIGURES

<u>Figure No.</u>	
13-1	Artifacts from Excavation at Farrell Creek
13-2	Historic Photos of the Peace River Valley

## SECTION 13.0 - HERITAGE SITES

### 13.1 INTRODUCTION

Archaeology and historical studies began in 1974 in the lower Peace River and continued during the summer of 1975, 1976 and 1977. The broad objectives of the work were to:

1. Estimate the number and type of heritage sites\* present in a defined study area.
2. Obtain an excavated sample of archaeological data for evaluation purposes.
3. Conduct a detailed inventory of historic sites.

Surveys in 1974 through 1976 were judgmental and varied in intensity. In 1977 a probabilistic sampling program was adopted. The sample design involved division of the Site C study area into seven strata which were further divided into 500 m x 500 m quadrats. A random sample (usually 10 percent) of quadrats were intensively investigated for archaeological information by test pit excavations and visual inspections.

### 13.2 KNOWN HERITAGE SITES

In 1974, 114 heritage sites were identified within or along the Site C pondage area. Several large prehistoric sites of obvious importance were located as well as an important historic site - Rocky

---

\* The term heritage site is used to denote a location at which archaeological or historic materials were found. These materials ranged from common flakes of chert to the remains of historic structures. A description of each site is on file at the Provincial Archaeological Office.

### 13.2 KNOWN HERITAGE SITES - (Cont'd)

Mountain Portage House. The location of historic Rocky Mountain Fort was the only activity within the Site C impact zone during 1975. In 1976 a total of 61 new archaeological sites were added to the study inventory. The probabilistic sampling program in 1977 yielded a further 72 formerly unknown archaeological sites in the vicinity of the proposed development. To date, 241 heritage sites have been recorded in the study area including 31 historic sites.

About 80 percent of all sites contain flakes and 40 percent contain other cultural items some of which were of diagnostic value. A small scale excavation conducted at one of the larger aboriginal sites near the confluence of Farrell Creek and the Peace River yielded nearly 6000 stone artifacts, the bulk of which were chips of black chert. Examples of excavated artifacts are shown in Fig. 13-1.

### 13.3 HISTORICAL FEATURES

#### The Fur Trade and Initial Contact Period (1793 to 1900)

The first white man to travel the Peace River was Alexander Mackenzie who passed through the lower Peace River valley on his way to the Pacific. Following his recommendations, a fort was built the following year on the west side of the mouth of the Moberly River. The present site contains the remains of Rocky Mountain Fort and two later furtrading posts. These outposts of the North West Company and Hudson's Bay Company were the nucleus of the first permanent settlements in British Columbia.

The post that replaced Rocky Mountain Fort was built in 1805 by Simon Fraser across the Peace River from present-day Hudson Hope. This fort was called Rocky Mountain Portage House and remained in use until 1824. It was re-established from 1866 to 1900. The present site shows complex pits, mounds, depressions and ridges which are evidence of long occupation and probably much rebuilding. Also on this site are

### 13.3 HISTORICAL FEATURES - (Cont'd)

a log cabin, foundations of a cabin and traces of the old Hudson Hope ferry landing.

#### The Independent Trapping and Gold Rush Period (1860 to 1910)

The buildings of this period were exclusively log in structure and are not well preserved. A very delapidated log cabin with a small corral on the south bank near Hudson Hope may date from this period. Many miners probably stayed in the valley prospecting and trapping along the Peace, Halfway and Pine rivers, however, historic sources for this period are limited.

#### Agricultural Settlement (1910 to 1950)

Settlements and homesteads were connected by the old Hudson Hope Road which wound its way from Charlie Lake to Wilder Creek where a homestead and small store were located. From Wilder Creek the road led to homesteads and cabins near Jim Rose Prairie, Bear Flats, Watson's Hill, the Halfway River flats, Farrell Creek and Lynx Creek. A fairly good historic record exists of these early settlers; Fig. 13-2 presents historic photos from this period.

Information has been collected on all standing log buildings in the impact zone. Several physical attributes have been used to classify these structures such as corner material, foundation type and roofing style.

### 13.4 DISTURBANCE OF HERITAGE SITES

Seventy percent (170 sites) of the 241 known heritage sites within or near the proposed reservoir have been disturbed to various degrees in the past. Agricultural operations, road construction and natural erosion have been the main causes of this disturbance. This type of disturbance will probably continue whether the Site C development proceeds or not.

#### 13.4 DISTURBANCE OF HERITAGE SITES - (Cont'd)

The Site C reservoir would inundate 64 known heritage sites, 16 of which are historic in origin and include the Rocky Mountain Fort and Rocky Mountain Portage House sites. Adverse effects of flooding include loss of access for further investigations and possible physical changes due to continued inundation. The surface of these sites could also be disturbed during reservoir clearing operations.

Approximately 49 known sites occur very near full supply level where breaching, water erosion and minor sloughing would be greatest. It is expected that all of these sites would be directly affected. An additional 41 known sites occur above full supply level and beyond the zone of local beach erosion. The degree to which these 41 sites would be affected would depend on the degree of active erosion or instability that develops. It is not possible to state which sites might be affected but probably less than 10 of the 41 sites would be disturbed by the reservoir induced erosion.

The relocation of Highway 29 and construction at the damsite could disturb another 23 known sites bringing the total number of known heritage sites directly affected by the Site C development to 146.

#### 13.5 MITIGATION AND COMPENSATION OPTIONS

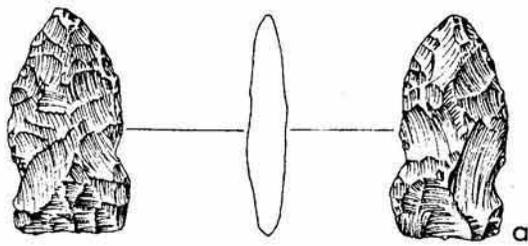
Efforts could be made during the construction phase to inform workers of the location of significant heritage resources so they can be avoided or preserved wherever practical. Protection measures could include covering with earth or rock, fencing and patrolling against vandalism.

A local information program would be desirable to inform the public of the scientific importance and legal status of heritage resources.

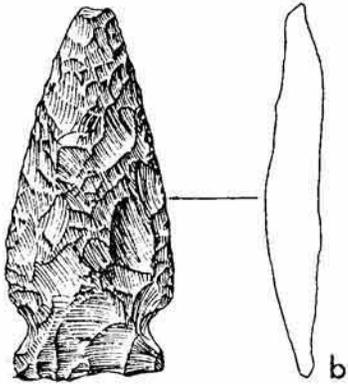
13.5 MITIGATION AND COMPENSATION OPTIONS - (Cont'd)

Perhaps the least desirable option is total or partial excavation and recovery of artifacts. This work would need to be scientific in design and linked to a rapid dissemination of results. A preliminary assessment of the relative significance of all known sites has been made as a guide for possible excavation or protection.

One form of compensation for loss of heritage sites could be the reconstruction of Rocky Mountain Fort or Rocky Mountain Portage House in conjunction with an interpretation complex (e.g. replication of habitation sites from various periods) and native prehistory displays. Since this type of a facility would be of long-term utility and general public benefit, it could be a joint local-provincial-federal project.



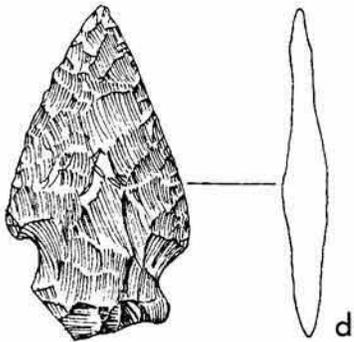
Chert Projectile Point



Chert Projectile Point



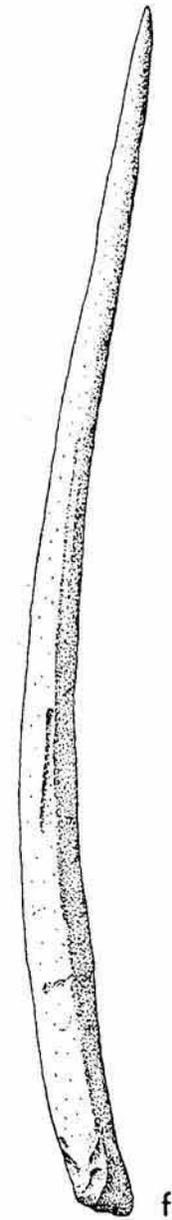
Chert Projectile



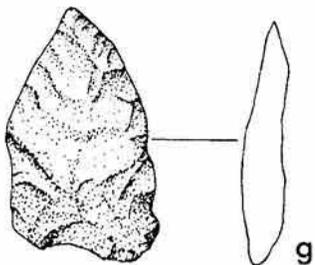
Chert Projectile Point



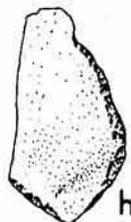
Chert Scraper



Bone Awl



Chert Projectile Point



Quartzite Flake



Chert Projectile

ARTIFACTS FROM EXCAVATION AT FARRELL CREEK



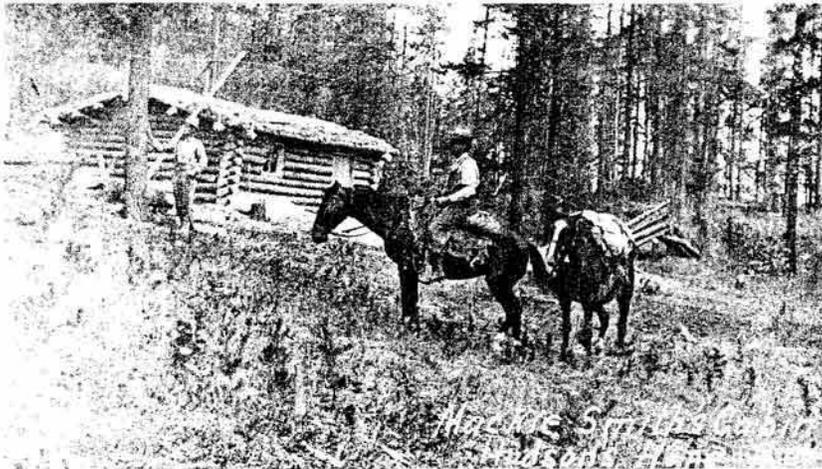
1912 Pioneers



Home built at  
Cache Creek in 1911

HISTORIC PHOTOS OF THE  
PEACE RIVER VALLEY

Hudson's Bay Company  
boat on the Peace River



1912 cabin  
in Hudson Hope



SECTION 14.0 - SOCIOLOGY

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
14.1	INTRODUCTION	14 - 1
14.2	RELOCATION AND RURAL IMPACTS	14 - 2
14.3	URBAN IMPACTS	14 - 3
14.4	IN-MIGRANT FAMILY PREFERENCES	14 - 4
14.5	SPECIAL INTEREST GROUPS	14 - 4
14.6	RANGE OF LOCAL OPINIONS ON THE PROJECT	14 - 4

## SECTION 14.0 - SOCIOLOGY

### 14.1 INTRODUCTION\*

The objectives of the social impact studies have been to:

1. Provide an assessment of the social impacts on families and settlements that would be affected by the proposed development.
2. Identify project-induced social service requirements and community needs particularly in Fort St. John.
3. Review the potential impacts of the project on those special interest groups that might be more affected than others by the project.

Surveys conducted during the summer of 1977 include:

1. Personal interviews with nonfarm and farm families that could be directly affected by the project (46 interviews).
2. A mail-out questionnaire to nonresident property owners whose land could be affected (29 questionnaires analyzed).
3. A questionnaire form completed by local professionals and representatives of health and welfare groups (27 questionnaires analyzed).

---

\* The material in this section is based on research done in 1977. At the time this document went to press a draft report was received which updates the earlier work. The report is entitled "Peace River Site C Hydroelectric Development Social Assessment Update" Draft, June 1980, Christine Lattey and Associates Ltd.

#### 14.1 INTRODUCTION - (Cont'd)

4. Personal interviews with in-migrant families associated with the Site One hydroelectric project near Hudson Hope (52 interviews).

Assessment of impact on special interest groups was obtained by an analysis of available statistical data on the social situation of local women, native people, trappers and guides. Further, personal contact was made with representatives of these groups during the field work associated with the study.

#### 14.2 RELOCATION AND RURAL IMPACTS

The project would require the forced relocation of at least 41 existing resident families (comprising about 157 individuals) and would cause certain other forms of disruption in the Peace River valley. Of all the social changes associated with the Site C project, the phenomenon of forced relocation has to rank as the most serious. Past relocation studies consistently support the basic proposition that involuntary displacement is a stressful and disruptive experience for most individuals and that it creates apprehension and a sense of powerlessness among them. The findings of this study support that general finding.

Some valley residents might not find the move stressful or difficult. However, most residents would be adversely affected by the project. The project planning process has already created uncertainty and apprehension among most families. During the construction phase, when well-known structures are removed or torn down, most people would experience an acute sense of loss as well as major physical disruptions and serious inconveniences.

It should be noted that, in comparison to some other projects in British Columbia and the United States, the numbers of people who would be seriously affected by the project are relatively small. It is

#### 14.2 RELOCATION AND RURAL IMPACTS - (Cont'd)

unlikely that these relocations would have any major regional implications in terms of shifting centres of population. That the relocations would have no major regional population impacts and that they are relatively few in number would not, however, diminish the extent and level of impact experienced by the individuals and families directly involved. Mitigation and compensation measures could be applied to help families deal with the financial implications of forced relocation. However, it is difficult to suppose that the social disruptions accompanying forced relocation could be mitigated or compensated for in any significant way.

#### 14.3 URBAN IMPACTS

In the past 5 years, Fort St. John has developed a social service infrastructure which, although limited in some respects, provides a full range of social, health, education and law enforcement services to residents. Both public agencies and self-help groups have extended their services in recent years. However, mental health, dental care and child care services remain inadequate and are major areas of concern to local residents.

Hydroelectric developments are characterized by a short, labour-intensive construction phase followed by a long-term operational phase that requires only a small workforce. Some 2400 persons would be hired during the peak construction year for the Site C dam. It is estimated that up to 1100 workers would live in a construction camp and that about 400 workers would bring their families.

The size and nature of such a population influx could have major ramifications on the delivery of social, health, education and law enforcement services in Fort St. John. Unless specific initiatives are taken to facilitate expansion in key areas, notably child care, mental and dental care services, and alcohol and drug counselling, the

#### 14.3 URBAN IMPACTS - (Cont'd)

quality of service to community residents would decline. School District No. 60 would be faced with the need for temporary expansion of its facilities and staff, and additional physicians and dentists would be required.

#### 14.4 IN-MIGRANT FAMILY PREFERENCES

Based upon information gathered through family interviews in Hudson Hope, it is anticipated that most in-migrant families would be young (30 to 37 years old) with one or two children. The majority of children would be school-aged. These families would make considerable use of child care services.

Most unionized workers with families would live in mobile home parks and appear to prefer parks that are integrated into existing residential areas. Supervisory staff prefer to live throughout the community rather than in a company-sponsored housing development.

The ice rink, swimming pool and other recreational facilities would receive extensive use by new families.

#### 14.5 SPECIAL INTEREST GROUPS

It is likely that certain groups in the Peace River area would be more adversely affected than others by the development. For example, many native people and women are not in a position to benefit economically from the project and would be adversely affected by any decline in community services as a result of the project.

#### 14.6 RANGE OF LOCAL OPINIONS ON THE PROJECT

Most local groups with whom contact was made during the study were strongly opposed to the project. A large number of groups passed

14.6 RANGE OF LOCAL OPINIONS ON THE PROJECT - (Cont'd)

resolutions opposing the dam, built alone or in conjunction with the McGregor Diversion Project, or any other dams on the Peace River. They expressed the following major concerns:

1. The irreversible loss of a valuable environment.
2. The loss of prime agricultural land.
3. The need to develop alternative sources of power.
4. The question of project-induced costs and impacts on community life.
5. The relocation of families.
6. The question of shoreline stability.

SECTION 15.0 - REGIONAL ECONOMICS AND RESOURCE VALUES

CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
15.1	REGIONAL ECONOMIC OVERVIEW	15 - 1
15.2	EMPLOYMENT EFFECTS	15 - 3
15.3	POPULATION EFFECTS	15 - 4
15.4	INCOME EFFECTS	15 - 5
15.5	HOUSING AND COMMUNITY SERVICES	15 - 5
15.6	LOCAL GOVERNMENT SPENDING	15 - 6
15.7	RESOURCE EVALUATION	15 - 7

TABLES

<u>Table No.</u>		
15-1	Population Distribution in Peace-Liard Regional District for 1971 and 1976	15 - 2
15-2	Summary of Resource Costs and Benefits Attributable to the Peace River Site C Hydroelectric Development using a 10 percent Discount Rate	15 - 9

## SECTION 15.0 - REGIONAL ECONOMICS AND RESOURCE VALUES

### 15.1 REGIONAL ECONOMIC OVERVIEW\*

Agricultural development stimulated much of the early growth in the economy and population of the Peace region. More recently the exploitation of petroleum, forest and mineral resources has promoted growth. As an indication of recent growth rates, population distribution in the Peace-Liard Regional District in 1971 and 1976 is shown in Table 15-1.

Coal developments at several mine sites in the southern and western parts of the region will be an important source of future growth in basic employment. Several coal development scenarios have been prepared in recent economic studies. Assuming a slow rate of coal development an estimated 2800 new direct jobs would be created by 1996; this compares with 4200 jobs assuming rapid development.

The number of persons involved in exploration and development of petroleum resources has varied considerably since 1970; with current high levels of exploration and development, employment in this sector is much higher than it was 3 or 4 years ago. The Grizzly valley will provide an impetus to employment growth. The proposed Alcan Gas Pipeline will also be a significant construction project affecting the region.

---

\* The material in this section on regional economics is based on data collected in 1977 and 1978. At the time this document went to press a draft report was received which updates the earlier work. The report is entitled "Peace River Site C Hydroelectric Development Environmental and Socio-economic Assessment: Regional Economic Impact Study" Draft, July 1980, Canadian Resourcecon Ltd. The general observations in this section remain valid, but discussions with local, regional and provincial agencies will be based on the updated report.

TABLE 15-1  
POPULATION DISTRIBUTION IN PEACE-LIARD REGIONAL  
DISTRICT FOR 1971 AND 1976<sup>1</sup>

	Population		% Distribution	
	1971	1976	1971	1976
<u>Urban Population</u>				
Dawson Creek	11 885	10 528	27.0	23.5
Fort St. John	8 260	8 947	18.8	20.0
Hudson Hope	1 745	1 330	4.0	3.0
Chetwynd	1 260	1 487	2.9	3.5
Fort Nelson	2 290	2 916	5.2	6.5
Pouce Coupe	595	776	1.3	1.7
Taylor	<u>605</u>	<u>649</u>	<u>1.4</u>	<u>1.4</u>
Sub-total	26 640	26 633	60.6	59.4
<u>Rural Population</u>				
Census Subdivision A	9 155	9 775	20.8	21.8
Census Subdivision B	7 365	7 640	16.7	17.0
Indian reserves	<u>835</u>	<u>794</u>	<u>1.9</u>	<u>1.8</u>
Sub-total	17 355	18 209	39.4	40.6
Peace River-Liard Regional District	43 995	44 842	100.0	100.0

<sup>1</sup> Source: Statistics Canada.

## 15.1 REGIONAL ECONOMIC OVERVIEW - (Cont'd)

While growth is expected in the forestry, agriculture, recreation, tourism, transportation and manufacturing sectors, it will not compare with the expansion expected in mining.

Over the 1976 to 1996 forecast period total regional employment is expected to increase by 7000 to 9800 jobs depending on the rate of coal development. From 800 to 1600 of these jobs would accrue to the Fort St. John-Taylor area. Assuming this growth in employment, the population of the Peace-Liard region would be expected to increase from 44,800 at present to about 65,000 by 1996. The Fort St. John-Taylor area would increase from 15,600 to nearly 19,000.

The urban centres of Fort St. John and Taylor and the surrounding rural areas are of greatest interest in relation to the Site C development. This area owes much of its growth in the past 15 years to improvements in rail and highway systems and to oil and gas exploration and processing. Four sectors account for nearly 60 percent of the experienced labour force. These are: service trades, wholesale and retail trades, transportation and communication, and agriculture. Total employment in 1971 was about 7800 in the Fort St. John-Taylor area.

During 1974, gross income reported on personal income tax returns by residents of Fort St. John-Taylor was approximately \$58 million, with an average of \$8480 per income recipient.

## 15.2 EMPLOYMENT EFFECTS

Construction of the Site C dam, reservoir clearing and transmission line construction would extend over an 8-year period and would have a significant impact upon regional and local employment opportunities. The main employment effects are forecast as follows:

## 15.2 EMPLOYMENT EFFECTS - (Cont'd)

1. Manpower requirements would total 5110 man-years; some 1430 man-years would be required in the peak year.
2. Depending on the demand for labour on other projects in the region, the employment of regional residents on the Site C development would be roughly 45 percent of the total labour requirement.
3. In-migration of non-resident construction workers who would relocate there would peak at approximately 400 families in the region. Most of these families would reside in the Fort St. John area.
4. Indirect employment generated by local expenditures of contractors hired by B.C. Hydro could generate up to 50 additional jobs in the region.
5. Net employment growth in service sectors, attributable to project-related increases in population and income, would peak at 350 jobs.
6. When operational the dam would employ a permanent workforce of 25, which would result in an increase in local employment of about 50 jobs.

## 15.3 POPULATION EFFECTS

In-migration of construction workers, their families and persons filling vacant positions in local service sectors would increase the population of the Fort St. John-Taylor area by about 1500 during the peak construction year, an increase of about 9 percent over that expected without the Site C development.

### 15.3 POPULATION EFFECTS - (Cont'd)

A construction workers' camp located at the damsite would house an additional 1100 people during peak construction.

This short-term increase in population would disappear upon completion of the project unless other employment opportunities existed. Long-term population increases due to the development would be about 80 people.

### 15.4 INCOME EFFECTS

During the construction period, regional income would expand appreciably. The main income effects are forecast as follows:

1. Gross wages and salaries to those employed on all aspects of the development would total nearly \$179 million (1980 dollars).
2. About \$128 million would be paid to employees who are permanent or temporary residents in the area. In disposable income terms, about \$89 million would be injected into the local economy over the construction period. Local spending by workers living in the construction camp could amount to an additional \$8 million.
3. The increase in basic income would generate roughly \$97 million of nonbasic income in the Fort St. John-Taylor area.
4. Operation of the dam would generate nearly \$1 million annually of direct and indirect income.

### 15.5 HOUSING AND COMMUNITY SERVICES

The Fort St. John-Taylor area has ample undeveloped land and many serviced building sites. The peak demand for housing would be roughly 450 units, about 320 of which would be required for 4 years or

#### 15.5 HOUSING AND COMMUNITY SERVICES - (Cont'd)

less. Short-term requirements could best be filled by mobile home parks, with the remaining 130 units as permanent residences. The housing requirements for full-time operating staff would be approximately 25 single family units.

Water supply, treatment, pipeline and distribution systems appear adequate to meet the expected population influx to Fort St. John and Taylor. The design capacity of the sewage treatment plants is also adequate. Land use and servicing requirements would need to be reviewed in greater detail as construction schedules become known.

#### 15.6 LOCAL GOVERNMENT SPENDING

During project construction, additional revenues would accrue to the city of Fort St. John due to an enlarged taxable assessment and increased sales of municipal services such as water and sewer. However, it is expected that incremental revenues would not sufficiently offset the extra operating costs of providing services to the expanded population of the city. The revenue shortfall (general revenue fund plus water and sewer utilities) is forecast to be in the order of \$383 000 (1980 dollars) over the 8-year construction period. It is expected that the city would not incur any major capital expenditures, such as water or sewer system improvements.

Project-induced fiscal impacts on the village of Taylor have not been determined but are expected to be much less than for Fort St. John.

School District No. 60 would face a sizable (at least \$2 million) increase in operating costs as a result of project-induced increases in school enrollment. Incremental school tax revenues and provincial government grants would offset these increased costs.

15.6 LOCAL GOVERNMENT SPENDING - (Cont'd)

Based on 1977 property assessments and mill rates, it is estimated that flooding of properties in the Lynx Creek subdivision could result in a minor loss of tax revenue to the district of Hudson Hope.

15.7 RESOURCE EVALUATION

Presently, the lower Peace River valley has various resource values associated with agriculture, forestry, trapping, fishing, hunting and general outdoor recreation. Any alteration in the actual and potential value of these resources due to the Site C development would represent a cost associated with the project.

A range of resource costs and benefits were identified and valued according to various assumptions regarding future resource demands and corresponding values. Owing to the uncertainty associated with forecasting, it is not possible to derive a single estimate of resource opportunity costs. A range of estimates has been developed therefore and are presented in Section 3.0. Resource opportunity costs are summarized in Table 15-2. The values shown in this table are representative values showing the relative magnitude of each impact and not necessarily a best or most likely value.

The main impacts of the Site C development would be felt in the recreation and agricultural sectors. Within the northeast region and even on a provincial basis the agricultural and recreational resources of the lower Peace River have particular characteristics that make them valuable. For example, the soils and microclimate of the valley give the area a high agricultural capability and the river offers a wide variety of recreational experiences, including boating, fishing, hunting and camping in a unique and varied setting. As the supply of these two resources decreases over time, their importance

15.7 RESOURCE EVALUATION - (Cont'd)

(and value) may be expected to grow from regional and provincial viewpoints. The development of the Site C hydroelectric project would diminish both the quantity and quality of these resources for future resource users.

The Site C project would have the least impact on forestry resources. The forestry resources within the pondage area are of relatively minor importance; only 20 percent of the forest areas contains merchantable timber and access to these areas is difficult. The net loss of forestry resources would constitute less than 3 percent of the total resource values which may be lost.

As noted in earlier sections of the Report, various mitigation and enhancement measures exist which, if undertaken, may reduce the potential loss of resource values. These projects are limited mainly to the recreation sector; the benefits of relatively small investments in recreation facilities would offset most general recreation losses (see Section 18.0).