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HAT CREEK
ENVIRONMENTAL STUDIES

RESOURCE EVALUATION

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1. INTRODUCTION

1.1 Introduction

The Resource Evaluation Report attempts to determine the economic implications of resource or environmental impacts identified throughout the land, water and air quality studies of the Hat Creek project. The objective is to determine the resource value changes, both positive and negative, that would be brought about by the project. These value changes reflect resource opportunities foregone or created and should be included in the overall accounting of project benefits and costs. In addition, the distributional implications of resource value changes for the Hat Creek region are identified. These effects do not represent additions to or deductions from the value of provincial resources but, rather, represent changes in regional resident welfare relative to other provincial residents.

The resource reports that formed the basis for these evaluations, not only identified project impacts but, also developed recommendations to mitigate impacts and compensate resource owners, or users, for impacts that could not be mitigated. These concepts can be defined as follows:

Mitigation refers to actions which may be taken in the planning, design or operation of a project that will lessen adverse impacts on values associated with the resources affected by a project.

Compensation refers to payments for losses in resource values which are not mitigated and which, therefore, remain as net resource value losses associated with the project.

Expenditures on mitigation should reduce resource value losses by a greater amount than the cost of the mitigation measure. They should, therefore, be efficient expenditures. Compensation, on the other hand, can be made on efficiency or equity grounds. They can result in a more efficient use of society's resources or in their redistribution among the members of society.

In this report, mitigation and compensation recommendations are evaluated, where possible, in terms of their economic validity.

The evaluation approaches and criteria applied in this report are consistent with those suggested by the Provincial Benefit-Cost Guidelines.* The resource uses included for evaluation include: forestry, commercial fisheries, wildlife, recreation, water, minerals, agriculture and aesthetics. Each resource use is evaluated separately in the following sections.

1.2 Summary

The impacts of the Hat Creek Project on provincial resource values and resource users in the region are summarized in the following Table.

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* Environmental Land Use Committee Secretariat, "Guidelines for Benefit-Cost Analysis", Province of British Columbia, June 1977.

TABLE 1.1

ECONOMIC EVALUATION OF RESOURCE IMPACTS

RESOURCE USE	NATURE OF IMPACT	PROVINCIAL INCOME CHANGES (at discount rate range of 12% - 6%; $ 1978)	REGIONAL EFFECTS
FORESTRY	Removal of forest land from production and reduction in forest growth due to stack emissions.		
	• effects on gross AAC		
	- maximum physical damage	$1,261,900 - $2,204,000	
	• effects on net AAC		
	- maximum physical damage less Hat Creek mining allowance	$1,149,000 - $1,994,600	loss of 50 future potential jobs. Loss of $925,000 annual potential regional income.
COMMERCIAL FISHERY	Impingement and entrainment of juvenile pink salmon		
	- maximum loss potential	$12,500 - $32,500	nil
WILDLIFE TRAPPING	No impacts on wildlife trapping	nil	nil

RESOURCE USE	NATURE OF IMPACT	PROVINCIAL INCOME CHANGES (at discount rate range of 12% - 6%; $ 1978)	REGIONAL EFFECTS
RECREATION	Physical disruption to land and water used for recreation		
	- hunting	$271,000 - $735,000	induce regional users to substitute alternative sites
	- fishing	$235,000 - $659,000	
	- general recreation	$39,000 - $116,000	
	Differential congestion effects due to project induced population growth	probable value reduction	increased conjestion would reduce willingness to pay and induce substitution among regional users
	Change in regional tourism	nil	minimal positive or negative effect on tourist related income and employment
DOMESTIC WATER	Disrupted ground water supplies	unestimated, value included in residential land values	nil
MINERALS	Sterilization of various mineral deposits	nil	nil
	Increased use of aggregate deposits	nil	unestimated increase in regional income and employment
AGRICULTURE	Alienation of agricultural land and loss of land productivity due to stack emissions	$76,000 - $159,000	loss of about 5 potential jobs and an annual income loss of about $50,000

RESOURCE USE	NATURE OF IMPACT	PROVINCIAL INCOME CHANGES (at discount rate range of 12% - 6%; $ 1978)	REGIONAL EFFECTS
AESTHETICS	Alteration of Valley aesthetic characteristics of recreation, tourism and settlement use	- recreational losses included in provincial recreation values - settlement values contiguous to site would decline; extent of reduction not estimated - no tourist related provincial income changes	- possible reduction in regional residents willingness to pay for recreation at the site; substitute alternative sites - minimal positive or native effect on tourist related regional income and employment

2. FORESTRY

2.1 Introduction

The following assessment of potential forest sector impacts of the Hat Creek Project is based on Appendix A-3: Forestry Impacts, Hat Creek Project Detailed Environmental Studies, prepared by Reid, Collins and Associates Ltd., Vancouver, July 1978. (revised)

To prepare quantitative estimates of the forest resource impact three study areas were defined:

1. Regional study area . . . . . 2,335,800 ha
   - bounded by 100 Mile House, Kamloops, Lytton, and Seton Lake

2. Local study area . . . . . 196,350 ha
   - within a 25 km radius of plant facilities at Harry Lake

3. Site specific study area . . . . . 4,320 ha
   - encompassing the mine, plant, dumps, and associated facilities including 20 m buffer zones.

Based on information in B.C. Forest Service Unit Survey Reports for the PSYU's affected, about 70% of the regional and local study areas, and 60% of the site specific area is classified as productive forest land. This is shown in Table 2.1. Over 92% of the productive forest land in the regional study area (94% in the local study area) is Crown owned and under sustained yield management. The estimated allowable annual cut which these areas would support as calculated by Reid, Collins & Associates Ltd. is also included in Table 2.1.

TABLE 2.1

FOREST AREAS & ESTIMATED ALLOWABLE ANNUAL CUT

FOR REGIONAL, LOCAL & SITE SPECIFIC STUDY AREAS

Study Area	Total Area (ha)	Productive Forest Area (ha)	Estimated Allowable Annual Cut (m^3/year)
Regional	2 335 800	1 613 800	1 857 500
Local	196 350	132 180	146 200
Site Specific	2 833	1 571	1 774

Source: Tables 4-2, 4-4, 4-19, 4-37, and Section 4 text, Reid, Collins & Associates Ltd., Hat Creek Project Detailed Environmental Studies, Appendix A-3: Forestry, July 1978. (revised)

2.2 Summary of Impacts

a) Physical Impacts

Construction and operation of the project would have two main physical impacts upon the forest resource:

(i) permanent removal of forest land from production in certain site-specific areas required for the mine, plant, and associated facilities.

(ii) reduction of forest growth due to stack emission effects in the area of the fume path.

Both of these impacts would affect physical productivity and lead to a reduction in forest growth in the affected area. It was assumed that productivity losses in the site specific area would be permanent and equal to 1 774 m^3/year; see Table 2.2. Although reforestration would renew the forest cover on these lands, their resultant productivity would be classified as "low" thereby excluding them from any future AAC calculations (by today's rules).

In the area of the fume path, it was assumed that productivity or growth rate would be depressed over the life of the project (35 years), but would return to normal thereafter. The extent of the possible losses varies with the system of emission control assumed and since there was uncertainty as to the effectiveness of these options in controlling flouride emissions, the consultant's worst probable fluorides emission level has been used to determine resource losses; see Table 2-2.

A summary of potential physical losses of timber growth for alternative systems of emission control is given in Table 2-3. It can be seen that potential losses range from 24.674 m^3/year to a high of 24.806 m^3/year.

TABLE 2.2

POTENTIAL PHYSICAL LOSS OF

TIMBER GROWTH WITH THE PROJECT

	Volume (m^3/year)
1. Losses due to permanent removal of forest land in the site specific area:	1 774
2. Losses due to SO_2 Emission Fallout in the Fume Path Area, assuming:	
SO_2 Control MCS - 244	132
SO_2 Control MCS - 366	77
SO_2 Control FGD - 366	0
3. Losses due to Flourides Emission Fallout in the Fume Path Area, assuming:	
worst probable impact*	22 900

* Average annual loss over 35 years.

Note: MCS-244 = Meterological Control System with stack height of 244 m.

FGD-366 = Flue Gas Desulfurization with stack height of 366 m

Source: Table 5-13, Reid Collins & Associates Ltd. op.cit.

TABLE 2.3

POTENTIAL PHYSICAL LOSSES OF TIMBER GROWTH

WITH THE PROJECT

(m^3/year)

Worst Probable Fluorides Emission Level		
MCS-244	MCS-366	FGD-366
24 806	24 751	24 674

Note: For explanation of abbreviations see note to Table 2.2.

SOURCE: Table 5-13, Reid Collins and Associates Ltd., Hat Creek Project Detailed Environmental Studies, Appendix A3; Forestry, July, 1978. (revised)

b) Forest Management Impacts

A reduction in the rate of timber growth affects forest management planning, particularly the calculation of allowable annual cut (AAC), which is based on the inventory of mature timber, the assumed rotation age, and average annual rate of growth. For management purposes, this calculation is applied to individual management units, and is revised periodically. The calculation of net AAC includes deductions for "non-recoverable losses", such as damage from fire and insects, breakage during logging and losses of potential harvest associated with other than forest industrial use; e.g. open-pit mining.

The current calculation of the net AAC in the Botanie PSYU includes a deduction of 21 520 m^3/year over one rotation for potential losses from developments such as parks and open-pit mines. Roughly 10%, or 2 205 m^3/year of the above 21 520 m^3/year allowance has been specifically assigned to the Hat Creek project (Reid Collins, P.31). The net AAC currently used for the Botanie PSYU is approximately 408 000 m^3/year.

2.3 Economic Evaluation of Forest Impacts

a) Value of Timber Growth Losses

The present value of timber growth foregone under various design and operating conditions of the project is calculated by Reid, Collins and Associates Ltd. in their Appendix A3 study, assuming a constant real value of timber equal to \$5.50/m^3, and discount rates ranging from 3 to 12 percent (see Reid, Collins Table 5-12). The \$5.50/m^3 figure is assumed to be representative of the current and future average value of standing timber authorized for cutting in the Hat Creek region.

The value of potential forestry losses due to the project depends upon the impact in mind. From a physical resource point of view the loss of timber growth represents a real loss of forest productivity and therefore a reduction in the physical amount of timber on which gross AAC is calculated. The maximum value of this physical loss would be 136 433/year (24 806 m^3/year x \$5.50/m^3).

Alternatively, from the point of view of forest resource allocation which takes into consideration economic timber supply, and timber demand, the importance of these physical losses depends on their resultant impact upon the net AAC situation. Thus any losses

up to a level covered by the total special mining allowance would have no effect on the economic supply of timber and therefore would impose no additional cost upon the forest sector; up to this point there would be no benefits foregone by the forest sector in terms of lost opportunities to harvest timber under today's forest management rules. However, damage in excess of the total special mining allowance would reduce net AAC.

The Maximum physical losses from the project (24 806 m^3/year) exceed the Hat Creek mining allowance by 22 601 m^3/year. The value of this reduction in the net AAC would be $124 305/year (22 601 m^3 x $5.50/$m^3$).

The present value of project impacts in terms of the reduction of both gross and net AAC are shown in Table 2-4 for a range of discount rates from 6% to 12%. For the gross AAC, present values were discounted to 35 years for emission effects and to perpetuity for site specific alienations. For the impact on net AAC, the site specific impacts remaining after the 35 year project life would be offset by the Hat Creek mining allowance.

b) Forest Sector Employment

The impact of the project on forest sector employment would depend on the level of timber losses sustained and the resultant levels of committed and uncommitted net AAC. It would also depend on the distribution of this timber supply impact among the various forest companies affected.

The forestry losses associated with the Hat Creek project would result in a reduction in net AAC of approximately 23 000 m^3/year. As the net AAC in the region is roughly 20% under committed, this impact would not affect existing levels of production and employment in the

TABLE 2.4

PRESENT VALUE OF POTENTIAL FOREST SECTOR LOSSES* DUE TO THE PROJECT

	Volume Lost (m^3/yr)	Value at \$5.50/m^3 (\$/yr)	Present Value of Losses at Indicated (\$ Thousand 1978) Discount Rates 6%	8%	10%	12%
Impacts on Gross AAC						
Maximum physical damage	24 806	136 433	2 204.1	1 768.5	1 472.6	1 261.9
Impacts on Net AAC						
Maximum physical damage less Hat Creek mining allowance	22 601	124 305	1 994.6	1 606.6	1 339.9	1 149.0

*Assuming maximum physical losses of 24 806 m^3/year.

forest sector. The reduced level of uncommitted net AAC within the region, however, would limit the number of new jobs that might be created through future expansion of the forest industry.

It is difficult to assess the change in potential forest sector employment associated with a change in total harvest without a knowledge of the marginal productivity of labour for the local logging and wood processing operations over this range of outputs. However, a first approximation can be attempted in terms of average labour productivity, expressed as the ratio of total AAC to numbers employed.

The Reid, Collins study reports an employment level of about 2400 in forest industrial plants in the regional study area in 1976 (Reid, Collin's Table 4-14). Allowing an additional 800 jobs in logging (25% of total forest industry employment) yields approximately 3200 jobs associated with a committed net AAC of 1.5 million m^3/year*; or 470 m^3/year per job. Applying this factor to the impact on net AAC indicates a loss of about 50 future potential jobs. Associated with this employment impact would be a reduction in annual potential regional income of approximately $925 000.

c) Summary

The potential physical losses of timber growth attributable to the Hat Creek porject would be approximately 25 000 m^3/year. The value of these losses were evaluated in terms of the effect on both gross and net AAC.

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* Estimated by portioning the committed AAC of each PSYU to its portion of the regional study area. See Reid, Collins Tables 4.2 and Addendum 2.

The annual losses associated with the reduction in gross AAC were valued at $136 000/year. The present value of losses due to the project was calculated over a 35 year project life (with site specific losses calculated to perpetuity) and range from $1 261 900 to $2 204 100 (1978 dollars) depending on the discount rate.

Economic supply or net AAC represents the supply of timber available to industry under society's current forest management policy, and is calculated as gross AAC less allowances for non-recoverable losses including special mining allowances. With the Hat Creek mining allowance available to offset 2 205 m^3/year of project losses, the reduction in net AAC would be about 23 000 m^3/year. The discounted value of these losses would range from $1 149 000 (1978 dollars) at a 12% discount rate to $1 994 600 (1978 dollars) at a 6% discount rate.

Employment impacts of the project are tied to the effects on net AAC. With a reduction in uncommitted net AAC of 23,000 m^3/year, a loss of about 50 potential jobs within the forestry sector could occur.

3. COMMERCIAL FISHERY

3.1 Introduction

Process water for the proposed Hat Creek Project is to be supplied through a direct water intake to be constructed on the Thompson River. The physical impact of the operation of this water intake upon fish stocks in the Thompson River basin has been estimated by Ebasco Services of Canada Limited; Environmental Consultants (ESCLEC).

The ESCLEC report stresses that their estimated impacts represent a "worst-case" scenario. This scenario would be valid if protective features of the intake system are completely ineffective in preventing fish entrapment.

3.2 Summary of Resource Impacts

It is expected that the impact of the proposed water intake will be felt only by juvenile pink salmon, largely as a result of impingement on the intake screens and entrainment in the intake flow to the plant, during their rearing and downstream migration stages. Adult pinks are expected to bypass the intake successfully to reach their spawning grounds upstream. However, there may be some danger to adult fish in their becoming disoriented and delayed in the vicinity of the intake, thereby upsetting their delicate balance of energy reserves for spawning.

A "vulnerability assessment" of the impact of the water intake upon fish stocks exposed at various stages of their life cycle provided the basis for identifying and estimating fish losses. Assuming no compensatory and related population effects during the remaining life cycle, and employing published data on survival rates and catch/escapement ratios for species involved, these losses were translated

into a loss of returning adults and a subsequent reduction in the total commercial catch.

The ESCLEC study concluded that damage to fish habitat resulting from the construction of the proposed water intake would be minimal. There is reportedly no productive habitat by way of suitable spawning gravel in the 8,000 foot reach of river in which the proposed intake is located and therefore no impact is predicted for early life stages (eggs, alevins, and early fry). Construction impacts would be limited to stream habitat disruption associated with the intake pier construction in the Thompson River, and in the buried pipeline crossing and access bridge on the Bonaparte River. These activities could be scheduled during the fall and winter of even-numbered years and the spring of odd-numbered years, effectively avoiding all impact to pink salmon.

Some disruption of downstream spawing areas in the Lower Bonaparte River during construction would result in a small loss of returning adults. The ESCLEC report suggests that this impact could be mitigated by proper restorative measures in the disturbed area.

Following construction, the intake pier located in the mainstream would disrupt the flow immediately downstream and possibly provide an attraction for predators or an interruption of migrators. No data are presented on the loss of mature adults returning upstream and it is noted that this aspect requires further research and study.

3.3 Economic Evaluation

Under the worst case scenario, the operation of the water intake would ultimately result in a loss of returning pink salmon which would otherwise be taken as part of the commercial fishing harvest. The economic impact of the intake can be estimated in terms of the

commercial fishery utilization opportunities foregone. The economic value of losses to the commercial fishery is measured by the decline in net value (economic rent) to that fishery.

Table 3.1 presents a summary of the estimated average biannual commercial catch attributable to the Thompson River and the maximum reduction in commercial catch resulting from operation of the water intake.

TABLE 3.1

COMMERCIAL CATCH REDUCTIONS

AS A RESULT OF THE THOMPSON RIVER INTAKE

	Average Escapement to Thompson River* (no. of fish)	Catch/ Escapement Ratio**	Commercial Catch (no. of fish)	Maximum Loss of Returning Adults = Reduction in Catch*** (no. of fish)	(% of catch)
Pink Salmon	330,600	2.9:1	958,700	5,000	.52

* Every other year.

** Only includes commercial catch. Commercial catch is 99.5% of total catch, therefore, saltwater sport catch is only about 4,800 fish.

*** Unadjusted for saltwater sport catch.

SOURCE: ESCLEC, "Water Intake, Appendix B3", B.C. Hydro and Power Authority, 1978.

As long as the decline in numbers is small, it is reasonable to assume that the total harvesting costs of the commercial fishery would be the same with or without the project. In that case, the loss of net revenue to the fishery would be equivalent to the reduction in total gross revenue, since the same effort would be applied to take the

slightly smaller total catch.* If the decline in catch is large, then one would anticipate a related decline in effort, as fewer fishermen go out or fewer trips are made to the fishing grounds. In this case, the economic loss attributable to the project would be equivalent to the difference in net revenues with and without the project.

Since the loss of returning adults is, in fact, small, the decline in gross revenue at landing is considered to be the appropriate measure of the economic loss to the commercial fishery. The annual value of this loss may be derived by multiplying the annual pink catch loss by the unit landed value ($ per fish) of the catch.

It is also possible to develop average unit values, for "processed" pinks at the wholesale level. The choice of which value to use, landed value or wholesale value, depends upon the point of view adopted in any subsequent analysis. For purposes of this study, and to maintain consistency with other resource impacts in an overall benefit-cost analysis of the Hat Creek project, fish loss values are based upon landed values.

Table 3.2 presents estimates of the 1978 value of the commercial catch without the project and the value of the maximum losses due to the intake using a unit landed value of $2.12/fish.** The commercial fishery loss from operation of the proposed water intake is in the order of $10,600 (every odd numberd year) when there is a pink salmon run. The average annual loss would therefore by $5,300.

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* Rough estimates by the Economics Working Group of the Salmonid Enhancement Program (SEP) place the incremental costs of harvesting small changes in the catch at 10¢ per fish.

** Environment Canada, Fisheries and Oceans, Enhancement Services Branch.

TABLE 3.2

ANNUAL VALUE OF COMMERCIAL FISHERY

LOSSES FROM THE THOMPSON RIVER INTAKE

	Without the Project Gross Commercial Value		Maximum Estimated Commercial Fishery Losses	
	(No.)	(Landed Value)	(No.)	(Landed value)
Pink Salmon**	479,350	$1,016,200	2,500	$5,300

* Based on unpublished landed value data provided by the Economic Working Group, Salmonid Enhancement Program, June, 1978.

** Average annual number of pinks and estimated value over two year cycle.

SOURCE: ESCLEC, op.cit., 1978.,
Strong Hall & Associates Ltd., 1979

The fisheries impact of the water intake will extend into the future over the lifespan of the project, taken to be 35 years. It is therefore necessary to determine the future change in fry production, losses, and real prices of landed fish over the period of disruption in order to estimate the present value of future losses. The ESCLEC study assumed fry production and consequent losses would be constant over the impact period, at the 1978 levels. The Federal government Salmonid Enhancement Program currently plans three projects in the Thompson River basin above the proposed water intake (Deadman Creek, Shuswap River, Barriere River). Each of these is for enhancement of the Chinook stocks and since no Chinook losses are expected to occur at the intake, the implications can be safely ignored. However, if it should be decided at some time in the future to enhance pink stocks, these impacts could be significant. It is the nature of most SEP projects to greatly increase the ratio of juvenile downstream migrants to adult upstream migrants that spawn successfully,

and of course the intake's impact is largely upon juvenile fish. Although pink salmon production is not expected to be substantially enhanced during the project life, other changes might be significant to the determination of fisheries present values.

In terms of real price changes, evaluations of proposed SEP projects have taken a conservative approach and have assumed steady-state prices for fish and fish products. Current studies under way suggest that the real price will escalate at less than one percent per annum. For purposes of this study, therefore, it seems reasonable to assume a real price escalation of one percent in the calculation of the present value of future fishery losses.

Assuming future physical losses in the commercial fishery remain the same as shown in Table 3.1, and if the real price of landed fish escalates at 1% per annum, the present value of future losses to the commercial fishery for the period 1978 to 2022 would be a maximum of $65,000. The sensitivity of this calculation to the discount rate is shown in Table 3.3.

TABLE 3.3

ALTERNATIVE PRESENT VALUES OF MAXIMUM PINK SALMON LOSSES FROM THOMPSON RIVER INTAKE

($ 1978)

Discount Rate	Present Value of Maximum Pink Salmon Losses	Present Value of Maximum Pink Salmon Losses to British Columbia*
6%	$65,000	$32,500
8%	$46,000	$23,000
10%	$34,000	$17,000
12%	$25,000	$12,500

SOURCE: Strong Hall & Associates Ltd.

* Approximately 50% of the commercial pink catch is taken by British Columbia. Therefore, the value of pink salmon losses to the province would be one half of the total value.

The maximum value of commercial losses to British Columbia would be between $12,500 adn $32,500, due to the historical split of Fraser River pink catches between Canada and the United States.

In addition to the commercial fishery losses, the reduction in fry from the intake might result in reduced saltwater sport fishery values. However, since pink salmon are not a significant sport species, no measurable impact on the saltwater recreational Fishery would occur.

3.4 Mitigation

The Water Intake Report (Appendix B3) identifies the potential fishery losses without consideration to the effectiveness of the protective features of the intake system. This assessment is, therefore, appropriate for an unmitigated intake system. The present value of losses from the unmitigated system are estimated at a maximum of $65,000, or $32,500 to Canada.

The cost of specific mitigative design features has not been included in the B3 report or the project description of offsite facilities. Therefore, no economic evaluation of mitigation options can be undertaken. However, on economic efficiency grounds, mitigative features costing in excess of the estimated value of commercial fishery losses are questionable.

4. WILDLIFE

4.1 Introduction

The economic evaluation of wildlife resource impacts pertains to two types of resource uses: consumptive and non-consumptive. Consumptive uses include recreational hunting and commercial trapping. Non-consumptive uses involve wildlife viewing, wildlife photography, nature studies and other uses.

Assessment of the implications of wildlife impacts on consumptive and non-consumptive recreation activities appear in the Recreation Report (Appendix A5)*. The economic evaluation of recreation activity changes appears in Section 5 of this report.

Hat Creek project implications for commercial trapping values are examined below.

4.2 Summary of Trapping Impacts*

Furbearer harvests are relatively low within the regional study area and almost nil within the local study area. No traplines are registered within the local study area.

Without substantial improvement in the economics of trapping, it is considered unlikely that the regional trapping industry will expand significantly without the Hat Creek project. No forecasts of future trapping activity or harvests have been developed.

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* EBASCO, "Recreation Report", British Columbia Hydro and Power Authority, August, 1978

The Hat Creek project is expected to have minimal effect on furbearer populations. With the project, no changes are expected in the consumptive use of furbearers. No registered traplines would be affected by the project and the influx of project-induced population would likely have no impact on furbearer harvests.

4.3 Economic Evaluation

Since the Hat Creek project would have little or no effect on future furbearer harvests, it can be concluded that there would be no economic rents foregone pertaining to the commercial trapping of wildlife as a result of the project. At the same time no regional income or employment changes in the regional trapping industry would be associated with the project.

4.4 Mitigation and Compensation

A number of mitigation and compensation recommendations are put forward in the Wildlife Report. None of them pertain exclusively to furbearer populations, although recommendations on riparian habitat and vegitation would apply to furbearers and other species.

Since the Hat Creek project would not affect commercial furbearer values, no expenditures related to mitigation or compensation could be justified for this use. Recommendations affecting hunting and non-consumptive values are discussed in Section 5.

5. RECREATION

5.1 Introduction

An altered pattern of land and water use attributable directly to the Hat Creek Project and indirectly to project-induced population increases may change the value of the recreational resources in the area. These changes affect overall social welfare, in a provincial context, as well as welfare distribution.

More specifically, a first set of impacts are those which would be caused directly by physical disruption to land and water resources in the Hat Creek Valley and adjacent areas. The project would directly affect resources in a manner which would preclude their use in recreation or alter the quality of the recreation experience they provide. These changes would affect the overall value of the province's resources. A second set of impacts reflects changes resulting from project-induced population growth. It is anticipated that the project would increase the population of the local area by approximately 40%. The increased concentration of recreationists in the local area may reduce the value of the province's resources for recreation below those that would accrue without the project. In addition, the effects of these resource value alterations would be experienced by the resource users. Impacts will thus be experienced by some regional residents.

5.2 Approach

The evaluation of changes in the value of recreation resources presented in subsequent sections of this chapter, is based upon data provided in a previous study conducted as part of the overall Hat Creek Environmental Studies.* While that study assessed changes in the resource base and in recreational usage patterns, the purpose of this assessment is to evaluate the economic implications of these

changes and, where possible, to measure them in monetary terms. It is recognized that not all recreation impacts can be measured in monetary terms. Where identifice, these are described in qualitative terms.

The valuation criterion used for assessing change in the value of recreation resources is the value in use.** This value reflects the demand for the area's resources for recreation purposes, and is measured by the "willingness to pay" of individuals to enjoy the recreation experience provided by those resources.***

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* EBASCO, Recreation Report for the Hat Creek Project, 1978.

** Values in use do not necessarily reflect the total value of the resource. There may also be a value to retaining an option for future use of the resource or a value in the mere existence of the biological diversity and natural landscape variety. These option and existence values are extremely difficult to quantify and tend to be most relevant to unique natural resources. They are not considered applicable to the relatively common resources found in the Hat Creek Valley.

*** An alternative to this evaluation approach, reflecting the fact that part of the Hat Creek resources are being removed from public use, would be based on the compensation principle. This approach reflects the user's appraisal of the value of compensation they would require to forego the recreational use of the resources. Due to unresolved theoretical and operational problems, the consultants chose the more common willingness to pay approach.

There are essentially two basic techniques for determining willingness to pay values: indirect techniques, which examine behavioral patterns and impute associated travel costs; and direct techniques, which directly question users to elicit their perceived value of the resource or experience. While both techniques provide theoretically acceptable measures of the total value of the resource for recreation, each has operational difficulties. In this evaluation the direct approach was attempted. However, upon evaluating the responses it was determined that the data was inadequate to reasonably estimate demand. Therefore, the value of recreation losses was estimated using standard recreation day values determined in previous studies in British Columbia.*

The second impact identified earlier, i.e., changes in perceived recreation quality due to crowding, will be evaluated qualitatively. The extremely high degree of uncertainty surrounding the distribution of with-project recreation activity, at the variety of competing sites in the local study area, precludes attempts at monetarization. Distributional effects on recreation resource users will be evaluated in terms of regional impacts.

5.3 Summary of Impacts

There would be no measurable reduction in the value of recreation sites outside the Hat Creek Valley area resulting directly from project impacts on the natural resource base. However, development of the coal mine and thermal plant would result in a displacement of recreational opportunities in angling, hunting, and general recreation from the Hat Creek Valley and immediate environs.

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* This approach, while reflecting individuals willingness to pay, lacks the precision of the travel cost or questionnaire techniques. It is not particularly site sensitive and, as a single point value, it does not permit the estimation of consumers' surplus. In addition, it does not indicate the shape of the demand curve, which would permit conclusions on the perceived substitutability of the resource.

As lake and shore recreation activities are not likely to be physically disturbed, they have been excluded from subsequent analyses.

a) Current Recreational Use

Within the Hat Creek Valley and environs (see map 5.1) it is estimated that recreational activity comprises 8,150 angling days, 10,450 hunting days and 10,360 general recreation days in 1976. About 20% of the angling and 60% of the hunting is generated by local residents.*

Hat Creek is fished for rainbow trout but its productivity compares poorly with competing fishing resources nearby. Hunting takes place for big game, such as deer and moose, upland game and waterfowl. General recreation takes the form of driving for pleasure, backroad travel, hiking, rock collection and other activities.

b) Recreational Use Without the Project

Future recreation without the project is a function of population growth, changing preferences and the capacity of the resource in relation to substitute areas.

The EBASCO Report**forecasts activity in the Hat Creek Valley on the basis of local population projections and traffic volume forecasts in the area. The latter reflects the demand increases associated with a growing provincial population, primarily located in the Lower Mainland.

Table 5.1 shows the estimated activity levels in the Hat Creek Valley and environs projected for the period 1976 to 2026 without the project.

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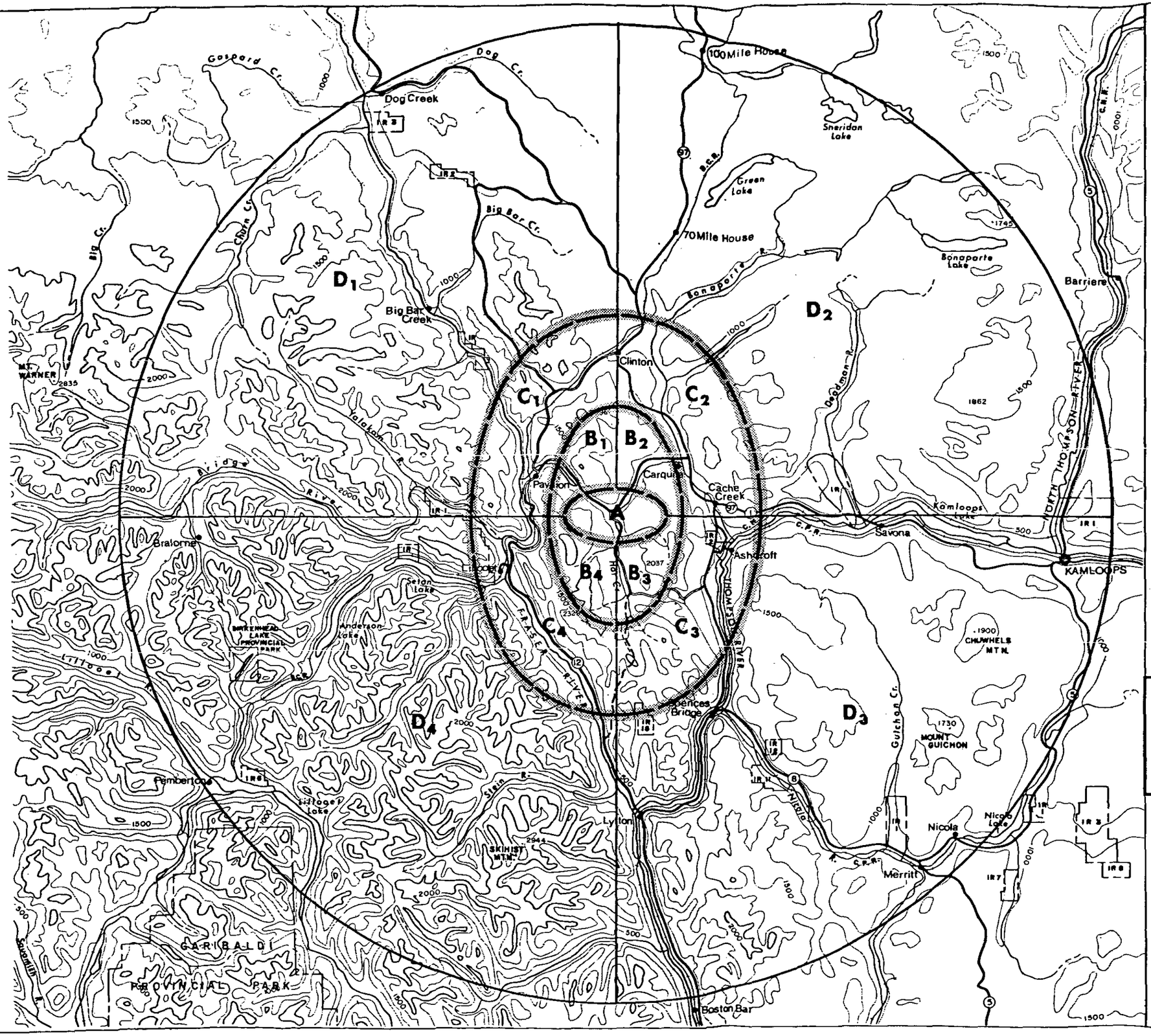
* EBASCO, op.cit., 1978

** EBASCO, op.cit., 1978



BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

ANALYSIS AREAS

FIGURE 5-1

TABLE 5.1

ESTIMATED ACTIVITY DAYS

HAT CREEK VALLEY AND ENVIRONS

1977 - 2026 (without project)

Activity	1977	1978	1987	1990	2026
Angling	8,558	8,985	13,560	16,785	34,240
Hunting	10,974	11,525	17,390	21,520	43,898
General Recreation	19,280	20,245	30,550	37,815	77,138

SOURCE: Strong Hall & Associates Ltd. based on data in EBASCO op.cit.,1978.

The time periods shown represent key project milestones selected for the comparison of "without" and "with" project cases. For example, 1987 is the year of full operation, and the year 1990 is the assumed congestion level of the Hat Creek Valley without the project.*

The EBASCO Report developed the following use scenario. Land capability classifications in the area are generally low to moderate, but have some potential for hunting and viewing. In the "without case", agricultrual use and private ownership of land would restrict the development of recreation potential. By 1990, existing use levels would virtually double, and the consumptive success rates in hunting and fishing would likely have decreased to the point where users would turn to substitute areas. Growth rates beyond 1990 are considerably lower. The growth rates for the various periods and activities are shown in Table 5.2.

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* The congestion level is the point at which crowding has reduced the quality of the recreational experience such that users substitute new areas.

Congestion points for hunting, fishing, and general recreation were assumed to coincide. While this coincidence is unlikely to occur, it has not been possible to differentiate among them for this study.

TABLE 5.2

GROWTH RATES IN RECREATION ACTIVITY*

1977 - 2026

Activity	1977	1978-87	1988-90	1991-2026**
Angling	5.0%	4.7%	7.4%	2.0%
Hunting	5.0%	4.7%	7.4%	2.0%
General Recreation	5.0%	4.7%	7.4%	2.0%

SOURCE: Strong Hall & Associates Ltd., based on data in EBASCO, op.cit., 1978

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* Growth rates for the period 1977 to 1990 are derived from data in the EBASCO report (Appendix A-5). Growth in recreation activity within the Hat Creek Valley is generated by both local and non-local demand. The report makes the following assumptions:

a) resident activity days will increase at a rate comprised of both forecast increase in local population and an increase in participation rates of 5% per year.

b) non-local growth will be in proportion to highway volume increases on Highway No. 12 in the vicinity of Highway No. 97 which have approximated 100% per decade.

c) the distribution of activities within the Valley by type and location will not vary from the distribution estimated at present.

** B.C. Research estimated a provincial population growth rate of 2.3% for the period 1974 to 1996. In the light of recent declines in the growth rate, the figure of 2.0% has been assumed in this report for the period 1991 - 2026 (See Appendix C-1).

c) Recreational Use With the Project

The construction of the project would alienate land and water resources presently used for hunting, fishing and general recreation. In the operations phase, air and water quality would be affected, and pit excavation and ash disposal would eliminate further areas for recreational use.

EBASCO (1978) estimates a fixed annual number of days displaced for the construction and operation phases. However, it seems more appropriate to use a percentage loss because, if available, the resource would support an increasing number of users over time. Accordingly, the annual percentage loss for the entire construction and operation phases is calculated as the percentage loss occurring in the first year displacement.*

Table 5.3 shows the annual loss in activity days and the percentage losses used for calculating annual losses attributable to the alienation of recreational resources by the Hat Creek project.

TABLE 5.3

ANNUAL RECREATIONAL ACTIVITY DAY LOSSES
HAT CREEK AND ENVIRONS
(with project)

Activity	Construction Phase (1978-87)	%	Operation Phase (1987-2026)	%
Angling	1,490	16.6	-	16.6
Hunting	840	7.3	940	5.4
General Recreation	200	1.0	550	1.8

SOURCE: EBASCO (1978)

* Example: In 1987, the beginning of the operations phase, an estimated 940 hunting days would be displaced by the project. This figure is 5.4% of the 1987 without project activity level of 17,390 hunting days. Losses in subsequent operation years are calculated at 5.4% of the without project activity levels for those years.

5.4 Economic Evaluation

The estimation of recreational resource value changes is, in this study, calculated on the basis of a single value criterion - the standard recreation day value for each recreation activity. This willingness to pay measure is applied to "without" and "with" project recreational use projections to approximate recreation demand for each case. The present value of the difference between these two streams reflects the change in resource value attributable to the project.

User-day values have been drawn from a variety of sources with a view to estimating recreation values for the Hat Creek Valley which reflect its characteristics relative to other sites in the area.

a) Sport Fishing

Sport fishing values have been estimated in British Columbia for sites ranging considerably in productivity and attractiveness.

A 1977 review of province-wide sport fishing values estimated a range between $8 and $16 per day depending on the site characteristics and alternative sites within a specified region.* Adjusting these to reflect 1978 values, the range would be in the order of $9.00 to $18.00.**

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* Quadra Economic Consultants "Fish and Wildlife in B.C.: A Review of Resource Values", British Columbia Fish and Wildlife Branch, 1977.

** Willingness to pay for recreation over time is considered to be income elastic, but there is little guidance in the literature as to the appropriate rate of growth of the relative price increase. Krutilla (1971) used rates between 2% and 5% for the analyses of Hell's Canyon. The rate of 4% was assumed to apply to the price of Hat Creek's recreational resources. Theoretically, separate rates would be developed for angling, hunting and general recreation, but the data base does not permit this refinement.

The actual value attributed to the Hat Creek sport fishery requires a subjective estimate. The moderate capability of the Hat Creek fishery and the numerous alternative stream fishery opportunities within the area suggest that angler day values are at the lower end of the range discussed above.* A value of $9.00 per day, in 1978 terms, has been selected for the evaluation of sport fishery losses.

b) Hunting

Hunting in the affected area of the Hat Creek Valley is constrained by private land holdings. However, hunting does take place and hunter day losses attributable to the project are likely to occur. Principal game species likely to be affected are deer, moose and, to a lesser extent, upland game and waterfowl.

Standard recreation day values for hunting were provided by the above 1977 study province-wide study which estimated big game hunting values at between $18 and $36 per day (1976 values) and small game/upland birds/waterfowl at $9.00 per day. Given the predominance of deer hunting activity in the Hat Creek Valley, the above-mentioned low value for big game has been adopted for all hunting activities, and inflated to reflect a 1978 value. The resulting value is $22.50 per hunter day.**

(continued from ** 5 - 8)

In conjunction with changes in relative price an average inflation rate of 7.7% (CPI Vancouver) has been used to adjust the above estimates to 1978. Hence, the adjustment formula becomes: (relative price increase) (inflation rate) = adjustment rate

* It is argued that for the majority of users of the Hat Creek Valley the cross-elasticity of demand for recreational pursuits at this site is extremely low, that is, willingness to pay for visiting this site is relatively low when other similar sites are available locally.

** As per the formula presented above.

c) General Recreation

General Recreation as defined in this study incorporates sightseeing, backroad travel, and other less popular pursuits in which much of the value of the recreation experience is related to the scenic qualities of the area. In this respect the Lower Hat Creek Valley, although pleasant, is considered to be comparatively ordinary relative to other sites in the region. Standard recreation day values for this activity were drawn from the Quadra Report found 1977 provincial values to average $9 per day. Due to the modest scenic quality of the affected portion of the Hat Creek Valley, and the alternatives which offer a similar experience in the region, a 1978 value of $7 per general recreation day has been assumed for this evaluation.

d) Present Value of Recreation Resource Losses

On the basis of the standard recreation day values discussed above and the projected use estimates presented in section 5.3 of this chapter, the present value of recreation resource losses due to displacement have been developed. These losses, shown in Table 5.4, are calculated over a 10 year period and discounted at rates between 6 and 12%.

TABLE 5.4

PRESENT VALUE OF THE RECREATIONAL RESOURCE LOSSES

ARISING FROM THE HAT CREEK PROJECT

($1978)

Discount Rate	Activity	Value Without ($ 000)	Value With ($ 000)	Value Loss ($ 000)
6%	Angling	3,973	3,314	659
	Hunting	12,732	11,997	735
	General Recreation	6,962	6,846	116
	TOTAL			1,510
8%	Angling	2,587	2,158	429
	Hunting	8,292	7,808	484
	General Recreation	4,534	4,460	74
	TOTAL			987
10%	Angling	1,847	1,540	307
	Hunting	5,918	5,568	350
	General Recreation	3,236	3,185	51
	TOTAL			708
12%	Angling	1,412	1,177	234
	Hunting	4,525	4,254	271
	General Recreation	2,474	2,435	39
	TOTAL			545

Hunting losses, constitute the most important change with a present value of between approximately $271,000 and $735,000 depending on discount rate. This is followed by angling ($235,000 to $659,000) and general recreation ($39,000 to $116,000).

The total present value of direct provincial recreation losses range from $545,000 to $1,510,000 discounted over a 70 year time period at 12% and 6% respectively.

It might be argued that the recreation loss values estimated should be considered maximum values and, that, actual losses due to displaced activities would be substantially less. Since the relative quality of the Hat Creek resources are modest and since there are a number of alternative sites in the local area with similar characteristics to the affected sites, recreationists can substitute the other areas for their activities at little real or perceived incremental cost. Consequently, the value of the affected site is close to zero for recreation.

In the survey of households undertaken to directly estimate willingness to pay values, respondents were asked to determine their willingness to pay for a day's recreation in the Valley, keeping in mind the alternatives available to them. Some respondents would pay nothing. Others, however, were willing to pay a positive price for the experience. These responses would suggest, therefore, that there is a perceived value to this area in spite of the alternatives and that substitutes are somewhat imperfect.

Since the results of this survey provided insufficient data on which to construct a demand schedule, a site specific value could not be determined. The use of standard values, even though the values at the low end of the range were consistently used, are informed judgement estimates for the Hat Creek area. However, considering the information available, they are considered reasonable.

In addition to recreational dislocations, the value of recreation resources in the local study area would likely be affected by the increased activity levels brought about by local population increases induced by the project. It is estimated that study area populations

would increase by about 40% as a result of the project. While it cannot be accurately estimated, it is expected that the incremental population would originate from a wide variety of geographic locations throughout British Columbia and western Canada. Therefore, while their withdrawal from these diverse areas would have only marginal effects on recreation values at the sites they normally use, their concentration in the local study area may produce congestion effects at some sites in the Hat Creek region sooner than they would occur without the project. This issue is extremely complex and, while the direction of value change is likely to be a reduction in provincial resource values for recreation, neither the extent of the reduction nor the site locations primarily affected can be determined. It has been assumed by EBASCO that recreation activity patterns for the incoming populations would be similar to existing populations across the variety of recreation sites in the local area. This appears to be a reasonable assumption for the first visits of this population. However, as participation increased at specific sites, a variety of unpredictable site substitutions would likely occur by both the incoming and existing populations. As individual sites became crowded, individuals would seek alternative sites. Participation at one set of sites would decline and would expand at other sites.

This adjustment process would likely continue as an on-going process throughout the region. Its effects on the value of specific sites cannot be determined. Its effect on the overall value of the total set of resources in the study area might be estimable, assuming a fixed supply of resources, but would require comprehensive local and non-local participation data for the whole area, and an assessment of regional carrying capacity. This information is not available.

Therefore, while it is likely that the project induced population would have some negative effect on the value of provincial recreation resources as a result of their increased concentration in the Hat

Creek area, their effects are indeterminable. It must be remembered, however, that numerous recreation sites in the study area are popular destination points for Lower Mainland residents and the pressure that population growth in that area is likely to put on the study region would probably render Hat Creek population effects as minimal.

e) Regional Impacts

An assessment of the regional impacts associated with the resource value changes previously described requires an examination of the distribution of recreation participants at the affected sites. To the extent that the majority of users are regional residents, then generally speaking, they would be most heavily impacted by the predicted impacts.

While some data of this nature has been developed and presented in the EBASCO Report, it is rather limited. The report indicates that in the Hat Creek Valley area, 51% of the estimated activity days involved local area residents. The remainder were either from other areas of British Columbia or from outside the province. While this data would tend to suggest that local area and non-local area residents would be about equally affected, it must be remembered that, to local residents, Hat Creek area sites are likely destination points whereas they are simply points of interest to most non-local residents passing through the area. Therefore, the degree of the impact may be viewed differently by these two groups. In addition, activities in the Valley area constitute about 15% of local resident outdoor recreation activities while they are likely to occupy a much smaller proportion of non-local resident activities. This would further indicate that disruptions to local resident activities may be more strongly felt than their proportional participation would suggest.

Beyond the Valley, project impacts would be primarily through induced population effects. Local residents spend about 40% of their activity days at sites in the local study area but outside the Hat Creek Valley. While data on total recreation use at these sites is extremely limited, it is evident that they constitute a much lower proportion of the total activity at these sites than at the Hat Creek Valley sites. There are a number of higher quality locations in this area that have traditionally attracted recreationists from throughout British Columbia and elsewhere. Therefore, proportionately, non-local residents are likely to be more heavily affected by congestion at these sites than are local residents.

However, the degree of effect is once again important. Non-local residents travel relatively long distances to these sites and, therefore, likely have a wide range of substitutes within equidistance of their residence. Substitituions can be made at marginal incremental cost relative to the costs of reaching the original destination. Local residents, on the other hand, face more limited choices within equidistance of their residence and substitutions further afield would be made at higher marginal cost. Therefore, again, impacts on local residents are likely to be higher than their proportional participation would suggest.

A final regional impact, potentially arising from the Hat Creek development, relates to incremental income and employment from increased tourism associated with the project. The EBASCO Report estimates between 1000 and 2000 site visitations per year are likely to occur. If some portion of these site visitations are drawing trips to the study area that would not have been made without the project, or if the diversion to the sites keeps tourists longer in the area, then regional income gains might be claimed. However, it is considered unlikely that this would be the case for all but a few of the site visitors.

Discussions with Lornex and Bethlehem officials, representing major open pit copper mines in the area, indicated that their tour programs attract primarily tourists who are vacationing with the families of their employees. Site visitation is simply one of the activities they undertake on their vacation in the area. It is not the attraction that brings them to the area nor does it extend their stay. Other tourists would likely add no more than two hours to their stay in the area by visiting the project, due to the accessibility of the plant from major traffic corridors.

On the other hand, some tourists coming to the region may not have come without the project. Their spending would represent real income gains to the area. However, it is expected that these gains would be small.

5.5 Mitigation and Compensation

Mitigation and compensation suggestions of relevance to recreation appear in the Wildlife Report, the Fisheries Report and the Recreation Report. Many of the recommendations are of a "housekeeping" nature and could likely be implemented at minimal cost. Most of the recommendations lack sufficient detail to enable evaluation.

The Wildlife Report provides one opportunity for a very general evaluation in their suggestion to eliminate, relocate or redesign the landing strip temporary topsoil stockpile.

The topsoil stockpile reduces the sagebrush vegetation available to mule deer, the primary big game species hunted in the area. The project, as it is designed, alienates 62.6% of the sagebrush vegetation in the Valley, and alteration of the stockpile as suggested would recover 3.4% of the resource. To justify the recommendation on efficiency grounds, the cost of its implementation should be less than the benefits to recreation accruing from its implementation.

The value of recreation losses from displaced hunting activity is between $223,000 and $604,000. In addition there may be resource losses due to increasec hunting activity, brought about by population growth, and a decline in the quality of the hunting experience. This potential loss has not been quantified. Finally, some of the general recreation values for sightseeing and possibly photography, ranging from $39,000 to $116,000, would be related to the presence of mule deer in the Valley.

Since no estimates are available of improvement in the deer resource and its effects on hunting participation and quality, as a result of altering the stockpile, it is not possible to rigorously assess this mitigative measure. However, an order of magnitude guide might be possible.

While it is not possible to specify the contribution of the specific 26 ha (64 acres) in question to overall wildlife values, if one makes the simplifying assumption that resource values are evenly distributed across the sagebrush habitat, then 5.4% of the estimated deer hunting losses due to displacement would be avoided if this resource were preserved. Therefore, an efficient allocation of resources would permit up to $15,000 at 12% discount rate or $40,000 at 6%, to be spent on mitigating this sagebrush loss to avoid displacement losses. Since additional values are involved, associated with maintaining hunting quality under increased hunting pressure, and preserving some portion of non-consumptive wildlife values in general recreation these estimates should be considered a minimum. However, it is unlikely that consideration of these other values would substantially alter these estimates.

A second set of recommendations relating to compensation in kind deserve comment. The Wildlife Report suggests enhancement of certain waterfowl habitat as compensation for habitat destroyed during construction. The Recreation Report recommends a variety of enhancement measures to improve alternative recreation sites in the local area.

In our judgement, ad hoc enhancement expenditures by a developer (e.g. B.C. Hydro) should be discouraged. While each expenditure of compensation in kind may be efficient, they are unlikely to produce the most efficient allocation of total Provincial resources.

It is recommended, therefore, that B.C. Hydro pay compensation payments, where appropriate, to the Provincial Government for inclusion in general revenues. They can then be expended by government to achieve Provincial efficiency or equity objectives.

6. WATER RESOURCES

6.1 Introduction

The Hat Creek project would result in a number of changes to the water regime of the Hat Creek Valley area. In addition, it would draw water from the Thompson River for utilization in the thermal plant and infrastructural elements.

The resource allocation implications of changes in the Valley water regime relate to the value of the water in uses that are affected or precluded by the project. These uses include water for irrigation, wildlife, fisheries, aesthetics, and domestic uses. Project effects on irrigation uses are reflected in the agricultural productivity losses discussed in Section 8. Effects on wildlife, fisheries, and aesthetic considerations are reflected in the recreation resource losses assessed in Section 5. Domestic water implications are not covered elsewhere and, therefore, will be discussed below.

The Thompson River also supports a wide variety of competing uses, including domestic water, irrigation, fisheries, wildlife, aesthetics, and waste assimilation. However, the removal of about 1% of the river's water supply is not expected to alter or preclude the future continuation or expected expansion of these uses.

The following economic assessment of water resource use opportunities affected by the Hat Creek Valley, therefore, is restricted to domestic uses within the Hat Creek Valley area.

6.2 Summary of Resource Impacts

Groundwater aquifers in the Hat Creek Valley are small and of limited areal extent. Present groundwater use has been estimated at about 160 m^3/d or about 1.7% of the total groundwater potential in the area. The current domestic water consumption is about 30 m^3/d, or

0.5% of the potential.

The impact of the project on groundwater resources would be restricted to an area within a radius of 7 km from the centre of the coal pit. Domestic consumption would be reduced by about half, to roughly 15 m^3/d. Impacts would be temporary and, once the Thompson River water supply was available, most of the groundwater abstractions would cease. Construction camps would use about 328 m^3/d of groundwater for about five years only, and industrial requirements could increase to about 1,400 m^3/d. Maximum groundwater use could approach 36% of the available groundwater potential towards the end of the construction phase.

The volume of surface water licensed for domestic use in the Hat Creek Valley is small; 84 m^3/d, with 22% of this licensed for diversion out of the Hat Creek watershed.

Domestic surface water uses throughout the various phases of the project are expected to be small, relative to the specific resources, and, therefore, the impact in all cases is expected to be insignificant.

All water requirements for the mine and plant during the construction phase, including construction camp and infrastructure, would be from groundwater sources.

At the termination of the project, mine and plant water requirements would return to zero, and domestic surface water usage would reduce as people moved away from the surrounding area.

6.3 Economic Evaluation

The impact of the Hat Creek project upon domestic water supplies in the Valley area is expected to be minimal in relation to the available potential supply. A few individual consumers would

have to relocate their residences and give up any economic rents they might otherwise have enjoyed if their domestic water supply had not been disrupted by the project. The value of these rents could be approximated in terms of the least cost alternative means of replacing the disrupted domestic water supply services, and one approach would be to estimate the drilling and piping costs of bringing on a new groundwater well at a new location outside a 7 km radius about the centre of the coal pit.

It has been estimated that a new 200-foot deep well drilled in the Hat Creek region would cost from $500 to $1,000 for the pump, piping and well. Operating costs would be about $50 per year for a water supply capacity of about 1.6m^3/d (350 gallons per day), but these costs would likely be unchanged from their operating costs without the project.

The Project would require that five existing wells be abandoned, having a combined estimated pumpage of 16m^3/d. The cost of 10 wells, to produce an equivalent volume, therefore, would amount to between $5,000 and $10,000.

However, it should be recognized that the value of the domestic water supply to residents of Hat Creek Valley is contained in the market value of their property, and there are no identifiable externalities affecting other resource owners. Assuming that the real estate market is reasonably efficient, and that compensation paid to displaced residents reflects at least this market value, the value of domestic water supply rights would be included in this compensation.

6.4 Mitigation

The Hydrology report (Appendix B-1) suggests mitigative actions in the areas of hydrology, water quality and water use. Economic evaluation of the suggested actions is not possible since data concerning the costs of mitigative actions, the anticipated success in the reduction of environmental impacts, and, more specifically, the effects on ultimate water users are not readily identified.

Impacts on the hydrological regime are proposed to be reduced by:

- limited dewatering of Finney Lake
- restricted seepage from waste rock and ash ponds
- relocation of the Hat Creek Diversion canal
- installation of drainage and erosion controls prior to terrain disturbances
- minimizing the exposure of unprotected areas and unvegetated soil
- adoption of acequate design criteria for lagoons

In the area of water quality and use, the minimization of ground and surface water contamination and the maintenance of a supply of irrigation water are the key objectives. To achieve these objectives, it is suggested that construction or operation modifications for lagoons, waste storage areas, stockpile areas and other facilities be effected.

While it is technically possible to calculate the costs of the above-mentioned measures, it is not possible, at this time, to assign monetary values to the benefits as the affected populations are not identified. Further investigation should identify the specific populations affected by anticipated changes in water quality, specify the type and level of use, estimate the cost of mitigative actions, and specify the effectiveness of the measures.

7. MINERALS

7.1 Introduction

The development of the Hat Creek Project is likely to affect a number of mineral deposits in the area but the resource allocation implications are minor.

7.2 Summary of Resource Impacts

The Houth Meadows limestone deposit would be partially sterilized by the development, but is is doubtful that the resource would be developed without the project. With the project, it could be utilized to a level of 4.4 million tons, over the life of the project, if flue gas desulphurization technology is employed in the thermal plant.

This utilization would suggest an economic benefit to the project in terms of the present value of incremental resource rents, but this value would be minimal and is not likely to occur, given the existing thermal plant design.

The project would have implications for the use of claystone and baked claystone, but no economic allocation effects are likely.

The project would affect aggregated deposits in the Hat Creek Valley and in the local study area, altering the present value of future net rents from existing aggregate deposits as well as affecting income and employment in the study region.

There are three active aggregate quarries located within the Crown Reserves of the Hat Creek project: two of these currently produce gravel for highway construction and maintenance; the third yields

sand for surfacing icy roads in the winter. Two additional quarries lie near the Crown Reserves. Data on all five quarries are presented in Table 7.1, along with a description of the likely impacts they are expected to incur.

Upper Hat Creek gravel quarry at the site of No. 1 coal deposit is owned by B. C. Hydro and leased to the Ministry of Highways for a nominal annual rent. Boston Flats No. 2 sand quarry and Pavilion Lake gravel quarry are on Crown Land leased also to the Ministry of Highways. The remaining two quarries are privately owned: one at Lower Hat Creek, situated in the Bonaparte Indian Reserve, is leased to the Ministry of Highways. This lease is currently being renegotiated. The Boston Flats No. 1 gravel operation is privately owned and is currently leased to a private operator. This quarry has only recently been opened up, following initial excavation and stockpiling by the private operator.

Without the Hat Creek project, production of aggregate from the Upper Hat Creek quarry is expected to decline, upon completion of the Upper Hat Creek Valley road, to a level consistent with annual road maintenance requirements on that road and nearby parts of Highway 12. There is a possibility that this highway might be paved, which would induce a short-term spurt in production of aggregate, followed by a sharp drop-off to some minimum level necessary for minor repairs and upkeep thereafter.

It is expected that production from the remaining quarries, to meet road maintenance requirements on Highways 12 and 97, would continue at present levels in the absence of the Hat Creek project. Some additional demand for aggregate from the Boston Flats gravel quarry could be expected, with increased demand for housing and services in the Cache Creek and Ashcroft areas, should construction begin on a number of major mining projects in the region.

TABLE 7.1

ACTIVE AGGREGATE QUARRIES WITHIN
THE HAT CREEK PROJECT CROWN RESERVE

Quarry Name/Site	Sand or Gravel	Owner	Lessor	Current Market	Impact of Hat Creek Project
Upper Hat Creek Valley	Gravel (586 million tonnes)	B.C. Hydro	Dept. of Highways	Upper Hat Creek	1. Partially sterilized 2. Accelerated production into stock pile 3. Market expansion of 100 million tonnes.
Boston Flats No. 2	Sand	Crown	Dept. of Highways	Highway 97 winter sanding	1. Partially sterilized
Pavilion Lake	Gravel	Crown	Dept. of Highways	Highway 12 Maintenance	1. No impact anticipated 2. Possible minor expansion for local housing construction demand
Lower Hat Creek Valley	Gravel	Indian Band	Dept. of Highways	Highways 12, 97 Maintenance	1. No impact anticipated, but subject to contract renegotiations
Boston Falts No. 1	Gravel	Woodburn	1. Dept. of Highways 2. Cassidio	Roads in Cache Creek	1. Private operator anticipates future profits from regional economic development in Cache Creek area.

SOURCE: B. C. Hydro & Power Authority, "Hat Creek Detailed Environmental Studies, Minerals and Petroleum", 1978.

However, it is not clear whether this increased supply of construction grade aggregate would be met from the Boston Flats gravel quarry or whether some would be supplied from an existing quarry approximately 3.2 km (2 miles) east of Ashcroft and outside the Crown Reserve.

If the Hat Creek thermal development goes ahead, a portion of the Upper Hat Creek gravel deposit, and some of the deposits on Boston Flats, would be unavailable for future use (sterilized). However, there would be some compensating effects, in the way of an increase in demand for gravel, from the unsterilized portions of these deposits. Upper Hat Creek gravel would be used in construction of on-site facilities, and aggregate from Boston Flats No. 1 would be utilized in construction of the proposed water supply system, access road and airstrip. In both instances, production of aggregate would be accelerated over the near term and total production would be greater over the lifespan of the project.

7.3 Economic Evaluation

a) Provincial Account

Generally speaking, each quarry within the Crown Reserve services a local area determined by the relative location of each quarry, and the average cost of hauling. With the exception of gravel from the privately operated Boston Flats No. 1 deposit, the Ministry of Highways acts as both sole operator and sole buyer of aggregate from each quarry. The value of aggregate, therefore, must be based largely upon its cost of extraction and handling at the quarry site.

Based on a limited survey of public and private agencies dealing in aggregates, the following range of estimates were obtained for the value of raw and crushed aggregates in the Hat Creek region.

TABLE 7.2
ESTIMATED GRAVEL COSTS AT QUARRY SITE

	Raw Gravel		Crushed Gravel	
	$/m^3$	$/tonne	$/m^3$	$/tonne
Ministry of Highways*	2.00-2.40	1.45-1.70	5.70-5.90	4.00-4.20
Private** (including royalty)	2.45-2.85	1.75-2.05	6.15-6.35	4.30-4.50

Since the imputed value of aggregate produced from these deposits is based on estimated costs of extraction and handling at the quarry site, there is no economic resource rent generated at the Crown owned quarries; that is, there is no surplus revenue over and above the cost of production. Increases or decreases in production of aggregate from these quarries, due to the project, would result in increases or decreases in regional economic activity, but resource rents would remain constant at zero.

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* Assuming Ministry of Highways owns its own quarries, and pays no royalty.

** Cost of extraction at quarry site, including royalty.

SOURCE: Ministry of Highways, personal communication, July, 1978

Aggregate produced from privately owned deposits appear to incur a royalty charge, which could be treated as rent to the Crown, but only if the gravel were sold to a private buyer. Such is not likely to be the case at Hat Creek, however, as long as a) there is no competitive market price for gravel and b) the buyer, in most instances, is the Crown itself (i.e., the Ministry of Highways).

Private rents in the form of lease payments received by a private owner are also reported to accrue at the Boston Flats gravel quarry and the Bonaparte Indian Reserve deposit. The value of these leases varies from quarry to quarry, but is reported to be in the order of 10¢ to 40¢ per tonne.* At the time of writing, the Ministry of Highways is renegotiating its lease on the Bonaparte Reserve deposit and there is every likelihood that the price will increase, increasing the economic rent value of this property. However, it would be spurious to ascribe this increase directly to the Hat Creek project.

B. C. Hydro construction contractors working on offsites would likely pay a price for crushed gravel from the private quarry at Boston Flats that would include some rent. However, no estimates are available on the likely tonnages involved. The project would also consume an estimate 1.1 million tonnes (1.2 million short tons) for construction of the powerplant and adjacent facilities, spread over about a five-year construction period. However, the gravel would likely come from the Crown-owned quarry at Upper Hat Creek, which would be producing zero economic rents with or without the project.

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* Ministry of Highways, personal communication, July, 1978.

One must conclude, therefore, that economic rents on the Crown-owned or Crown-operated aggregate deposits will remain at zero, with or without the project. Rents on privately-owned quarries would increase above current levels due to induced production increases brought on by the project, at a rate of between 40¢ to 70¢ per tonne.

b) Regional Account

The project would not directly alter regional income or employment through its effects or mineral resource use. However, it would induce marginal increases in both income and employment through the expansion of aggregate production brought on by project associated population growth.

This expansion has been captured in the induced income and employment estimates of the Regional Socio-Economic Report (Appendix C 1 and C 2) but has not been specifically disaggregated. It is expected that these increases would be marginal.

7.4 Mitigation

The mitigation section of the Minerals and Petroleum Report (Appendix # 2) suggests a number of measures that can be taken to mitigate adverse project effects on mineral deposits . These measures include:

- isolating aggregate in part of the waste dump area so that it can be preserved for future use.
- adopting PD-NCB alternative B waste disposal plan to minimize the sterilization of limestone deposits.
- substituting bottom ash for some future aggregate uses.
- segregation of claystone for possible future use.

From an efficiency point of view it is doubtful that these mitigative measures should be pursued.

Aggregate supplies in the area appear to be well in excess of demand in the foreseeable future. Therefore the sterilization likely to take place would have no economic value.

Limestone deposits are also in abundant supply and the limited sterilization forecast with the project would not have economic consequences.

The substitution of bottom ash for aggregate, the use of claystone or baked claystone and the utilization of the coaly wastes may prove economically viable in their own right as a result of the project. However, their segregation and development should not be viewed as a mitigative or compensatory measure. Rather, the net economic rents generated by the utilization of these resources would be included as additional income benefits of the project.

8. AGRICULTURE

8.1 Introduction

According to the Agriculture Impact Report, the Hat Creek Project would cause a reduction in future agricultural production in the study area through the alientation of productive agricultural land for the mine, thermal plant and offsite facilities, and reduction in available water supplies for irrigation and the reduction in land productivity brought about by air contamination.*

The criterion for assessing the economic losses to the province arising from the alternative use of agricultural resources is the difference in agricultural rents produced from the affected land with and without the project. In addition, the loss of future production would result in a decline in value added in the Hat Creek region. This loss would represent a decline in regional income.

8.2 Summary of Resource Impacts

Agricultural lands affected by the project are currently producing beef cattle and would likely continue in this use without the Hat Creek project.

The base scheme project activities and facilities would alienate 3724.8 ha of land predominantly (96 percent) lying at the northern end of upper Hat Creek valley.

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* Canadian Bio Resources Consultants Ltd., "Agriculture, Volume II Impact Assessment", B. C. Hydro & Power Authority, January 1979

Of the lands alienated, 2020.7 ha lie within the Agricultural Land Reserve (ALR). This represents 14.3 percent of the ALR lands in the Hat Creek basin, 31.9 percent of ALR lands in the Local Study Area, and about 0.2 percent of ALR lands in the Regional Study Area.

Almost all (99 percent) of the land that would be alienated by the project is presently in natural range or forest cover. Alienation of 34.4 ha of presently irrigated hay and pasture land, however, would occur. This represents about 3 percent of presently irrigated lands in the Hat Creek Basin and about 0.8 percent of those in the Local Study Area.

In terms of estimated probable agricultural land uses without the project, the following would be alienated by the project: irrigated land, 295.8 ha, spring rangeland, 1305.2 ha; and summer rangeland, 2123.8 ha. The alienation of irrigated land includes consideration of corn land and spring irrigated pasture projected to be irrigated in the future (though it is not at present) as well as presently irrigated hay and pasture lands.

Power plant stack emissions utilizing the Meterological Control Strategy (MCS) would also result in some losses of productive agricultural lands. The impact of SO_2 and NO_2 emissions of the 366 m stack MCS model on irrigated land was estimated to result in an effective loss of 13 ha of alfalfa production, from the expected production without the project, occurring mainly in the south portion of Hat Creek valley. The impact of SO_2 and NO_2 emissions of the 244 m stack MCS model on irrigated land was estimated to result in an effective loss of 16 ha.

The effect of these land productivity changes on the future beef herd of the Hat Creek Valley are shown in Table 8.1

Without the project, the Valley herd is expected to increase from 2,000 cows in 1977 to 3,300 cows by the year 2020. With the project the herd growth would be reduced to 3,109 cows in 2020. The maximum herd reductions would occur near the end of project construction, when about 400 less animals would be grazed in the valley. From 1990 to the end of the project's life the annual difference between the with and without situations would be about 191 cows.

8.3 Economic Evaluation

The economic evaluation estimates agricultural losses for the provincial income account in terms of economic rent, and for the regional account in terms of value added (income) and employment reductions.

a) Provincial Account

The cost and revenue information for beef production, from the agriculture report, has provided the basis for the rent analysis. These data are appropriate for a financial analysis, but require modification before computing economic rent. The main difficulty in using the financial data is that capital expenditures are expressed in terms of annual depreciation charges and interest payments rather than as lump sum capital expenditures in the year in which they were incurred. Since it was not possible to adjust capital expenditures appropriately with the available data, depreciation charges were treated as annualized capital expenditures for the determination of rents. This approach tends to understate capital costs in terms of their present value. There is also the

TABLE 8.1

HAT CREEK VALLEY BEEF INDUSTRY
PROBABLE HERD SIZE
WITHOUT AND WITH PROJECT

	Size of herd		Herd Reduction
	Without	With	
1977	2,000	2,000	-
1978	2,005	2,005	-
1980	2,038	2,038	-
1982	2,144	2,038	106
1984	2,394	2,125	269
1986	2,702	2,317	385
1988	2,923	2,625	298
1990	3,005	2,813	192
2000	3,200	3,009	191
2010	3,255	3,063	192
2020	3,300	3,109	191
2022	3,309	3,118	191

SOURCE: Canadian Bio Resources Consultants, July 12, 1978

problem of establishing what consitutes a "reasonable return" to investment in the farm operation, a factor cost which should be deducted from gross revenue to obtain economic rent. Since this amount could not be satisfactorily separated, it is included with the estimation of economic rent. Interest payments, which are irrelevant to the allocation of resources, were eliminated for the calculation. The resultant rent estimate is, therefore, not technically rent but a modified net revenue estimate which overstates the actual rent.

Table 8.2 compares the modified production cost calculation used in the economic appraisal with the financial cost estimates of the Agricultural Report.

A summary of the cost and revenue data, for selected years, used to compute net revenue is presented in Table 8.3. Gross revenue per cow in 1977 was estimated at $135. As this price was at the low end of the 'normal' price cycle, gross revenue per cow in subsequent years was assumed to be $161, based on the average price of the normal cycle, expressed in 1977 dollars.

The economic costs of beef production are estimated at $109.51 per cow. From 1978 onward, the Agricultural Report assumes a constant long-term real cost/revenue relationship. Therefore, net revenue per cow is estimated at $25.50 in 1977 and $51.50 thereafter. The net revenue per cow, multiplied by the size of the cow herd with and without the project, yields total net revenue per annum in 1977 dollar terms for beef production in the Hat Creek basin over the life of the project The difference between the with and without cases in Table 8.3 approximates the annual loss of economic rent to agriculture as a result of the project, and represents the real economic cost of using agricultural land.

TABLE 8.2

ANNUAL BEEF PRODUCTION COSTS PER COW

Item	Financial Annual Cost per Cow [1]	Economic Annual Cost per Cow [2]
	($1977)	
Salt, vitamins and minerals	$ 2.00	$ 2.00
Veterinary expense	3.00	3.00
Utilities and miscellaneous	3.00	3.00
Labour*	14.00	14.00
Bull**	2.50	2.50
Building**	1.25	1.25
Winter feed***	72.60	72.60
Management expense	6.30	6.30
Rangeland and pasture administration/management (Crown permit lease land)****	4.86	4.86
Interest Costs	18.00	-
	$127.51	$109.51

* 4 hours at $3.50 per hour

** Depreciation charge

*** 1.65 Mg X $44 Mg

**** It has been assumed that the cost of administering and managing Crown land leased for grazing and pasture are equal to permit and lease charges and spring rangeland reseeding costs. This item equals rangeland charge plus irrigated pasture expense in Table 5.20 of the agriculture impact report. This assumption likely tends to underestimate actual administration costs.

SOURCE: 1. Canadian Bio Resources Consultants, Agriculture

2. Strong Hall & Associates Ltd.

TABLE 8.3

REVENUES AND COSTS FOR THE BEEF INDUSTRY OF THE HAT CREEK BASIN 1977-2020

	1		2	3		4		5				6		7			
	No. of Cows		Gross Revenue per Cow	Total Gross Revenue (1 x 2)		Cost per Cow		Total Costs (1 x 4)				Net Revenue per Cow (2 - 4)		Total Net Revenue (3 - 5)			
								Without		With				Without		With	
	Without	With		Without	With	CBRC*	SHA**	CBRC	SHA	CBRC	SHA	CBRC	SHA	CBRC	SHA	CBRC	SHA
			$	$		$		$		$		$		$		$	
1977	2,000	2,000	135	270,660	270,000	127.51	109.51	255,020	210,020	255,020	219,020	8	25.5	15,640	51,000	14,980	50,980
1980	2,038	2,038	161	327,999	328,118	127.51	109.51	259,865	223,181	259,865	223,181	33	51.5	68,134	104,960	68,253	104,937
1990	3,005	2,813	161	483,475	452,893	127.51	109.51	383,168	329,078	358,686	308,052	33	51.5	100,307	154,760	94,207	144,841
2000	3,200	3,009	161	514,816	484,449	127.51	109.51	408,032	350,432	383,678	329,516	33	51.5	106,784	164,800	100,771	154,933
2020	3,300	3,109	161	531,076	500,549	127.51	109.51	420,783	361,383	396,429	340,467	33	51.5	110,293	169,950	104,120	160,082

SOURCE: Based on data supplied by Canadian Bio Resources July 20, 1978

All dollar figures are in 1977 terms.

* Canadian Bio Resources Consultants

** Strong Hall & Associates Ltd.

Table 8.4 indicates that the present value of future net losses (inflated to $1978) to agriculture for the period 1978 to 2022, at discount rates of 6%, 8%, 10% and 12%, ranges from approximately $76,000 to $159,000.

TABLE 8.4

PRESENT VALUE OF
AGRICULTURAL LOSSES
($ 1978)

Discount Rate	Present Value Without Project ($ 000)	Present Value With Project ($ 000)	Agricultural Losses ($ 000)
6%	2,482	2,323	159
8%	1,919	1,799	144
10%	1,548	1,453	95
12%	1,289	1,213	76

SOURCE: *Strong Hall & Associates Ltd.*

b) Regional Account

From the regional perspective, losses of value added and employment resulting from decreased agricultural production with the project must be considered; however, it is expected that these losses will be minor. Although estimates of agricultural income and employment with and without the project have not yet been rigorously determined, employment growth in the region's agricultural sector with the project is expected to amount to about five jobs less than would be realized in the without project case. The corresponding reduction of employment income is not expected to exceed $50,000 per year. Indirect and induced losses of value added and employment at the regional level would be negligible.

8.4 Mitigation

The agricultural report (Appendix A-4) proposes mitigative actions for three impact areas: land alienation, dust emission and physical barriers.

a) Land Alienation Impacts

Relocation of mine construction camp facilities onto lower capability agricultural land is suggested to save approximately 7 hectares of potential corn land and to permit a more efficient use of other corn lands. From a resource allocation standpoint, the preservation of this comparatively small area of potential corn land, which would only be affected during the construction phase, would likely be uneconomic, unless alterations to the camp design and relocation could be carried out at minimal incremental cost. Other mitigative options in the land alienation section lack sufficient detail to attempt useful comment.

b) Dust Emission Impacts

No evaluative comments.

c) Physical Barrier Impacts

Suggestions with respect to fencing and access would appear consistent with sound resource development principles.

Recommendations concerning the relocation of facilities to avoid splitting a presently irrigated field and potential corn land are difficult to assess since these agricultural options may be entirely precluded by the operation of the mine and plant.

9. AESTHETICS

9.1 Introduction

The consideration of aesthetic factors in project evaluation is basically limited to their contribution to recreation and settlement values of natural resources or man-made environments. In the context of the Hat Creek project, their assessment in the Aesthetics Report has been oriented towards:

1. Preserving the Valley's recreation quality by limiting visual exposure to the project.

2. Preserving the area's settlement values by limiting visual exposure to the project.

3. Enhancing the project's tourism potential by emphasizing its technological characteristics.

These objectives are to be achieved through a wide variety of project design changes, landscaping and decorative measures.

9.2 Economic Evaluation

Aesthetic factors are one of a number of factors which contribute to the recreation value of natural resources. They are a determinant of the quality of the recreation experience, whether it be hunting, fishing or general recreation activities. They are often one of the major determinants of the uniqueness of a particular set of resources and affect the degree of substitutability of alternative locations.

The contribution of the visual characteristics of alternative resource configurations to recreation values is highly individualistic and is most appropriately expressed through individual's willingness to pay for exposure to those resources. The recreation values provided in

Section 5 of this report would, theoretically, include the contribution of aesthetics.

No information is available that reflects user attitudes, that expresses the perceived relative importance of alternative visual characteristics, or that relates specific aesthetic characteristics to overall recreation values. Therefore, no economic evaluation of the aesthetic component of recreation values can be entertained beyond that appearing in Section 5. However, it is likely that some of the recreation days that would have been spent in the Valley without the project would be spent elsewhere as a result of changes in Valley aesthetics caused by the project.

The settlement values primarily affected by the project are those of Valley residents south and northwest of the project. The contribution of aesthetics to the settlement value of lands to the south cannot be determined as the overall settlement value is inextricably entwined with the value of these lands in agriculture. For residents on the Indian Reserve to the northwest, the contribution of settlement values might be obtained through discussions with residents, since no market exists for Reserve lands. It has not been possible, however, to obtain this information.*

At best it can be predicted that settlement values in these areas would decline for a few residents as a result of the change in visual characteristics of the Valley's resources. However, the extent of the decline cannot be determined.

The Hat Creek project would likely attract visitors to the site. Being the only large scale mine-mouth thermal plant in the province, it would be considered a tourist attraction.** Undoubtedly the visual technological characteristics of the project would be a major aspect of its attraction.

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* See Appendix C1 and C2 Impact Report

** The EBASCO Report estimates 1000 - 2000 site visitations per year.

However, whether the incremental visits to view the project would be greater than the recreation activity displaced by the change in Valley aesthetics is indeterminate.

9.3 Mitigation

The Aesthetics Report provides many mitigative actions to screen, blend or contrast various project facilities with the natural environment.

The report suggests that the open-pit mine, blending facilities, stockpiles and dump should be screened from foreground and middle-ground views. Public access and viewpoints should be managed and the impact of man-made elements minimized. The development of berms, extensions to retaining embankments and road relocations are proposed. It is suggested that the generation plant, stack and cooling towers be developed as a highly technical environment which reflects the function of the components and contrasts with the natural environment. The related ash dump and reservoir, however, should be blended into the landscape. Berming, revegetation, road relocation are suggested for the latter, while the massing of structures and the development of circulation patterns that will orient users and visitors to the plant will achieve the former objective.

The greatest visual impacts are associated with the three linkages: transmission corridor, main coal conveyer and access road. The conveyer would be emphasized as a strong man-made link, while the other two linear elements would be developed in a manner so as to achieve greater harmony with the natural landscape. Modulation of corridor boundaries, minimization of exposed and road relocations are proposed.

While these measures are considered technically feasible, cost estimates are not developed. In addition, the benefits in terms of

reduced recreation value losses, reduced settlement value losses or increased tourism benefits, are not estimated. No thorough evaluation of these mitigation measures can, therefore, be presented.

In our judgement, however, actions which would minimize the continuous exposure of nearby residents to the project and measures that would provide viewing access of the project to visitors should receive preferential consideration.