



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

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**NOTE TO READER:**

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**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.**

**PEACE SITE C PROJECT  
ENVIRONMENTAL IMPACT STATEMENT**

**Part Three**

**Mitigation  
and  
Compensation**

17.7 WILDLIFE - (Cont'd)

the new soil conditions and will rapidly provide a cover that reduced erosion. After that, natural ecological succession could be allowed to proceed." (Blood p. 76-7)

Construction specifications require all topsoil to be removed and stockpiled. When the construction work is completed the borrow and spoil disposal areas are graded to provide free draining surfaces which do not detract from the general appearance of the area and the work areas are seeded.

W-8 "Control of hunting access so that construction workers do not have opportunities not available to other people." (Blood p. 77)

B.C. Hydro always has a no-shooting zone around its construction projects.

W-9 "Reservoir filling will be least damaging to wildlife in the reservoir area if done in fall and early winter. However, this is not critical, since there will be minimal wildlife use once the clearing operation is completed. Downstream effects might be greater if the reservoir is filled during low flow periods than during the freshet, because a greater proportion of total flow would be held back and/or filling would take longer. The relative importance of these potential impacts cannot be assessed at this time." (Blood p. 77)

Filling is proposed to be carried out during the freshet and should take 20 to 60 days depending on inflow levels. This would minimize the period when downstream flows would be reduced due to the filling operation, and is also the best time as inflows from downstream tributaries would be at their maximum during this period.

W-10 The consultant's views on compensation are as follows:

"Mitigation measures may reduce some impacts during the construction phase, but will not prevent the permanent loss of habitats below full supply level and in the construction area. As previously mentioned, the flooded terrestrial

## 17.7 WILDLIFE - (Cont'd)

ecological systems cannot be duplicated, therefore other ways of substituting for the permanently lost wildlife values must be sought.

It might be argued that the project merely converts a terrestrial and flowing water environment into a ponded aquatic system in which secondary production is in the form of fish rather than birds, mammals, reptiles and amphibians. Fish production beyond that already present in the river system might be considered as compensation for lost wildlife. This argument however, falls short of satisfaction on several accounts. Firstly, fish cannot substitute for the non-consumptive enjoyment provided by wildlife in the impact area. Secondly, the area already seems to provide enough angling to satisfy local users, and additional populations would not necessarily provide more people-days of fishing recreation. In fact, the fish could be more difficult to obtain. A commercial fishery might economically equal or exceed wildlife production values, but could not compensate for lost hunting opportunity.

Thus a logical solution appears to be to replace lost wildlife production with some other kind of wildlife production. Even this approach usually falls short of true compensation however, since intensive management is only practical if carried out on relatively small areas and aimed at key species. Such programs do not compensate for the diversity and biomass of small mammals, songbirds and small furbearers, which is lost over larger development areas. Nevertheless, this is probably the only practical approach. Management programs might involve one or both of the following:

1. Construction of a waterfowl production unit by dyking a shallowly flooded areas along the reservoir perimeter. This would be aimed at development of a sizeable breeding flock of Canada geese, with secondary benefits for duck nesting, muskrats and other aquatic wildlife. Standard wetland management techniques such as water level manipulation, introduction of aquatic food plants, planting of upland food crops, and provision of nesting islands and structures would be employed. Lack of detailed topographic mapping makes choice of specific potential sites difficult, but the opportunities appear to be limited. Only two sites seem to have promise - the Peace Valley Ranch area (miles 46 to 49) and an area west of Bear Flat (miles 54.5 to 56). More detailed investigation might reveal topographic or soil limitations for habitat development at those sites.

17.7 WILDLIFE - (Cont'd)

2. Habitat management to improve the productivity of nearby uplands for moose, deer and elk. This might also have spin-off benefits for other herbivores such as snowshoe hares and ruffed grouse. Such a management program could be applied to any nearby wildlands for which long-term retention for wildlife production is reasonably assured. Major management techniques might include:

- burning some winter range to increase grass-forb cover and browse production
- clearing openings in dense forest cover to increase edge and browse production
- thinning of dense aspen or cottonwood stands
- range fertilization
- felling live trees to provide winter browse which has grown out of reach

Costs of the above programs cannot be predicted at this time. More investigation of lands which are available and suitable for such management is needed.

Lastly, compensation might be considered via the retention for permanent wildlife production, of land which would otherwise be taken out of wildlife production for agricultural or other uses. Assuming Crown lands to be involved, this approach would require a government policy commitment rather than a financial one. It might logically be argued however, that because such lands are already producing a natural wildlife crop, their permanent commitment to that purpose is not real compensation for losses brought about by Site C.

Enhancement - The Site C development will probably not present any striking opportunities to improve wildlife production via enhancement programs. The only worthwhile endeavor might be to place nesting structures suitable for Canada geese or ospreys at strategic locations around the shoreline." (Blood p. 77-9)

The whole question of mitigation and compensation for impacts on wildlife will be discussed with the Fish and Wildlife Branch and other interested parties in order to establish appropriate mitigation and compensation measures for wildlife losses.

W-11 The consultant made the following recommendations:

"Should a decision be made to proceed with the project, the following programs are recommended:

17.7 WILDLIFE - (Cont'd)

A more complete natural history inventory of the reservoir area for the scientific record. This should concentrate on the flora, including mosses and lichens, and probably include invertebrates, particularly insects. Wildlife populations should require little or no additional documentation. In view of the continuing loss of floodplain habitats, a better record of those remaining is desirable and would aid future taxonomic and distributional studies of B.C.'s flora and fauna." (Blood p. 79)

B.C. Hydro questions whether this would be an appropriate expenditure of wildlife compensation funds.

W-12 The consultant also recommended:

"A more detailed investigation of possibilities for wildlife habitat management or development programs which would compensate for Site C impacts. This would require input from several provincial government resource and land management agencies." (Blood p. 79)

This will be done jointly with the Fish and Wildlife Branch and other interested agencies.

17.8 WATER QUALITY AND USE (WQ)

The following recommendations are from the report "Peace River Site C Hydroelectric Development, Water Quality and Use" by Canadian Bio Resources Consultants Ltd. (CBRC).

WQ-1 "Further study regarding the temperature of water released by the Site C dam may be warranted in order to assess more completely the effect this aspect may have on beneficial uses downstream. In this respect, it is recommended that the present B.C. Hydro temperature monitoring of the river be continued at least another summer season to provide additional base data. It is further recommended that a monitoring station near Taylor be included in this monitoring program." (CBRC p. 65)

## 17.8 WATER QUALITY AND USE - (Cont'd)

This is being done.

WQ-2 "Because of the somewhat unique morphological nature of the Site C reservoir in British Columbia, if the project goes ahead, follow up studies regarding the Site C reservoir system would provide information from which to assess future hydroelectric developments of other river and reservoir systems. Gathering of pre-flood information would be important in providing a basis from which to assess water quality and use effects. An important feature of a monitoring program of this nature would be to systematically account for water quality changes that might result from land use changes, such as large scale coal development or large scale agricultural development, occurring prior or after reservoir development." (CBRC p. 65)

In view of the work already done in this area it is not clear to Hydro that such a program is warranted. However if it can be demonstrated that the expenditures would be justified Hydro would fund a water quality monitoring program for the impact of the Site C project.

If the objective were to account for water quality changes due not only to the Site C project but to other uses such as coal development, or agriculture, then Hydro would agree to participate with the other developers in such a study.

## 17.9 FISHERIES (F)

The following recommendations are from the report "Peace River Site C Hydroelectric Development, Fish and Aquatic Environment" by Renewable Resources Consulting Services Ltd. (RRCS).

### Construction Phase

F-1 "Fish movement and migrations between the Site C area and downstream areas are poorly known. If upstream fish migrations are blocked by dam construction, temporary fish passage facilities or other instream protective devices could possibly be incorporated into the construction plan. The minimum water velocity that will block or impede fish movements is dependent on the species and size of fish, the water

## 17.9 FISHERIES - (Cont'd)

temperature, and a complex of innate factors caused by photoperiodism and hormonal cycles (Jones et al. 1974; MacPhee and Watts 1976). After reviewing the literature, McCart and Jones (1975) recommended that to allow the passage of at least the larger adult fish, water velocities near the shoreline in diversion works should not exceed 1.5 ft/s (46 cm/s) for a distance greater than 60 feet (18 m). The velocity can be somewhat greater if the distance between resting areas is reduced by the use of baffling or rock groins placed to create eddies at intervals (Clay 1961).

If large concentrations of fish develop during spawning migration periods, contingency plans could also be developed for a live trapping program below the site and removal of these fish to the river above the construction area." (RRCS p. 60)

The practicality of fish passage facilities during the period when the river would be diverted through tunnels appears questionable. The need and cost effectiveness of this would have to be discussed with the Fish and Wildlife Branch and considered within the context of an overall fisheries compensation program. In general B.C. Hydro believes it better to allocate funds to measures intended to provide long-term benefits rather than to ameliorate temporary conditions.

F-2 "During the construction of the dam, care should be taken to minimize sediment input into the river. This would include sediment input caused by construction activities and the long-term erosion of the soils within the project area.

Many alternatives are available to minimize the erosion and input of sediment into the river during construction. Sciandrone (1974) describes appropriate measures such as mulching, seeding of exposed soils, protective plastic sheeting, etc. Effluents with high suspended sediment levels from gravel washing operations should not be released directly into the river; rather, settling basins should be constructed to reduce suspended sediment levels prior to discharging the water." (RRCS p. 61)

The control of sediment runoff during construction is a standard requirement in all B.C. Hydro construction contracts. All wash water must be passed through a settling pond prior to discharge into the river. For example, see Clause 7.07 in Appendix A.

17.9 FISHERIES - (Cont'd)

In order to minimize long-term erosion of soils which have been disturbed as a result of the construction activity, B.C. Hydro would ensure that these areas are seeded in order to re-establish a suitable ground cover.

F-3 "Waste material (e.g. gas, oil, greases, salts, sewage and chemicals) could reduce the local water quality of the Peace River, if they are allowed to enter the system.

To ensure that waste materials that may affect fish will not enter the watercourse, precise storage and disposal methods for these materials should be written into the construction contract. The construction area should be monitored to ensure no violations of the contract occur." (RRCS p. 61-2)

All Hydro construction contracts contain clauses covering the prevention of water pollution, for example see Clause 7.07 in Appendix A. The construction area would be monitored to ensure that no violations of the contract occur.

F-4 "The construction contract should specify methods to be employed in the use of underwater explosives. These methods should be designed to minimize mortality caused by explosives.

Fish mortality resulting from underwater explosions can be reduced by the following:

1. burying the charge as deep as possible into the substrate;
2. having major detonations as a series of successive charges, with sufficient time between firings to allow dissipation of most of the shock wave; and
3. dispersing concentrations of fish in the area by the use of sonic or electrical shock." (RRCS p. 62)

All, or almost all, blasting would be done in the dry.

## 17.9 FISHERIES - (Cont'd)

- F-5 "If it appears that the additional fishing pressure caused by construction workers or local residents is depleting fish stocks and, in particular, removing large numbers of fish from populations that may concentrate immediately below the construction site, it may be necessary for the B.C. Fish and Wildlife Branch to reduce the length of the open seasons or to reduce the catch limit in the affected areas." (RRCS p. 62-3)

B.C. Hydro's contracts require the contractor to enforce all legal requirements for hunting and fishing in the project area.

### Operational Phase

- F-6 "To reduce the impact of the proposed development on any possible fish migrations at the Site C dam, fish passage facilities could be provided to allow passage of fish over the dam. A variety of types and sizes of fishways have been developed to facilitate fish passage. Descriptions of various fishways are presented in Ziemer (1962), Bell (1973), and Clay (1961). Murray (1976) has also reviewed the literature and costs of fishways.

Basing estimations on a head of approximately 150 feet (46 m) for the Site C dam, and using capital costs from Murray (1976), the cost of a pool and weir type fishway at the Site C dam would be between \$450,000 and \$906,000.

Because of the extremely high costs involved in fishway construction, the relatively small populations of fish that could be expected to migrate past the site, the unidentified problems for downstream passage of juvenile and adult fish, and because it is not known if the resident fish species would use the fishway to surmount the height necessary for passage over the Site C dam, the incorporation of fish passage facilities into the design of the dam cannot be recommended at this time. It should be noted, however, that the B.C. Fish and Wildlife Branch will not rule out fish passage facilities at the Site C dam as one of their management options at this time (G. Chislett, pers. comm.)." (RRCS p. 63-4)

At Site C the costs of a fishway would probably be considerably higher than indicated above. In view of this and the questionable effectiveness, B.C. Hydro agrees with the consultant's conclusion that fish passage facilities could not be justified at Site C.

## 17.9 FISHERIES - (Cont'd)

F-7 "Inundation of the Peace River and the lower sections of many of the tributaries to the Peace River will reduce the amount of spawning habitat available to river spawning species of fish. To minimize the impact of reduced spawning areas caused by flooding, a number of alternatives are possible. One such alternative is to scarify sections of the shoreline of the proposed reservoir shortly before filling. Scarifying will expose clean rock and gravel which could be used for spawning by sport or commercially valuable species of fish such as lake whitefish, yellow walleye (if they become established in the reservoir), Arctic grayling and mountain whitefish. Because siltation of the substrate usually reduces the survival of eggs on the substrate, preparation of the shoreline should be done in only those areas where siltation from shoreline erosion from bank slumping, or from the inflow of tributaries would be slight (D. Smith, pers. comm.). Many areas would probably be suitable; these could best be identified and prepared during vegetation clearing operations. Because heavy equipment will be used during the clearing operations, the additional expense involved to scarify a number of areas would be very low, probably less than \$10,000." (RRCS p. 64-5)

Siltation from tributary inflow would occur and the distribution and severity would be difficult to determine in advance. However, it may be worthwhile to try this in a few selected areas. It is an unproven measure that will be considered if the Fish and Wildlife Branch propose management for a given species that would utilize such areas. Fish and Wildlife would also have to determine the selected areas where this should be done.

F-8 "Areas that will be shallow (less than 15 feet (5 m) deep) and not subject to siltation but have an overburden above gravel and rocks could be used for the construction of an artificial spawning shoal for the species mentioned previously. The construction of the spawning shoal would involve the placement of clean gravels and rubble on the substrate by barge after flooding the area. Two areas along the south shore that probably would be most suitable are at mile 58 (km 93) (slightly downstream of the Halfway River) and at miles 71 to 72 (km 114 to 116) (slightly downstream of Farrell Creek). The cost of this mitigation measure would be proportional to the size of the shoal created (i.e. the amount of gravel and rubble hauled). It is estimated that

17.9 FISHERIES - (Cont'd)

installation 5000 yd<sup>2</sup> (4200 m<sup>2</sup>) of suitable spawning substrate (1.5 feet deep; 0.5 m deep) would cost less than \$30,000 (D. Smith, pers. comm.)." (RRCS p. 65)

Both of the locations proposed appear to be liable to silting from the tributaries which enter the Peace just upstream. It appears potentially more beneficial to spend funds on stripping overburden from gravel in suitable areas as proposed in previous and following paragraphs. This method has been used successfully for lake trout, characteristically a lake (reef) spawner, but not for the species mentioned.

F-9 "Because of the small cost of preparing the reservoir bottom along the shoreline to create suitable spawning sites for lake spawning sport fish, and because of the potential benefits than can be derived, it is recommended that, prior to flooding, shoreline preparation be conducted in suitable areas." (RRCS p. 65)

This could be included as part of the overall fisheries compensation program.

Clearing the Reservoir Area

F-10 "To minimize the effects of potential increases in sediment loads, clearing of the vegetation should be conducted during the period immediately preceding dam completion to reduce massive erosion of the cleared banks and the subsequent siltation in the streams and rivers." (RRCS p. 66)

It is not practical to leave all clearing to the last minute. Where areas of high sensitivity can be defined some clearing can be left until late in the construction period.

Spillway Construction

F-11 "It is recommended that the design of the spillway be modified so that the probability for oxygen and nitrogen gas supersaturation in the water flowing over it is minimal." (RRCS p. 66)

## 17.9 FISHERIES - (Cont'd)

The foundation conditions at Site C limit the spillway energy dissipation facilities to a stilling basin of the type proposed. However, because a large proportion of the total flow would be passed through the powerplant it is expected that supersaturation would not be a problem.

### Enhancement Opportunities

F-12 "The consultant evaluated a number of management options available to enhance the sport fishery in the Site C area, and concluded that the provision of incubation boxes would be the most practical and cost-effective means of salmonid enhancement." (RRCS p. 67-79).

B.C. Hydro will discuss these various options with the Fish and Wildlife Branch and other interested parties to establish the most desirable and cost effective fisheries compensation program.

## 17.10 HERITAGE SITES (HS)

The following recommendations are from the report "The Site C Heritage Resource Inventory and Assessment" which was prepared by the Department of Archaeology, Simon Fraser University (Study Director Brian E. Spurling).

HS-1 "Option One - mid-1980s inservice date - This option provides 6 to 8 years for a cultural resource program. Field programs during 1978, 1979 and 1980 should include intensified survey and inventory in order to increase the present sample fractions for the sample strata and reduce the large standard errors for the present stratum resource population estimates. A target sample fraction of between 30 and 50 percent of the study area should be set. It will be possible to reduce the size of the study area as the effects of the project become known in detail. It should be clear that any advance in lead time for both completion of the inventory and assessment phase and the mitigation phase is desirable given 1. the proven and predicted resource density of the study area and 2. the provincial significance of several of the known cultural heritage resources which would be impacted by project development.

17.10 HERITAGE SITES - (Cont'd)

Coincident with this program should be small scale test excavation of located sites in order to determine their subsurface extent. Such sites should be selected on a representative basis. This step is necessary in order to provide costing information for any subsequent mitigation phase. A smaller sample of representative sites should be chosen and subjected to scientific investigation utilizing probability sampling techniques designed to acquire a large enough data base to contribute to problems in settlement and subsistence interpretation, culture history, exchange, and excavation and recovery methodologies. Given a 6 to 8-year time frame and the need to acquire a priori information on single site significance this recommendation is not an undue exploitation of the resource base. Target site excavation sample fractions should range between 2 to 5 percent.

During this period experiments designed to develop efficient means of data recovery from surface sites should be initiated.

From the years 1980 to project completion full scale mitigation procedures should be undertaken. This would include:

1. increased inventory and survey coverage,
2. full scale excavation of a representative sample of archaeological sites with large target sample fractions,
3. the detailed mapping of, and establishment of permanent datums on, resources which will be impacted,
4. experimentation with, and the eventual erection of, physical facilities to ameliorate impacts,
5. the year round presence of a research team available to fire-fight resource/development conflicts as they occur during such activities as highway relocation and clear cutting,
6. a feasibility study of the construction of a museum or cultural facility, and
7. annual peer review of the measures and results of the project throughout its duration.

Following project completion an annual inspection program should be maintained up to the time of reservoir stabilization in order to monitor the effect of the reservoir on inundated and shoreline sites." (Spurling p. 70-1)

17.10 HERITAGE SITES - (Cont'd)

Hydro is concerned that there are no guidelines for the amount of public funding which should be spent on archaeological studies and research. As pointed out towards the end of Section 16.5, it is extremely difficult to quantify the value of heritage resources, and therefore value cannot be used as a yardstick to determine how much ought to be spent.

These issues will have to be discussed with the Provincial Archaeologist to try to determine an appropriate and mutually acceptable course of action.

17.11 SOCIAL IMPACTS (S)

The following recommendations are from the report "Peace River Site C Hydroelectric Development Environmental and Socio-economic Assessment, Socio-economic Impact Study" by Canadian Resourcecon Limited, Suzanne Veit and Associates Inc., Urban Programme Planners, and Sigma Engineering Ltd. The section of the report covering social impacts was prepared by Suzanne Veit and Associates Inc.

S-1 "B.C. Hydro should provide a grant of not less than \$80,000 to local groups in the Peace River area that wish to make presentations at the hearings associated with the project. The grant should be given directly to the Provincial Government Environment and Land Use Committee, which would review applications for funds and then allocate the money to representative groups. These funds should be allocated at least 6 months prior to the public hearings." (Veit p. VI-30)

B.C. Hydro believes that requests for such funding would be more appropriately addressed to the government.

S-2 "B.C. Hydro should prepare immediately a booklet on its land acquisition policy in the Peace River area, and such a document should be forwarded to all residents who live in the Peace River valley between Hudson's Hope and Fort St. John,

17.11 SOCIAL IMPACTS - (Cont'd)

and to all trappers and guides in the study area." (Veit p. VI-32)

A booklet describing B.C. Hydro's land acquisition policy has been prepared by B.C. Hydro's Properties Division and is contained in Appendix B to this Environmental Impact Statement.

S-3 "B.C. Hydro should send a written recommendation to the Provincial Ministers of Health, Education, Human Resource and the Attorney General that the Fort St. John area receive provincial priority status for social development services during the construction phase of the project." (Veit p. VI-33)

B.C. Hydro will forward this recommendation to the Ministries listed. These Ministries are being informed of the needs of the project through meetings with Hydro and the consultants and through distribution of the socio-economic studies report.

S-4 "B.C. Hydro should pay the salary of a social planner for a period of not less than 6 years, starting immediately after final approval of the water licence. This person should be responsible to a local social planning body and be appointed by such a body." (Veit p. VI-34)

The desirability of a social planner will be discussed with the city of Fort St. John, the Regional District, and the proposed impact monitoring committee.

S-5 "B.C. Hydro should provide an annual grant of not less than \$25,000 to the city council of Fort St. John to be allocated during the construction phase to local self-help groups that are working in the health and welfare fields." (Veit p. VI-36)

B.C. Hydro is prepared to consider this recommendation if the city of Fort St. John and the proposed impact monitoring committee feel that such a program is necessary.

17.11 SOCIAL IMPACTS - (Cont'd)

- S-6 "B.C. Hydro should make a formal commitment to the city of Fort St. John and to School District No. 60 that there will be no basic change in the proportion of school taxes that are borne locally as a result of the project." (Veit p. VI-37)

Hydro agrees with the principle of this recommendation provided that it is applied equally to other developers in the area, and will discuss its implementation with the Ministry of Education.

- S-7 "B.C. Hydro should retain a camp physician and dentist for the 3 peak construction years." (Veit p. VI-37)

B.C. Hydro will discuss this with local practitioners. Initially Hydro believes that it would be more satisfactory for Hydro to assist local practitioners in recruiting additional staff should a need develop as a direct result of the project.

- S-8 "B.C. Hydro should provide daily bus transportation to project workers from Fort St. John to the project site." (Veit p. VI-37)

This will be discussed with the Allied Hydro Council of Unions. Current trade union contracts make this expensive and undesirable. Past experience indicates that most workers will be involved in car pools thus freeing cars for non-working spouses which is the consultant's concern in this recommendation.

- S-9 "B.C. Hydro should pay moving expenses for individuals who have to relocate." (Veit p. VI-38)

This is discussed in B.C. Hydro's land acquisition policy which is described in Appendix B.

- S-10 "B.C. Hydro should initiate a meeting with small business owners who would be affected by the project to discuss mitigation and compensation measures." (Veit p. VI-38)

17.11 SOCIAL IMPACTS - (Cont'd)

B.C. Hydro will be prepared to meet with small business owners to discuss their concerns and see what can be done to assist them.

S-11 "B.C. Hydro should initiate a meeting with tenant families who would be affected by the project to discuss mitigation and compensation measures." (Veit p. VI-38)

B.C. Hydro Properties Division will be prepared to meet with tenant families who would be affected by the project to discuss their concerns.

17.12 SOCIO-ECONOMIC IMPACTS (SE)

The following recommendations are from the same report as those in Section 17.11. The sections of the report covering economic impacts were prepared by Canadian Resourcecon Ltd., Urban Programme Planners, and Sigma Engineering Ltd.

SE-1 "A project impact assessment committee should be established for the duration of the project construction period." (p. VI-2)

B.C. Hydro endorses this recommendation and is prepared to provide advice and assistance in setting up such a committee.

SE-2 "A program should be established to monitor the social and economic impacts of the Site C project." (p. VI-22)

A comprehensive socio-economic monitoring program would be proposed for this project.

SE-3 "B.C. Hydro should work closely with the city of Fort St. John and regional district to ensure that housing developed to accommodate the project workforce (apart from the single men's camp) is located within the municipality." (p. VI-23)

17.12 SOCIO-ECONOMIC IMPACTS - (Cont'd)

Discussions on the provision of workforce family housing will be undertaken with the city of Fort St. John and the regional district.

SE-4 "All housing not required to meet the base requirement of 130 units should be comprised of mobile units. These units should be situated in mobile home parks. Adequate servicing should be installed so that these parks could be converted to other urban uses if required upon project completion." (p. VI-23)

Discussion will be held with the municipality and regional district to arrange for appropriately serviced temporary workforce housing.

SE-5 "Housing for B.C. Hydro and project contractor supervisory personnel should be distributed throughout the developed residential sections of the municipality rather than concentrated in one or two specially designed subdivisions." (p. VI-23)

B.C. Hydro will attempt to spread its housing requirements throughout the municipality. However, the extent to which this can be achieved will depend largely upon conditions in the private housing market.

SE-6 "B.C. Hydro should contribute towards the capital costs of any physical infrastructure required specifically to accommodate the temporary population increase associated with the project." (p. VI-23)

Negotiations will commence to determine what, if any, physical infrastructure expansions are required for the project. B.C. Hydro will make contributions toward increased service costs which are directly attributable to the project and which will not be absorbed as part of the normal expansion of the Fort St. John community.

SE-7 "B.C. Hydro should take due regard of the Taylor water supply river intake when planning flow changes in the Peace River in connection with the project and arrange for alternate water supply for Taylor if such low flow period affect the village intake system." (p. VI-24)

17.12 SOCIO-ECONOMIC IMPACTS - (Cont'd)

It is not expected that there would be a problem with the Taylor water intake due to low water levels. However, B.C. Hydro would undertake remedial measures if required.

SE-8 "B.C. Hydro should undertake the cost of replacing the municipal water supply pumphouse and intake system at Hudson's Hope and connecting the new pumphouse to the distribution system." (p. VI-24)

B.C. Hydro would relocate the pumphouse and intake system and connections as required by the changed water levels.

SE-9 "B.C. Hydro should provide financial compensation to local governments and institutions if it can be demonstrated that the costs incurred in providing services (for example, general government, water supply, sewage disposal, education, etc.) to the project induced in-migrant population exceed the revenues derived in the form of taxes, levies, fees, etc." (p. VI-24)

This is agreeable to B.C. Hydro.

SE-10 "B.C. Hydro should provide financial compensation to the district of Hudson's Hope if the municipality incurs a net decline in property tax revenue as a result of precluded land use due to reservoir flooding in Lynx Creek or shoreline instability in other parts of the municipality." (p. VI-25)

The effect of this project on Hudson's Hope will have to be determined through careful study and monitoring. When impacts are identified appropriate compensation will be negotiated with the municipality.

SE-11 "Definitive studies should be undertaken to assess the extent to which normal use of properties which would front on the reservoir in the townsite area of Hudson's Hope would be constrained or precluded due to slope instability attributable to reservoir flooding." (p. VI-25)

17.12 SOCIO-ECONOMIC IMPACTS - (Cont'd)

Bank protection will be provided where necessary to ensure that there will be no instability of the reservoir slopes in the townsite area.

SE-12 "B.C. Hydro should work closely with government agencies and the regional college to encourage the employment of local residents on the project and in new jobs created in local service sectors." (p. VI-26)

The obstacles to maximizing local employment on project related jobs or newly created jobs in the service sector are detailed by the consultant. They include lack of appropriate training programs and potential problems with obtaining required union membership. B.C. Hydro would certainly be willing to work with appropriate local and government agencies and provide information necessary to develop training programs to encourage local employment.

SE-13 "Project contractors should be encouraged to utilize materials, supplies and services available from local firms." (p. VI-27)

B.C. Hydro has a policy of actively encouraging the use of British Columbia's goods and services and this is included in contract specifications - Clause 2.10 in construction contracts. Although local suppliers would benefit to some extent from the construction of Site C, Hydro does not force contractors to purchase locally but permits them to get their requirements at the lowest price.

SE-14 "Reservoir logging and clearing and transmission line right-of-way clearing should be undertaken by independent local contractors." (p. VI-27)

As the merchantable timber is under the jurisdiction of the B.C. Forest Service, it is expected that the reservoir logging and clearing would be carried out under the direction of the Forest Service at B.C. Hydro's expense. Accordingly this recommendation will be passed on to the Forest Service for implementation where practical.

17.12 SOCIO-ECONOMIC IMPACTS - (Cont'd)

SE-15 "A study should be undertaken to estimate the combined social and economic impacts of major resource development projects expected to occur in northeastern B.C. during the next 10 years." (p. VI-28)

B.C. Hydro would be prepared to contribute to such a study provided that it were conducted by an independent government agency, and that other northern developers were required to share the costs of the study.

SECTION 18.0 - EVALUATION OF MITIGATION AND COMPENSATION PROPOSALS

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## SECTION 18.0 - EVALUATION OF MITIGATION AND COMPENSATION PROPOSALS

### 18.1 INTRODUCTION

Proposals for compensation or mitigation which require capital expenditures are well suited to benefit/cost evaluation. The principles outlined in Section 16.0 are derived from the benefit/cost framework and the decision as to whether a particular program is worthwhile should be based on a careful weighing of its benefits and costs. The major proposals involving capital expenditures made by the environmental consultants are evaluated in this section. Compensation or mitigation recommendations which cannot readily be evaluated are commented upon in terms of a qualitative judgement about their desirability.

### 18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES

Table 18-1 reviews the social opportunity costs of resources that would be impacted by the Peace Site C project. These costs are comparable to those shown in Table 3-3 in the chapter on social benefit/cost analysis with the exception that Table 3-3 assumes a cleared reservoir (and the costs of reservoir clearing are included in Table 3-1). The purpose of showing the results without reservoir clearing is to demonstrate that clearing in itself is a significant mitigation measure. The net change in resource values is reduced by \$33.0 million through clearing and clean-up. The present discounted cost of reservoir clearing and clean-up is \$7.7 million. The benefit/cost ratio for this measure would thus be 4.3:1.

The reductions in resource losses, i.e. the net gains, from reservoir clearing are achieved through activities made possible by informal access to a useable reservoir. Both fishing and general recreation would otherwise be precluded. Significant environmental

TABLE 18-1

THE SOCIAL COST OF RESOURCE IMPACTS OF  
PEACE SITE C  
(\$ Thousands, 1980)

<u>Resource</u>	<u>Social Opportunity Value</u>	<u>Nature of Impact</u>	<u>Value with Peace Site C before Clearing<sup>1</sup></u>	<u>Value with Peace Site C after Clearing<sup>1</sup></u>	<u>Net Social Cost<sup>1</sup></u>
Fishing	10,614	loss of angler days	1,655	8,359	2,255
Hunting	2,791	loss of hunter days	2,014	2,014	777
Recreation	57,946	loss of river based recreation	3,385	29,649	28,297
Guiding	111	loss of guiding income	110	110	1
Trapping	765	loss of pelt production	753	753	12
Agriculture <sup>2</sup>	19,518	loss of vegetable production capability	1,752	1,752	17,766
Forestry <sup>2</sup>	528	lower annual allowable cut	-	-	528
	<u>92,273</u>		<u>9,669</u>	<u>42,637</u>	<u>49,636</u>

<sup>1</sup> Present discounted value at 6 percent over 70 years.

<sup>2</sup> Measured as potential rather than actual value.

## 18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

resource losses would remain, however, which suggests substantial scope for compensation measures. Table 18-2 shows the present discounted value of remaining resource losses (the same as Table 3-3). These are calculated at a 6 percent discount rate using the medium scenarios for resource evaluation. The 6 percent discount rate and the medium value scenarios are in B.C. Hydro's view, the most appropriate on which to base mitigation and compensation decisions. The programs are described resource by resource.

### (a) General Recreation

Picnic areas, boat launching facilities and campgrounds have been suggested as possible compensation measures for general recreation impacts. The recreation consultant identified a potential campground site at Bear Flats and potential sites for picnic grounds at Lynx Creek and Farrell Creek. Each of these sites would have boat launching facilities. The amount of use these facilities would attract was evaluated in the resource evaluation report. The results are shown in Table 18-3. For a capital investment of less than \$1 million it is estimated that general recreation benefits of \$17.2 million (medium value at 6 percent) would be generated over and above the values that would be realized from reservoir clearing alone.

### (b) Fishing

Reservoir clearing would in itself mitigate much of the impact on the value of recreational fishing. The reservoir will be a relatively productive aquatic environment, especially in the first few years following flooding. Clearing would have the effect of making the fish accessible to anglers. However, there would still be a residual impact for which a valid case can be made for compensation on a regional equity argument. Local fishermen would be worse off by an estimated \$2 million on a present worth basis.

TABLE 18-2  
 COMPENSATION MEASURES FOR RESOURCE IMPACTS OF  
 PEACE SITE C  
 (\$ Thousands, 1980)

<u>Recreation</u>	<u>Value of Resource Impact after Reservoir Clearing</u>	<u>Compensation Measure</u>	<u>Value of Compensation<sup>1</sup></u>
Fishing	2,255	Yellow walleye stocking - trout incubation/rearing facilities	18-1243
Hunting	777	Wildlife management	777
Recreation	28,297	Camping, boat launching, picnic facilities	17,186
Guiding	1	Payment to guides	1
Trapping	12	Payment to trappers	12
Agriculture <sup>2</sup>	17,766	Purchase of private land	
Forestry <sup>2</sup>	<u>528</u>	-	
	<u>49,636</u>		<u>17,994-19,219<sup>3</sup></u>

<sup>1</sup> Present discounted value at 6 percent, medium resource value.

<sup>2</sup> Measured as potential rather than actual value.

<sup>3</sup> This total excludes the cost of purchasing private land as this has not yet been negotiated in many cases.

TABLE 18-3  
 VALUE OF RESERVOIR ENHANCEMENT FACILITIES FOR  
 PEACE SITE C  
 (\$ Thousands, 1980)

Facility	Present Value of Cost of Facilities			Value Increase Scenario	Present Discounted Value at:		
	3%	6%	10%		3%	6%	10%
	Bear Flats: Campground and launch ramp	1219.2	652.1		356.7	Low <sup>1</sup> Medium <sup>2</sup> High <sup>3</sup>	12,801.4 30,249.3 121,783.3
Lynx/Farrel Creek: Picnic grounds and launch ramps	230.9	129.5	73.8	Low Medium High	7,756.8 17,846.8 71,111.9	3,286.5 6,445.7 19,093.7	1,380.8 2,392.1 5,358.5
TOTAL	1450.1	781.6	430.5	Low Medium High	20,558.2 48,096.1 192,895.2	8,640.0 17,186.2 51,449.9	3,581.8 5,939.4 14,239.5

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- <sup>1</sup> Zero increase in relative value per year.
  - <sup>2</sup> Two percent increase in relative value per year.
  - <sup>3</sup> Five percent increase in relative value per year.

18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

Several proposals were considered by the consultant on fisheries and aquatic environment as a means of compensating for fisheries losses, including annual stocking, hatchery, spawning channel and incubation boxes. There are potential problems with each of these proposals in terms of their useful implementation and cost per level of output. Stocking the reservoir with yellow walleye was proposed as one option for fisheries compensation. An alternative would be to provide incubation and rearing facilities for rainbow trout, although this enhancement measure is relatively untested in British Columbia fresh water sport fisheries. Both proposals are evaluated in Table 18-4. The benefits for each are not additive, however, as they are mutually exclusive alternatives.

TABLE 18-4  
EVALUATION OF ALTERNATIVE  
FISHERIES ENHANCEMENT MEASURES  
(\$ Thousands 1980)

Enhancement Measure	Cost of Enhancement at:			Value Increase Scenario	Present Discounted Value at:		
	3%	6%	10%		3%	6%	10%
Incubation box for trout	2352	1087	503	Low	1,814	431	90
				Medium	5,915	1,243	222
				High	19,067	3,575	538
Stocking with yellow walleye	307	204	121	Low	237	-	-
				Medium	1,519	18	-
				High	6,519	635	-

To provide an indication of the incremental fishing benefits that might result from a rainbow trout enhancement program, it has been assumed that the yield of the reservoir would remain the same (14,000 angler-days) but the relative value of fishing would be higher than without enhancement. The additional values would begin in 1995, the third year of the program. It is

18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

probable that the reservoir will stabilize much earlier and thus that the program could begin earlier producing a commensurately larger present worth of enhancement benefits.

The incubation/rearing program for rainbow trout has a benefit/cost ratio of 1.1:1.\* This program would be preferred in terms of producing a much higher net present value, one that is substantially closer to the estimated resource loss.

(c) Hunting

A relatively small number of hunter-days would be displaced by the project because of the loss of habitat for game animals. If the assumption is made that no adjustments take place in hunting animals in nearby areas, i.e. that all of these displaced days would be lost, then the value of the loss would be \$777,000 on a present worth basis at a 6 percent discount rate. More intensive management of the area's wildlife habitat should be sufficient to compensate for this loss and, indeed, it may be possible to do so for less than the value of the estimated loss in hunter-days. If, for example, the annual salary of a wildlife biologist plus expenses were charged to the project starting in 1986, it would be the equivalent in present worth terms of \$502,000 (constant 1980 dollars at 6%).

(d) Guiding and Trapping

The loss of income to guides and trappers in the Site C area as estimated by the consultants is relatively small compared to the other values presented in this section: about \$12,000 for trapping and \$1,000 for guiding. However, the loss of income is a significant matter to the individuals concerned and they would be compensated if the project is licensed.

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\* Six percent discount rate, medium value increase scenario.

## 18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

B.C. Hydro is currently working on a plan where trappers would have the option of participating in a joint program with B.C. Hydro, the Fish and Wildlife Branch and the Trappers' Association for annual payments over a period of 5 years. The objective would be to encourage the development of trapping potential in parts of the land not affected by the project while maintaining the same income as before the project. This program may result in a more satisfactory solution than a lump sum payment. Further details of the proposed program are contained in Appendix B, Section B.7.

### (e) Forestry

Without the project and without the clearing of the reservoir it is unlikely that the small amount of isolated, inaccessible merchantable timber in the Site C area would ever be harvested. Thus the value of salvaged merchantable timber would simply be applied to the costs of clearing. From this view, no social or regional costs would be incurred in the forest sector if the project were to be built.

An alternative perspective, one used by the forestry consultant, is that the presently uneconomic timber would ultimately become economic. Thus, if the area were managed on a Public Sustained Yield Unit basis, the reservoir area would contribute to the annual allowable cut in the PSYU in the amount of its mean annual increment of wood growth. The net present discounted value based on this approach would be \$528,000 at a 6 percent discount rate. However, there is no persuasive case for compensation on a regional equity argument since no loss of regional income or employment would occur in the forestry sector if the project were to be built.

## 18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

### (f) Agriculture

Compensation for privately held agricultural land has been included in the direct project costs. However, because of circumstances which may be unique to B.C., agricultural land is deemed to have a higher social value than private market transactions would indicate. Thus the Agricultural Land Reserve System was instituted to prevent or at least severely curtail the transformation of land with agricultural capability from farm to non-farm uses. If the market would pay more for a non-farm use but society as a whole says that farm use is preferable it suggests the existence of social values of agricultural land preservation which are at least as high as the difference in private market valuation between the two uses.

As a guide to decision making this evaluation process is appealingly simple: no matter what the alternative use might be the social value of agricultural use will be greater, and thus no change in land use can be justified. But it is a deficient response in terms of the needs of an expanding economy. There is little doubt in the public's mind that strong measures were needed to protect agricultural land and it was a highly popular move to put the onus on those who would use farm land for other purposes to argue the greater social merits of their proposal. Preservation at any cost, however, is not the logical extension of that concern.

The preservation of agricultural land has a basic appeal. Long term security of food supply and the maintenance of options for future land use are not taken into account by the market. These values have been given institutional expression through the formation of Agricultural Land Reserves. However, within that institutional setting the actual agricultural value of the land must be objectively evaluated against alternative uses.

## 18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

Both the first round of studies on agriculture in the Peace River Site C area and the subsequent more detailed study of the future of a vegetable industry in the area suggest that a realistic evolution of the industry would be to serve at most a regional market. Furthermore the impact of the Peace Site C project alone would not impair the ability of the industry to realize this potential.

Though the impact of Site C on regional agriculture options is minimal, the consultant has recommended certain compensation and mitigation measures - most notably the removal of flood reserves downstream of Site C. By building Site C, the option of a high dam at Site E would be eliminated and thus the flood reserves should be lowered. While Site E is not presently being considered by B.C. Hydro for development in its long-range planning, the removal of land that would be effected by Site E from the flood reserves is a political question tied to long-term provincial energy policy.

### (g) Mineral Resources

Gravel deposits would be flooded by the Peace Site C reservoir and there is a possibility that a portion of a coal deposit would become unavailable. Neither of these mineral resources is considered to be economically significant. There are a large number of alternative gravel deposits and there are large, more readily accessible coal deposits which are barely exploited. Therefore there is no case to be made either for prior recovery of these resources or for compensation payments.

### (h) Heritage Resources

Impacts on archaeological and historical sites are impossible to evaluate. The sites are undoubtedly of interest and value, but it is so far impracticable to estimate what that value

## 18.2 MITIGATION AND COMPENSATION FOR ENVIRONMENTAL RESOURCES - (Cont'd)

might be in dollar terms or to whom these values are accruing, i.e. are they local, regional or Provincial in character?

While the Archaeological Studies team would prefer to see a careful inventory and preservation of sites, B.C. Hydro would argue that a great deal has already been spent on inventory during the impact assessment phase. There may be a case, however, for selective excavation for display of outstanding artifacts in a regional facility. That way the maximum benefit would be secured for both local residents and visitors. The amount of money which B.C. Hydro would be prepared to contribute can only be arrived at through discussion and negotiation once options have been identified.

## 18.3 MITIGATION AND COMPENSATION FOR COMMUNITY SERVICE IMPACTS

B.C. Hydro's policy is to attempt to maintain the level and quality of physical infrastructure and social and medical services in communities affected by its construction projects. Short term effects on water supply, sewage disposal, recreation facilities and so on may be compensated for through funding of replacement or additional facilities, but only if these short-term effects are not offset by greater local benefits in terms of income, employment and taxation. Fort St. John is a fairly large community and is growing rapidly with the recent interest in oil and gas exploration. Circumstances are changing so rapidly that it was necessary to update the community impact assessment report before negotiations with the local community can begin.

As with community infrastructure B.C. Hydro will try to ensure that the quality of social and medical services does not deteriorate as a result of its project. The importance of monitoring impacts and generating predictive data on impacts has to be stressed.

18.3 MITIGATION AND COMPENSATION FOR COMMUNITY SERVICE IMPACTS - (Cont'd)

Impacts are very difficult to predict. Proposals for a monitoring program with support for community agencies and groups would be endorsed by B.C. Hydro in order to assist in managing the impacts as they occur. The assistance and monitoring programs would be designed specifically to allow for flexibility and innovation in response. The monitoring program would also be established early enough in the post-licencing period to help to manage the impacts that occur as a result of economic boom expectations.