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BRITISH COLUMBIA POWER AND HYDRO AUTHORITY

TRANSPORTATION STUDY

PROPOSED HAT CREEK DEVELOPMENT

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SECTION 1

INTRODUCTION AND SUMMARY

SECTION 1

INTRODUCTION & SUMMARY

1.1 BACKGROUND

British Columbia Hydro and Power Authority is considering the development of coal deposits in the Hat Creek Valley as a potential source of thermal energy for the generation of electric power. In this regard a selection of seven potential locations for a thermal plant has been made by B.C. Hydro on the basis of preliminary studies, including an environmental impact study completed in August 1975 by B.C. Research and Dolmage Campbell and Associates.

A number of factors must be considered in determining the relative merits and shortcomings of the alternative locations for the thermal plant. Prominent among these factors is the cost of transporting coal and the environmental and social impacts which result from the construction of transportation systems and from the operation of the transportation services. Consequently, in late 1975, B.C. Hydro commissioned the team of Swan Wooster Engineering Co. Ltd., Tera Environmental Resource Analyst Ltd., and B.C. Research to jointly undertake a study of the transportation alternatives associated with the development of the mine site and each of the potential thermal plant locations.

1.2 TERMS OF REFERENCE

An abstract included by B.C. Hydro in the Terms of Reference for this study, reads as follows:

> "Provide engineering services for a transportation study related to the development of B.C. Hydro's Hat Creek coal deposit. The study is to include a technical, economic and environmental description and comparative evaluation of road, rail and other facilities as they relate to the transportation facets of a coal test burn, a coal mine development, and a thermal power plant. Also required is the study of potential airstrip sites near the coal deposit."

The specific terms of reference as provided by B.C. Hydro are included in this report as Appendix A. The major parameters of the coal transportation requirement were as follows:

a) Volumes

The annual volumes and the anticipated maximum daily volumes for the two sizes of thermal plants considered in this study are shown in Figure 1-1.

FIGURE 1-1

ESTIMATED COAL REQUIREMENT

Plant Site Location	Plant Size (megawatts)	Coal Volume Peak Daily (tons)	Coal Volume Annual (tons)
Tidewater	2,000	32,000	8,800,000
	5,000	80,000	21,900,000
Interior	2,000	40,000	11,000,000
	5,000	100,000	27,500,000

Note: Coal shipped to "Tidewater" locations would be beneficated at the mine site. Volume to these locations is therefore less than to Interior sites.

Source: B.C. Hydro and Power Authority

b) Potential Locations for Thermal Plants

The location of the coal mine and each of the potential thermal plant sites are shown on the map in Appendix F. The locations for a thermal plant include:

i) Mine Mouth - located at the north end upper Hat Creek Valley near B.C. Highway 12; site elevation approximately 2,750 feet.

ii) Harry Lake - the flat land east of Harry Lake; site elevation approximately 4,300 feet.

iii) Big Bar Creek - on the east side of the Fraser River just north of Big Bar Creek; site elevation approximately 3,500 feet.

iv) Ashcroft - on the Thompson River roughly 5 miles south of Ashcroft; site elevation 1,000 to 2,000 feet.

v) Squamish - on tide water in the vicinity of Squamish.

vi) Britannia - on tide water in the vicinity of Britannia.

vii) Roberts Bank - on tide water in the vicinity of the Roberts Bank development.

1.3 PURPOSE AND SCOPE OF THE STUDY

This study is primarily an assessment of the technical and economic elements of the transportation requirements and touches only briefly on the environmental and social implications. The transportation requirements of the Hat Creek development include:

a) transportation services for coal from the mine site to the thermal power plant;

b) access to the mine and to the thermal plant for equipment, supplies, employees and others;

c) transportation of ash from the thermal plant to the mine site;

d) airstrip facilities near the mine to accommodate the air travel and transport associated with the construction and operations of the mine;

e) transportation services for coal from the mine site to Alberta for a test burn.

In view of the many alternatives which required evaluation, the engineering detail was limited to a level of accuracy which would allow order-of-magnitude estimates of cost.

The coal transportation systems considered in this study are all designed to handle the peak daily volume requirements of a 2,000 megawatt plant. The impact of increased volumes as required by a plant of up to 5,000 megawatts is discussed in this report, but is not examined in detail.

1.4 SUMMARY

The several transportation requirements of the proposed Hat Creek Development were examined and the findings are briefly summarized in the following paragraphs. Note that all of the costs shown in this report are in January 1976 dollars and a rate of interest of ten percent per annum has been assumed in the estimates of capital amortization. Details of anticipated environmental and social impacts can be found in Appendices D and E.

a) Coal Transportation

All of the systems which are known to be available for the transportation of bulk commodities were examined and it is concluded that railway unit train service is the most economic system for transporting coal from the mine to most of the potential locations for a thermal power plant. Overland conveyor systems become an effective alternative only on the short routes where the gradient is too steep for such a railway operation.

The one possible exception to these conclusions is that slurry pipelines may, in certain circumstances, be competitive with railway or conveyor and may have an environmental advantage as an alternative mode of transportation. It is recommended, therefore, that pipeline be examined in greater depth when a plant site has been selected for detailed study.

The following summary identifies the system of transportation which was found to be optimum for each plant location, the estimated cost per ton of each system, and a ranking of its environmental and social impact. The alternatives are rated on a scale of one to nine with nine being least attractive environmentally and/or socially.

FIGURE 1-2

ESTIMATED COST AND IMPACTS OF COAL TRANSPORTATION ALTERNATIVES

Plant Site	Mode	Transportation Cost $/Ton	Environmental Rank	Social Rank
Mine Mouth	Extension of mine system	-	-	-
Harry Lake	Conveyor	0.33	1	5
Big Bar Creek	Rail	2.07	8	6
	Conveyor/Rail	3.20	9	4
Ashcroft	Rail	1.12	7	8
	Rail/Conveyor	1.47	2	2
Squamish/ Britannia	Rail	6.84	4	9
	Conveyor/Rail	6.74	6	3
Roberts Bank	Rail	7.09	5	7
	Rail/Conveyor	8.07	3	1

Note 1: Transportation services from the mine to the mine mouth are considered to be part of the mine operation and are not examined, therefore, in this report.

Note 2: The conveyor and rail combination systems shown for Big Bar Creek, Ashcroft, Squamish, Britannia and Roberts Bank are alternatives which avoid the use of native Indian land.

b) Access to the Mine and Power Plant Sites

All of the potential routings for highway access to the mine and to each of the alternative power plant locations have been examined in terms of capital requirement, environmental impact and social concern. The conclusions of this part of the study are contained in Figure 1-3.

FIGURE 1-3

ESTIMATED COST AND IMPACTS OF HIGHWAY ACCESS

Plant Site	Roadway Route	Capital ($million)	Environmental Rank	Social Rank
Mine and Mine Mouth	Highway 12	5	1	4
	Medicine/ Cornwall Creek	12	2	3
Harry Lake	Highway 12	4.5	1	5
	Medicine/ Cornwall Creek	1	2	2
Big Bar Creek	North from Clinton	20	3	6
Ashcroft	Connect with Highway #1	0.5	Nominal	1
Squamish	Existing	-	Nominal	7
Britannia	Existing	-	Nominal	7
Roberts Bank	Existing	-	Nominal	8

c) Transportation of Ash

This aspect of the study was limited to an examination of the technical feasibility of backhauling ash from the plant site to the mine in the same transportation system which is used for coal. Although it is technically possible to employ a reversible conveyor to move ash, a considerable additional investment would be involved because the conveyor would have to be of a larger size to handle the ash in addition to coal, and it would have to include dust prevention and containment equipment which is not required for coal. It is not considered practical to handle ash in the same railway equipment which is used for coal. An air-slide type of railway car would more properly be used including appropriate pneumatic loading and discharge equipment in order to control the dust problem which is normally associated with the transportation of this product.

d) Airport Location

Several potential locations for an airstrip were examined. The best location is believed to be between Ashcroft and Cache Creek, west of Highway #1 and north of the existing local refuse dump. (See Section 5, Figure 5-3.) The capital cost of a Class "C" airstrip is estimated at $2.5 million. It is possible for this amount to be reduced by a Federal Government contribution of up to $175,000 for such a facility. The Provincial Government could be expected to provide planning assistance and low cost leases for the use of Crown land.

e) Transportation Service for a Test Burn

For the test burn, it was assumed that 50,000 tons of coal would be transported to the Sundance thermal plant near Wabamun, Alberta. It is proposed that the coal be trucked from the mine site to a transfer point on the C.N.R. just south of Ashcroft, then loaded into railway cars with front-end loaders and transported by rail to the plant. The estimated cost to transport the coal from the mine to Wabamun (the assumed destination) is $23.00 per ton.

SECTION 2

COAL TRANSPORT PRELIMINARY EVALUATION

SECTION 2

COAL TRANSPORT - PRELIMINARY ASSESSMENT

2.1 TRANSPORTATION MODES

Considerable progress has been made in recent years in the development of transportation systems for bulk commodities. The significant innovations include the unit train concept with its rapid loading and unloading capability, longer and higher capacity conveyors, heavy off-highway trucks, pipelines for an increasing number of bulk commodities and industrial ropeways for steep and difficult terrain. Each of these and other potential modes can become the optimum for a particular set of conditions, e.g. traffic volume, distance, terrain, service reliability and flexibility. The purpose of this section is to briefly consider each of the technically feasible modes of transportation for Hat Creek coal with a view to reducing the array of potential alternatives to those which merit detailed consideration in the next section of this report.

2.1.1 Railway

Railways are one of the most efficient and versatile modes of transportation. Their applicability and operational design, however, is a function of the terrain, length of haul and volume of traffic.

Railway systems are most effective on flat terrain with a minimum of gradient and shallow curves. Both capital and operating costs increase rapidly with increases in grade and with increases in the number of sharp curves.

Two percent grades and four degree curves are generally considered to be the upper limits in track design for railway operations.

Unit train systems are the most efficient method of railway operation for a large volume, bulk commodity. The unit train typically has railway cars and locomotives which are dedicated to the service and which are virtually in continuous motion between origin and destination. The resulting productivity from equipment and labour plus the energy efficiency of a railway operation are combined in such a system to achieve unit costs which are usually lower than other modes of overland transportation.

The particular conditions which favour unit train operations are available in several of the potential transportation routes for Hat Creek coal. This mode will be considered in detail, therefore, in the next section of this report.

2.1.2 Pipeline

Slurry pipelines have been introduced for coal transportation in at least three locations. The longest line, located in Arizona, is 273 miles in length and has an annual throughput of 4.8 million tons. A second line in Ohio is 108 miles long with an annual throughput of 1.3 million tons. The shortest line is reported to be in the U.S.S.R. at 38 miles and an annual capability of 1.9 million tons. In addition to these pipelines, several others are in the planning stage.

Pipelines have several advantages over other transportation modes. They have a low labour content for operation and are thus relatively insensitive to labour disputes and wage escalations. Pipelines also have the advantage of being normally more reliable than other modes as they are not usually affected by weather or traffic congestion. They can sometimes have minimal environmental and social impact because there is usually little in the way of above-ground structures.

One of the disadvantages of a pipeline is its inflexibility. A pipeline has a throughput which is limited to its design capacity, has a fixed origin and destination, and cannot readily be utilized for transporting other products. Pipelines also require heavy capital expenditures for the construction of the line itself as well as for the slurry preparation plant at its origin and the slurry recovery system at the destination. Compared with unit train operations, some slurry pipelines are not as efficient in the use of energy.

A factor to be considered carefully in coal pipelining is the effectiveness of the dewatering system at the destination. Difficulties have been experienced at existing applications in extracting the coal fines from the water and these problems do not appear to have been completely resolved. There is also the problem of cleansing the water of fines and dissolved chemicals at the destination before it can be disposed of or used in a power generation plant.

On the basis of a brief review of pipeline capabilities and economics, including a review of a pipeline study made available by B.C. Hydro[1], it appears that a slurry system is potentially competitive with railway over the longer haul routes and may be competitive with conveyors on shorter routes.

(1) "Coal Gasification and Related Studies - Study D, - Appendix II". Draft Submission - September, 1975. Intercontinental Engineering Limited.

It is apparent, however, that pipelines would offer only marginal savings and they do not have a proven dependability or suitability. This mode was therefore not examined in further detail. An in-depth assessment may be warranted when the plant site is selected.

2.1.3 Trucks

Trucks offer greater flexibility than most other modes in terms of adaptability to changes in volumes and/or changes in the origin and destination. They are, however, inefficient in the handling of large volume movements compared with most other modes. This is due to a relatively poor utilization of energy and labour, and a high capital investment per unit of cargo capacity. The cost disadvantage of trucks can be partially overcome by the use of large 100 to 200 ton capacity off-highway vehicles operating on a private roadway. Such vehicles, however, are only competitive in short hauls where flexibility is important and where the terrain is reasonably level. These particular conditions are not available for any of the alternatives under consideration in this study for Hat Creek coal and trucks have, therefore, been discarded as a viable alternative.

2.1.4 Conveyors

Conveyors have been commonly applied for many years in materials handling systems, for loading or unloading transportation vehicles, for transferring product from one transportation mode to another, and for moving product short distances to and from stockpiles. More recently, conveyors have been used effectively as an overland transportation mode, particularly where rough and/or steep terrain prohibits the use of other systems.

Overland conveyor systems have the advantage of being highly automated and relatively insensitive, therefore, to labour disputes and wage escalations. They are also less disruptive to the environment than some of the other systems.

The major disadvantages of conveyors are their inflexibility in terms of throughput volumes, type of traffic and changes in origin and/or destination.

Conveyors are to be considered in detail in the next section of this report since some of the routes out of the Hat Creek Valley are through the steep and rough terrain which can be bridged effectively by a conveyor system.

2.1.5 Ropeways

There have been several applications of industrial ropeways in recent years for the transportation of ore over rough, steep terrain. Ropeways consist of buckets attached to cables which are suspended between towers. Their advantage of being able to traverse rugged terrain with a minimum of disturbance is countered by high capital investment and limited throughput. There are no installations moving volumes which approach those anticipated in the Hat Creek development.

A brief review of ropeway economics revealed that its cost would be roughly twice that of a conveyor, and that ropeways would offer no other advantages in the transportation of Hat Creek coal. For this reason, a ropeway was not examined in further detail.

2.1.6 Funicular Railway

Funicular or cable railways combine the ability of conveyor and ropeway to climb steep terrain with some of the advantages of a railway system. They are efficient, however, only on very short hauls with uniform gradients. A brief study indicated that it could not compete with conveyor for the short haul routes and, since there were no other advantages offered by this mode, it was not considered further in the study.

2.2 ROUTE SELECTION

The preliminary assessment of transportation alternatives indicated that railway is the preferred system whenever it can be applied and that conveyor is the preferred mode for rough and steep terrain. In the light of these findings, the geography and topography of the Hat Creek area was examined in detail to identify all of the potential routes between the mine and the alternative sites for power plants which can be supplied by railway or conveyor or a combination of these modes.

The terms of reference requested that consideration be given to at least one transportation route to each plant site which avoids the use of native Indian lands. The specific routings of the transportation alternatives, including those which do not require the use of native Indian lands, are outlined in the following paragraphs.

2.2.1 Plant Site at the Mine Mouth

It is presumed that the handling system for coal from the mine to the mine mouth would be common to all schemes and should be considered as part of the mine operation. No attempt was made, therefore, to identify or evaluate the potential alternatives for transporting coal to a mine mouth location.

2.2.2 Plant Site at Harry Lake

This site is located about 2½ miles east of the mine and at an elevation some 1,200 feet above the mine. Conveyor appears to be the only practical alternative for this relatively steep terrain and the conveyor in this case can follow a direct route from the mine to the plant. Since there are no native Indian lands involved in this routing, it was not necessary to consider other, more costly, alternatives.

2.2.3 Big Bar Creek

The two routes to Big Bar Creek which were selected for detailed assessment were:

a) railway following Hat Creek from the mine site to Carquile, then via the proposed Ashcroft/Clinton Connector to Clinton and from there via a new rail line to Big Bar Creek.

b) a conveyor/railway combination with the conveyor following the route of Sallus Creek from the mine site to Glenfraser, then by B.C. Rail to Clinton and from there via a new rail line to Big Bar Creek. This alternative does not encroach upon native Indian lands.

A second possibility for railway routing from the mine to Pavilion and then to Big Bar Creek via Clinton was examined briefly but was found to be inferior to the routing outlined in a) above because of relatively higher construction cost, which would result from a slightly longer distance and a greater number of adverse grades.

Other possibilities which were examined briefly were a rail route which parallels the Fraser River from Pavilion to Big Bar Creek and a route north from Kelly Lake paralleling an existing road. The route paralleling the Fraser River was found to have a significantly higher construction cost than the routing outlined in a) above and was also undesirable from an environmental standpoint since it would interfere with the big-horn sheep population. The route north of Kelly Lake was found to have excessive grades.

2.2.4 Plant Site at Ashcroft

The routes considered to be optimum from the mine to a power plant near Ashcroft are as follows:

a) railway via a new line from the mine to Carquile and then south paralleling Highways 97 and 1 to the plant site location.

b) a railway/conveyor combination with a new rail line from the mine south to the head of Oregon Jack Creek (three miles east of Upper Hat Creek) and then via conveyor to the plant site. This route avoids alienation of native Indian lands.

Also considered was the possibility of an all-rail route from the mine to the south end of the Hat Creek Valley then along Oregon Jack Creek to the plant site; and an all-rail route directly east from the mine via Medicine and Cornwall Creeks and then south to the plant site. Both of these routes were found to have grades which would be too steep for practical railway operations.

Another alternative consisting of a rail line to the Ashcroft/Clinton Connector and then via the latter to the C.N.R. connection at Semlin and along the C.N.R. main line to the power plant site,was studied and found to be impractical because it is considered unlikely that the C.N.R. would permit the use of a few miles of their track at the cost of tying up a significant portion of their mainline capacity. This route would also require additional transfer equipment at the discharge end to accommodate expected differences in rail and plant elevations.

An alternative conveyor/railway route comprising a conveyor system along Medicine and Cornwall Creek Valleys to the vicinity of Highway 1 and then by railway to the plant site was also examined. This alternative would have a higher cost, however, since it covers the same total distance as the Oregon Jack Creek route but has a longer conveyor segment.

2.2.5 Squamish/Britannia

These two sites are located on the same rail line within 9 miles of each other and because they are in the same area no attempt was made to differentiate between them at this stage from the main line haul point of view. The two practical routes are:

a) railway via a new rail line from the mine to Pavilion and then via B.C.R. to the plant.

b) conveyor from the mine to Glenfraser then south by railway over the B.C.R. to the plant site.

Rail access from the mine to these plant sites is also possible via a new rail line to Carquile, then over the Ashcroft/Clinton Connector to Clinton and from there over the B.C.R. This alternative route was not considered competitive as it is 85 miles longer, the elevation change is greater, and there are no apparent advantages over route a) as described above.

Another possible route which was considered but deemed uneconomic was east to either the C.N.R. or C.P.R. mainline, using either railway to the Lower Mainland and then over B.C.R. north to Squamish or Britannia. In addition to higher costs, this route would add to the congestion which already exists in the Lower Mainland railway systems.

2.2.6 Plant Location at Roberts Bank

A Roberts Bank plant location can be adequately served by either the C.P.R. or the C.N.R. systems. The alternative routings considered in this study were:

a) railway with a new rail line from the mine to the Ashcroft/Clinton Connector at Carquile, on the connector to the C.N.R. or C.P.R. lines and then over either or both of these lines to Roberts Bank.

b) a railway/conveyor combination with a new rail line south to the head of Oregon Jack Creek, via conveyor from there to a loading facility at Basque and then over either or both the C.N.R. and C.P.R. lines to Roberts Bank.

The other routing possibilities for this plant site are the same as those outlined for transporting the coal to the Squamish and Britannia plant sites. From a tidewater location on Howe Sound the coal could either be transferred to a barge system for the last leg of the journey to Roberts Bank or moved by rail through the Lower Mainland rail system to the plant. Neither of these alternatives was considered practical because of higher cost and the congested railway lines in the Lower Mainland.

2.3 SELECTED COAL TRANSPORT SYSTEMS

Figure 2-1 contains a summary of the alternatives which have been identified above as the routings which merit detailed examination in the next section of this report.

FIGURE 2-1 SELECTED COAL TRANSPORT SYSTEMS

Plant Location	Alternative Number	Carrier	Route
Mine Mouth	1.	Extension of mine transport	Plant assumed to be adjacent to mine.
Harry Lake	1.	Conveyor	Direct line mine to plant.
Big Bar Creék	1.	Rail	New rail line from mine to Carquile, Ashcroft/Clinton Connector then new rail line Clinton to Plant Site.
	2.	Conveyor	Mine to Glenfraser via Sallus Creek.
		Rail	Existing B.C.R. to Clinton then new rail line to Plant Site.
Ashcroft	1.	Rail	New rail line from mine to plant parallel to Highways 12, 97 and 1.
	2.	Rail	New rail line from mine south to head of Oregon Jack Creek.
		Conveyor	Conveyor from head of Oregon Jack Creek to Plant Site.
Squamish/ Britannia	1.	Rail	New rail line from mine west to Pavilion then existing B.C.R. line to Plant Sites.
	2.	Conveyor	Mine to Glenfraser via Sallus Creek.
		Rail	Existing B.C.R. line Glenfraser to Plant Sites.

FIGURE 2-1 SELECTED COAL TRANSPORT SYSTEMS (continued)

Plant Location	Alternative Number	Carrier	Route
Roberts Bank	1.	Rail	New rail line mine to Carquile, Ashcroft/Clinton Connector to existing C.N.R./ C.P.R. line, existing lines to Plant Site.
	2.	Rail	New rail line from mine south to head of Oregon Jack Creek.
		Conveyor	Mine to Basque.
		Rail	Existing C.N.R./ C.P.R. line Basque to Plant Site.

Notes: Alternatives 1 (except Harry Lake) require additional alienation of native Indian lands.

Alternatives 2 do not require use of native Indian lands.

SECTION 3

COAL TRANSPORT DETAILED ANALYSIS

SECTION 3.0

TRANSPORTATION

3.0 TRANSPORTATION - DETAILED ANALYSIS

The transportation alternatives for coal which appeared to merit detailed consideration in this study included railway, conveyor and a combination of these two modes. It is the purpose of this section to:

- Discuss the specific railway and conveyor requirement for each of the routes to which these modes apply
- Describe the storage facilities and the transfer facilities which are required on those routes which involve a combination of railway and conveyor
- Present an analysis of the cost and the environmental and social impacts of each of the transportation systems for each of the potential plant locations.

This study also considered the possibility of returning ash from thermal plant sites to the mine site as a back-haul with the same facilities which would be used to transport coal. Conclusions on this aspect are contained in the last paragraph of this section.

3.1 RAILWAY AND CONVEYOR FACILITIES FOR COAL

3.1.1 Train Operations

All of the railway services which were contemplated in this study would employ the "unit train" method of operation.

The essence of a unit train is that the service operates between origin and destination on a continuous basis with rail cars permanently coupled together and with loading and unloading facilities which operate while the train is in motion. The more common operation which involves long trains of 50 to 100 rail cars and a full train crew to direct and control the operations was examined for all of the longer haul requirements. The feasibility of a more automated system, electrically powered and operated with a one-man crew, was considered for the short operation between the mine site and the head of Oregon Jack Creek.

The optimum size of train is related to such factors as the volume of traffic, distance travelled and roadway gradients. Figure 3-1 shows the size of trains which appear to be optimum for the several routes considered in this study in terms of the numbers of railway cars and locomotives.

FIGURE 3-1

TRAIN OPERATIONS

Route	Distance (miles)	Cars/ Train	Locos/ Train	Trains/ Day
Mine to Big Bar Creek	80	50	5	8
Glenfraser to Big Bar Creek	75	50	5	8
Mine to Ashcroft	31	80	3	5
Mine to Oregon Jack Creek	14	20	2	20
Mine to Squamish	160	91	8	3½
Glenfraser to Squamish	140	98	9	3¼
Mine to Roberts Bank	245	98	3	3¼
Basque to Roberts Bank	210	98	3	3¼

Several of the potential railway routes would require the construction of new roadbed and trackage. The segments of new line which have been considered in this study and their estimated capital requirement are shown in Figure 3-2(a). These estimates do not include the cost of the land which would be required for the railway lines.

FIGURE 3-2(a)

ESTIMATED CAPITAL REQUIRED FOR NEW RAILWAY LINES

Location	Construction Distance (miles)	Capital ($ millions)
Mine to Carquile	14	10.1
Clinton to Big Bar Creek	41	23.4
Mine to Ashcroft	31	23.9
Mine to Oregon Jack Creek	14	10.8
Mine to Pavilion	16	19.8
Loop Track at Glenfraser	-	5.5
Loop Track at Basque	-	4.3
Loop Track at Plant Site	-	1.1
Loop Track at Mine	-	1.1

Figure 3-2(b) contains an estimate of the capital cost per ton for each railway transportation route, based upon the capital required for new rail lines as indicated in Figure 3-2(a) plus the capital required for rolling stock (railway cars and locomotives).

FIGURE 5-2(b)

ESTIMATED CAPITAL COST PER TON RAILWAY SERVICES

Railway Route	Route Miles	New Rail Line Miles	New Rail Line Capital ($ m)	Rolling Stock ($ m)	Annual Capital Recovery ($ m)	Total Per Ton $
Mine to Big Bar Creek	80	55	35.7	24.3	6.9	0.65
Glenfraser to Big Bar Creek	75	41	30.0	24.3	6.3	0.55
Mine to Ashcroft	31	31	26.1	11.6	4.2	0.40
Mine to Oregon Jack Creek	14	14	10.8	9.7	2.4	0.20
Mine to Squamish	160	16	22.0	50.8	9.0	1.00
Glenfraser to Squamish	140	-	6.6	45.0	6.6	0.75
Mine to Roberts Bank	245	14	12.3	25.5	4.6	0.55
Basque to Roberts Bank	210	-	5.4	25.5	3.9	0.45

The costs per ton in Figure 3-2(b) assume capital recovery at an annual interest rate of ten percent as prescribed in the Terms of Reference for this study, amortized over a period of 15 years for rolling stock and 35 years for new rail lines. The unit costs were based on the assumption that the four interior sites would receive 11 million tons of coal per year while the coastal sites would receive 8.8 million tons per year.

For purposes of estimating the cost of railway service, it was assumed that the new railway lines to service the short-haul alternatives, i.e., Big Bar Creek and Ashcroft, would be built and operated by B.C. Hydro. The cost of the service, then, is the total of capital recovery and operating cost as indicated in Figure 3-3.

In the case of railway services to Squamish, Britannia or Roberts Bank, the operation would be largely over existing railway lines and it was assumed, therefore, that one or the other of B.C.R., C.N.R. or C.P.R. would construct the additional railway line and would provide the railway services at a price to be determined in a negotiated tariff. To estimate the probable railway tariff, a rough indication of rates was obtained from the railways (see Appendix B) and this indication was compared with tariffs which are apparently in effect for coal movements between other origins and destinations. The railways indicated rates of:

- $8.35 per ton from the mine to Squamish
- $5.65 per ton from Glenfraser to Squamish
- $8.90 per ton from the mine or from Ashcroft to Roberts Bank.

For comparison purposes, the brief analysis of tariffs for other coal movements revealed that the railways are obtaining rates which are equivalent to the total of capital and operating costs plus a mark-up of from twenty-five to fifty percent - the fifty percent applying to shorter hauls. Since Hat Creek would fall into the short-haul category, it may be reasonable to assume that the railways would require a minimum mark-up of fifty percent. On this basis one would expect the tariff to be approximately:

$4.65 per ton from the mine to Squamish
$3.80 per ton from Glenfraser to Squamish
$4.55 per ton from the mine to Roberts Bank
$4.00 per ton from Ashcroft to Roberts Bank.

The difference between these estimates and the railways' indications above may partially reflect a need by the railways for a higher rate of interest on capital than the ten percent which has been assumed in this analysis. (The ten percent rate of interest is in line with utility financing but is less than would normally be required by a railway company for new capital expenditures.) It probably also reflects the opportunity cost to C.N.R. and C.P.R. of utilizing the limited remaining capacity of their main railway lines to the Lower Mainland and the cost of increasing this capacity, and the substantial capital investment which would be required by B.C.R. to upgrade its line to the standards which would be required to handle Hat Creek coal. In any event, however, it appears that there would still be a fairly broad scope for negotiation even after allowing for these factors and that the rates which would ultimately apply will fall between the rough boundaries of the "costs plus fifty percent" as shown above and the indications received from the railways. For purposes of this study, it has been assumed that rates will fall mid-point between these upper and lower limits. (An attempt to define the probable rate level more precisely would be speculative only since it is in the process of actual negotiation with the railways that the rate will be finally determined.)

FIGURE 3-3

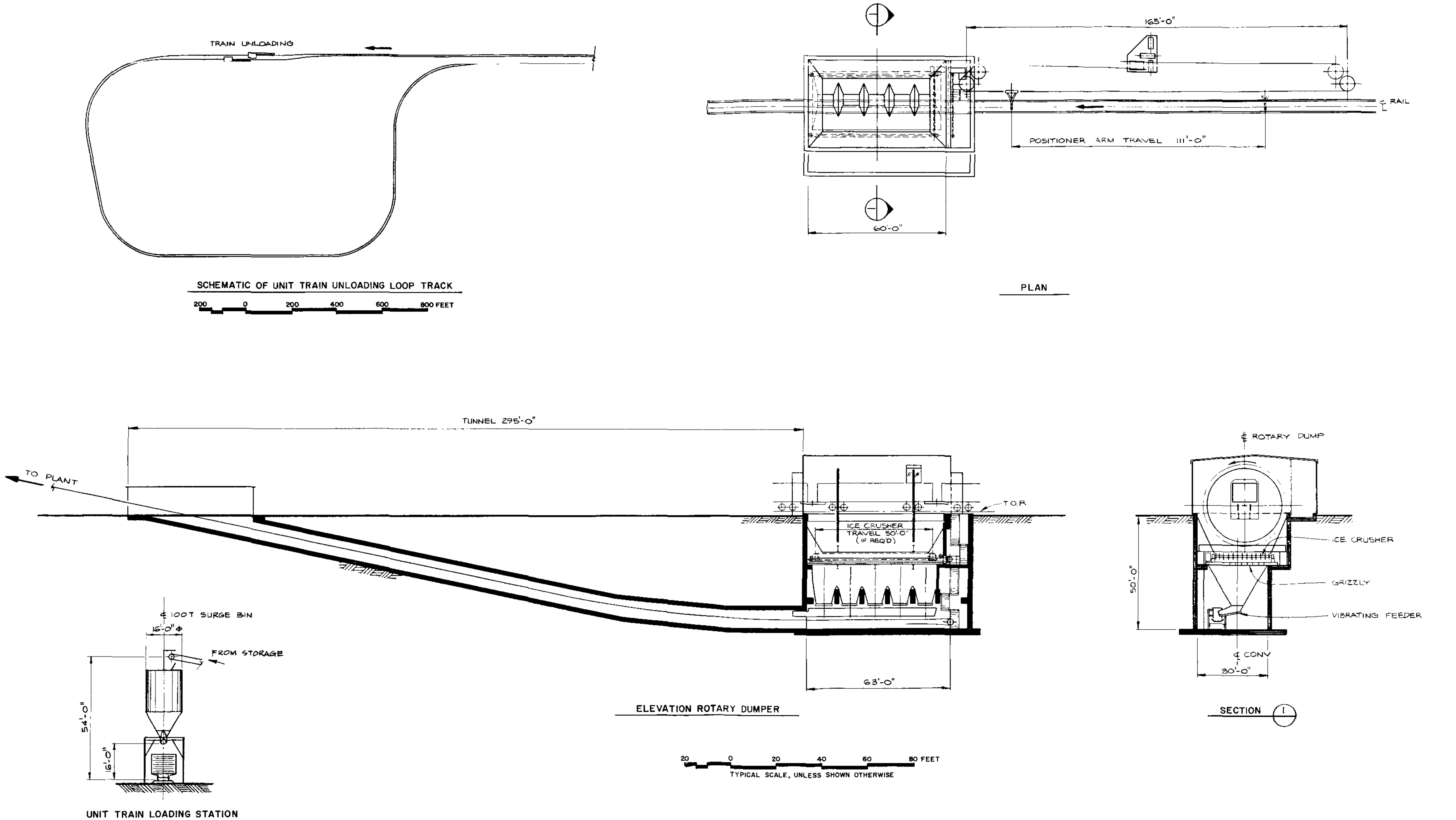
ESTIMATED RAILWAY COSTS AND TARIFF

Route	Capital Recovery ($/Ton)	Operating Cost ($/Ton)	Total Cost ($/Ton)	Freight Tariff ($/Ton)
Mine to Big Bar Creek	0.65	1.15	1.80	N/A
Glenfraser to Big Bar Creek	0.55	1.05	1.60	N/A
Mine to Ashcroft	0.40	0.45	0.85	N/A
Mine to Oregon Jack Creek	0.20	0.30	0.50	N/A
Mine to Squamish/ Britannia	1.00	2.10	3.10	6.50
Glenfraser to Squamish/Britannia	0.75	1.80	2.55	4.75
Mine to Roberts Bank	0.55	2.50	3.05	6.75
Basque to Roberts Bank	0.45	2.20	2.65	6.45

The operating costs shown in Figure 3-3 are based upon formulae developed by the McPherson Royal Commission on Transportation. Base data for calculation of these costs was taken from the railway transport publications of Statistics Canada for the years 1964 to 1974 projected to January 1976 and adjusted for the significant rate of inflation which occurred in 1975.

3.1.2 Unit Train Loading at the Mine Site

To load unit trains at the mine site would require an elevating conveyor from coal storage feeding into a surge bin mounted over the tracks (see Figure 3-4). The train would be flood loaded as it passes through the facility



UNIT TRAIN LOADING AND UNLOADING

SWAN WOOSTER ENGINEERING CO. LTD. **FIGURE 3-4**

at a speed of about 1/2 mile per hour. This facility would have an initial capital cost of $0.4 million. At an interest rate of ten percent the annual capital cost would be $0.1 million. The facility would be operated in conjunction with the mine storage and operating costs are included in those shown for the mine storage in paragraph 3.3.1.

3.1.3 Unit Train Unloading at the Plant Site

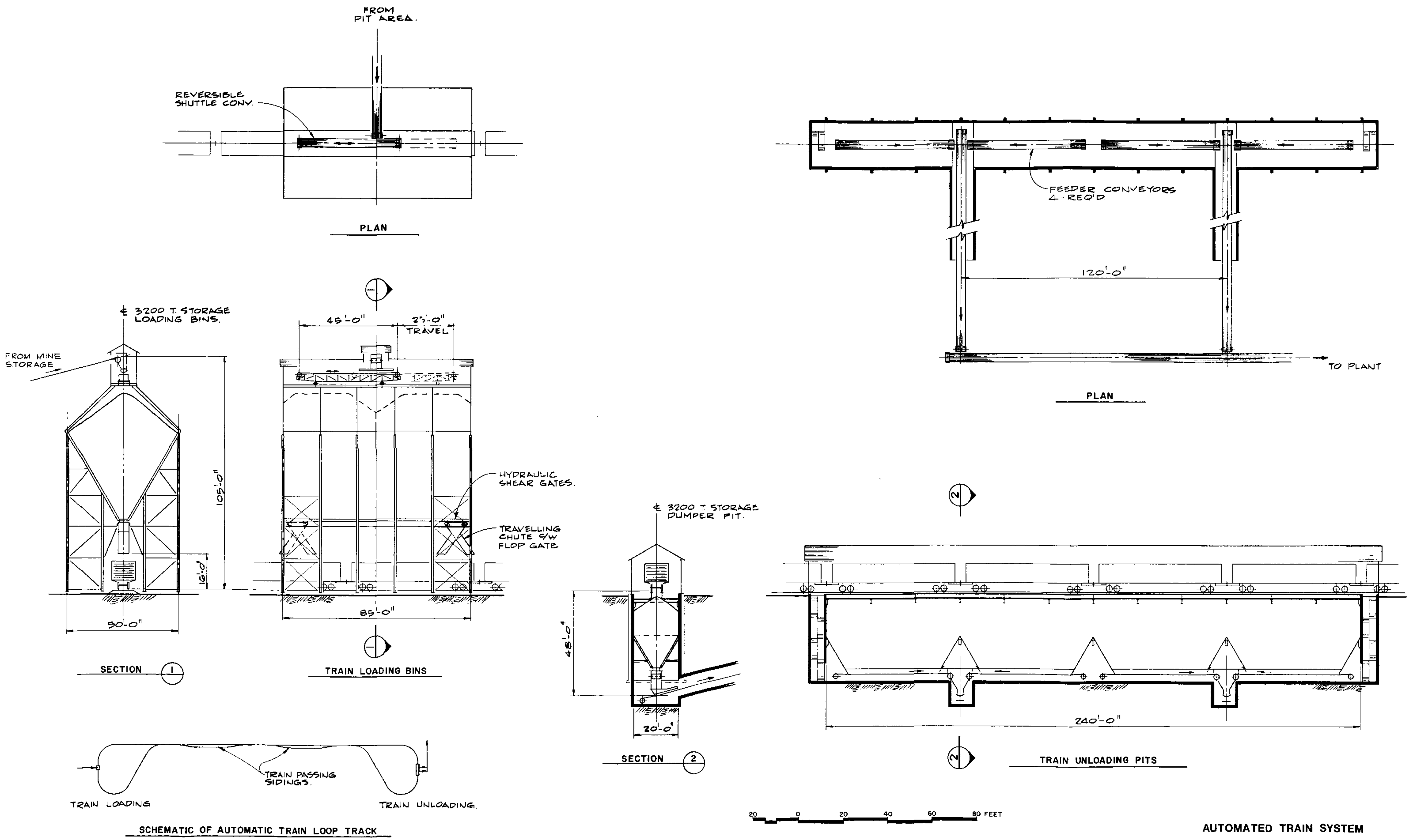
One of the most common and effective systems for unloading unit trains is illustrated in Figure 3-4. Two rotary dumpers would be required to handle the volume of Hat Creek coal with double loop trackage and train indexers for advancing complete trains through the dumpers. In this facility, coal from the rail cars would be dumped into receiving hoppers and elevated from there to ground level storage by conveyor.

This facility would have an initial capital outlay of $5.2 million and would have an annual capital cost of $0.8 million assuming an interest rate of ten percent. Operating costs would be approximately $0.7 million annually.

3.1.4 Loading for Automated Train Operation

The relatively short trains contemplated in the railway service from the mine to Oregon Jack Creek would be loaded from an elevated bunker which would have sufficient capacity to load the entire train without refilling. The bunker would be filled by an elevating conveyor and the rail cars would be loaded by gravity from hydraulically operated shear gates as the train passes beneath the bunker (see Figure 3-5).

The estimated capital cost of this facility would be about $1.6 million and the annual capital cost would be $0.3 million, assuming an interest rate of ten percent. Operating



AUTOMATED TRAIN SYSTEM

SWAN WOOSTER ENGINEERING CO. LTD. **FIGURE 3-5**

costs are included in the mine storage costs as described in paragraph 3.3.1.

3.1.5 Unloading Automated Trains

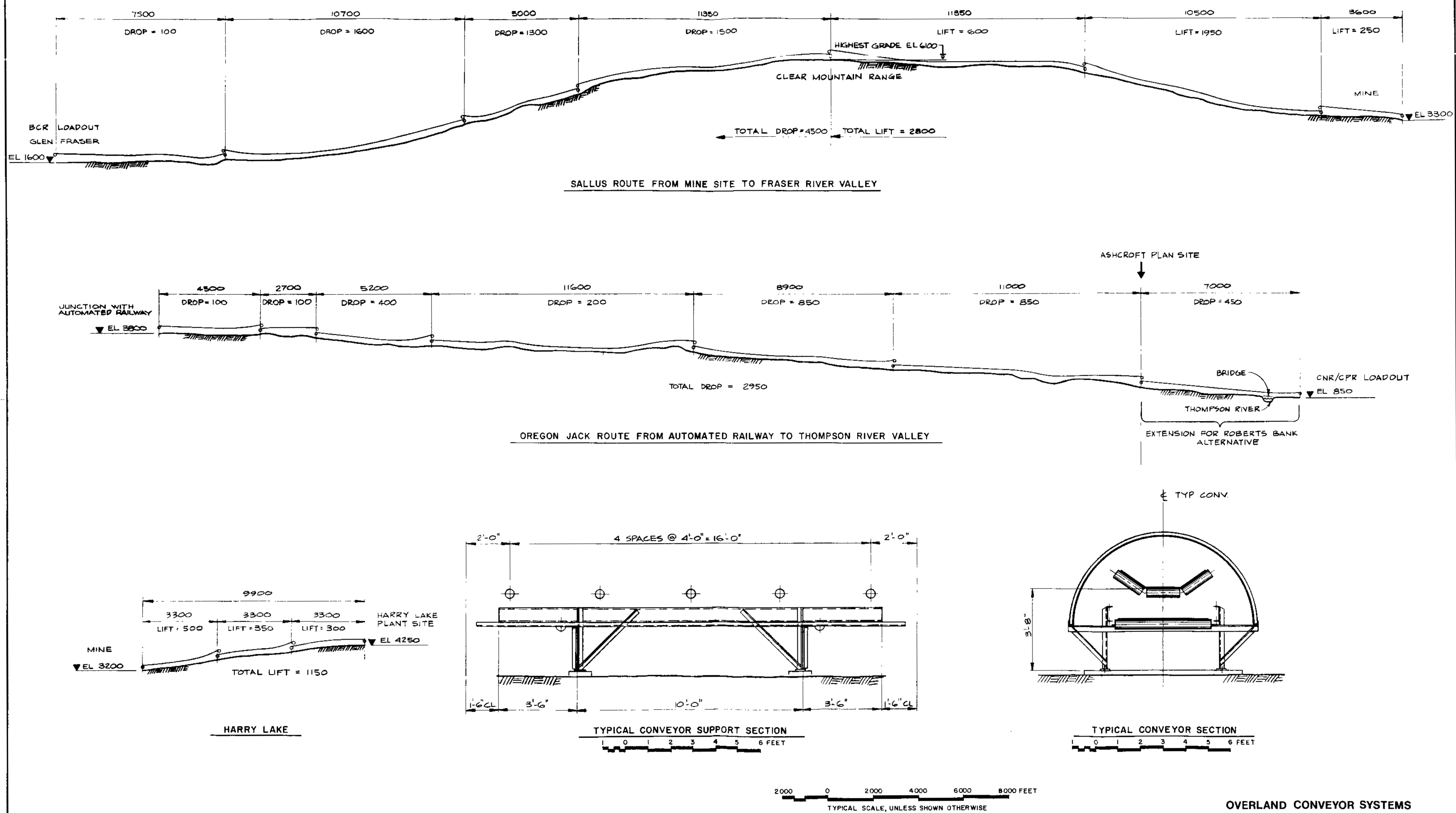
The bottom-dump rail cars which would be used in this case would have their discharge doors opened automatically as the train passes over a long receiving hopper at the destination. The product would then be moved from the hopper to storage via an elevating conveyor. (See Figure 3-5.) The capital and operating costs of this facility are included in the estimates for storage and other transfer facilities at Oregon Jack Creek as shown in paragraph 3.2.3.

3.1.6 Overland Conveyor Facilities

Three overland conveyor alternatives were considered in some depth in this study. One line connects the mine with a plant site at Harry Lake. The second line from the mine site over the Clear Mountain range to Glenfraser provides alternative access to B.C. Rail for services to Big Bar Creek, Squamish or Britannia. A third line connects with rail at the head of Oregon Jack Creek to carry product to a plant site at Ashcroft or to transfer product to C.N.R. or C.P.R. near Ashcroft for transportation to Roberts Bank.

A single 48 inch wide conveyor, protected from wind and precipitation by a continuous cover such as the one illustrated in Figure 3-6, would be able to handle the anticipated volumes of traffic and would have sufficient surplus capacity for catch-up requirements and for any peaking in the volume of coal to be moved.

The reliability of conveyors is comparable with other transportation components considered in this study. It was not considered desirable or necessary, therefore, to



OVERLAND CONVEYOR SYSTEMS

SWAN WOOSTER ENGINEERING CO. LTD. **FIGURE 3-6**

provide back-up capability in the form of a second, standby conveyor line. Sufficient storage capacity at the plant site, or at the interchange point in the case of railway/ conveyor combination, would be necessary, of course, to protect against normal breakdowns or delays in the transportation system.

The estimated capital costs for the conveyor systems are shown in Figure 3-7(a) and the estimated annual and unit costs including capital and operations are shown in Figure 3-7(b). Costs of access roads which are required for inspection and maintenance purposes are included in these estimates. Estimates do not include the cost of the land which would be required for the conveyor and its access road.

3.2 STORAGE AND INTER-MODAL TRANSFER FACILITIES

3.2.1 Mine Storage and Reclaim

Storage at the mine site will require cover to protect the product from ice and snow. An effective facility for this purpose is an A-frame shed with a "paddle-wheel" feeder/ reclaimer. (See Figure 3-8.) Stockpiling into this structure would be by overhead conveyor and this conveyor would be carried beyond the shed to permit stockpiling in an open area for emergency storage.

It was assumed that the storage facility would be required to accommodate four to five days of consumption, i.e. about 80,000 tons of live storage and 80,000 tons of emergency stock.

FIGURE 3-7(a)

ESTIMATED CAPITAL REQUIREMENT ($ MILLIONS) - CONVEYOR SYSTEMS

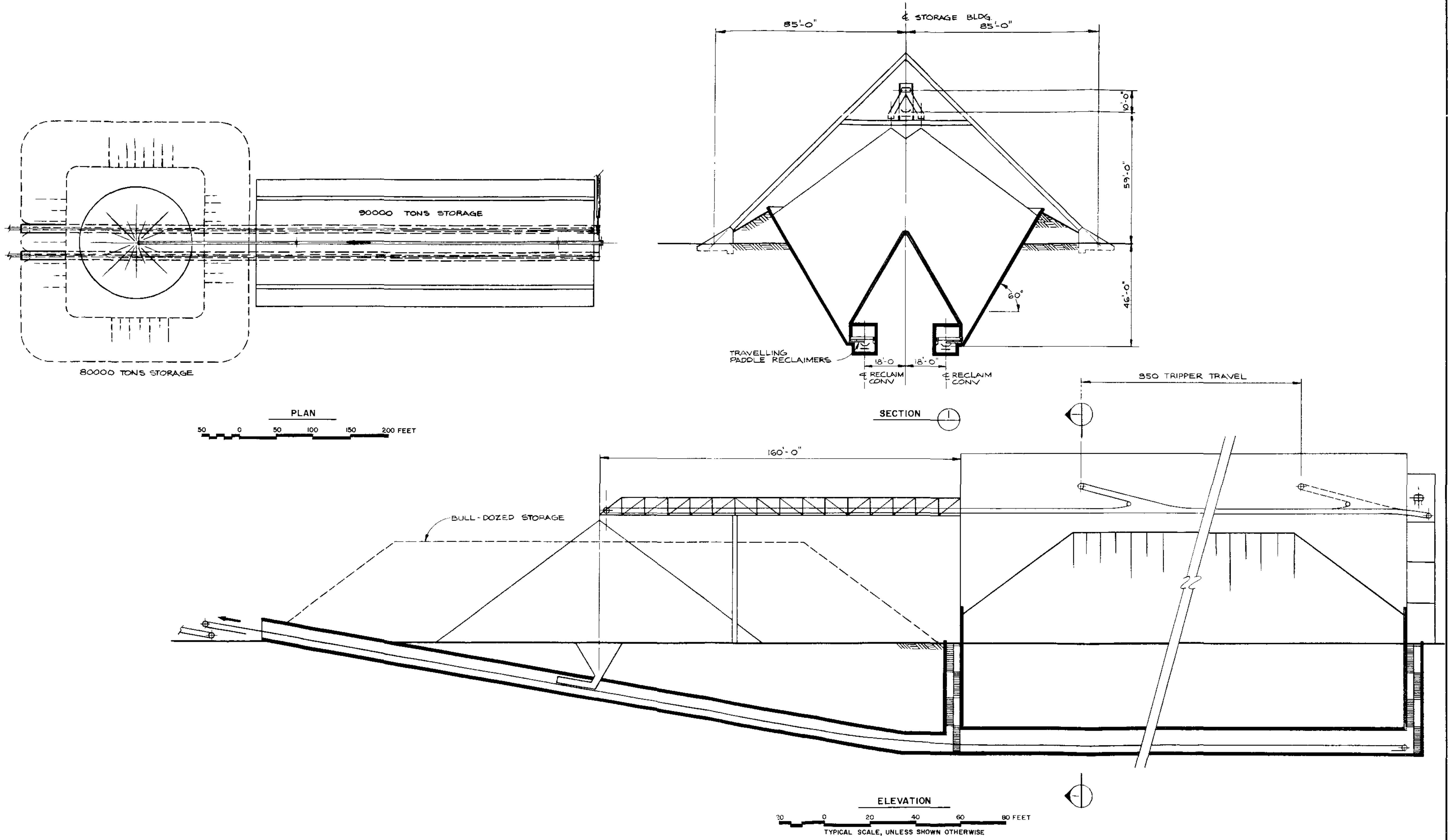
Route	Distance	Mechanical ($ millions)	Electrical ($ millions)	Civil ($ millions)	Total ($ millions)
Mine to Harry Lake	2	2.8	2.4	3.2	8.4
Mine to Glenfraser	12	15.6	11.0	21.7	48.3
Oregon Jack Creek to Ashcroft	12	10.1	8.4	14.9	32.4

FIGURE 3-7 (b)

ESTIMATED ANNUAL COST - CONVEYOR SYSTEMS

Route	Volume of Coal (million tons)	Capital Recovery ($ /Ton)	Operations ($ /Ton)	Total Annual Cost ($/Ton)
Mine to Harry Lake	11	0.10	0.10	0.20
Mine to Glenfraser				
- enroute Big Bar Creek	11	0.65	0.55	1.20
- enroute Squamish or Britannia	8.8	0.80	0.70	1.50
Oregon Jack Creek-Ashcroft				
- enroute Ashcroft	11	0.40	0.30	0.70
- enroute Roberts Bank	8.8	0.55	0.40	0.95

Note: Annual capital recovery assumes an interest rate of ten percent and an estimated life of seven years for mechanical, fifteen years for electrical and thirty-five years for civil components.



MINE STORAGE

SWAN WOOSTER ENGINEERING CO. LTD.

FIGURE 3-8

The estimated cost of this size of facility is $7.3 million with an annual capital cost of $0.9 million at an interest rate of ten percent. Operating costs are estimated at $0.5 million.

3.2.2 Conveyor to Railway Transfer at Glenfraser or Basque

The transfer facility at Glenfraser would include storage and reclaim as well as a rail car loader, and would be similar in general to the one already described for the mine site (see Figure 3-8). It was considered that storage for about 80,000 tons should be provided at Glenfraser as a buffer against interruption and delay in the conveyor and railway links in the system.

The costs of these transfer facilities are estimated at $7.3 million capital with an annual capital cost of $0.9 million at an interest rate of ten percent. Annual operating costs are estimated at $0.5 million.

3.2.3 Railway to Conveyor Transfer at Oregon Jack Creek

The transfer operation at Oregon Jack Creek will include train discharge as previously described in paragraph 3.1.5 as part of the mine site operation, and storage/reclaim facilities. It is assumed that storage should be provided at this location to protect against interruption or delay in the railway and/or conveyor segments of the system.

The estimated costs of transfer facilities at Oregon Jack Creek are $5.3 million capital with an annual capital recovery requirement of $0.8 million at an interest rate of ten percent. Operating costs are estimated at $0.5 million annually.

3.3 SYSTEM COSTS AND ENVIRONMENTAL/SOCIAL IMPACTS

The following paragraphs contain a brief description of the transportation systems which are recommended for the several potential plant sites, together with a summary of the economic, environmental and social implications of these systems. To facilitate a comparison of costs and impacts, a summary table is presented at the end of this section which shows the estimated unit cost of transportation to each plant site as well as a ranking of the environmental and social impacts.

As would be expected, the most economic route to some of the plant sites passes through native Indian lands. Where this occurs an alternative routing is considered which does not require the use of these native Indian lands. These second options are referred to as "Alternative 2" in the following review.

Note that the estimates of capital and operating costs contained in this report are in January 1976 dollars as requested in the terms of reference and an interest rate of ten percent has been applied in all calculations of annual capital recovery.

3.3.1 Plant Site at the Mine Mouth

The handling system for coal from the mine to the mine mouth would be common to all schemes and should be considered as part of the mine operation. For comparative purposes, then, there are no costs and no environmental and social impacts associated with transportation to this plant site.

3.3.2 Plant Site at Harry Lake

An overland conveyor as indicated in Figure 3-9 is the optimum means of transporting coal over the approximate 2 miles from the mine to Harry Lake. The system in this case would comprise of a single 48 inch wide conveyor, protected from wind and precipitation by a continuous cover.

Estimated costs for this system are as follows:

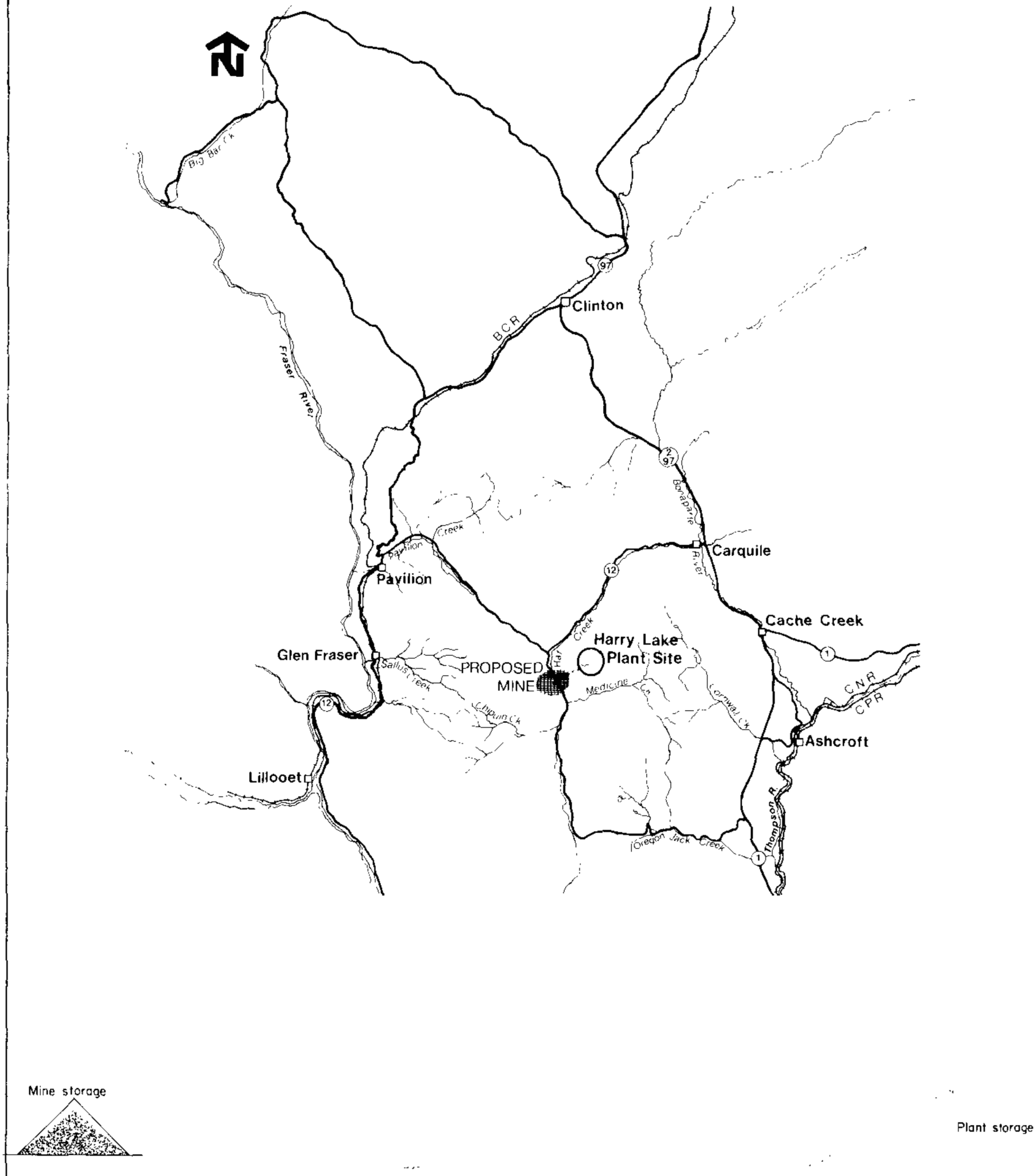
FIGURE 3-10

ESTIMATED COST - HARRY LAKE

	Capital ($millions)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage and reclaim	7.3	0.08	0.05	0.13
Conveyor	8.4	0.10	0.10	0.20
TOTAL	15.7			0.33

The environmental impact of this alternative would be relatively insignificant. A potential interference by the conveyor with the movement of ungulate such as deer and moose in the Harry Lake area can be easily overcome by providing passage ways under the conveyor line. From the social standpoint, this transportation system appears to have few impacts, either positive or negative.

FIGURE 3-9 PLAN OF COAL TRANSPORTATION SYSTEMS - HARRY LAKE PLANT SITE



Source: Swan Wooster Engineering Co. Ltd.

3.3.3 Plant Site at Big Bar Creek

a) Alternative 1

Unit train operation is possible in this area following the route of Hat Creek from the mine to Carquile, then via the proposed Ashcroft/Clinton Connector to Clinton and along a new rail line to Big Bar Creek. (See Figure 3-11.) The estimated cost of this alternative is as follows:

FIGURE 3-12(a)

ESTIMATED COST - BIG BAR CREEK - ALTERNATIVE 1

	Capital ($millions)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/ reclaim/ car loading	7.7	0.09	0.05	0.14
Railway	60.0	0.65	1.15	1.80
Rail car unloading	5.2	0.07	0.06	0.13
TOTAL	72.9			2.07

The construction of a railway between the mine and Carquile along the Hat Creek Valley would have a significant hydrological impact as a result of the need for the railway to cross the creek at several locations. The main impact of the northern leg between Clinton and Big Bar Creek is the length of the rail line and the consequent alienation of a relatively large amount of land. In this regard, it is felt that the potential impacts of this alternative on forestry, fish and wildlife, can be reduced to moderate levels through careful planning and construction of the railway.

From the social standpoint a significant impact would result from the relatively large amount of land which is required for the railway right-of-way, with 100 of the approximate 680 acres coming from native Indian lands. This negative aspect would appear to more than offset the economic advantage to nearby communities of the railway construction and operation.

b) Alternative 2

This alternative which does not encroach upon native Indian lands, requires a conveyor line from the mine site to Glenfraser and a transfer at that point to unit trains for transportation via the existing B.C. Rail line to Clinton and a new rail line from there to Big Bar Creek. (See Figure 3-11.)

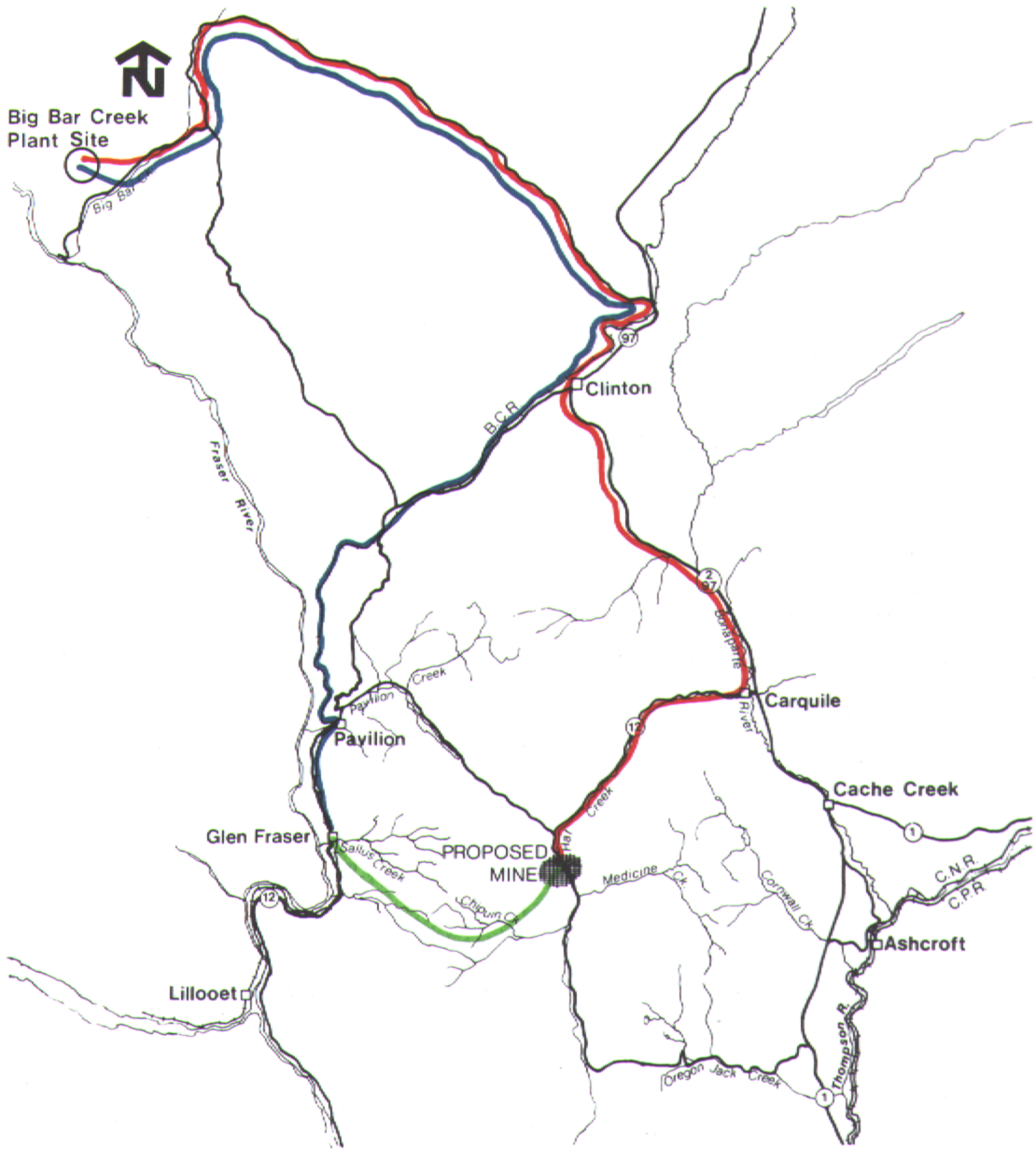
Estimated costs are as follows:

FIGURE 3-12(b)

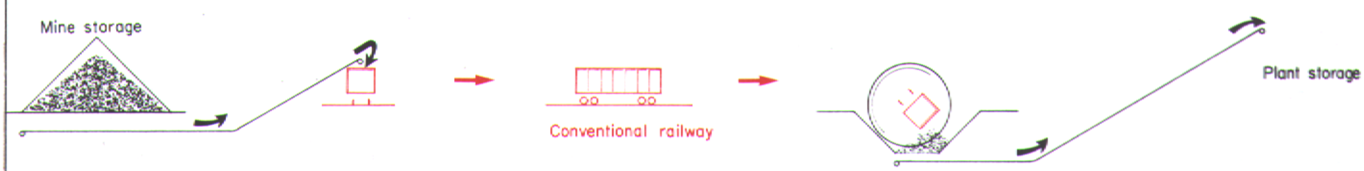
ESTIMATED COST - BIG BAR CREEK - ALTERNATIVE 2

	Capital ($millions)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/ reclaim	7.3	0.08	0.05	0.13
Overland conveyor	48.3	0.65	0.55	1.20
Storage/reclaim/ car loading	7.3	0.08	0.05	0.13
Railway	54.3	0.55	1.05	1.60
Rail car unloading	5.2	0.08	0.06	0.14
TOTAL	121.3			3.20

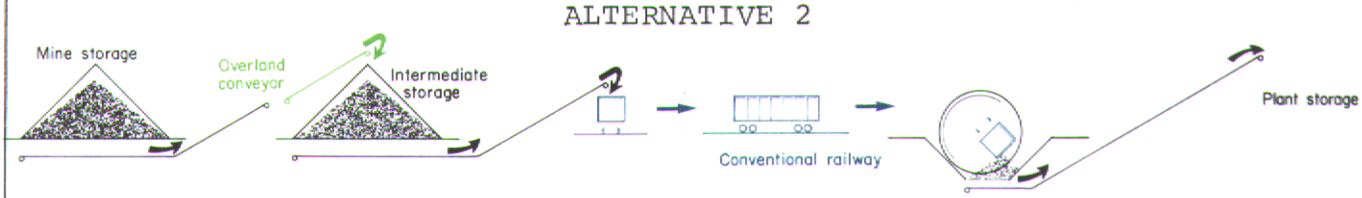
FIGURE 3-11 PLAN OF COAL TRANSPORTATION SYSTEMS - BIG BAR CREEK PLANT SITE



ALTERNATIVE 1



ALTERNATIVE 2



Source: Swan Wooster Engineering Co. Ltd.

From an environmental viewpoint, this routing is only moderately better than Alternative 1. Although it avoids the negative impacts on the Hat Creek Valley, there are erosion problems which would be difficult to overcome in the construction of a conveyor through the Sallus Creek area.

Land alienation is the major social consideration, moderated somewhat in this routing as compared with Alternative 1 by avoiding the native Indian lands in the Hat Creek Valley. On balance, however, this alternative also appears to have a significant negative impact.

3.3.4 Plant Site at Ashcroft

a) Alternative 1

Unit train is the optimum transportation mode in this case following the route of Hat Creek to Carquile and then south via a new rail line to the plant site near Ashcroft. (See Figure 3-13.) The estimated cost of this alternative is as follows:

FIGURE 3-14(a)

ESTIMATED COST - ASHCROFT - ALTERNATIVE 1

	Capital ($millions)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/ reclaim/car loading	7.7	0.09	0.05	0.14
Railway	37.7	0.40	0.45	0.85
Rail car unloading	5.2	0.07	0.06	0.13
TOTAL	50.6			1.12

The major environmental concern in this case would be the significant impact on hydrology in the Hat Creek Valley with the railway crossing the creek at several locations.

From a social standpoint, the economic benefits from the operation of the railway would be more than offset by the negative effect of land alienation including 140 acres of native Indian lands and potential urban land in the vicinity of Cache Creek. Four separate Indian Reserves would be affected by this routing. On balance this alternative is expected to have a negative impact of relatively major proportions.

b) Alternative 2

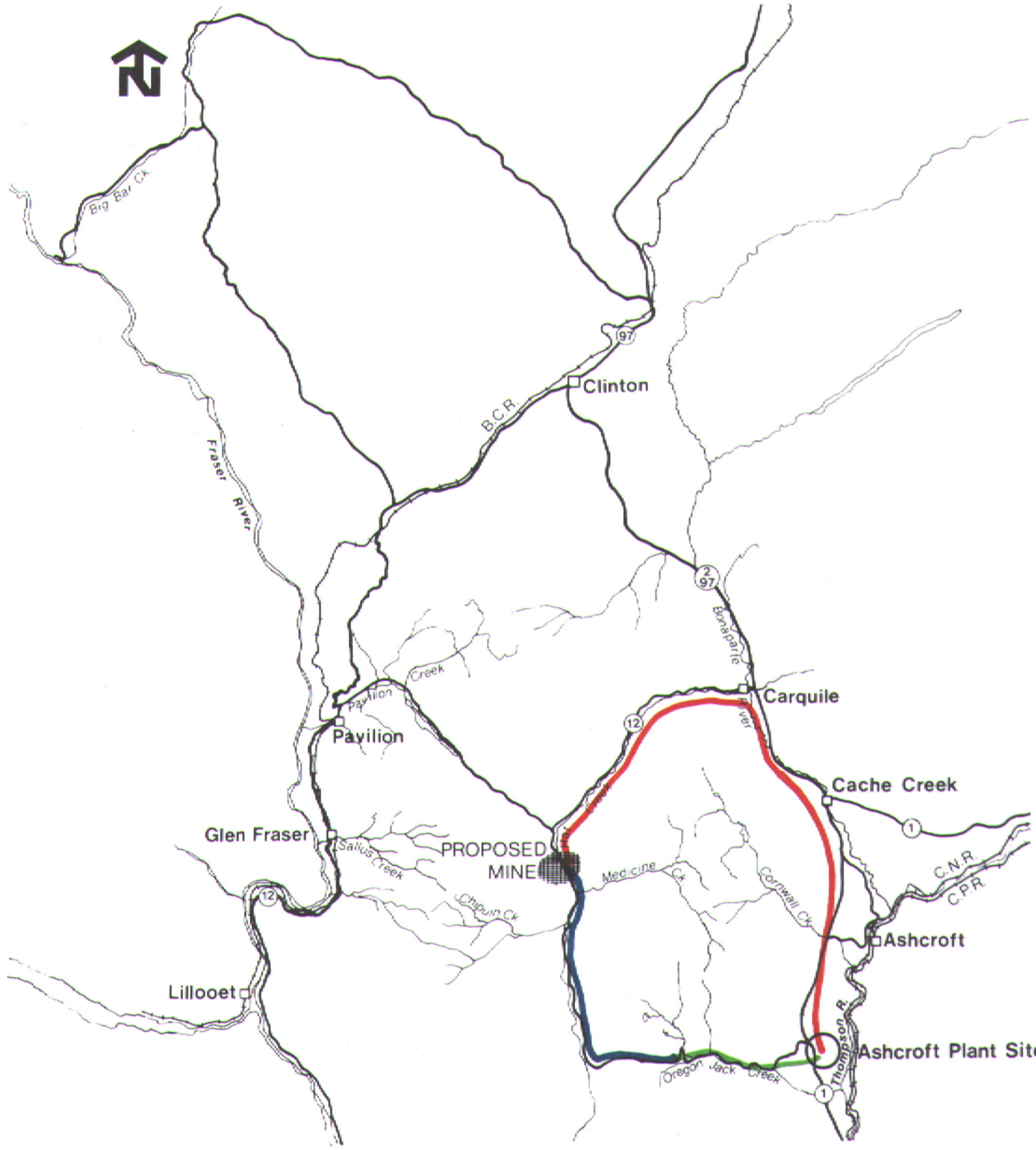
This option which does not require the use of native Indian lands, takes the southern route from the mine to the head of Oregon Jack Creek by rail with a transfer at that point to conveyor for transportation to the plant. (See Figure 3-13.) Estimated costs are as follows:

FIGURE 3-14(b)

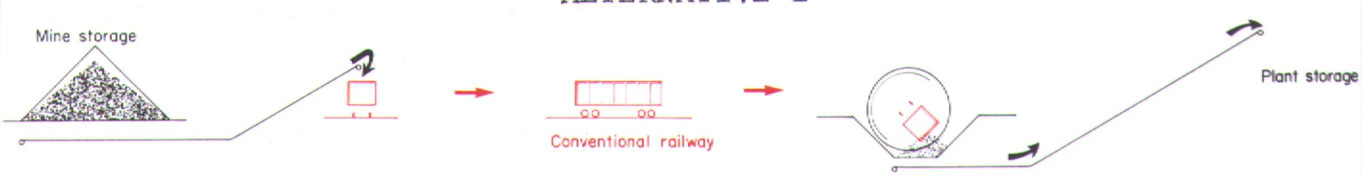
ESTIMATED COST - ASHCROFT - ALTERNATIVE 2

	Capital ($millions)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/ reclaim/car loading	8.9	0.10	0.05	0.15
Railway	20.5	0.20	0.30	0.50
Car unloading/ storage	5.3	0.07	0.05	0.12
Conveyor	33.4	0.40	0.30	0.70
TOTAL	68.1			1.47

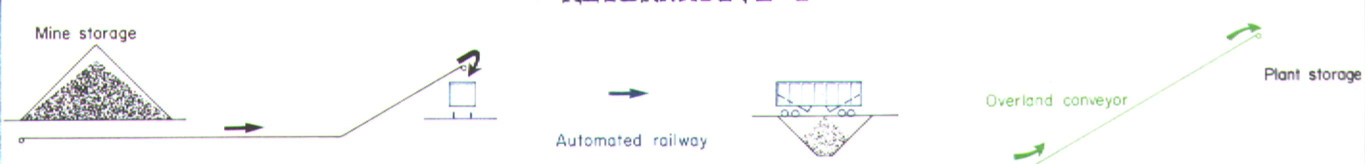
FIGURE 3-13 PLAN OF COAL TRANSPORTATION SYSTEMS - ASHCROFT PLANT SITE



ALTERNATIVE 1



ALTERNATIVE 2



Source: Swan Wooster Engineering Co. Ltd.

The conveyor section in this case would follow the deeply incised Oregon Jack Creek Valley and would present potential environmental problems in soil erosion, revegetation of disturbed areas due to a high salt content in the soil, and some interruption of the natural seepage. Careful location and construction of the conveyor would be necessary to reduce these potential impacts to moderate proportions.

The major social considerations would be the frequent train movements which could be a source of annoyance to the few residents of the Upper Hat Creek Valley. The economic stimulus would be an off-setting factor, however, to give this route a slightly favourable assessment.

3.3.5 Plant Site at Squamish or Britannia

a) Alternative 1

Unit trains in this case would follow a route from the mine site to Pavilion and then on B.C. Rail to the plant site. (See Figure 3-15.)

The estimated cost of this alternative is as follows:

FIGURE 3-16(a)

ESTIMATED COST SQUAMISH/BRITANNIA ALTERNATIVE 1

	Capital ($ Million)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/reclaim car loading	7.7	0.11	0.06	0.17
Railway	72.8	1.00	2.10	6.50*
Rail car unloading	5.2	0.09	0.08	0.17
TOTAL	85.7			6.84

*Estimated railway freight tariff.

The primary concerns from the environmental standpoint would be the extensive cut-and-fill which would be required for construction in the area of Pavilion Lake. Proper contouring and revegetation would be required to prevent erosion.

From the social viewpoint, a major concern would be the alienation of approximately 80 acres of native Indian land plus 25 acres of land in Marble Canyon Park. It seems likely that recreationalists as well as local residents would both object strongly to the noise of trains operating frequently through the canyon.

b) Alternative 2

This alternative which does not encroach upon native Indian land would utilize conveyor from the mine to Glenfraser and then transfer to B.C. Rail for transportation to the plant site. (See Figure 3-15.)

Estimated costs are:

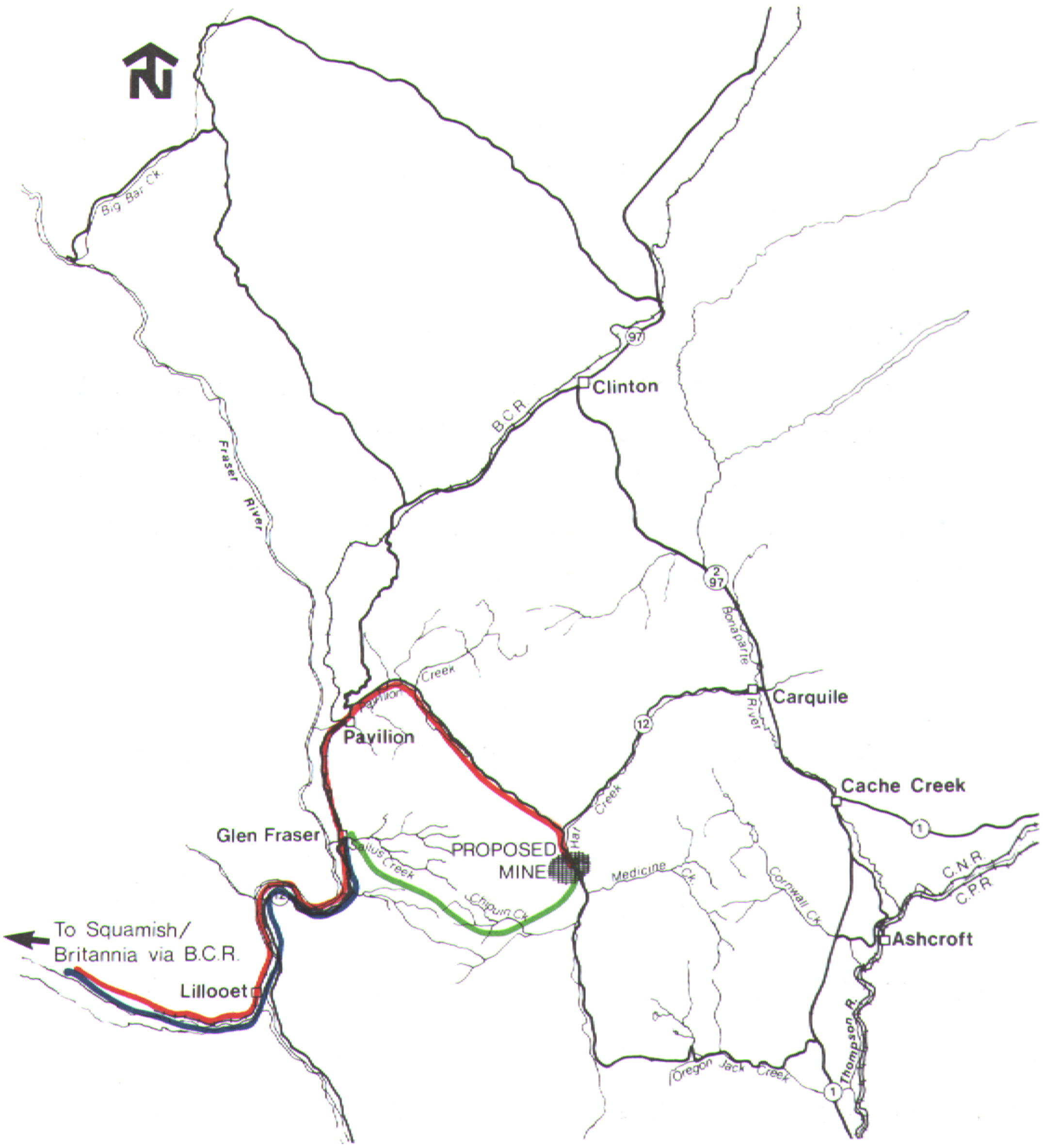
FIGURE 3-16(b)

ESTIMATED COST - SQUAMISH/BRITANNIA ALTERNATIVE 2

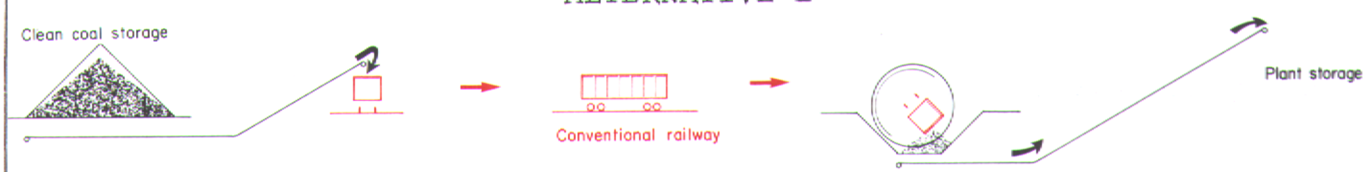
	Capital ($ Million)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/reclaim	7.3	0.10	0.06	0.16
Conveyor	48.3	0.80	0.70	1.50
Storage/reclaim/rail car loading	7.3	0.10	0.06	0.16
Railway	51.6	0.75	1.80	4.75*
Rail car unloading	5.2	0.09	0.08	0.17
	119.7			6.74

*Estimated railway freight tariff.

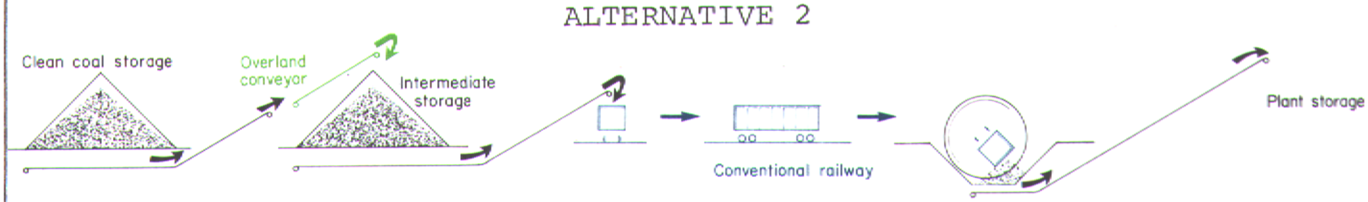
FIGURE 3-15 PLAN OF COAL TRANSPORTATION SYSTEMS - SQUAMISH/BRITANNIA PLANT SITES



ALTERNATIVE 1



ALTERNATIVE 2



Source: Swan Wooster Engineering Co. Ltd.

The major environmental concern is the conveyor section between the mine site and Glenfraser. Erosion problems on this section would be difficult to overcome.

Land alienation as a result of the conveyor right-of-way would be the major social consideration in this routing.

3.3.6 Plant Site at Roberts Bank

a) Alternative 1

Unit train is the optimum alternative following a new rail line from the mine site to Carquile, the Ashcroft/Clinton Connector to the C.N.R. or C.P.R. mainline and then one or the other of these railways to Roberts Bank. (See Figure 3-17.) The estimated cost of this alternative follows:

FIGURE 3-18(a)

ESTIMATED COST - ROBERTS BANK ALTERNATIVE 1

	Capital ($ Million)	Capital Amortization ($/Ton)	Operations ($/Ton)	Total ($/Ton)
Mine storage/reclaim	7.7	0.11	0.06	0.17
Railway	37.8	0.55	2.50	6.75*
Rail car unloading	5.2	0.09	0.08	0.17
TOTAL	50.7			7.09

*Estimated railway freight tariff.

The primary environmental concern is the hydrological impact on Hat Creek with the need for the railway to cross the creek at several locations.

A significant social impact can be anticipated from the large amount of land which is required for the railway right-of-way. About 680 acres of land would be required between the mine site and Carquile with about 100 acres of this total from native Indian lands.

b) Alternative 2

This alternative which does not require the use of native Indian lands would utilize railway from the mine site to the head of Oregon Jack Creek, conveyor from there to the C.P.R. and/or C.N.R. mainlines at Basque and then via the C.P.R. or C.N.R. to Roberts Bank. The estimated cost of this alternative is as follows:

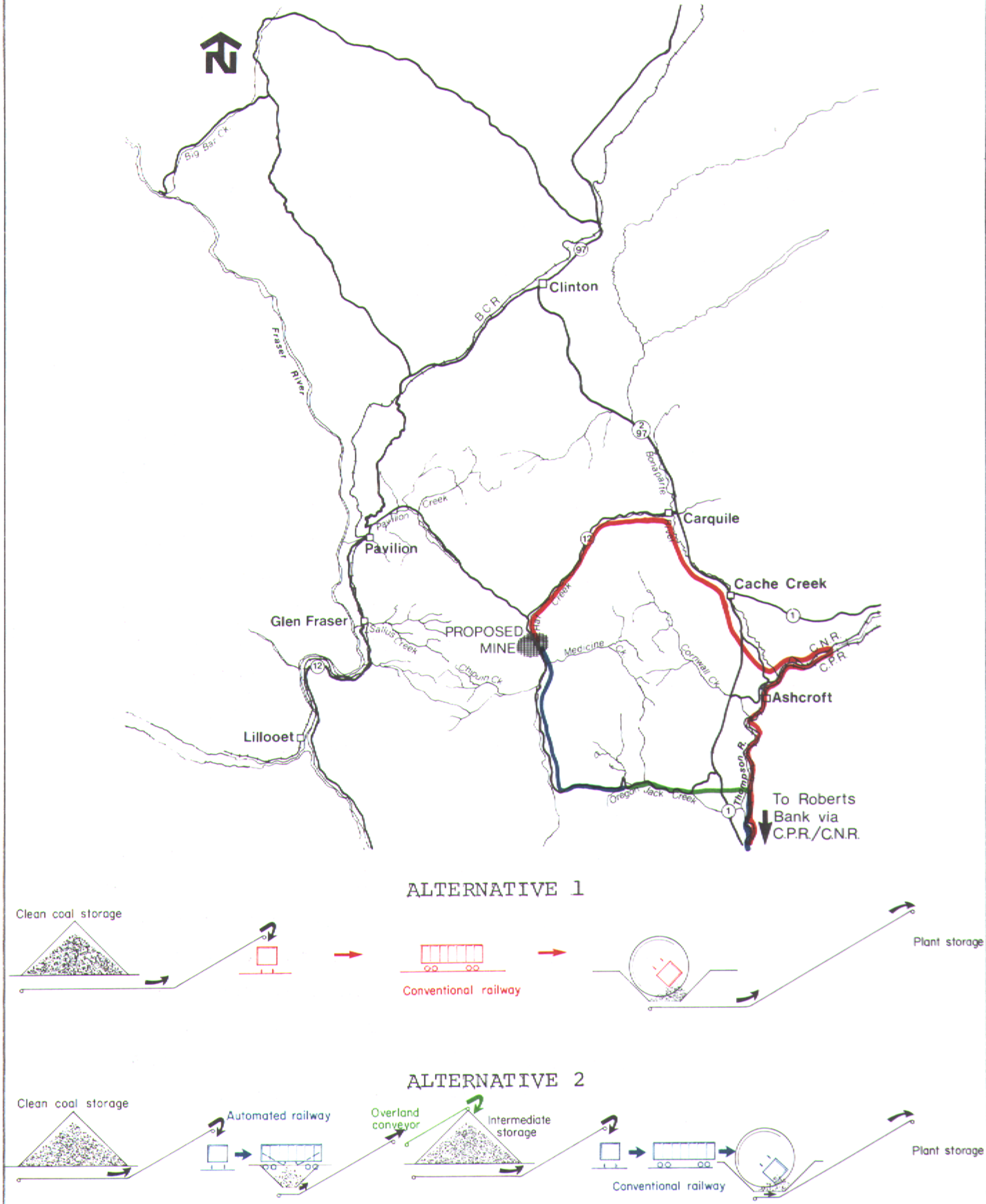
FIGURE 3-18(b)

ESTIMATED COST - ROBERTS BANK - ALTERNATIVE 2

	Capital ($ Million)	Capital Amortization ($/Ton)	Operation ($/Ton)	Total ($/Ton)
Mine storage/reclaim /car loading	8.9	0.13	0.06	0.19
Car unloading/storage	5.3	0.09	0.06	0.15
Overland conveyor	33.4	0.55	0.40	0.95
Storage/reclaim/load	7.3	0.10	0.06	0.16
Railway	30.9	0.45	2.20	6.45*
Rail car unloading	5.2	0.09	0.08	0.17
TOTAL	91.0			8.07

*Estimated railway freight tariff.

FIGURE 3-17 PLAN OF COAL TRANSPORTATION SYSTEMS
- ROBERTS BANK PLANT SITE



Source: Swan Wooster Engineering Co. Ltd.

Careful location and construction of a railway would be necessary in this case in the segment from the mine to Oregon Jack Creek because of potential problems in soil erosion. Revegetation is difficult in this area because of high salt content in the soil.

This routing would have a slightly favourable impact on balance on the Hat Creek region due to the economic stimulus created by the construction and operation of a railway.

3.4 SUMMARY OF COAL TRANSPORTATION ALTERNATIVES

Figure 3-19 contains a summary of the estimated cost per ton for each of the alternative transportation systems to each of the potential thermal plant locations. This summary also contains an environmental and social ranking for each of the systems. This ranking is in numbers from one to nine with the numbr one assigned to the alternative which appears to have the least impact and progressively higher numbers assigned to alternatives which have a progressively greater negative effect. The detailed analysis of environmental and social impacts can be found in Appendices D and E.

The effect of doubling the volume of coal is also shown in Figure 3-19. In general, it would be necessary to duplicate the cargo carrying facilities(conveyor line, rail cars and locomotives) in order to handle the additional volume. There would be some economies of scale in that the same right-of-way could be used for a second conveyor and the same railway lines could accommodate the increase in trains. These economies would be relatively minor, however, and it

FIGURE 3-19

SUMMARY OF COAL TRANSPORTATION SYSTEMS
FOR 2,000 MW PLANTS

Plant Site	Carrier	Route	Transportation Cost $ / Ton	Environmental Ranking	Social Ranking	Effect of Doubling Throughput	Technical Considerations
Mine Mouth	No System Considered		0	0	0	-	-
Harry Lake	Conveyor	Direct Line	0.33	1	5	Complete system requires duplication.	Minor
Big Bar Creek	Rail	Hat Creek/Carquille/ Clinton/Big Bar Creek	2.07	8	6	Loading and unloading components must be duplicated.	Minor
	Conveyor/ Rail	Sallus/Medicine Creek to Glenfraser Glenfraser/Clinton/ Big Bar Creek	3.20	9	4	Conveyor loading and unloading must be duplicated.	Minor
Ashcroft	Rail	Hat Creek/Carquille/ Cache Creek/Plant Site	1.12	7	8	Loading and unloading components must be duplicated.	Minor
	Rail/ Conveyor/	Mine South to Oregon Jack Creek Along Oregon Jack Creek to Plant	1.47	2	2	Conveyor, loading and unloading components must be duplicated.	Minor
Squamish/ Britannia	Rail	Hat Creek/Pavillion/ Plant Site	6.84*	4	9	Loading and unloading components must be duplicated.	Difficulties in constructing rail access Pavillion to mine.
	Conveyor/ Rail/	Sallus/Medicine Creek to Glenfraser Glenfraser/Plant Site	6.74*	6	3	Conveyor, loading and unloading components must be duplicated.	Upgrading of B.C.R. and impact on capacity.
Roberts Bank	Rail	Hat Creek/Carquille/ McAbee/Plant Site	7.09*	5	7	Loading and unloading components must be duplicated.	Impact on capacity of C.P.R./C.N.R.
	Rail/ Conveyor/ Rail/	Mine to Oregon Jack Creek. Oregon Jack Creek to Basque Basque to Plant Site	8.07*	3	1	Conveyor, loading and unloading must be duplicated.	Impact on capacity of C.P.R./C.N.R.

*Estimated freight tariff.

is not expected that the unit costs would be much lower for the increased volumes than those which are indicated in Figure 3-19.

The general traffic growth which is predicted for both C.N.R. and C.P.R. lines through the Fraser Canyon to the Lower Mainland is expected to create some future capacity problems. The addition of Hat Creek coal would advance the date that action will have to be taken to increase the capacity of these lines. There appears to be adequate capacity on the B.C.R. line to Squamish or Britannia even with the doubling of Hat Creek volume to about 64,000 tons per day.

3.5 TRANSPORTATION OF ASH

The study of the possibilities for the transportation of ash was limited to a brief examination of the technical feasibility of returning ash from the plant sites to the mine in the same equipment which is used to transport the coal.

It is possible to handle ash on a conveyor provided proper dust collection and containment facilities are incorporated into the system. The conveyor systems which are proposed in this report would have to be increased in capacity to handle ash as well as coal. It is not considered practical to handle ash in the type of rail cars which are proposed for coal. The air-slide type of tank cars which are used for cement and other similar products would likely be required for ash in order to minimize the dust problem. The overhead gravity-flow system for loading railway cars and the rotary dumpers for discharge would also be inappropriate for ash, again because of the dust containment problems. In conclusion, then, it would appear that an entirely separate system of railway operation would be required if ash is to be returned from the plant site to the mine.

SECTION 4.0

ROAD TRANSPORT

4.1 ROAD REQUIREMENTS

This section of the report is concerned with highway access to the mine and to each of the seven plant sites. Consideration is given to the capital cost of developing roads, the impact of additional traffic on existing highways and the social and environmental impact of the new roadway facilities. For geographical reference the reader is directed to the maps in Appendix F.

Roads into the mine and plant are necessary to accommodate employees, sales and service representatives, emergency services, deliveries for some types of supplies and sight-seers. These roads will also serve as access routes for construction materials. The anticipated levels of traffic will require a good class of two lane, all-weather, paved highway, constructed to provincial standards for grades and curves.

One of the requirements of the terms of reference for this study was to identify at least one alternative route for each location which would avoid further alienation of native Indian lands.

The following paragraphs describe the alternative routes for access to the mine and to each of the plant sites and provide estimates of cost and an assessment of environmental and social impact.

4.2 MINE ACCESS

There are four potential routes that could provide reasonable access to the mine area. These routes are:

a) An upgraded Highway 12 from Carquile to the northern end of the Hat Creek Valley then on a new road to the mine site. This route would provide direct access from the communities of Clinton, Cache Creek and Ashcroft with approximate travelling distances of 31 miles, 20 miles and 26 miles, respectively.

b) A new highway following the route of Medicine and Cornwall Creeks from the vicinity of Ashcroft directly west to the mine area. This route also provides good access to the Ashcroft/Cache Creek area with distances of 19 and 22 miles, respectively, from the mine. The distance to Clinton is approximately 46 miles via this route.

c) A new road which follows Oregon Jack Creek from Highway 1 some three miles south of the Ashcroft turn-off up to the Hat Creek Valley and then north to the mine site. The distances to Ashcroft, Cache Creek and Clinton are 29 miles, 35 miles, and 56 miles, respectively.

d) An upgraded highway from Lillooet north along the Fraser Canyon and then through the Pavillion Lake/ Marble Canyon Valley to Hat Creek and south to the mine over existing roads. This route would require extensive upgrading. The travelling distance is about 35 miles from Lillooet to the mine.

The best alternative for mine access appears to be alternative a) as described above because:

- .It is the most centralized route providing the lowest average travelling distance to three of the four major communities in the area;
- .Capital cost for this route is significantly lower than for the other alternatives; and
- .It is a relatively easy driving route with reasonable grades and curves over most of its length.

This route, however, has a disadvantage in that further alienation of native Indian lands would be caused by the upgrading of the existing highway.

The second alternative, route b), has a slightly higher average driving distance than route a), is more costly and has more difficult grades and curvatures. It does, however, have the advantage of providing access to the mine site without further alienation of native Indian lands.

Route c) has a driving distance significantly higher than that of routes a) and b), is more costly, and will be the most difficult to drive because of grades and curvatures. It may be possible to construct this route into the area without further alienation of native Indian lands.

Route d) appears to be inferior to the other alternatives in that it has a driving distance greater than the average achieved by routes a) and b), a high capital cost because of extensive upgrading to provide provincial highway standards, and difficult driving conditions because of grades and curvatures.

The approximate capital cost for upgrading and/or constructing new roads on routes a), b), and c) are estimated at $4 million, $12 million, and $15 million, respectively.

It is anticipated that the increased traffic generated by the mine development will have a relatively severe impact on traffic levels on Highway 1, particularly in the summer months, but will not seriously affect Highways 12 or 97. The impacts on highway traffic for the four routes would probably be in the same range with route c), possibly being the most severe because it would put more traffic onto Highway #1.

The best access route into the mine area would be route a) which utilizes Highway 12 to its junction with the Hat Creek Valley and a new road south to the mine site. The other route for further consideration, as the option which avoids further alienation of native Indian lands, is alternative b), a new highway constructed via Cornwall and Medicine Creeks.

The environmental and social considerations [1] for routes a) and b) which were selected as the best alternatives are as follows:

a) Upgrading of Highway 12 from Carquile to the mine site:

The upgrading of Highway 12 from the mine to Highway 97 requires some widening and fill in areas where the creek is presently constricted by road bank. This widening of the road bed could cause increased channelization. All other environmental sensitivities are low, making this alternative the most acceptable from an environmental point of view.

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(1) The environmental and social considerations given in this section are extracted from the reports prepared by TERA Environmental Research Analysts Ltd. and B.C. Research which are attached to this report as Appendices D and E.

Half the length of this section of Highway 12 is within the bounds of the two reserves of the Bonaparte Indian Band. The land requirements are not large but could be a matter of considerable concern.

The lowest average commuting distance from Ashcroft, Clinton and Cache Creek gives this alternative the best social ranking as a mine access route.

b) New Road via Cornwall and Medicine Creeks:

This alternative would require construction of a new road taking advantage of some stretches of existing dirt track. The new road passes through good productive forest at the headwaters of the two creeks. It also traverses a fairly narrow steep-sided valley which creates moderate concern for the impact on fish and wildlife. Environmentally this corridor ranks a distant second to the upgrading of Highway 12.

From the social standpoint, this alternative is preferred since it does not alienate native Indian land and commuting distances are relatively short.

4.3 PLANT ACCESS

The road access alternatives considered in this study for each thermal plant location, are as follows:

a) Mine Mouth Plant

This plant site would be in the immediate vicinity of the proposed mine and would therefore use the same road system as the mine. The commentary on costs and impacts described in the previous section for mine access would be the same for this plant site. Traffic levels would be slightly higher but this increase would not be expected to create significant additional problems.

b) Harry Lake Plant Site

Access to this plant would be over the same road system serving the mine except that some 6 miles of new road would have to be constructed from the mine to the plant site if the Highway 12 alternative is selected. The estimated cost of this extension would be approximately $4.5 million. If the Medicine-Cornwall Creek alternative is selected for mine access, an additional one mile branch to the plant will be required. Capital cost in this case would be about $1 million.

The environmental and social impacts of road access into this plant site would be the same as for the mine mouth plant.

c) Big Bar Creek Plant Site

There are three possible access routes to the Big Bar Creek plant site:

1. A substantial upgrading of an existing road from its intersection with Highway 97, 6 miles north of Clinton, to a point about 6 miles short of the plant site then via a new road to the plant. The distance, from Clinton, over this route is 47 miles.

2. An upgrading of the existing road from Clinton to near Kelly Lake and substantial upgrading of the road from Kelly Lake to a point about 6 miles from the plant site then construction of a new road to the plant. This route provides access to Clinton with a travelling distance of 39 miles.

3. A new road from Pavillion north along the Fraser River to Big Bar Creek, then via Big Bar Creek and west to the plant site.

Alternative 3 was rejected as a viable alternative on apparent ecological and economic grounds. An access route in this corridor would run the risk of interfering with the big horn sheep and deer population. The steep nature of the Fraser River Canyon in this area would also make construction more expensive and difficult when compared with the first alternative.

The second route as outlined above, even though it has the advantage of being shorter than the first route, passes through relatively more difficult terrain than alternative 1. and would therefore be more expensive to construct and more difficult to drive.

For the above reasons, the first alternative appears to be optimum. The estimated cost of this route would be in the order of $20 million.

The environmental impact of the selected alternative could be fairly severe with regard to wildlife and agricultural sensitivity. Other environmental considerations would be moderate.

The extreme distance from this plant site to existing communities is a major drawback. Furthermore, a roadway from north of Clinton would require about 250 acres of land, a one-company town would have to be created and the cost of the social infra-structure together with the isolated location makes this alternative unappealing from a social point of view.

d) Ashcroft Plant Site

Road access into this plant site would be via a 1 mile connection to the Trans-Canada Highway at a point about 3 miles south of Ashcroft. The estimated capital cost of this short extension is in the order of $0.5 million.

The increased highway traffic in this case would aggrevate an already congested section of Highway 1 between Ashcroft and the plant site.

This additional one mile roadway would have no significant environmental impact and no significant social impact apart from the inconvenience of the additional highway congestion referred to above.

e) Squamish Plant Site

It was assumed that access into a plant site in the Squamish area would be via existing roads. It is also assumed that many of the employees at the plant would live in the Squamish area. Therefore, little capital would be required for roads and the access road to the plant would have little impact on existing highways and on the environmental or social structures in the area.

f) Britannia Plant Site

The conclusions on this plant site are the same as those for Squamish except that a plant in this area could increase traffic levels on Highway 99, contributing to congestion on this route during peak periods.

g) Roberts Bank Plant Site

No problems are foreseen in obtaining road access to this plant site since the existing road system appears to be able to easily absorb the increased traffic levels.

4.5 SUMMARY

A summary of roadway routes for access to the mine site and the power plants is contained in Figure 4-1. The summary includes estimates of capital requirements as well as a ranking of environmental and social impact. In this ranking, the number one is assigned to the alternative having the least impact while progressively higher numbers are assigned to alternatives with a greater negative impact. The detailed review of environmental and social considerations can be found in Appendices D and E.

FIGURE 4-1

ROAD REQUIREMENTS AND COSTS
PREFERRED ROUTES

Site	Alternate Number	Route	Length of Construction (Miles)	Capital Cost	Environmental Rank	Social Rank
Mine	1.	Highway #12	-	5.0	1	4
	2.	Medicine/ Cornwall		12.0	2	3
Mine Mouth Plant	1.	SAME AS MINE				
Harry Lake	1.*	Highway #12	6	4.5	1	5
	2.**	Medicine/ Cornwall	1	1.0	2	2
Big Bar Creek	1.	Northwest from Clinton	41	20.0	3	6
Ashcroft	1.	From Highway #1	1	0.5	Nominal	1
Squamish	1.	None Required	-	-	Nominal	7
Britannia	1.	None Required	-	-	Nominal	7
Roberts Bank	1.	None Required	-	-	Nominal	8

* Alternative 1 to Harry Lake would apply if Alternative 1 to the mine is selected.
** Alternative 2 to Harry Lake would apply if Alternative 2 to the mine is selected.

SECTION 5.0

AIRPORT LOCATION

5.1 AIRPORT REQUIREMENTS

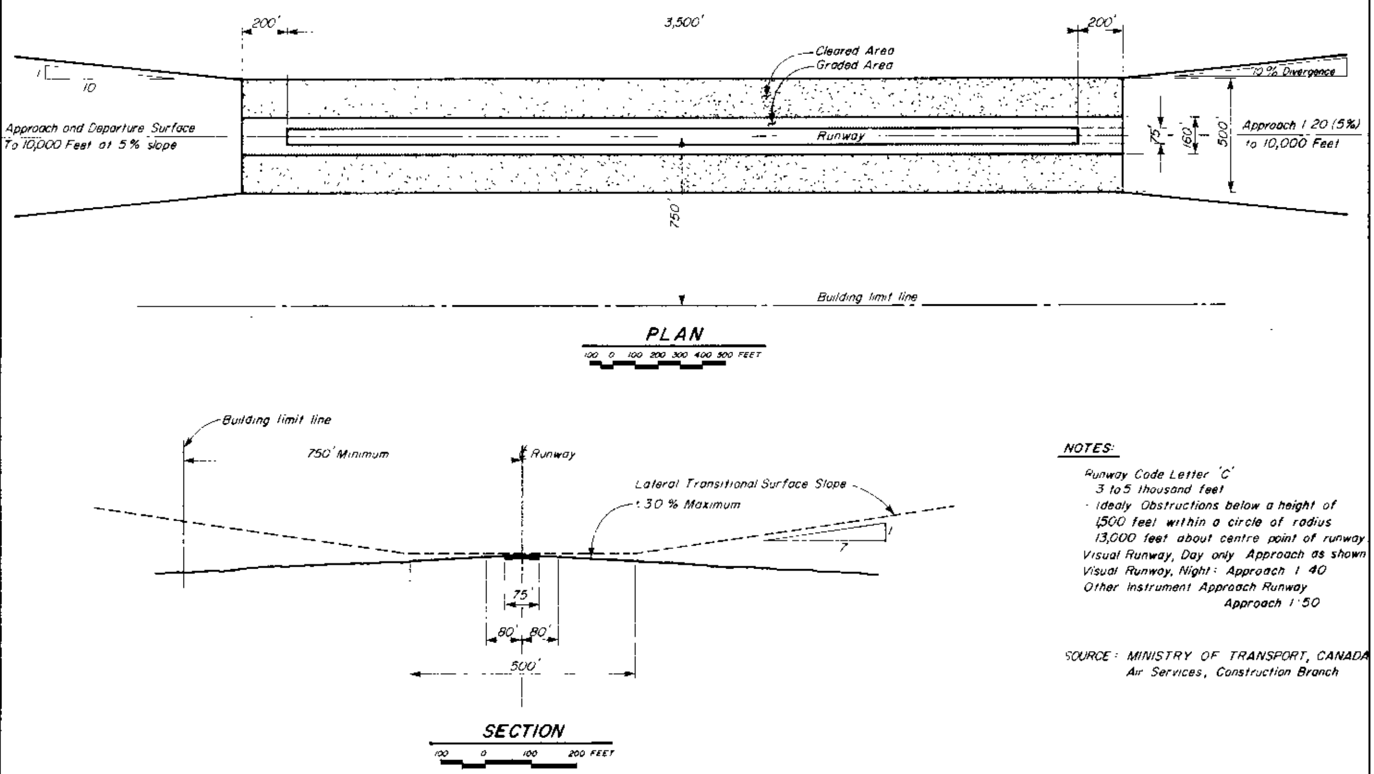
This study of potential airstrip sites near the coal deposit was completed as part of the overall transportation study requirements for the proposed Hat Creek Development. The purpose of this examination was to determine a location that satisfied B.C. Hydro's requirements and at the same time benefitted nearby communities. To accomplish this, the potential airport facility requirements were established and both existing and new airstrip site alternatives in the region were investigated. In addition a brief investigation of development procedures and financial support possibilities was also completed.

B.C. Hydro require an airport location that minimizes travel times and distances to the mine site development and to a regional thermal power plant if one is located in that area.

The facility would also be developed for the general and emergency use of local and itinerant flyers. There are increasing numbers and types of aircraft being used by private owners for business and/or pleasure. As well, if suitably licenced, the facility could provide an alternate landing strip for scheduled airlines and a localized landing strip for mercy flights and water bombers.

The airstrip size, access and location requirements were determined in consultation with B.C. Hydro's Chief Pilot, Mr. George Williamson. The size and class of runway that

Mr. Williamson recommended for the expanding requirements of the region was a 75' by 3500' Class "C" licenced runway. The guide lines for a typical Class "C" zoned runway are illustrated on Figure 5-1.



GUIDE LINES FOR TYPICAL CLASS 'C' AIRPORT RUNWAY

SWAN WOOSTER ENGINEERING CO. LTD. **FIGURE 5-1**

5.2 EXISTING FACILITIES

A brief survey of all airports or landing strips in the region was completed to determine what facilities are available. A summary of the information available from the B.C. Aviation Council and the M.O.T. published VRF Chart Supplement, describing these small and, in most cases, unlicenced local airports, is listed in Figure 5-2. The approximate locations of these existing airstrips relative to the proposed B.C. Hydro Development are shown on the map in Appendix F.

5.3 ALTERNATIVE AIRPORT SITES

The areas and facilities near the proposed development were discussed with Mr. Williamson to obtain his input to the study regarding both B.C. Hydro's requirements and the growing needs of the local communities.

The Hat Creek Valley was considered unsuitable for the airstrip because of the rough surrounding terrain and the possibility of excessive cloud cover. This area is also somewhat more isolated from the regional population centres.

The area north of Cache Creek toward Clinton along the Bonaparte River was not considered desirable for the airport development because of the narrow "Box" like valley conditions. This type of confined airspace limits the maneuverability of aircraft and is not suitable from an operations and safety point of view.

The region concluded to have the best potential for an airstrip in the vicinity of B.C. Hydro's proposed development was the triangle roughly created by the Trans Canada Highway No. 1 between Ashcroft and Cache Creek along the west, the Semlin Valley from Cache Creek to McAbee along the north and the Thompson River from McAbee to Ashcroft along the south. This relatively open airspace, particularly within and along the mentioned corridors, would afford aircraft room to safely maneuver.

FIGURE 5-2

EXISTING AIRSTRIPS

Name	Type	Length	Elevation	Location	Remarks
Ashcroft	VFR	2,000'	1,700'	50°44'N/121°19'W	Dirt, facilities in town 3 miles east.
Bar Q Ranch	VFR	2,650'	1,770'	50°40'N/121°16'W	Gravel, fuel and facilities at an adjacent Ranch.
Clinton	VFR	3,082'	3,650'	51°09'N/121°32'W	Clay, facilities in town 5 miles southwest.
Kamloops	IFR	6,000'	1,134'	50°42'N/120°27'W	Asphalt, all facilities, water landing adjacent.
Knutsford	VFR	1,530'	3,280'	50°37'N/120°17'W	Emergency only.
Lillooet	VFR	2,400'	850'	50°41'N/121°55'W	Grass, soft sand north end, watch for turbulence.
Lytton	VFR	2,450'	922'	50°15'N/121°34'W	Gravel, facilities in town 1 mile southwest.

Notes: .VFR - Visual Flying Rules
.IFR - Instrument Flying Rules

Source: B.C. Aviation Council, Ministry of Transport VFR Chart Supplement.

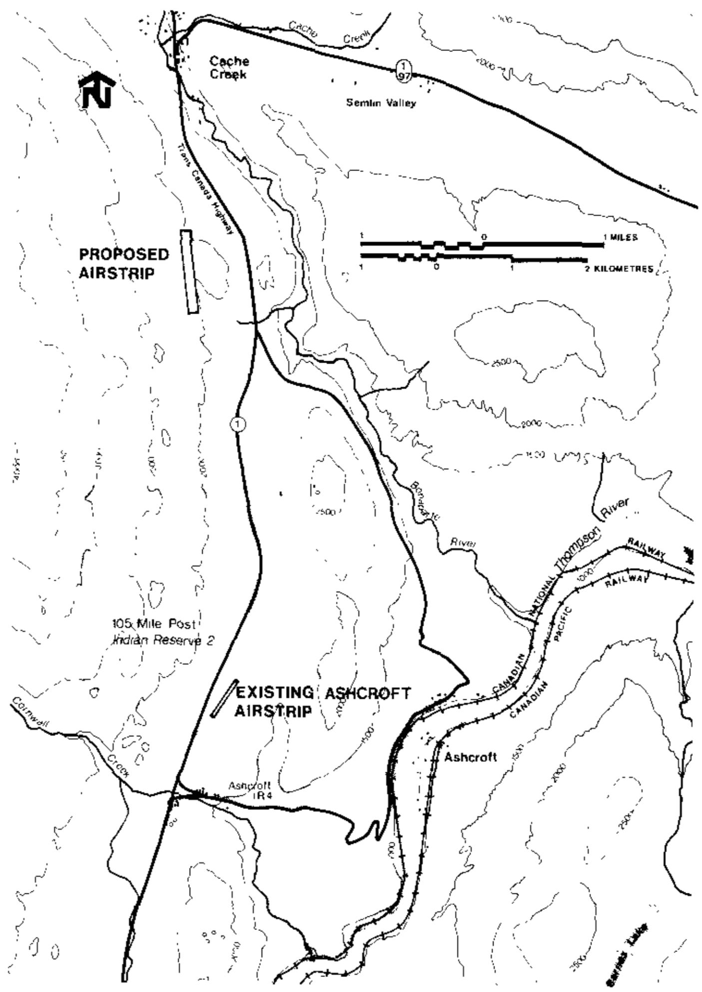
Within this triangle, the Ashcroft airport currently serves the communities of Ashcroft which is about three miles to the east and Cache Creek which is about six miles to the north. The airstrip is situated on the 105 Mile Post Indian Reserve 2 and is aligned approximately parallel to the Trans Canada Highway No. 1 immediately to the west. The approximate alignment of this runway is shown on Figure 5-4. This land is leased from the native Indians and currently is in the last year of a three year agreement. The current annual lease cost of $558 is shared equally by the Corporation of the Village of Ashcroft, the Village of Cache Creek and the Ashcroft Aero Club. The Aero Club is also responsible for the maintenance of this facility.

This site was not considered suitable for the proposed development for two main reasons; the local topography and the ownership of the land. The runway is roughly in line with a hill rising to an elevation of 2,700 feet within 10,000 feet of the north edge of the landing strip. Another hill, off line to the south east, within a horizontal distance of 10,000 feet has an elevation of 2,200 feet. The tops of both hills are decorated with at least one radio tower. These observations do not satisfy the runway approach clearances specified by the MOT for a Class "C" licenced airport. The fact that the runway is located on native Indian land may also limit this airport's suitability for this project.

In addition, from the Village of Ashcroft's point of view, the excavation required to expand the present site would be costly and the uncertain tenure of the existing lease make the existing airport undesirable for long term purposes.

An alternative site in the Semlin Valley was originally proposed some time ago by the Village of Cache Creek. This site has the disadvantage of being located on privately owned agricultural land and, therefore likely subject to the B.C. Government's agricultural land freeze. For this reason and the fact that a more suitable alternative new site was determined, the precise location of the Semlin Valley airstrip was not established in this report.

The airport site recommended by Mr. G. Williamson and supported by the local communities is situated west of Highway No. 1 north of the existing refuse dump. Figure 5-3 shows the approximate positioning and alignment of the proposed development.



PROPOSED AIRSTRIP LOCATION

SWAN WOOSTER ENGINEERING CO. LTD. FIGURE 5-3

The likely post excavation elevation of a proposed runway on this site is 2,000 feet above sea level. At this elevation and for the projected requirements of local communities and developments, Mr. Williamson indicated minimum runway dimensions of 75 feet by 3,500 feet. A runway with these dimensions and the necessary clearance zones specified by the MOT for a Class "C" licenced airport are shown on Figure 5-1. The runway alignment shown on Figure 5-4 generally satisfies all clearance requirements with one minor exception. Beyond the building limit line to the west, the lateral transitional surface slope changes from a 1 : 7 to a 1 : 5 slope. Other suitable sites in the region that also satisfy these specified clearances were not obviously evident.

The Provincial Government's land use map for the area (Ashcroft, B.C. MAP 921/NM, Third Status Edition) indicates that this site is located on surveyed lands which are noted as alienated or covered by application under the Land Act. Although it was not confirmed, the land in the area is likely leased to local ranchers for grazing purposes. If this is the case, then acquiring the land for an airport should not cause any special difficulties.

The weather conditions in the valley were considered suitable for the proposed application. The annual precipitation figures are relatively low and the maximum average wind speed for the peak month is only slightly greater than 15 miles per hour.

The location, when developed, could service the airport requirements of all local communities and developments including those in Hat Creek Valley. Road access to the site is good with major connecting routes in three directions. Cache Creek would be less than three miles to the north and Ashcroft would be less than five miles to the south east.

The basic and ancillary facility requirements for this proposed V.F.R. (visual flying rules) airport development would include the following:

- wind socks
- approach flash boards
- runway and runway markers
- off-runway aircraft parking
- ground vehicle access and parking
- general purpose graded storage area
- and fencing.

The paving of the runway was recommended to increase the efficiency of the airport and reduce the damage to airplanes caused by loose stones and pot-holes. Also a small shelter with washroom facilities and a telephone could be added eventually.

The order-of-magnitude capital cost estimate for a Class "C" zoned airport at the proposed location between Cache Creek and Ashcroft is shown in Figure 5-4. The contingency amount includes all required ancillary equipment. No amount was included in the total for land acquisition, buildings, power or fuel supply. No estimate was made of annual operating costs. These costs to maintain an unsupervised facility excluding any annual charges for land use or taxes are expected to be nominal.

FIGURE 5-4

ESTIMATED CAPITAL COST FOR AIRPORT DEVELOPMENT

Description		Estimate Cost
Clearing & Grubbing		50
Excavation (cut & fill)		900
Drainage		100
Gravel surfacing		50
Runway base & paving		350
Water supply		150
Access road		500
Fencing		150
	Sub-Total	2,250
Contingencies		250
	Total	2,500

5.4 GOVERNMENT PARTICIPATION

5.4.1 Federal

The Federal Government's participation in a development of this nature would depend on whether the facility was to be licenced and whether financial assistance was applied for. As the airport licencing body the MOT must judge if the facility satisfies their specified requirements. Financial assistance toward the construction of new airports or for the improvement of existing airports is available to Community Groups. For airports that apply and qualify up to $175,000 is available for intermediate local classified airports and up to $100,000 for small local airpots.

The application must be made to the Regional Manager of Airports by or on behalf of a municipality or other public body. The measure of justification for the aid is based on a cost benefit study considering sociological and economic factors. This assistance does not include any financial aid toward the cost of land and will not be provided in respect of any work performed prior to approval of an application for financial assistance. Details of this program are given in the document, "Financial Assistance to Construction and Operation of Municipal and Other Airports" attached as Appendix C.

5.4.2 Provincial

The Provincial Government apparently provides assistance in two forms.

The Transport Planning, Research and Development Bureau, Department of Transport and Communications, can provide assistance to municipalities and regional districts in planning and coordinating a proposed airport development with the MOT. Secondly, the Land Management Branch, Department of Lands, Forests and Water Resources, may issue leases at nominal rentals of $25.00 per year for a term of up to 20 years to municipalities and regional districts which require Crown land for airport purposes.

Applications for airstrips from corporations such as mining companies, construction companies or Crown corporations are approved by way of a letter of consent to construct an airstrip on Crown land. There is no annual rental payable in connection with a letter of consent, however, the air-strip can be used by anyone requiring to land a plane, and the airstrip can be taken over by the Province without any compensation.

5.5 SUMMARY AND RECOMMENDATIONS

The proposed airport location between Ashcroft and Cache Creek, west of Highway No. 1 and north of the existing refuse dump would best serve the requirements of B.C. Hydro and at the same time afford the local communities an improved alternate to existing airport sites. The development of a Class "C" zoned runway at this location as recommended by Mr. G. Williamson, B.C. Hydro's Chief Pilot, would have the advantage of serving the growing needs of the surrounding communities and the possibility of obtaining MOT participation and eventual licencing. The approximate capital cost of constructing this class of runway at the proposed location would be in the order of $2.5 million.

To further determine the suitability and applicability of this site and proposed development, an application to the MOT for a site investigation and evaluation should be made. If the results of this more detailed study are favourable, then applications should be made by or on behalf of the local communities to the B.C. Government for a land lease for airport purposes and to the Federal Government for planning and financial assistance.

SECTION 6

TEST BURN COAL TRANSPORT

SECTION 6.0

TEST BURN COAL TRANSPORT

6.1 TRANSPORTATION REQUIREMENTS

The last transportation consideration in this analysis is the transferring of 50,000 tons of coal from the Hat Creek Mine area to an existing thermal/electric plant in Alberta. In order to develop total costs for this move the Sundance Power Plant near Wabamun was assumed to be representative and used to determine costs.

The movement of the test burn coal is expected to take place over a four month period in early 1977 well in advance of the rest of the development. This early date requires development of a temporary transportation system independent of the ultimate system selected to serve the mine and thermal plants.

The temporary nature of the system required to move the coal indicates truck and rail haul using existing roads, rail lines and other facilities as far as possible.

Assuming that the coal will be mined and stockpiled at the mine site, the most practical system would involve: front end loaders at the mine site loading conventional trucks; truck haul over existing roads (Highways 12, 97 and 1) to Ashcroft or vicinity; transfer into rail cars; rail haul to the plant site.

The following paragraphs consider the alternative sites which might be available at or near Ashcroft for the transfer of the product from trucks to railway.

6.2 Review of Potential Loading Sites

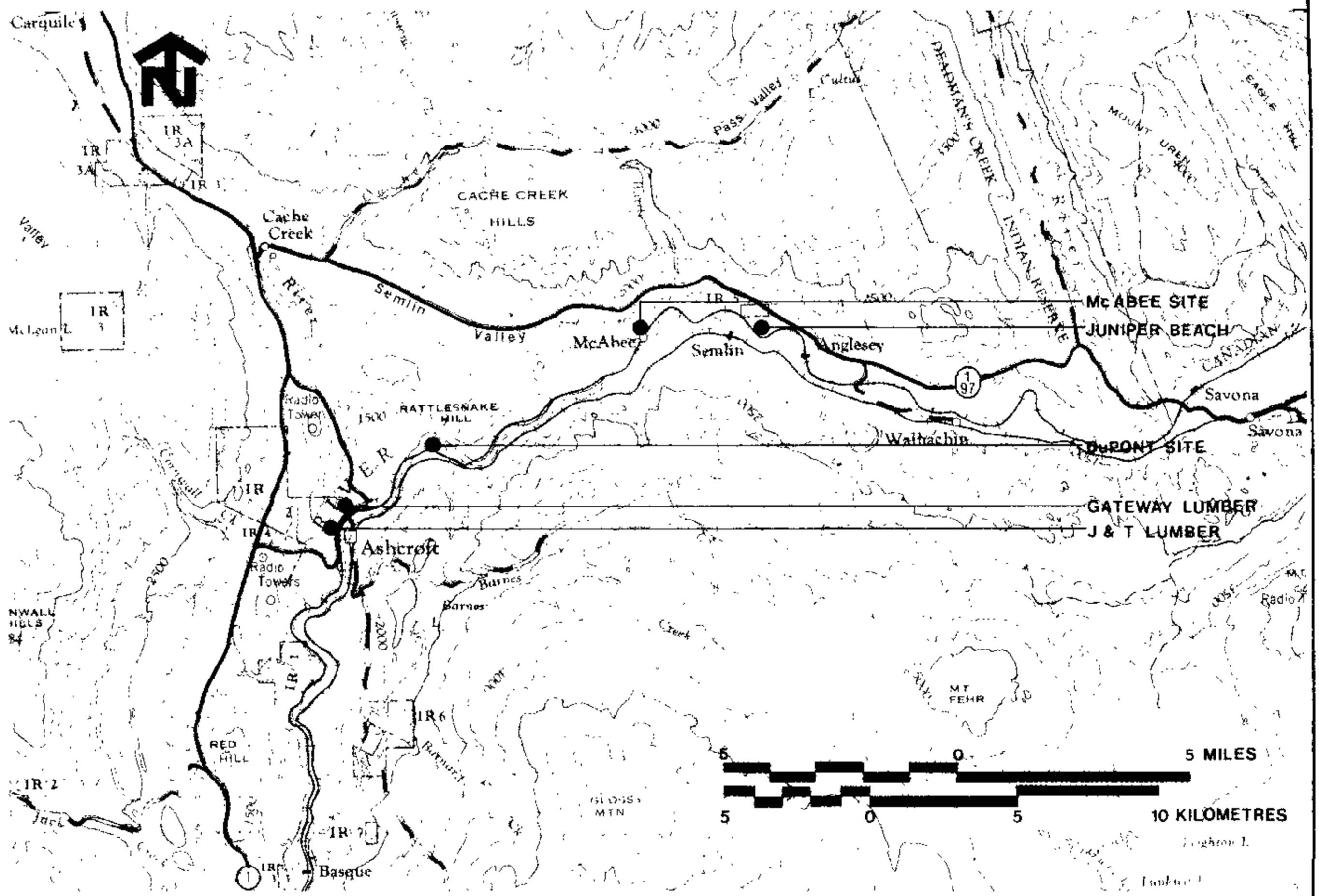
Since the assumed thermal plant location in Alberta is on C.N.R. trackage only sites on the C.N.R. in the vicinity of Ashcroft were investigated. Where possible it was assumed that rail cars would be loaded with a front end loader from a stockpile on the site to ensure minimum capital costs. At sites where excavation costs are excessive a carpuller system and loading structure would be substituted.

The following sites, as shown on Figure 6-1, were selected for analysis.

6.2.1 J&T Lumber Site (Mile 50-Ashcroft Sub-C.N.R.)

This site is located approximately one mile west of Ashcroft on land owned by the Indians of Reservation #5 (see photo-1). C.N.R. have in the past leased this property for similar use. The site requires minimum preparation to establish a transfer facility (see photo-2). A loading system using front end loaders from a stockpile directly to railcars is possible at this site.

Photo 1 - Overview of Site Viewed Westward, J&T Lumber Site



POTENTIAL SITES FOR STOCKPILING AND LOADING TEST BURN COAL

SWAN WOOSTER ENGINEERING CO. LTD **FIGURE 6-1**

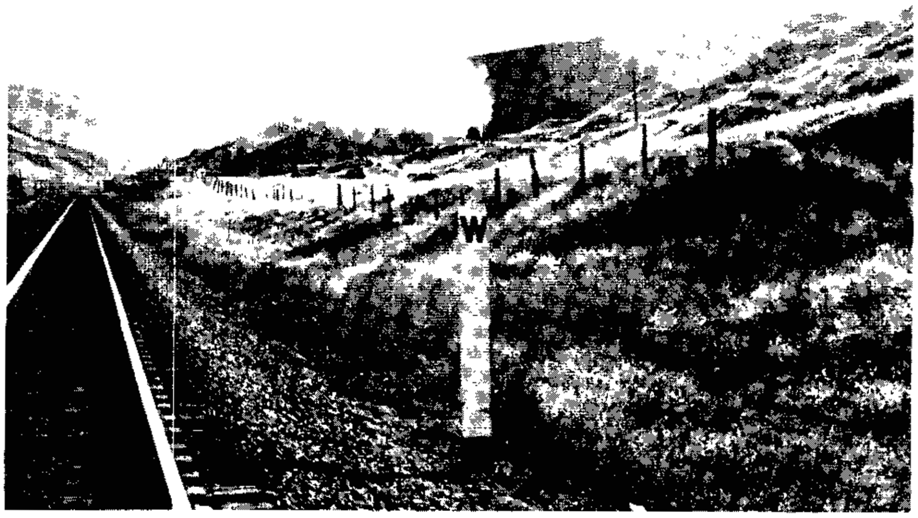


Photo 2 - View Westward at Proposed Point of Switch, J&T Lumber Site

Any trackage or other improvements constructed at this site have potential for other usage after the coal move is completed, consequently, C.N.R. might be willing to share the construction costs.

It is anticipated that lease arrangements and construction of the necessary track would require approximately 8 months lead time to complete.

6.2.2 Gateway Lumber Site (Mile 49-Ashcroft Sub-C.N.R.)

The site is located close to a school and residential area near the C.N.R. Station in Ashcroft (see photo-3). To gain access trucks must pass through the residential area. A carpuller and loading structure would be needed at this site to load rail cars to minimize excavating costs.

Photo 3 - View Eastward, Gateway Lumber Site

The property, which is controlled by Evans Products Co. Ltd., is for sale so there should be no objection from the owners to establishing a transfer facility at this location. However, since the facility is close to a residential area we expect the public would object.

6.2.3 DuPont Site (Mile 46.5-Ashcroft Sub-C.N.R.)

This site is located approximately two miles east of Ashcroft (see photo-4) on property owned by DuPont of Canada Ltd. Because of its location, trucks must cross the Ashcroft bridge and go through town to gain access to it. A facility using carpullers and a loading structure would have to be provided at this site since excavation costs to establish a front end loader operation would be prohibitive.

Photo 4 - View Eastward, DuPont Site

6.2.4 McAbee Site (Mile 41-Ashcroft Sub-C.N.R.)

This site is located approximately seven miles east of Ashcroft (see photos 5 and 6) and would require minimum site preparation for a coal transfer facility. It is, however, about two miles away from Highway #1 and approximately eight hundred feet below in elevation. Because the existing road is too narrow and steep for truck access, a costly road must be constructed.

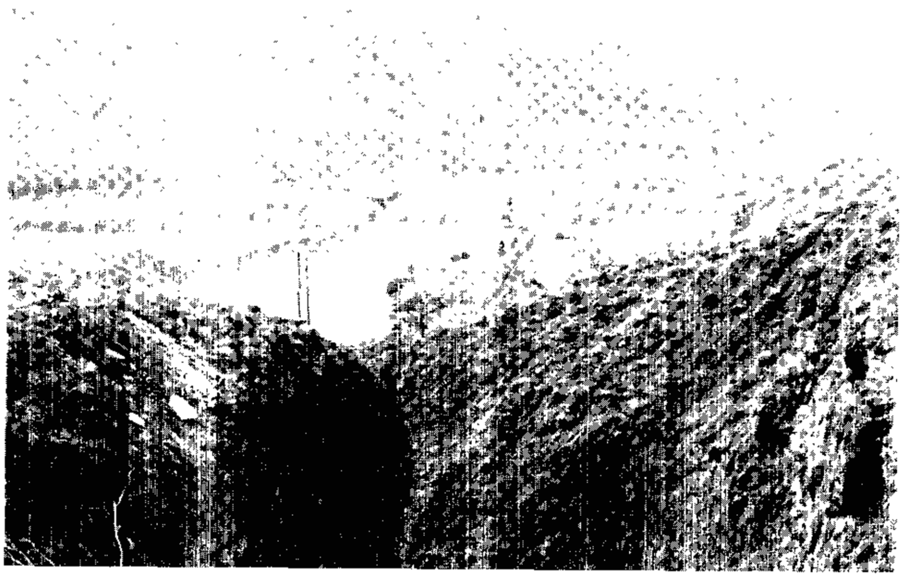


Photo 5 - Overview of Site Viewed Westward, McAbee Site

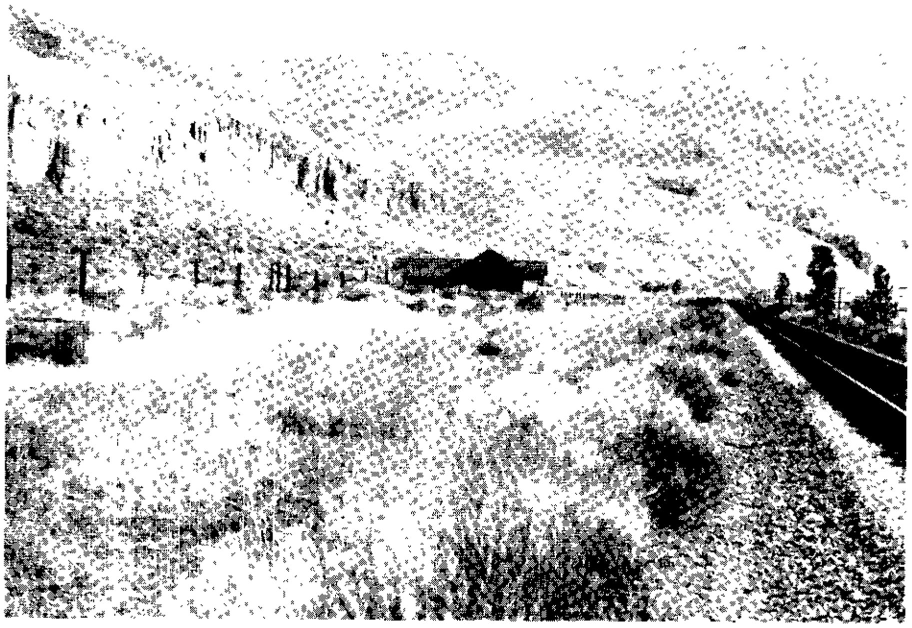


Photo 6 - Viewed Eastward, McAbee Site

The site and access road are privately owned by a local rancher, Mr. J. Christianson.

This site location does have the advantage of being completely removed from public view.

6.2.5 Juniper Beach Site (Mile 38-Ashcroft Sub-C.N.R.)

This site is located approximately eleven miles east of Ashcroft (see photos 7 and 8) and requires minimum preparation. The proposed transfer facility would be approximately 0.7 miles from Highway #1 via an access road that requires minimal upgrading to handle coal trucks. The site is, however, close to a campground and visible to the public from Highway #1. The site is also privately owned and used as a campground in the summer months.

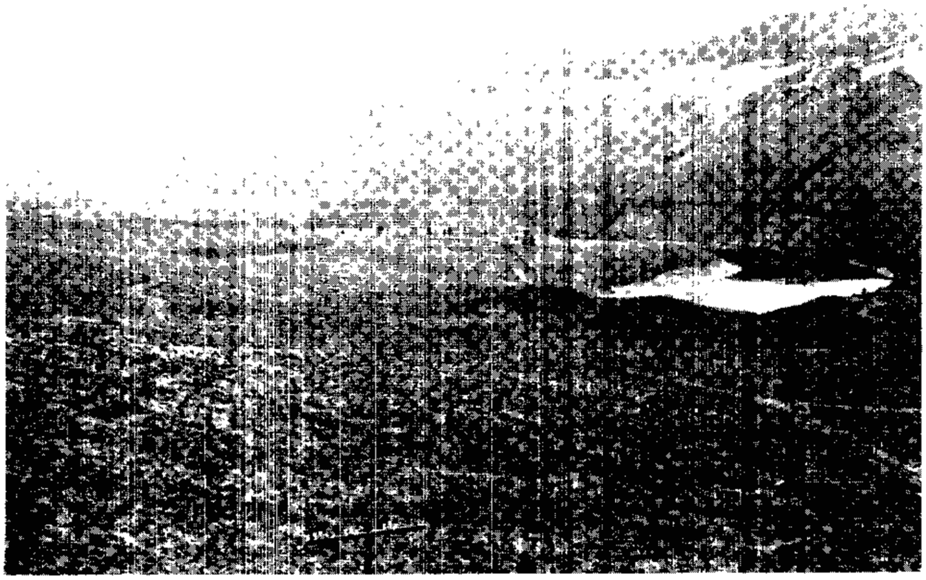


Photo 7 - Overview of Site Viewed Eastward,
Juniper Beach Site

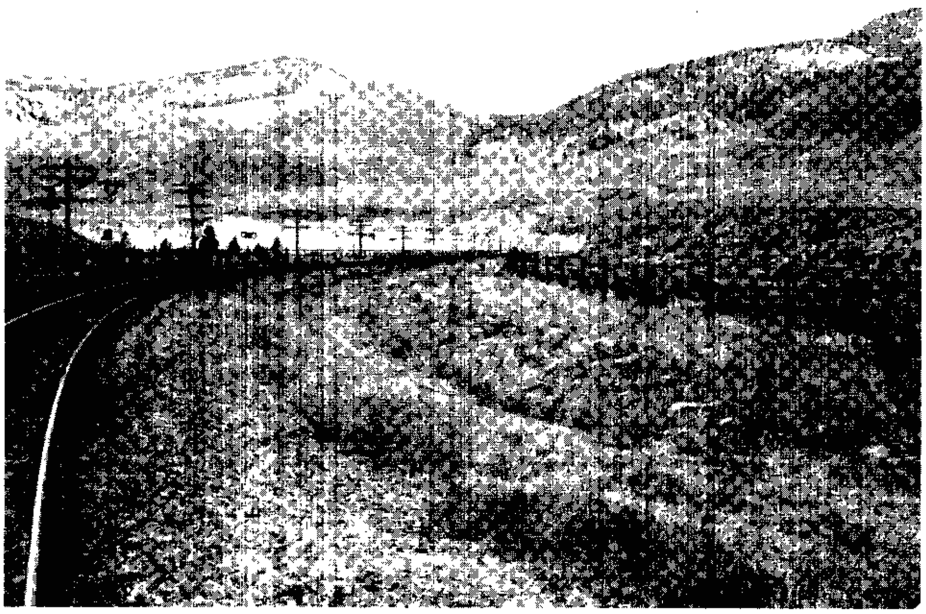


Photo 8 - Viewed Westward, Juniper Beach Site

6.2.6 Estimated Costs for Coal Transfer Facilities

The estimated costs for developing the coal transfer facilities at each of the various locations are shown in Figure 6-2. Lead time for land lease negotiations, site preparation and construction of facilities is estimated at a minimum of eight months for each of the alternative locations. The J&T Lumber site and Juniper Beach site are the easiest sites to serve. The other sites require more elaborate transfer facilities or expensive access roads. The J&T Lumber site was selected as optimal and used as the location for truck/rail transfer in the rest of the analysis.

FIGURE 6-2 COMPARISON OF COSTS FOR COAL TRANSFER FACILITIES

LOCATION	ESTIMATED COST ($)							TOTAL COST ($)
	Site Prep. (Struct. etc.)	Access Road	Track Construct.	Site Rental	Track Rental	Scale Rental	Engineering & Cont.(15%)	
J & T Lumber (Mile 50)	5,750	7,100	22,100	10,000	2,090	8,850	8,110	65,000
Gateway Lumber (Mile 49)	199,000	—	22,100	10,000	2,090	8,850	36,960	279,000
DuPont Site (Mile 46)	145,000	—	22,100	10,000	2,090	8,850	21,960	210,000
Mc Abee Site (Mile 41)	5,500	150,000	22,100	10,000	2,090	8,850	29,460	228,000
Juniper Beach (Mile 38)	5,500	9,900	22,100	10,000	2,090	8,500	8,560	68,000

6.3 TRANSPORTATION

6.3.1 Rail Haul

C.N. Rail have indicated that they will handle the coal movement from Ashcroft to Sundance using eight ten-car sets of "323-series" triple crosshopper cars. The operation would be set up to move 10 cars per day, seven days per week. The capacity of the hoppers is between 82 and 90 tons so approximately 800 tons per day must be loaded at the transfer facility.

A new twenty-car rail siding is needed to support this operation. A west-bound "series-300" train would set out 10 empties each day while loading is proceeding on another 10-car set. An eastbound "series-400" train would pick up 10 loads each day and spot the waiting empty set ready for loading.

C.N.R. have estimated that it will take seven ten-car sets to handle the move but have included an extra set for "bad-order" provisions. At 800 tons per day the 50,000 tons requires approximately 63 days to complete the move. Assuming the move taking place between March 1 and June 1 next year, it would leave approximately 30 days for unforseen difficulties.

6.3.2 Truck Haul

The 50,000 tons of coal will be mined and stockpiled at the mine, ready for loading into trucks with a front end loader, by others. Coal will be mined in a 3"-minus size range.

Trucks with a capacity of 25-30 tons of coal would be used on the move from the mine site to the railcar facility. At 800 tons per day approximately 32 truck-loads per day are needed to satisfy the daily rail movement.

The logical truck route is via Highway #12, Highway #97, Highway #1 and then into Ashcroft, using the southern entrance into the town, thereby minimizing the disturbance of local residents. Another route via Oregon Jack Creek road is possible, however, extensive and costly upgrading is needed to permit its use as a haul road.

6.3.3 Transportation Costs

Since the destination is on C.N.R. lines, rail costs were obtained only from C.N.R. Truck costs were obtained from a number of companies with experience in this type of bulk move.

Figure 6-3 summarizes the estimated transportation costs for the rail haul, truck haul and the total for various combinations.

FIGURE 6-3 ESTIMATED TRANSPORTATION COSTS TEST BURN COAL

COMPANY	HAUL ROUTE	DISTANCE (Miles-approx.)	RATE ($/TON)	RAIL PLUS TRUCK RATE ($/TON)
C.N. Rail	Ashcroft / Sundance	517	15.11	—
Trucking Contractor no. 1	Hat Creek to Ashcroft	30.5	7.75	22.86
Trucking Contractor no. 2	Hat Creek to Ashcroft	30.5	5.95	21.06
Trucking Contractor no. 3	Hat Creek to Ashcroft	30.5	5.36	20.47

6.4 SUMMARY

The selected system for transporting the test burn coal is front end loader from mine stockpile to truck, truck over existing roads to the J&T Lumber site at Ashcroft then C.N.R. rail to the Alberta thermal plant. The estimated cost of this system is $20.50 to $23.00 for transportation costs plus $65,000 capital investment for site development giving a total cost per ton of $21.80 to $24.30, say $23.00 per ton.

The other two considerations in the test burn coal move are environmental and lead time.

The major environmental/social considerations[1] are disturbances to local residents by increased traffic and coal spillage. The environmental impact should not be significant because of the small amount of coal to be handled over a relatively short period of time. The coal spillage problem can be resolved by using tarpaulins to cover the trucks, sealing the tail gates and cleaning the outside of the trucks after loading is completed.

Construction of the Cornwall/Medicine Creek road ahead of developing the rest of the mine could resolve the social/environmental problems associated with this move. This solution, however, does not appear to be practical because of lead time and because the full decision on development will not be forthcoming until a later date.

Lead time for constructing the facilities necessary to complete the move are at least 8 months for land lease negotiations and site preparation.

(1) See Appendices D and E for detailed Environmental and Social Reports.

APPENDIX A

TERMS OF REFERENCE

17 October 1975

TERMS OF REFERENCE

TRANSPORTATION STUDY
PROPOSED HAT CREEK DEVELOPMENT

ABSTRACT

Provide engineering services for a transportation study related to the development of B.C. Hydro's Hat Creek coal deposit. The study is to include a technical, economic and environmental description and comparative evaluation of road, rail and other facilities as they relate to the transportation facets of a coal test burn, a coal mine development, and a thermal power plant. Also required is the study of potential airstrip sites near the coal deposit.

TERMS OF REFERENCE

1.0 The study shall consider the following phases of development affecting transportation facilities related to the Hat Creek mine and the power plant.

1.1 Coal Test Burn

This phase includes the transport and delivery of 50,000 tons (excluding losses) of coal mined from the Hat Creek coal deposit to a power plant in Alberta. Delivery is to commence after 1 March 1976 and be completed by 1 June 1976.

1.2 Construction and Operation of a Coal Mine and Thermal Power Plant

The second phase includes construction and subsequent continuous operation of a coal mining development and a three or four unit 2000 MW thermal power plant with the first unit in service by 1 January 1983 and all units in service by 1 January 1985. The assumed plant life will be 35 years. The transport of construction materials, supplies and personnel would be the major concerns during construction. The transport of coal, ash, operating supplies and personnel would be the major concerns during operation of the development.

1.3 Expansion of Coal Mining and Thermal Power Generation

The final phase includes general consideration for future expansion of the mining and thermal power generation to 4000 to 5000 MW.

2.0 The coal mining site for the 2000 MW development would be located in the Upper Hat Creek Valley coal deposit. Alternate mine sites within the deposit may be provided by B.C. Hydro for the future expansion phase as the study progresses.

3.0 The thermal power plant sites considered for the initial 2000 MW phase are to include:

3.1 Interior Sites

a) Mine Mouth - north end of Upper Hat Creek Valley near B.C. Highway 12; site elevation approximately 2750 feet.

b) High Altitude - the flat land east of Harry Lake; site elevation approximately 4300 feet. Investigation of coal transportation to this site should include conveyor belt.

c) Interior Plateau - on the east side of the Fraser River just north of Big Bar Creek; site elevation approximately 3500 feet.

d) East of Valley near Water Supply - on the Thompson River within roughly 5 miles of Ashcroft; site elevation 1000 to 2000 feet.

3.2 Tidewater Sites - three alternatives on the southwest coast of the B.C. mainland.

Details may be provided by B.C. Hydro on the expansion of the thermal generating capacity at either the initial 2000 MW plant site or at a selected alternate site.

4.0 The work shall include comparative engineering studies including documentation and appraisal of all existing, upgraded and new road and rail transport modes, their related loading and unloading facilities and required transfer terminals for the aforementioned plant sites. In addition, alternative modes such as conveyors, non-conventional train systems, slurry pipelines and aerial tramways would entail brief consideration. Input from previous consultant studies will be provided for evaluating slurry pipelines.

With respect to potential airstrip sites, the work shall also include investigation of sites that would benefit nearby communities. Airstrip sizing, access and location requirements are to be determined in consultation with B.C. Hydro's Chief Pilot.

5.0 Consultation with Government departments and public and private industry who have or would have interests or plans for the transportation facilities affected by the development will be required. Initial contacts with various agencies would be made by B.C. Hydro.

6.0 Background information and technical details of coal characteristics, preliminary mine and thermal power plant equipment and manpower construction and operating requirements will be provided by B.C. Hydro. Assumptions made by the consultant shall be identified and approved by the study coordinator.

7.0 Coal transportation shall be based on power plant requirements of 40,000 tons/day for 2000 MW at either of the interior sites. At the tidewater sites it is assumed the coal would be beneficiated at the mine to reduce transportation costs and the transportation requirement would be reduced to 32,000 tons/day. Allowance for losses shall be estimated and identified as a portion of the total coal transported.

8.0 The study shall clearly identify the limitations of existing transportation facilities and the proposed improvements, both temporary and permanent, to meet development requirements to 1985. A schedule of proposed improvements including estimated costs by year is required.

9.0 An overview evaluation of transportation route land alienation is to be studied including an investigation of land use, land type and aesthetic and economic value. Site specific variations in land alienation due to coal or ash storage/disposal requirements are not included.

10.0 Identification of major environmental and socio-economic impacts of alternate transportation facilities and routes is required. Effects of increases in rail and road traffic as they relate to accident frequency, noise, dust and vehicle emissions are to be considered. Beneficial as well as adverse effects are to be identified with means of minimizing impacts and enhancing potential benefits studied.

With respect to Indian Reservations, comparison of transportation routes should include an alternative which avoids the use of Indian Land as well as the most economic and environmentally sound proposals.

11.0 Cost estimates shall be calculated for the alternate transportation schemes studied. Capital cost estimates shall be broken down to clearly itemize the component costs. All estimates shall be in January 1976 dollars with a breakdown of yearly costs given where appropriate. The interest on capital and interest during construction of new facilities shall be assumed as 10% but itemized in such a way that the effect on an alternative rate can easily be applied.

Where upgraded or new facilities could involve partial or full participation by sources other than B.C. Hydro, these should be identified although no attempt should be made to estimate or establish cost sharing policies.

12.0 The complete report shall be submitted in draft form by 30 January 1976 and in final form by 15 March 1976. Progress reports shall be submitted monthly summarizing results achieved, costs incurred and scheduling of future work and associated costs.

13.0 The study is to be controlled and coordinated by Mr. E.H. Martin, Assistant General Manager Engineering, or his appointee.

The terms of reference were modified, during the course of the study, as follows:

a) The Thompson River thermal plant site was defined as:

Lot 35 on the west side of the Thompson River half-way between Cheetsum's Far and Oregon Jack Creek Indian Reserves just to the east of Red Hill.

b) It was assumed that the Hat Creek Valley from its junction with Highway 12 to its southern end would be classified as mine area and therefore not require environmental consideration in this report.

c) It was assumed that the Ashcroft/Clinton connection between the Canadian National Railway and the British Columbia Railway would be constructed and part of the existing railway system by the time this development proceeds.

d) The report completion dates were later modified to March 1st for submission of the Draft Report and May 7th for submission of the Final Report.

APPENDIX B

RAILWAY CORRESPONDENCE

January 5th, 1976
File: 3297/00

Mr. W.D. McKay
Assistant to Vice President
Canadian National Railways
777 Hornby Street
Vancouver, B.C.

Subject: Transportation Study
Proposed Hat Creek Development

Dear Sir:

As we discussed in our meeting on December 11th, Swan Wooster Engineering Co. Ltd. have been engaged by B.C. Hydro and Power Authority to carry out a transportation study related to the development of the Hat Creek coal deposit and thermal plants for the generation of electricity. This study involves all aspects of transportation but is mainly concerned with moving twelve million tons of coal per year from the mine to various thermal power plant locations. The approximate location of the mine and the various thermal power plants are shown on the attached drawing.

In order to assist us in completing this study we would like some information on the proposed Ashcroft/Clinton connector. We would like to know: a) when the Environmental Impact Study will be completed and how we may obtain a copy of it;
b) the cost of constructing this line, in two parts. One for the section from Clinton to the Hat Creek crossing, the other from the Hat Creek crossing to the connection with the C.N.R. mainline at McAbee. We understand from our discussions of the approximate location of the proposed connector, that the adverse gradient southbound on the connector will be 1% and that the adverse gradient northbound will be 2.2% and that the Canadian National Railways are not investigating the connection between this line and the proposed Hat Creek mine.

You will note on the attached plan that one of the proposed thermal generating plant sites is located on the Lower Mainland. For the purposes of our study this location has been approximated in the Roberts Bank area. Could you please advise us of your Company's official position with regard to handling the movement of coal from Hat Creek to the tentative Roberts Bank location, the initial tonnage has been set at about twelve

........./2

million tons per year with a possible doubling in later years. We would also like to know, if possible, the thoughts on what the cost of such a movement might be.

One other aspect of this study which we would like information on is the moving of 50,000 tons of coal from Ashcroft to the Sundance thermal electric plant near Edmonton. The two main items of information required are rates for the movement and the location of a loading area. Our Mr. Kichler will contact you with regard to this.

Thank you for your interest in this project and for the initial information supplied at our meeting.

Yours very truly,

SWAN WOOSTER ENGINEERING CO. LTD.

D. Krefting

DK/jeb
Enclosure

With respect to moving 12 to 24 million tons of coal annually from Hat Creek to Roberts Bank, frankly we do not believe that rail transportation of coal in the volumes contemplated over the territory can be accomplished economically compared to the alternative of generating the electrical power at Hat Creek. This is assuming, of course, a mine-mouth power station transmitting the power to a load centre in the Vancouver area. If you wish to determine the validity of our opinion, it is suggested that you calculate a coal transportation cost range **beneath which** rail transportation might compete with electrical transmission costs. We would then react to this figure or range of figures and in all probability quickly advise you that rail transportation was not viable at the price range implied.

Apart from the information above, we will be in a position shortly to provide rates and recommendations for a trans-shipping site to handle 50,000 tons of coal later this year, for test purposes, from Ashcroft to the Sundance thermal electric plant near Edmonton. We will be in touch.

Yours very truly,

W.D. Mackay,
Assistant to Vice-President.

WDM/nat

January 20th, 1976
File: 3297/00

British Columbia Railways
1177 West Hastings Street
Vancouver, B.C.

Attention: Mr. Cordon Ritchie
Chief of Real Estate and
Industrial Development

Subject: Proposed Hat Creek Development
Transportation Study

Dear Sir:

This letter will confirm our meeting of January 15th, 1976 where we discussed the above project which considers the transportation problems associated with developing a coal mine at Hat Creek and the possible thermal electric generating plants at several locations. Both the mine area and the potential thermal plant locations are shown on the attached sketch.

As discussed we would like to have you consider the problems and costs associated with transporting 12 million tons of coal per year from both the mine area and near Glen Fraser to Squamish and Britannia utilizing the following basic assumptions:

a) The 12 million tons of coal per year will start at a level of 4 million tons in 1983 and increase by 4 million tons in both 1984 and 1985.

b) The load-out equipment will provide for continuous flood loading of moving trains at the rate of 5,000 tons per hour.

c) The unloading will be by means of two single rotary car dumpers on separate loop tracks.

In addition to approximate rates for the above hauls we would like your rough assessment of the impact of this movement on your system, comments on necessary improvements and order-of-magnitude costs for these improvements would be appreciated as

......../2

well as the expected capacity of your system and the impact of this movement on that capacity.

Finally, along similar lines to the above, could we have your comments on the impact if the 12 million tons were to be doubled to 24 million tons sometime after 1985.

If you wish to discuss this further, please contact the undersigned. Thank you for your consideration.

Yours very truly,

SWAN WOOSTER ENGINEERING CO. LTD.

D. Krefting

DK/jeb
Enclosure

BRITISH COLUMBIA RAILWAY

MAR 19 1976

D.K.

16 March 1976

Swan Wooster Engineering Co., Ltd.,
1525 Robson Street,
Vancouver, B. C.
V6G 1C3

Attention: Mr. Doug Krefting

Dear Mr. Krefting:

SUBJECT: Proposed Hat Creek Development Transportation Study

In response to your letter dated January 20, 1976, and as agreed during our meeting of February 28, 1976 and two telephone conversations of March 2 and March 4, we are confirming the rate of 8.35/ton from Hat Creek and 5.65/ton from Glenfraser in accordance with the following:-

General Conditions

1. The rates have been estimated in terms of 1975 cost levels and are indicative of the "order of magnitude only", subject to future escalation.

2. These rates are subject to the assumption that production will commence at 4,000,000 short tons in the first year and will build in increments of 4,000,000 short tons annually, reaching a regular production level of 12,000,000 short tons in the third year.

3. It is assumed that the coal trains would be in operation 48 weeks per year.

4. *The possible trips per year on a 48 week basis have been reduced a further 10% to allow for disruption of service.*

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Executive Offices: 1177 West Hastings Street, Vancouver, B.C. V6E 2N6 Phone: 681-3131
General Offices: 1095 West Pender Street, Vancouver, B.C. V6E 2N6 Phone: 681-3131
Served by Telex.

Estimated Rate, Hat Creek - Britannia $8.35/ton

1. Operating Scheme:

- 78 cars/train, 7,995 tons payload capacity;
- 8 train sets;
- 9 3,000 hp units/train; 4 leading, 5 remote;
- 39' 15" cycle; 185 trips/year/set;
- approximately 5 trains/day, 7 days/week.

2. Capital Requirements:

Extension (20 miles)		$ 20,000,000
Pavilion Tunnel (4 miles)		20,000,000
Line Upgrading		36,800,000
Sidings		7,000,000
Communications and Signalling		7,650,000
Maintenance facilities - Squamish		1,750,000
Unloading facilities - Britannia		33,100,000*
Locomotives (79)		51,350,000
Cars (686)		24,010,000
Cabooses (8)		480,000
	Sub-total	202,140,000
	(Plus 10% engineering)	20,214,000
	(Plus 20% contingencies)	40,428,000
	Total	$262,782,000

*This figure includes the capital cost estimate of $27,000,000 derived from the Swan Wooster study for a proposed bulk materials terminal at Britannia Beach dated September 12, 1975. B. C. Railway considers this study to be indicative of the order of magnitude cost levels for unloading facilities at the proposed coal thermal generating plant.

Estimated Rate, Glenfraser - Britannia $5.65/ton

1. Operating Scheme:

- 78 cars/train, 7,995 tons payload capacity;
- 7 train sets;
- 9 3,000 hp units/train; 4 leading, 5 remote;
- 34' 15" cycle; 212 trips/year/set;
- approximately 5 trains/day, 7 days/week.

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2. Capital Requirements:

Transhipment facilities (Glenfraser)		$ 5,500,000
Line Upgrading		35,575,000
Sidings		6,750,000
Communications and Signalling		7,367,500
Maintenance facilities - Squamish		1,750,000
Locomotives	(70)	45,500,000
Cars	(600)	21,000,000
Cabooses	(7)	420,000
Sub-total		123,862,500
(Plus 10% engineering)		12,386,250
(Plus 20% contingencies)		24,772,500
Total		$161,021,250

Comments

It is the position of the Railway that the majority of the capital requirements be the responsibility of the shipper. We would recommend that the extension and tunnel (if required), the transhipment facilities (at Glenfraser), the unloading facilities (at Britannia) and the rolling stock and locomotives be the responsibility of B. C. Hydro. In this way the shipper would assume the risk for the necessary capital, allowing B. C. Railway to lower the rates quoted to a level more in line with operating costs.

Impact - Hat Creek Coal Movement @ 12,000,000 t.p.y.

1. Train Movements:

The addition of a 12,000,000 t.p.y. Hat Creek coal movement would have a profound effect on the Railway's operations. We have estimated that 5 loaded trains per day would be required to handle the tonnage contemplated. In total, 10 coal train movements per day (loaded and empty) would be added to the present operation of 6 through freights (north and southbound), a Squamish switcher (travelling either northward or southward) and 2 passenger train movements (one northbound, one southbound) per day.

2. Upgrading of Right-of-Way:

Considerable work would have to be undertaken to upgrade the Railway's right-of-way south to Britannia. Improvements would include the provision of improved sub-grade, realignment of track, reduction of curvatures and installation of 132 lb. rail. Bridge loadings would also be increased either through modification or replacement of existing bridges. It must be pointed however, that matters have not been considered in any detail at this time.

3. Sidings:

In order to facilitate train movements with minimum station intervals we have determined that 5 additional sidings would have to be constructed. Considering the extremely difficult terrain in which most of these sidings will have to be located, it is estimated that their average cost will be in the range of $750,000 per siding. Existing sidings will have to be lengthened and upgraded to conform with the anticipated size and weight of the coal trains.

4. Communications and Signalling:

With the expected train frequency resulting from the Hat Creek coal movement it is assumed that a form of Centralized Traffic Control will have to be installed. Such an installation would include a control centre, signal towers along the right-of-way, and power switches at each siding.

Conclusions - Capacity

Given the necessary upgrading of our facilities, the B. C. Railway does not feel that the addition of Hat Creek coal at 12,000,000 t.p.y. will tax the capacity of the Railway. Approximately 20 trains per day would be operating between a connecting point on our main line near Hat Creek and an unloading site at Britannia. Referring to a C. P. estimate of 30 trains per day for single track main line capacity where heavy gradients exist, the B.C.R. feels that the projected traffic levels are well within this limit.

Impact - Hat Creek Coal Movement @ 24,000,000 t.p.y.

If we assume that the frequency of coal trains is simply doubled to handle 24,000,000 t.p.y. from 12,000,000 t.p.y., then approximately 20 coal trains per day would be operated. Also given a conservative projection of forest products traffic growth, the B.C.R. should be handling 4 regular through freight trains per day in each direction after 1985. The remaining traffic - switcher and passenger operations, could be expected to remain unchanged from present practice. As a result the B.C.R. main line south of Hat Creek would be handling 20 coal trains (loaded and empty), 8 through freights (northbound and southbound), 2 passenger trains (northbound and southbound) and 1 switcher movement (alternating direction every other day) for a total of 31 train movements per day.

This projected traffic level appears to be at the limit of single track main line capacity where heavy gradients prevail. However, the B. C. Railway feels that it does have the residual capacity to absorb the full 24,000,000 t.p.y. into its operations, given additional improvements to its facilities.

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If necessary, route relocations for the purpose of grade reductions could be reviewed. Gradient reductions would offer increases in the capacity of the Railway system beyond the 30 trains per day cited.

Yours truly,

L. E. Morgan,
Project Specialist

LEM:lw

c.c. R. W. Young
G. L. Ritchie
A. C. Sturgeon
N. A. McPherson

January 20th, 1976
File: 3297/00

C.P. Rail
200 Granville Square
Vancouver, B.C.

Attention: Mr. R. Ritchie
Coal Marketing Manager

Subject: Proposed Hat Creek Development
Transportation Study

Dear Sir:

We have been engaged by B.C. Hydro to investigate the transportation aspects of their Hat Creek development, both at the mine and the associated thermal electric generating plants. The investigation includes consideration of the movement of 12 million tons of coal per year from the mine to seven possible thermal plant sites. Both the mine area and the possible thermal plant locations are shown on the attached sketch.

We would like to have you consider transporting this coal from two possible loadout points, one in the mine area and one near Ashcroft, to Roberts Bank utilizing the following assumptions:

a) The initial movement will be 12 million tons of coal per year starting at a rate of 4 million tons in 1983 and increasing by 4 million tons per year in both 1984 and 1985.

b) The load-out equipment provided will accommodate flood loading of moving trains at the rate of 5,000 tons per hour.

c) The unloading equipment will be two single rotary car dumpers on separate loop tracks.

In addition to approximate rates for the above hauls we would like your rough assessment of the impact of this movement on your system, comments on necessary improvements and order-of-magnitude costs for these improvements would be appreciated as well as the expected capacity of your system and the impact of this movement on that capacity.

Finally, along similar lines to the above, we would like to have your comments on the impact of doubling the 12 million tons sometime after 1985.

If you need further information, please contact the undersigned. Thank you for your consideration.

Yours very truly,

SWAN WOOSTER ENGINEERING CO. LTD.

D. Krefting

DK/jeb
Enclosure

W D Wilks

CP Rail

Marketing & Sales
Granville Square ... Vancouver
British Columbia

February 26, 1976.
File: 2.29.0

Mr. D. Krefting,
Swan Wooster Engineering Co. Ltd.,
1525 Robson Street,
Vancouver, B.C.

Dear Doug:

This letter will confirm the information discussed in our meeting February 25th, in response to your letter of January 20, 1976 regarding transportation aspects of B.C. Hydro's Hat Creek development.

The approximate rate from either the minesite or Ashcroft to Roberts Bank would be in the area of $8.90 per short ton in present day terms. This is based on using CP Rail equipment and excludes loading and unloading facilities. Due to the time frame involved and the considerable expense of modelling high volume unit train operations, more accurate figures cannot be developed until such time as actual projects come on stream and operating parameters become more specific.

Based on annual movement of 12 million tons, moved in 110 car trains, 105 tons per car (rotary dump gondolas) and assuming 335 operating days per year, average movement would be 3.1 trains per day. Assuming a 30 hour turnaround time, 4 train sets would be required. A 36 hour turnaround would require 5 train sets. A turnaround of 28 hours is considered optimum from Ashcroft, allowing 8 hours for combined loading and unloading functions.

A rough estimate of the cost of grading and trackage to the minesite would be about $800,000 per mile, assuming no major construction requirements such as bridges, tunnels, etc. are involved. Maximum grade should not exceed 1.0% in the loaded direction compensated for track curvature and 1.8% empty.

Impact of this volume on the capacity of our System would be to advance the time frame for reaching capacity limits by two to three years, in conjunction with requirements for other traffic movem ents. Specific improvements required would be as follows:

1) Construct new siding between China Bar and Spuzzum.

2) Lengthen sidings and construct sections of double track where possible.

3) Examine the capacity of B.C. Hydro and B.C. Harbours Board Railways to Roberts Bank.

Providing the required capacity on CP Rail is physically possible. The economic feasibility for plant improvements would have to be determined as part of the final development of any proposed movement.

I trust this information will suit your requirements. We would be most interested in receiving a copy of your report to B.C. Hydro when it is completed.

Yours truly,

J. G. YORKE,
Marketing Representative.
/ah

APPENDIX C

AIRPORT DATA

CANADIAN AIR TRANSPORTATION ADMINISTRATION

FINANCIAL ASSISTANCE

TO

CONSTRUCTION AND OPERATION OF

MUNICIPAL AND OTHER AIRPORTS

PART I

INTRODUCTION

The Ministry's role in developing public airports or in contributing toward their development stems from duties and responsibilities assigned to the Minister of Transport by the Aeronautics Act, and in certain cases by the Air Canada Act. Accordingly, the Ministry has assumed responsibility for the construction and operation of airports required in support of regular air services established in the public interest. *In addition, the Ministry has assumed responsibility for* the construction and operation of satellite airports that are, in the interest of safety, required to relieve congestion at major airports. A large number of other public airports have been developed by the Federal, Provincial, Municipal Governments and private interests, and are being operated by provincial, municipal and private authorities.

The introduction and expanded use of large turbine aircraft resulted in a considerable federal expenditure on new and improved runways, terminal buildings, aids to navigation and other services. In recognition of a further responsibility to promote the development of civil aviation in Canada and in addition to assuming direct responsibility for major airport construction in the post-war years, the Ministry introduced a financial assistance policy after World War II aimed at cooperating with provinces, municipalities or other public bodies in the development of airports suitable for the smaller types of aircraft generally used by private owners for business or pleasure. This policy was subsequently revised with the intention of providing more assistance towards the development of airports used by these relatively light aircraft. It has now been revised effective January 1, 1972 with a view to furthering the development or improvement of smaller airports suitable for this segment of the aviation industry. As the use of relatively small aircraft in business continues to expand so must the availability of suitable landing strips in order that the many benefits of air travel may be fully realized.

PART I

The Ministry is also concerned that there are many regions which over varying periods of time are inaccessible to modern forms of transport. Therefore this policy provides for the construction of airports in such regions, to provide essential communications with isolated populations.

Civil airports in Canada have been reclassified based on an Air Traffic Demand Index. This index updated annually will be a measurement of the relative strength of total demand for air transport at Canadian airports based on the following factors:

(i) the number of boarding passengers;
(ii) the number of itinerant movements performed;
(iii) the proportion of itinerant movements performed by aircraft on scheduled services;
(iv) the amount of freight loaded;
(v) the amount of air mail carried out.

The new classification of civil airports is as follows:

National Groups: Airports of predominantly national interest with an Air Traffic Demand Index within the range 400 to 1000.

Primary — A Ministry owned and operated designated international or international alternate airport and other Ministry owned airports which serve population centers of over 40,000.

Secondary — An airport of predominantly national interest with an Air Traffic Demand Index over 400 operated either by the Ministry or a municipality or other designated body.

Satellite — A Ministry owned and operated airport specially built to relieve congestion caused by training activities at a major airport.

Community Groups: Airports of predominantly local interest with an Air Traffic Demand Index of less than 400.

Feeder — An airport of predominantly local interest for a principal industrial or market area serving an established need of private aircraft operators, commercial air services for support of business, industry and tourist activities and served by a commercial air service engaged in route pattern operations.

PART I

Local Industrial	An airport of predominantly local interest in a principal industrial or market area and used by private aircraft operators, commercial air services for support of business, industry and tourist activities. The airport would also be used on a frequent and continuing basis by business and charter aircraft. The airport would have a definite potential as a feeder or secondary airport.
Local Intermediate	An airport of predominantly local interest for use by aircraft normally capable of operating from a gravel runway. The principal users would be private owners, light commercial air services, flying training or charter operations, and itinerants travelling to and from the area or enroute to other points. The airport would also be used on a frequent and continuing basis by business charter aircraft. The airport should have some potential as a feeder or secondary airport.
Small Local	An airport of predominantly local interest for use by aircraft normally capable of operating from turf or gravel runways. The principle users would be private aircraft owners, light commercial air services for flying training or charter operations, and itinerant travelling to and from the area or enroute to other points. The airport would have little or no foreseeable potential as a feeder or secondary airport.
Remote	An airport required to relieve isolation in non-Arctic communities or settlements not served by reliable methods of surface transportation on a year-round basis.

<u>Arctic Group</u>: An airport in the area for which the Arctic Transportation Agency has program responsibility.

<u>Other Groups</u>:

Seaplane	Seaplane facilities refer to docks, floats or buoys provided to facilitate the safe mooring or docking of float equipped aircraft and includes, where necessary, breakwaters and dredging of sheltered areas to provide an adequate basin in which to manoeuver and moor aircraft.
Heliport	A heliport is an area of land or water licensed as an airport intended solely for use by helicopters. These are usually relatively inexpensive, of small size and predominantly of local or private interest.

Seaplane facilities and heliports while treated separately are regarded for the purpose of this policy as airports and the

the extent to which the Ministry develops or assists with the development of such facilities is dependent upon the classification into which they fall, e.g. National or Community groups.

Class I and Class II Air Carriers are defined as follows:

Class I - Air Carriers who offer public transportation of persons, mails and/or goods by aircraft serving designated points in accordance with a service schedule and at a toll per unit.

Class II - Air Carriers who offer public transportation of persons, mails and/or goods by aircraft serving designated points on a route pattern and with some degree of regularity and at a toll per unit.

The following pages outline in detail the criteria of the Financial Assistance Policy, Airport Construction and Operation, applicable to each group of airports referred to above. The costs referred to apply only to those costs normally charged against the Airport and Ground Services account in the Air Transportation Program, but do not apply to terminal traffic control or terminal electronic navigation aids.

Arctic airports shall be eligible for financial assistance in accordance with these criteria for the years 1972/73 and 1973/74 pending the development and approval of a distinctive Arctic Air Transportation Facility Policy.

PART II

Financial Assistance Available For National Groups Airports and Certain Designated Airports in the Community Groups

With respect to airports in the National groups, the Ministry assumes the responsibility for developing, operating and maintaining airports, associated services and facilities required in support of a commercial air service operating on a regular service. Inasmuch as a number of airports in this category are now operated by municipalities and other public bodies, the Ministry will encourage these agencies to continue operation of their airports and will provide financial assistance equal to 100% of approved capital expenditures as well as 100% of operating deficits up to a level approved by the Ministry in accordance with the criteria set out below.

In the transition to the new policy for financial assistance, certain airports which were eligible for an operating subsidy as of December 31, 1971 under the former operating subsidy policy would not be entitled to an operating subsidy under the new policy because their Air Traffic Demand Index is below 400. Notwithstanding, an airport which was so eligible shall receive financial assistance in accordance with the criteria contained in this PART, and provided that the airport continues to receive Class I or Class II air carrier service.

The Minister may designate an airport receiving a Class I or Class II air carrier service as eligible for an operating subsidy even though it had not been eligible for an operating subsidy as of December 31, 1971, notwithstanding that such an airport has an Air Traffic Demand Index below 400, and provided that such designation can be justified in consideration of less quantifiable factors related to aviation, sociological and/or the economic benefits.

PART II

Where an airport owned by a municipality or other public body is or comes within one of the three situations outlined above, and such airport is to be improved in accordance with the criteria set out below, the Ministry reserves the right to acquire title to the land at any time in accordance with clause 7 of the criteria. Before the Ministry may proceed with the improvement or development of such an airport, the municipality or public body must agree to continue to operate the airport as a public facility in accordance with the terms and conditions established in an agreement with the Ministry. The agreement will be in the form of a lease if title to the land is held by the Ministry, and an appropriate contract if title to the land is held by the municipality or other public body. If subsequently additional land is required for the further development of an airport to which this PART applies, such additional land shall be acquired at the cost of the Ministry and it shall be leased to the municipality or other public body concerned.

The following are the criteria relating to the Financial Assistance Policy, Airport Construction and Operation, with respect to airports to which this PART applies:

1. A public airport to which this PART applies shall receive an annual subsidy to a level approved by the Minister or his delegated officer, and the maximum level of the subsidy shall be determined annually in advance.
2. In determining the level of subsidy consideration shall be given to an airport's annual operating deficit. The financial statements in support of an application for an operating subsidy shall include:
   (a) depreciation at rates, to be determined from time to time by the Minister or his delegated officer but only on such classes of structures, improvements and equipment as are approved as being eligible by the Minister or his delegated officer.

PART II

Depreciation shall not be allowed with respect to any portions of structures, improvements and equipment which were paid for out of grants in aid, subsidy or reimbursement from any federal or provincial department or agency;

(b) bond interest, or reasonable charges for interest on advances and purchase contracts.

3. A reasonable amount for administrative services provided by a municipality or public body may be included as an airport operating expense.

4. No amount shall be included for depreciation, bond interest or operating expenses with respect to any class of structures, improvements, equipment not approved by the Minister or his delegated officer and any revenue derived by a municipality or public body with respect to such structures, improvements, equipment shall be excluded in calculating an operating deficit.

5. In the event that an airport to which this PART applies experiences an operating deficit in excess of the adjusted level approved by the Minister or his delegated officer such excess shall be subject to review. If in the opinion of the Minister or his delegated officer the causes for the excess are deemed to be justifiable the excess or such part of the excess as may be approved by him, shall be eligible as additional to the approved level. That portion of the excess deficit which is not approved by the Minister or his delegated officer shall be borne by the municipality or public body.

6. If the Minister or his delegated officer deems that a structure, improvement, equipment or an extension,

alteration or replacement thereof is required for the operation of a public airport, to which this PART applies, the provision thereof may be either included in the Air Transportation Program; or the Minister or his delegated officer may authorize the municipality or public body to construct or alter the structure or improvement or acquire the equipment and thereafter recover the cost thereof in accordance with paragraph 2 provided that such construction, alteration or acquisition shall be strictly in accordance with plans approved by the Minister or his delegated officer.

7. Notwithstanding paragraphs 2 and 6 the Minister or his delegated officer may elect to acquire a municipality's or public body's, title to land or any structure, improvement, equipment of an airport to which this PART applies. The purchase price to be paid by the Ministry shall not exceed the original acquisition price of land and non-depreciable improvements to land; and in respect of depreciable structures, improvements, equipment, the original acquisition price less an amount of accumulated depreciation as of the date of transfer of title to the Ministry. An amount equal to the total of contributions or subsidy paid by federal or provincial departments or agencies toward the original acquisition price shall be deducted in calculating the purchase price.

8. All payments to public airports to which this PART applies, whether as an operating subsidy or for a capital expenditure, are made subject to the condition that all structures, improvements and equipment of such classes which are

approved as eligible by the Minister or his delegated officer under paragraph 2 shall not be removed from the airport at any time and shall be used only with respect to the operation and maintenance of the airport.

9. Fees and charges at public airports to which this PART applies shall be not less than the fees and charges that would obtain if the revenue policies and standards in effect at Ministry airports were applied. If a municipality or public body does not implement pricing practices to develop revenue potential not less than would be obtained under Ministry of Transport revenue policies and standards the amount of the operating subsidy will be reduced accordingly. A reasonable time as determined by the Minister or his delegated officer will be allowed for implementing appropriate pricing practices. Nothing in this paragraph shall be construed to prevent a municipality or other public body from establishing fees and charges higher than those prevailing at Ministry airports.

10. All airport revenue including airport revenues on hand as of January 1, 1972, other than such revenue referred to in paragraph 5, shall be retained in an airport account. Any surplus revenue at the end of any one year shall be carried over to an airport's budgetary requirements for the following year, all in accordance with directions issued by the Minister or his delegated officer from time to time.

11. An airport to which this PART applies shall maintain such records of accounts, and follow budgetary and financial control procedures as may be issued by the Minister or his delegated

officer from time to time.

12. An airport to which this PART applies shall maintain such records of aircraft movements, of airport maintenance and such other records as may be prescribed by the Minister or his delegated officer from time to time.

13. Payments under this PART will be made at the time and in the menner prescribed by the Minister or his delegated officer provided that:

(a) Advances in any one year may be paid with respect to operating deficits, provided that the final payment for each year shall be made only upon receipt of such financial statements as may be determined by the Minister or his delegated officer.

(b) Progress payments may be made with respect to construction projects or acquisitions provided that an appropriate agreement has been completed before payments commence.

PART III

Financial Assistance Available for Community Groups Airports
(excepting certain designated airports eligible under PART II)

Financial assistance toward the construction of new airports or for the improvement of existing airports in this category may be up to the percentages and ceilings shown in the table below depending on the classification of the airport as determined in accordance with the definitions in PART I, and taking into account other less quantifiable factors which may be related to either aviation, sociological or economic benefits and could include the need for an airport to:

(i) accommodate a certain class of air carrier service

(ii) relieve isolation

(iii) provide an emergency landing facility

(iv) provide access to recreational areas

(v) *relieve congestion at major airports*

	Feeder	Local Industrial	Intermediate Local	Small Local	Remote
TOTAL ANNUAL BUDGET *	Variable	Minimum $1.0 M up to Maximum of $2.0 M			
MOT Participation					
a) Airport Const'n (runways, taxiways etc.)	Up to 100%	Up to 80%	Up to 90%	Up to 100%	Up to 100%
b) Airport Bldg's Capital toward non-revenue producing space.	Up to 100%	Up to 50%	Up to 50%	Up to 50%	Up to 50%
Guidelines MOT Participation	Cost/ Benefit Study	$250,000	$175,000	$100,000	$100,000
Operating Subsidy	STUDY	NIL	NIL	NIL	NIL

* For fiscal year 1972/73 a total of $3 million is provided of which $1 million is to apply to outstanding cases in the feeder class as well as any approved local or remote airports that remain outstanding during that period.

PART III

The financial assistance for airports to which this PART applies does not include the cost of land. The municipality or other public body concerned must acquire title in fee simple to land required for either airport development or expansion, and title to the land shall be subject to a restrictive covenant against title registered in favour of the Federal Crown to prevent the disposal of the land or any part thereof without the consent of the Minister. Notwithstanding the foregoing an airport may be leased without consent for continuing airport purposes or purposes compatible therewith, subject however to such conditions as may be stipulated by the Minister or his delegated officer in writing for the administration of the policies and/or standards of the Ministry. Land required for protection against obstructions to aircraft operation being erected shall likewise be acquired in fee simple or an easement in perpetuity.

Airports in this category owned by the Ministry may be leased for maintenance and operation to municipalities or other public bodies. In cases where major rehabilitation or expansion is required to meet the needs of general aviation, financial assistance in accordance with the principles contained in this PART may be made available to the municipality or other public body, however the applicant shall be required to acquire title to the site. The Federal Crown will sell the site to the applicant at a negotiated price but in any event not less than the amount which the Crown paid for the land.

Financial assistance under the principles outlined in this PART shall not be provided in respect of any work performed prior to approval of an application for financial assistance.

With respect to applications for work to be performed, prior to a project being considered the applicant will be required to make a firm commitment by way of By-Law or Resolution that, subject to the Ministry's approval to provide a contribution, it will:

(1) acquire any land deemed suitable and necessary by the Ministry to develop the airport to the specifications agreed upon and to protect the approaches to the landing strip(s);

PART III

(2) enter into a firm agreement with the Ministry to assume full responsibility for operation and maintenance of the airport after completion.

No project will be approved unless the applicant agrees to bear all costs in excess of an amount deemed appropriate by the Minister, provided in any event that the contribution to be paid by the Ministry shall not exceed the percentages and ceilings shown in the table above. When an agreement has been completed with the Ministry and provided funds have been voted by Parliament, progress payments may be made. An airport constructed or improved in accordance with the principles outlined in this PART shall be operated and maintained as a public airport by the applicant in accordance with the agreement.

The following are the eligible items for development which will be considered for a new airport or airport improvement:

(i) Preparation of Site:

Eligibility of grading, drainage and associated items of site preparation will be limited to one or more landing strips dependent upon the number of runways approved by the Ministry, (see sub-section - Runways) and the overall site preparation required for development in accordance with the approved plan. Site preparation for a passenger/operations building is eligible on the same basis as the building itself, i.e., site preparation cost to be pro-rated, based upon eligible and ineligible building space.

Drainage work off the airport site includes drainage outfalls, drainage disposal, interception ditches, etc. If there will be damage to adjacent property, work necessary to correct such damage is an eligible item.

(ii) Runways:

Runways may be developed initially of turf, graded, gravelled or paved surfaces in accordance with approved specifications and current Ministry standards depending upon the operational requirement in each case, subject to site consideration.

Types of work eligible includes pavement construction, reconstruction and resurfacing where such resurfacing is to increase the load bearing capacity of the runway or to provide a levelling course to correct major irregularities in the pavement. Runway resealing or refilling joints of an ordinary maintenance nature is not eligible for inclusion in a project. This however does not exclude the application of a bituminous surface treatment initially or where the existing surface course consists of such treatment and it needs re-application.

Where it has been determined that more than one runway would be justified, the preferential wind runway will be given first priority for paving if considered desirable for operational reasons.

(iii) Taxiways:

Taxiways may be developed initially of turf, graded, gravelled or paved surfaces in accordance with approved specifications and current Ministry standards depending

PART III

upon the operational requirement in each case.

The construction, alteration and repair of taxiways available for general public use are eligible items. The policy concerning resealing or refilling joints covered in the previous sub-section - Runways, applies also to paved taxiways.

(iv) Aprons:

The construction, alteration, and repair of aprons are eligible for Ministry participation upon a demonstrated need for general public use. The policy concerning resealing or refilling joints covered in the sub-section - Runways, applies also to paved aprons.

(v) Airport Lighting:

Runway, taxiway and apron lighting, illuminated windsock, and the lighting of designated obstructions on or in the vicinity of an airport are eligible. An airport so eligible will also be eligible for the installation of control equipment and other components of basic airport lighting including separate transformer vaults and connection to the nearest available power source. The installation of revolving beacon, if required, will also be eligible.

The installation of lighting facilities will be considered only at those airports which are or will be licensed for night operations, are required in support of a continuing public need, and which have a sufficient volume of existing or potential night operations. Before an application is considered, the applicant shall be made aware of his responsibilities regarding the method of operating and the approximate cost of maintaining the lighting facilities.

(vi) Passenger/Operations Building:

The Ministry will participate only to the extent shown in the table above towards the cost of non-revenue producing space in a passenger/operations building. In calculating the cost of the building for contribution purposes the following may be included. The plans and specifications for the building must be approved by the Ministry before construction commences.

Engineers' and architects' fees;
Building construction costs;
Sewer, water and power services;
Pavement for public building accesses;
Landscaping.

(vii) Utilities:

The cost of the installation of utilities are eligible only to the extent of the eligibility of the facilities and areas served. In the case of a utility serving both eligible and ineligible items, the extent of the Ministry participation will be established on a pro rata basis. A water system (including wells, pumps, hydrants, mains and necessary storage facilities) to the extent needed to serve eligible buildings, or for fire protection, is eligible.

(viii) Roads:

The construction, alteration and repair of airport roads which are wholly within the airport boundaries as defined by the Administrator are eligible if justified on the basis of actual need for operating and maintaining the airport.

PART III

(ix) Automobile Parking Facilities:

No part of the construction, alteration or repair (including grading, drainage, and other site preparation work) of facilities or areas to be used as public parking facilities for passenger automobiles are eligible.

(x) Landscaping, Turfing and Erosion Control:

Landscaping other than that required in connection with the construction of a passenger/operations building are not eligible. The establishment of turf on graded areas and special treatment to prevent slope erosion are eligible to the extent of the eligibility of the facilities or areas served, preserved or protected by such turf or treatment. In the case of such turfing or treatment for an area or facility that is only partly eligible, Ministry participation will be established on a pro rata basis.

(xi) Fencing:

Boundary or perimeter fences for security purposes are eligible.

(xii) Removal of Obstructions:

a) The removal of objects that exceed the maximum permissible heights in relation to designated flightways or adjacent to runways and which are designated by the Ministry as obstructions to be removed, is eligible. No Ministry funds will be used to remove obstructions however, unless arrangements satisfactory to the Ministry are made that will preclude an obstruction from being re-established.

Where removal is not feasible, the cost of marking and/or lighting an obstruction designated as such by the Ministry is eligible.

b) The removal of only those structures necessary to accomplish essential airport development are eligible.

c) Where a structure must be relocated under (a) or (b), if the existing structure is to be relocated either with or without disassembly, the actual cost of such relocation is an eligible item, including costs incidental to the relocation, such as necessary footings and floors. The re-erection of a structure must be substantially identical to the one that was disassembled.

d) Where a structure is to be demolished under (a) or (b), only the cost of demolition is an eligible item, and no Ministry funds will be used to erect a new structure.

(xiii) Miscellaneous Landing Aids:

The installation of wind socks and boundary markers are eligible.

(xiv) Marking:

The initial markings of runways, taxiway systems and aircraft parking aprons in a manner prescribed by the Ministry, if such markings are required and approved, are eligible.

PART III

(xv) Off-site Work:

The following works performed outside the boundaries of an airport site are eligible: -

1. Removal of obstructions as described in this PART.
2. Out-fall drainage ditches: The corrective work required to prevent any damage resulting from construction of ditches.
3. Relocation of roads and utilities constituting airport hazards.
4. Construction and installation of eligible utilities.
5. Lighting or marking of specified obstructions.

(xvi) Miscellaneous Items of Development:

In addition to above items, such other items that may be specifically approved by the Ministry are eligible.

(xvii) Eligibility of Repair Work - Exclusion of Maintenance Work:

Maintenance work is not eligible under this PART, and consequently a determination will be required whether the work proposed is maintenance or repair. As a guide maintenance should be regarded as including any regular or recurring work necessary to preserve an existing facility in good condition, any work involved in the care or cleaning, and incidental or minor repair work on existing airport facilities. On the other hand, repair work or reconstruction should be regarded as including any major work necessary to restore or preserve the facilities. Examples of maintenance items which are not eligible, include the following:

a) Mowing and fertilizing of turf areas, trimming and replacing all surface materials.
b) Cleaning of drainage systems and restoring eroded areas except where major damage has been caused by an act of God or the facility was improperly designed prior to federal participation and required reconstruction.
c) Repairing and replacing burned out or broken fixtures.
d) Surface repairs in localized areas except where the magnitude of the work is such that it is judged to constitute a major repair or reconstruction project.
e) Refilling cracks and joints and minor surface repairs to pavements.

The Ministry will provide standards and consulting services to assist airport authorities in developing appropriate maintenance procedures. The Ministry reserves the right to inspect airport facilities to determine whether an acceptable program of maintenance is being carried out. In processing applications for repair work, assessment by the Minister or his delegated officers as to eligibility of the repair work will take into consideration the airport authority's observance of recommended standards and maintenance procedures. The Minister may withhold approval of a repair work if recommended standards and maintenance procedures were not carried out.

PART IV

Financial Assistance Available for Other Groups

Seaplane Base

In cases where a suitable government wharf exists the Ministry will provide funds for the provision of an appropriate seaplane facility by arrangement with the Department of Public Works which is responsible under the Harbours and Piers Act for the construction of all installations constructed by the Federal Government in navigable waters including tidal waters, where it can be shown, as a result of economic and technical studies, that a seaplane facility is warranted in support of commercial seaplane operations or for general aviation. In such cases, upon completion, the seaplane facilities are transferred for administration and control to the Ministry.

Where no suitable wharf exists and where it can be shown in the same context as above that the provision of a facility by the Ministry either directly or on a contribution basis would be justified, the Ministry will, in the first instance, provide funds to the Department of Public Works for the acquisition of the site and provision of necessary facilities, and in the second instance will provide funds to the applicant in the same context as applicable under local airports. Also, subject to agreement by Public Works and the concurrence of the Governor-in-Council, the provisions of the Harbours and Piers Act relating to the powers of the Minister of Public Works might, in certain cases, be transferred to the Minister of Transport so the latter could arrange directly for the construction of certain seaplane facilities in the National and Community groups, when advisable.

Seaplane facilities constructed directly with federal funds will be maintained by the Federal Government but where feasible a local public body, aviation interest or individual may be appointed to act as wharfinger to provide a measure of control over its use.

PART IV

Heliport

For the purpose of this policy and to establish the extent of Ministry participation, heliports are regarded as airports. Where a requirement for heliport can be established as a result of an economic and technical study, financial assistance may be provided, or direct construction responsibility assumed in the same general context as applicable to the appropriate airport category.

APPENDIX D

ENVIRONMENTAL REPORT

ENVIRONMENTAL ASPECTS

OF A COAL

TRANSPORTATION STUDY

OF THE

PROPOSED HAT CREEK DEVELOPMENT

prepared for
Swan Wooster Engineering Co. Ltd.

prepared by
The TERA Environmental Resource Analyst Limited

April 1976

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5 Impact of the access and coal transportation corridors on sensitive vegetation units

6 Impact of the access and coal transportation corridors on fish and wildlife

7 Summary of impact data of access and coal transportation corridors on fish and wildlife

8 Impact of the access and coal transportation corridors on mining

9 Evaluation of the impact of the access and coal transportation corridors on the forestry values

10 Distance in miles of good, moderate, and poor agricultural land crossed by each corridor

11 Distance in miles of agricultural land reserve crossed by each corridor

12 Impact of the access and coal transportation corridors on agriculture and grazing values

13 Summary of physical and natural resource sensitivities towards the access and coal transportation corridors

1.0 INTRODUCTION

In November of 1975, Swan Wooster Engineering Co. Ltd. retained The TERA Environmental Resource Analyst Limited to act as environmental and social advisors on an upcoming study of alternative coal transportation corridors between the Hat Creek mine and a number of thermal generating sites. Subsequently, on recommendations of the client, B.C. Hydro and Power Authority, the social aspects of the study were assigned to B.C. Research. This would insure that the same people which had dealt with ranchers, Indians, and administrative municipal officials in previous studies for B.C. Hydro and Power Authority and the Canadian National Railway would continue their discourse. The basic objective of the environmental and social studies would be to facilitate a comparative ranking of all transportation corridors generated by the engineering and economic consultant.

2.0 ASSUMPTIONS AND LIMITATIONS

The scope of the environmental and social study was to act as an advisor to the engineers and economists in order to "red flag" potential conflicts in the generated transportation corridors. In addition, an attempt was made to rank each transportation corridor in terms of its environmental and social sensitivity for the construction and maintenance of the transportation corridor. Benefits accrued in environmental and social aspects would be high-lighted as well.

It should be stressed that the environmental and social studies in no way reflect the scope of the engineering and economic studies. Rather, they are confined to the identification and relative comparison of environmental and social economic impacts.

The terms of reference were as follows:

(1) A detailed evaluation of transportation route land alienation is to be studied including investigation of land use, land type and aesthetic and economic value.

(2) Identification of environmental and social economic impacts of alternate transportation facilities and routes are required. Effects of increases in rail and road traffic as they relate to accident frequency, noise, dust and vehicle emissions are to be considered. Beneficial, as well as adverse, effects are to be identified with means of minimizing impacts and enhancing potential benefits studied.

With respect to Native Indian reservations, comparison of transportation routes should include an alternative which avoids the use of Native Indian land, as well as the most economic and environmentally sound proposals.

Assumptions and Limitations (cont'd)

The following assumptions were made:

(1) That detailed environmental and social studies would commence subsequent to the coal transportation studies and could deal with the preferred transportation corridor(s).

(2) That the level of environmental and social information should facilitate a relative comparison and ranking of environmental and social parameters in order to facilitate a selection of preferred corridor(s).

(3) Where potential environmental and social limitations and conflicts would be identified, the specific technical details would be studied in a subsequent assessment by the detailed environmental and social studies.

(4) That the identification of environmental (physical and ecological) conflicts be identified on the basis of a field reconnaissance and published literature.

In total, the environmental and social studies would be an advisory, accompanying document and should not be considered a detailed environmental and social study.

3.0 PHYSICAL AND NATURAL RESOURCES

3.1 Landform and Geology

The immediate study area surrounding the Hat Creek coal deposit falls into the Interior Plateau physiographic region of British Columbia. Specifically, the region is made up of the Thompson Plateau and the northern portion of the Fraser Plateau. The western area consists of the Clear Range and Marble Range (Holland, 1963).

The geology of the region consists of a relatively stable crystalline basement plate between the Fraser Trench and the Thompson - Okanagan Trench. The crystalline bedrock is made up of metamorphic rocks which have been intruded by various plutonic rocks, such as in the Highland Valley and Bonaparte Lake areas. In fairly recent geologic history, this crystalline basement rock has been covered by volcanic flows which are interrupted by sedimentary sequences. It is such a recent sedimentary sequence which contains the Hat Creek coal deposit.

In the north, the study area consists primarily of re-crystallized limestone, characterized by Marble Canyon. The immediate Hat Creek drainage area consists of volcanic rock with inter-bedded sedimentary sequences. The recent sedimentary outcrops, in particular the claystones, are not resistant to weathering and erosion, and generally occur in topographically depressed areas.

The rebound of the land with the wasting of the ice sheet has created incised creek valleys and drainage areas within the study region. The strongest erosion was confined to major rivers, such as the Thompson and Fraser. The secondary creeks, such as Hat Creek and the Bonaparte River, have a generally higher profile and tumble through rapids and canyons to reach the level of the major rivers. This fact isolates all of the Bonaparte, Hat Creek, Pavilion, Big Bar and secondary creeks from access for anadromous fish.

Because of the frequency of occurrence of easily weathered and erodable bedrock, such as claystone and siltstone, poor foundation, high erosion, and severe dust problems are associated with these rocks.

3.1.1.1 Highway Access

3.1.1.1 A Mine, Mine Mouth and Harry Lake

In order to move equipment and people into the mine, mine mouth thermal generating site, and Harry Lake thermal generating site, Medicine/Cornwall would be a newly constructed route. It traverses through deeply-incised creek valleys. The floors are drift-covered and the side-slopes consist of weathered metamorphic rocks. In general, the upper valleys of both creeks show good foundation and low erodability. However, the mouths of Medicine and Cornwall creeks show some fine-textured loam with low bearing strenth and high dust potential.

Upgrading of Highway #12, along Hat Creek, would entail less disturbance to the bedrock and surficial materials. It primarily traverses volcanic materials which lead into the Marble Canyon formation in the proximity of the mine. Although the valley is confined and incised, it can accommodate the upgraded road.

3.1.1.1 B Big Bar Creek

The Big Bar Creek thermal generation site would require upgrading of an existing all-weather surface road. By virtue of the flat terrain, as well as a compact till plain, no foundation or erosion problems would be anticipated.

3.1.1.1 C Ashcroft

In order to move men and equipment into the Ashcroft thermal generation site, a short one-half mile long road would have to be constructed. Pockets of loam, as well as lacustrine deposits, may create certain foundation difficulties. This road would be prone to dust as well.

3.1.1.2 Coal Transportation

3.1.1.3 A Harry Lake Conveyor System

The Harry Lake conveyor from the mine to the lake traverses relatively steep terrain which consists primarily of volcanic materials. The thin soil mantle over the volcanic rocks should make it possible to select the most competent and stable substrate for the construction of the conveyor. Assuming careful selection, no foundation or erosion problems are envisioned.

3.1.1.2 B Transport to Existing Railways

A new rail route would be required to Big Bar Creek. This is between the Big Bar thermal plant and the existing B.C.R. railway in the vicinity of Clinton. It traverses relatively flat plateau country. This till plain has little landform or geological limitations, except for the presence of swales which are generally filled with lakes and wetlands. However, the nature of the flat terrain makes it possible to avoid these depressions.

There are two alternatives to join the new rail link between Big Bar Creek and the B.C.R. rail at Clinton to the mine site at Hat Creek. These are:

(1) the connection via the new C.N.R. rail to Carquile, then up Hat Creek, along Highway #12 to the mine. The lower Hat Creek Valley, although incised and narrow, shows good surficial and bedrock materials to accommodate a rail spur.

(2) a route from B.C.R. Clinton connector along B.C.R. to Glenfraser where the Chipuin-Sallus Creek conveyor would transfer the coal. The pass between the two creeks is relatively high and the two streams narrow and deeply incised. Bedrock consists of volcanics with moderate to good foundation. The unconsolidated materials are shallow and their foundation characteristics good. The major limitation is steepness of the valley flanks.

Alternatives to reach the Ashcroft thermal generating sites are: a new rail line from the mine to Carquile, and a new rail line from Carquile to the plant site along Highways 97 and 1. The rail line from the mine to Carquile has been discussed above. The rail line from Carquile to the plant site would follow the existing highways along the Bonaparte and Thompson river benchland. This benchland consists predominantly of glacial benches and some rock outcrop, mainly volcanic rocks. This latter corridor has relatively good foundation and excavation characteristics.

The conveyor to Basque, a conveyor system along Oregon Jack Creek, traverses a deeply incised valley which primarily consists of metamorphics, mainly re-crystallized limestone.

Major limitation lies in the narrowness of the valley and gradient of the creek. No foundation problems are anticipated.

The Squamish thermal generation plant site requires a new rail line from the mine through Pavilion connecting with the existing B.C.R. to Clinton. The Marble Canyon route traverses re-crystallized limestone in a deeply incised valley. The presence of some active slides is indicated and detailed study of the geotechnical ramifications of this corridor should be conducted. Steepness is one further limiting factor for the location of a coal transportation corridor. The other connection is via a conveyor at Sallus and Chipuin creeks.

In order to reach the Lower Mainland sites, a new rail line from the plant to Carquille, via the Ashcroft Clinton Connector to C.N./C.P. and the C.N./C.P. rail to the plant, and a conveyor to the plant site, via Oregon Jack Creek, are necessary (and have been discussed previously).

On the basis of landform and geology, the corridors are ranked in the following table.

TABLE 1

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON GEOLOGY AND LANDFORM

CORRIDOR ALTERNATIVES	SENSITIVITY	TYPE OF IMPACT
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	low	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	moderate	narrow valley; steep side slopes
Big Bar Creek Plant Northwest from Clinton	low	-
Ashcroft Plant Highway #1	low	-
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site)	low	-
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	moderate	swales may have poor foundation
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	moderate	swales may have poor foundation
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	low	-
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	moderate	narrow valley; steep side slopes
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	high	active slides
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	moderate	high and steep
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	low	-
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	moderate	narrow and steep

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3.2 Surface Water and Groundwater

The majority of precipitation within the study area falls during the winter in the form of snow at higher elevations. The pronounced increase in total precipitation at higher elevations indicates that most water storage is in the form of snow and confined to areas above 4500 feet.

The major river valleys are extremely dry because of the rainshadow effect. In addition, increased trans-evaporation due to milder temperatures and longer growing season utilizes available water in the drier valleys. The shorter growing season in the higher regions cannot utilize all the available waters and, thus, contributes a net water discharge to the lower regions.

Among the surface drainage, all drainage areas which have their water recharge within higher regions are perennial streams. In contrast, those streams which have a water recharge in lower areas without the benefit of snow accumulation during winter are either intermittant or ephemeral streams.

The dominant perennial streams, such as the Bonaparte River, Hat Creek, Pavilion Creek and Big Bar Creek, are important sources of irrigation water to ranchers and farmers.

Intermittent and ephemeral drainages, such as Medicine Creek, Cornwall Creek, Oregon Jack Creek, Chipuin Creek and Sallus Creek, nevertheless, act as important groundwater recharge during the summer drought. In many cases, such groundwater reservoirs have been taken advantage of by wells.

The groundwater in the higher region sheds its groundwater and the groundwater table is relatively close to the surface. However, in the broad, major valleys, groundwater tables fluctuate and are dependent upon either perennial streams or ephemeral streams and lateral seepage. Depending on texture of unconsolidated materials within the broader floodplains of the major valleys, groundwater tables can be fairly deep.

The major sensitivity which the surface and sub-surface hydrology exhibits lies in potential interference with surface and groundwater storage in the higher areas. Interruption of surface flow due to stream crossings, embankments or other structures can lead to siltation and changes in water quality.

Interferrence with groundwater can result through compaction of unconsolidated materials which interrupt lateral groundwater seepage, especially along the lower portions of side hills. For this reason, present water use for domestic, irrigation and industrial purposes should be documented, as well as an understanding of water requirements of vegetation and water-dependent animals be established. In the following discussions, very broad value judgments were made as to the sensitivity of certain drainages.

3.2.1.1 Highway Access

3.2.1.1 A Mine, Mine Mouth and Harry Lake

The upgrading of Highway #12, along the Hat Creek Valley, would only have moderate impact on the water regime of the creek. However, the road should maintain its location, as much as possible, away from the actual stream course, in order to avoid channelization.

The construction of a new road along Medicine and Cornwall creeks would result in a somewhat higher interference with the flow of these streams. The proposed road should be kept away from the actual floodplain and avoid the interruption of lateral seepage into the stream waters.

3.2.1.1 B Big Bar Creek

The road between Clinton and Big Bar Creek plant site would entail upgrading of the existing all-weather dirt road and little impact on the hydrology would be expected if the wetlands were avoided.

3.2.1.1 C Ashcroft

The short road into the thermal plant would show insignificant hydrological interference.

3.2.1.2 Coal Transportation

3.2.1.2 A Harry Lake Conveyor System

The construction of a conveyor to the Harry Lake plant site from the mine is expected to have little impact on the groundwater hydrology. No surface water would be traversed.

3.2.1.2 B Transport to Existing Railways

Of the two alternatives to Big Bar Creek plant site from the mine, one leads through Hat Creek, with a rail system connecting via the proposed Ashcroft/Clinton Connector. It shows relatively high interference of the meandering creek morphology of Hat Creek. The grade requirements and terrain requirements of the railway would cut through a number of creek meanders which would result in many crossings and stream channelization.

A new rail line connecting Clinton with the Big Bar Creek plant site should be far enough away from Big Bar Creek itself and its lakes so as to avoid any direct interference with the stream. However, Big Bar Creek is buffered by a number of lakes and its stream is sufficiently stable to show low sensitivity. However, foreign material during construction should be kept out of the stream.

The second alternative to Big Bar Creek is a conveyor system to Glenfraser via Sallus Creek. It shows relatively moderate impact on the hydrology of both Chipuin and Sallus creeks. Although Chipuin and Sallus creeks are intermittent streams, the smaller size of the right-of-way for the conveyor system and the low grade of road maintenance required to service the conveyor system represent less of a disturbance than, for instance, a major railway or highway.

For the Ashcroft thermal generation site, two new rail lines, one from the mine to Carquile and the other from Carquile to the plant along Highways 97 and 1, show rail crossings of many ephemeral streams. However, most of these gullies are already alienated by roads. They drain towards settled areas. Thus, the major impact could be to water users outside the Cache Creek and/or Ashcroft communities. However, the hydrological impact of a rail system along Highways 97 and 1, if provided with pervious aprons which allow percolation of groundwater, would be significantly reduced.

The conveyor system down Oregon Jack Creek would show some potential changes to the stream. The valley is deeply incised and it is difficult to stay out of the floodplain, which could result in channelization and some interruption of seepage into the stream. However, if the conveyor is maintained high on the side hill with adequate culverting and pervious aprons, the impact would be moderate.

For destinations such as Squamish, the new rail line to Pavilion, through Pavilion Creek and Marble Canyon, would show little interference with the hydrology of that stream system. Pavilion Lake provides good flow control and the headwaters of Pavilion Creek itself are located in the Marble Range. Subject to proper construction procedure, the anticipated impact on the Pavilion system would be low. In summary, the following table ranks the corridor alternatives in terms of hydrological sensitivity.

TABLE 2

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON HYDROLOGY

CORRIDOR ALTERNATIVES	SENSITIVITY	TYPE OF IMPACT
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	moderate	channelization
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	moderate	channelization; culverts; etc.
Big Bar Creek Plant Northwest from Clinton	moderate	wetlands
Ashcroft Plant Highway #1	low	-
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site	low	-
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	high	extreme creek bed alteration
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	moderate	water recharge alteration
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	high	extreme creek bed alteration
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	moderate	channelization
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	low	-
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	moderate	water recharge disturbance
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	high	extreme creek bed alteration
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	moderate	channelization

3.3 Soils

Soil formation is the interaction of climate, vegetation, topography, and time acting on parent material to produce soils with different physical and chemical properties. In other words, different soil types will form under different vegetation types and climatic regimes on the same parent material. Basically, seven broad soil orders described by the NSSC (1970) were crossed. These are Podzol, Gleysol, Brunisol, Regosol, Luvisol, Chernozem, and Organic.

Podzolic orders are well and imperfectly drained soils which develop in cold and moist climates under coniferous or mixed coniferous vegetation on acid parent materials. Podzols are most common in the Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone. These soils commonly have a thick, acid, organic accumulation on the surface. This soil order is fairly uncommon in the study area because of the high base status of the parent material and low rainfall preventing the leaching process.

Gleysolic orders are soils which are saturated with water for some period during the year. Reduction of iron commonly takes place under the anaerobic soil conditions and production of a mottled blue and brown horizon is formed (gleization). These soils occur in undrained depressions and level areas where seepage water or a high water table is present. The vegetation contains species that can withstand high water contents in the soil. These soils usually contain a large number of species, but are minor in total amount of area covered because of the dry climate conditions.

Luvisolic orders consist of soils developed under forests or forest and grass areas. The parent material is generally alkaline. The accumulation of silicate clay in the lower horizons is a characteristic feature. Lacustrine and alkaline glacial till are the most common pedogenic processes. This order is common in the upper Interior Douglas-fir Biogeoclimatic Zone.

Brunisolic orders occur in well to imperfectly drained conditions under forest and mixed forest and grass areas. These soils have an organic top horizon and, in contrast to the Podzolic order, fail to have a rust brown lower horizon (B-horizon). The parent material is usually basic and variable. This soil order commonly occurs under the dry forest conditions of the Interior Douglas-fir and Ponderosa Pine - Bunchgrass biogeoclimatic zones. This order is the most prevalent throughout the study area.

Regosols occur on well to imperfectly drained mineral soils under oxidizing conditions. These soils are usually very young soils and do not show any horizon development. These are associated with streams and recent alluvial deposits. The vegetation is mainly riparian. The alkalinity is very high due to evaporation drawing salts to the surface layers. Flooding is also common. The proposed transportation corridors probably effect this order the most.

Chernozemic soils have a very well developed dark surface layer with a high base saturation of the lower horizon. This soil develops under semi-arid conditions in a cool climate. Grassland is the representative vegetation type. The darkening of surface horizons by organic matter (melanization) and accumulation of calcium (calcification) are the dominant soil processes. This soil order is common in the Ponderosa Pine - Bunchgrass Biogeoclimatic Zone and grassland meadows of the lower Interior Douglas-fir Biogeoclimatic Zone. The soils are highly erodable and alkaline.

Localized occurrences of organic soils occur in poorly drained depressions in cool and sub-humic to humic climates where decomposition of organic matter is slow and accumulation takes place under anaerobic conditions. The typical vegetation is marsh type, made up of sedges, rushes and willows.

In general, the soils are fine-textured, alkaline and vary in depth from 30 feet to less than 6 inches. The fine-texture and alkalinity results from the derivation of the parent material from limestone, sandstone, shale and volcanic bedrock deposits. The soils derived from volcanic bedrock are less alkaline than those from limestone and sandstone. The majority of the upland soils are derived from glacial till and colluvium parent material. Within the valleys several parent materials, including glacio-fluvial and alluvial deposits give rise to heterogeneous soils.

3.3.1 Specific Corridor Considerations

The most important characteristics that affect the placement of the access and coal transportation corridors are erosion potential, very high salt accumulations in the surface soils, foundation and loading characteristics, flooding, and dusting problems of the soils (Table 3).

3.3.1.1 Highway Access

As with the vegetation, the impact of upgrading the present roads is much less than building a new road and, therefore, more desirable in terms of impact on soils. However, for social reasons, this may not be the case. The major impact would come during the construction stage. Revegetation of cut slopes and improved culverts to prevent loss of soils should be immediate. Dust would be a factor and watering should take place during construction.

3.3.1.1 A Mine, Mine Mouth and Harry Lake

The Medicine/Cornwall route has been suggested as an access corridor to the mine or the proposed Harry Lake thermal plant.

Major problems exist at each end where the corridor crosses highly erodable and alkaline Luvisols and Chernozems. Paving of the road would be necessary for dust control. Highway #12 involves upgrading of the existing road and would entail less soil disturbance.

3.3.1.1 B Big Bar Creek

Road access to Big Bar Creek would require upgrading of an existing gravel road. This road would traverse soils with relatively high salt content and medium texture. Problems associated with these soils would be salt accumulation, if disturbed, and dust.

3.3.1.1 C Ashcroft

A short access road to Ashcroft site would traverse Chernozem soils, which if wetted show plastic flow and high dusting.

3.3.1.2 Coal Transportation

3.3.1.2 A Harry Lake Conveyor System

This conveyor route crosses glacio-fluvial deposits along Hat Creek, as well as deep glacial till and colluvium farther up the slope. The soils are mainly Chernozems under the grassland and Luvisols on the upper slopes. As with most of the soils of the region, high salt concentrations occur here. Both soils are highly erodable, however, problems would only arise on the steep section of the corridor.

3.3.1.2 B Transport to Existing Railways

The conveyor down Oregon Jack Creek Valley would cross mainly colluvial deposits in the steep-sided valley and alluvial deposits along the streams. Several alluvial fans would also be crossed. The soil orders include Chernozems and Regosols. Both exhibit very high salt contents and, consequently, salt crusting and poor revegetation of the the disturbed areas might be a problem. The slopes are very steep and the fine-textured colluvium may erode or slump if too much material is removed from the toe-slope. Revegetation would have to be immediate. Additionally, numerous small lakes and swamps occur in the upper portion of the valley, where flooding and foundation problems on the highly organic soils are likely.

The rail line from the mine to Carquile, along Hat Creek, presents similar problems as the previous route. However, the valley is slightly wider and may accommodate a railway. Coarse-textured glacio-fluvial deposits are encountered in several areas along the route. The valley does constrict at several points and the railway would have to cross steep colluvial slopes. Sloughing could occur. Every attempt should be made to keep the railway off the meandering alluvial deposits along Hat Creek. Flooding and changes to the stream course, as well as salt accumulations in the surface soils over time, are limiting factors to the use of this area. Where alluvial fans must be crossed, an attempt should be made to utilize the upper portion of the fan where the seepage water is more channelized and culverts can be used. Placement of the railway along the bottom of the fan would result in complete interception of seepage water for a long distance.

The rail line from the mine to Pavilion encounters Chernozem soils along most of the corridor with the exception of the steep slope above Pavilion Lake where Brunisols are prevalent. The two important limiting factors on the Chernozem soils are high salt accumulations and dust problems. For most of the distance across the Chernozemic soils, the corridor follows the valley bottom or gently sloping lower slopes. Along Pavilion Lake, the steep Colluvial soils would present problems with regards to mass-wasting and erosion. The extensive cut-and-fill slopes would require revegetation and proper contouring to prevent erosion. The prevention of debris from reaching Pavilion Lake is an important consideration.

The conveyor system to Glenfraser via Chipuin and Sallus creeks crosses three major parent materials: glacial till, colluvium, and alluvium. Luvisols occur on the glacial till, Brunisols on colluvium, and Regosols on alluvium. On alluvial fans, Luvisols are prevalent, and at higher elevations, there are small local occurrences of Podzols and Gleysols. At the beginning of the corridor in Hat Creek Valley, the soils (Luvisols) are very prone to erosion, dusting and salt accumulations. On the Regosols, along streams, flooding is a problem. Since a considerable portion of this corridor crosses rugged terrain at high elevations, colluvium on steep slopes is the most common parent material. The only problems which arise here are erosion and mass-wasting of the steep slopes. To consider this corridor would require many cut-and-fill slopes that would have to be revegetated immediately to prevent erosion and sedimentation to the streams. The revegetation process is not easy in the relatively severe climate at these elevations.

Physical and Natural Resources (cont'd)

The rail line from Carquile to the Ashcroft plant site along Highways 97 and 1, from the confluence of Hat Creek and the Bonaparte River, crosses open grassland on fine-textured tills and alluvial fans, and coarse glacio-fluvial deposits. The soils are classed as Chernozems. These soils are highly erodable, but the gentle topography would limit the impact.

The rail line from Clinton to the Big Bar Creek plant site follows a broad flat lava plateau covered by deep till deposits. Drainage patterns are not well developed. Many saline-alkali lakes exist along the corridor. The corridor is forested except for the bunchgrass slopes along the Fraser River. The major soil order along the corridor is Brunisols with relatively high salt accumulations. Chernozems are found along the Fraser River.

TABLE 3

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON THE SOILS

CORRIDOR ALTERNATIVES	SENSITIVITY	TYPE OF IMPACT
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	low	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	moderate	erosion; flooding
Big Bar Plant Northwest from Clinton	moderate	salt accumulation
Ashcroft Plant Highway #1	low	-
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site)	moderate	erosion; salt accumulation; dust
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	moderate	salt accumulation; flooding; dust
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	high	erosion; salt accumulation; flooding; dust
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	moderate	salt accumulation; flooding; dust
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	moderate	erosion; salt accumulation
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	high	erosion; salt accumulation
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	high	erosion; flooding
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	moderate	salt accumulation; flooding
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	moderate	erosion; salt accumulation

3.4 Vegetation

The vegetation of the coal transportation corridors falls within four major vegetation or biogeoclimatic zones identified by Krajina (1965). These include the Ponderosa Pine - Bunchgrass, the Interior Douglas-fir, the Engelmann Spruce - Subalpine Fir, and the Cariboo Aspen - Lodgepole Pine - Douglas-fir biogeoclimatic zones. Each biogeoclimatic zone is climatically determined and contains a number of plant associations that reflect the influence of this climate. Consequently, each biogeoclimatic zone has its own set of major vegetation associations that form due to variations in soils, topography, micro-climate, and successional state (time).

The Ponderosa Pine - Bunchgrass Biogeoclimatic Zone is characterized by a semi-arid steppe climate. It is the driest and warmest in British Columbia. Rainfall is the major limiting factor to tree growth and vegetation development. The forest stands are open savanna-type stands. Altitudinally, this biogeoclimatic zone lies between 900 and 3000 feet in elevation and is the lowest forested zone in British Columbia. Within the study area, it occupies most major river valleys.

In this biogeoclimatic zone, ponderosa pine (Pinus ponderosa) regenerates in savanna-like stands in coarse-textured soils. On finer-textured soils, ponderosa pine is usually missing and the areas become grassland range. Douglas-fir (Pseutosuga menziesii var. glauca) may occur here, but is usually confined to cool north slopes. The forested stands are low to moderate in stocking and the productivity is very low.

Common understory species are mainly grass species. These include bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), crested wheatgrass (Agropyron cristatum) and cheatgrass (Bromus tectorum). Herb species include cactus (Opuntis fragilus), yarrow (Achillea millefolium), arrow-leaf balsamroot (Balsamorhiza sagittata), knapweed (Centaurea diffusa), and pussytoes (Antennaria spp.). Shrubs usually occur sporadically throughout this zone. Sagebrush (Artemisia tridentata), rabbitbrush (Chrysothamnus nauseosus), squawbrush (Ribes cereum), and western shadbush (Amelanchier alnifolia) are common associates.

Domestic grazing use of rangeland has been extensive in this biogeoclimatic zone. The effect of grazing is to alter the species composition towards species that can withstand grazing pressures. Consequently, there is a change in its vegetation association, favouring non-palatable forage species. This can be seen in the study area by an increase of sagebrush, rabbitbush, cheatgrass, balsamroot and needlegrass (Stipa comata). These species usually occur only as sporadic shrubs and grasses, but after intensive grazing they become the dominant species on the site.

The Interior Douglas-fir Biogeoclimatic Zone is the second warmest and driest zone in British Columbia. This biogeoclimatic zone occurs above the Ponderosa Pine - Bunchgrass Biogeoclimatic Zone and is the most predominant zone within the study area. In elevation, the zone varies from 100 to 4500 feet above sea level.

The two major coniferous species are ponderosa pine (Pinus ponderosa) and Douglas-fir (Pseudotsuga menziesii). The major successional species after fire or logging at elevations above 3000 feet is lodgepole pine (Pinus contorta). The climate of the zone is dry as a result of the rainshadow effect of the Coast Mountains. Consequently, the productivity of the trees is reduced. The forested area is a mosaic of open grown ponderosa pine and Douglas-fir, interspersed with open range. The open range areas may extend to the upper limits of this zone on steep south slopes on fine-textured soils.

The following understory species are common and indicative of this biogeoclimatic zone: bearberry (Arctostaphylos uva-ursi), buffaloberry (Shepherdia canadensis), shiny-leaf spirea (Spiraea betulifolia), roses (Rosa spp.), Rocky mountain juniper (Juniperus scopulorum), pinegrass (Calamagrostis rubescens), and strawberries (Fragaria spp.).

Environmental features such as soil texture, aspect, and topographic position have a critical influence on the distribution of the vegetation associations in the zone because of the dry climate (Brayshaw, 1970). All these factors affect the soil moisture status, thereby, favouring certain plant species. For example, Douglas-fir grows best on cool north slopes, while ponderosa pine grows better on southern exposures. On very fine-textured soil, grass species are dominant.

The Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone is a much-fragmented forest occupying the highest elevations of the study area. Altitudinally, it ranges between 4000 feet above sea level to treeline (7500 feet). The climate is characterized by Krajina (1965) as a continental cold humid climate. This feature varies considerably from the Interior Douglas-fir and Ponderosa Pine - Bunchgrass biogeoclimatic zones where the climate was relatively dry. The cold humid climate of the Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone results from moist air forced to rise by the mountains and, subsequently, condensing and falling as rain at the higher elevations.

Physical and Natural Resources (cont'd)

The ground is usually frozen before the snow falls. Winters are very severe with the snow lasting approximately 7 months. This, together with very cool nights, results in a short growing season (Arlidge, 1955). Trees which can tolerate this extended period of frozen ground and short growing season can survive here. The major species are Engelmann spruce (Picea engelmannii) and subalpine fir (Abies lasiocarpa). The common successional species after fires or logging is lodgepole pine (Pinus contorta). These forests differ from those of the Interior Douglas-fir and Ponderosa Pine - Bunchgrass biogeoclimatic zones. The forests of the Engelmann Spruce - Subalpine Fir zone are usually dense and fully stocked. The productivity is also higher, however, whereas moisture was restricting in the lower biogeoclimatic zones, the short growing season of the Engelmann Spruce - Subalpine Fir zone is somewhat restricting to tree growth.

Along the upper altitudinal boundary, the continuous forest gives way to an open-type "parkland" forest. Krumholz formation of the tree species is characteristic. These communities form due to the severe climate and extensive snowfall. Whitebark pine (Pinus albicaulis) and alpine larch (Larix lyallii) occur as scattered individuals.

The understory is very rich and a large number of species occur in the wide variety of habitats available. Common understory species include grouseberry (Vaccinium membranaceum), oval-leaf huckleberry (Vaccinium ovalifolium), mountain-ash (Sorbus sitchensis) and trailing rubus (Rubus pedatus). Herb species include heart-leaf arnica (Arnica cordifolia) and coolwort foamflower (Tiarella unifoliata). Along streams and receiving areas, cow-parsnip (Heracleum lanatum), mountain valerian (Valeriana sitchensis), and false hellebore (Veratrum viride) are common. In the "parkland" forest the understory herbs, red-mountain heather (Phyllodoce empetriformis) and moss-heather (Cassiope mertensiana) form a dominant part of the understory.

Physical and Natural Resources (cont'd)

The Cariboo Aspen - Lodgepole Pine - Douglas-fir Biogeoclimatic Zone is quite similar to the Interior Douglas-fir Biogeoclimatic Zone. However, because of its more northerly position, its climate is considerably colder and severe. This fact restricts many of the tree species that occur in the Interior Douglas-fir zone.

The most common trees are Douglas-fir (Pseudotsuga menziesii var. glauca) and lodgepole pine (Pinus contorta). White spruce (Picea glauca) is frequent in cool receiving areas. On fine-textured soils (silty loams), open steppe grassland associations are very prevalent.

Understory species include bearberry (Arctostaphylos uva-ursi), scrub birch (Betula glandulosa), pinegrass (Calamagrostis rubescens) and wild sarsaparilla (Aralia nudicaulis).

The Big Bar Creek route, the rail route from Clinton to the plant site, is the only proposed coal transportation route to fall within this biogeoclimatic zone.

The vegetation associations of the study area appear to be typical for lower British Columbia in their respective biogeoclimatic zones, according to the aerial photographs of the area, as well as two recent reports completed on the Hat Creek area (Hat Creek Development, 1975, and the Ashcroft-Clinton Connection, 1975). Disturbances such as logging, fires, and domestic grazing are widespread throughout the study area. However, although there are no known unique vegetation associations in the area, certain vegetation associations are more sensitive to disturbance than others.

Riparian vegetation occurs in all biogeoclimatic zones along stream courses. The vegetation is dominated by black cottonwood (Populus trichocarpa), willows (Salix spp.) and mountain alder (Alnus incana). The understory shrub component is very important and consists mainly of red-osier dogwood (Cornus stolonifera), Nootka rose (Rosa nutkana), snowberry (Symphoricarpus albus), and Douglas maple (Acer glabrum). In the Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone, Engelmann spruce (Picea engelmannii) becomes an important overstory component. This vegetation association is very sensitive to disturbance because it is important to stream stabilization especially during peak flow periods. Removal of this vegetation association from the stream banks would lead to stream bank erosion and associated sedimentation to the stream itself. Fish habitat and water quality would be adversely affected. Since the areas along streams are periodically flooded, removal of the vegetation could lead to changes in the stream channel and erosion further away from the actual stream channel. Therefore, any proposed route that crosses the least number of streams or disturbs the least amount of riparian vegetation if the proposed route parallels the stream is the most environmentally desirable.

In the Ponderosa Pine - Bunchgrass and Interior Douglas-fir biogeoclimatic zones, on strongly alkaline soils, a halophytic vegetation association forms in depressions or where seepage water collects during the spring. (Lakes may be formed in some cases.) Only plants that can withstand the high salt content of the soils grow here. Species included in this association are desert saltgrass (Distichlis stricta), foxtail barley (Hordeum jubatum), softstem bulrush (Scripus validus), red glasswort (Salicornia rubra), Nuttall's alkaligrass (Puccinellia nutalliana), and along the outer edges where salt accumulations are less, giant wildrye (Elymus cinereus) occurs.

Although this type of vegetation occurs in other parts of British Columbia, it does not cover an extensive area. Therefore, preservation of this vegetation association is of some significance. However, probably more important is the fact that once the vegetation is removed, salt-crusting on the soil surface occurs due to rapid evaporation loss to the soil.

Flooding and mucky soil conditions can also occur during the spring months. The salt-crusting will inhibit the establishment of any plant species on disturbed sites. Therefore, these areas should be either avoided or if development must take place, grass seeding should take place immediately.

Within the Ponderosa Pine - Bunchgrass and Interior Douglas-fir biogeoclimatic zones, open bunchgrass and sagebrush grassland occurs on fine-textured soils. Common species are bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), cheatgrass (Bromus tectorum), needlegrass (Stipa commata), rabbitbush (Chrysothamnus nauseosus), and sagebrush (Artemisia tridentata). On steep slopes (greater than 30%), the fine-textured soils under this vegetation association are very prone to rill erosion after disturbance. These areas should be avoided wherever possible. If a route is chosen that must cross this vegetation association, revegetation should occur immediately. This procedure would help prevent erosion and curtail the invasion of these areas by non-desirable forage plants such as knapweed (Centaurea diffusa).

The Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone is a zone of dense forests with good tree growth at the lower elevations within the zone. The most important vegetation association occurs at elevations above 6000 feet. The subalpine "parkland" vegetation association contains krumholz formed trees interspersed with heather - (Phyllodoce spp. and Cassiope spp.) covered meadows. This association is very aesthetically appealing and because of severe climate re-establishment of this "parkland" association is very slow and difficult. Proposed coal transportation conveyor from the mine to Glenfraser via Sallus and Chipuin creeks, is the only corridor that might interfere with this vegetation association. Strict avoidance of the subalpine "parkland" association is recommended.

TABLE 4

APPROXIMATE PERCENTAGE OF ACCESS AND COAL
TRANSPORTATION CORRIDORS CROSSING EACH BIOGEOCLIMATIC ZONE

CORRIDOR ALTERNATIVES	PONDEROSA PINE - BUNCHGRASS	INTERIOR DOUGLAS - FIR	ENGELMANN SPRUCE - SUBALPINE FIR	CARIBOO ASPEN LODGEPOLE PINE DOUGLAS FIR
HIGHWAY ACCESS ALTERNATIVES:				
Mine, Mine Mouth and Harry Lake Plant Highway #12	-	-	-	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	5%	50%	45%	-
Big Bar Plant Northwest from Clinton	-	-	-	100%
Ashcroft Plant Highway #1	100%	-	-	-
COAL TRANSPORTATION ALTERNATIVES:				
Harry Lake Plant (direct conveyor from mine to plant site)	-	100%	-	-
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	5%	35%	-	60%
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	2%	2%	21%	75%
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	20%	80%	-	-
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	30%	70%	-	-
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	5%	95%	-	-
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	5%	5%	90%	-
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	5%	95%	-	-
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site	5%	95%	-	-

3.4.1 Specific Coal Transportation Routes

Assessing the specific impact of the various proposed coal transportation routes and access routes on the vegetational component is difficult, since no detailed vegetation assessment has been made. However, by the use of aerial photographs and available maps, some basic comparisons of the proposed routes can be completed. Only the proposed coal transportation corridors that must be constructed will be discussed, since existing routes only have an effect on vegetation as far as coal dust, road dust, and possibly increased air pollutants are concerned. Dust effects vegetation by inhibiting the processes of photosynthesis and transpiration. However, since adequate measures are going to be taken to control dusting problems, these aspects do not have to be considered.

3.4.1.1 Highway Access

3.4.1.1 A Mine, Mine Mouth and Harry Lake

Several routes have been proposed to transport men and equipment to the mine site and the various thermal plant options. Only one route would have to be totally constructed, the Medicine/Cornwall route; the remainder would only require upgrading of existing roads.

The Medicine/Cornwall route follows the drainages of Medicine and Cornwall creeks from Hat Creek to Ashcroft. The impact on stream and riparian vegetation would be high, especially in the high elevation Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone where the forests are dense and a high degree of clearing would be needed. Windfall could be a problem in some dense, less winfirm, stands along the right-of-way.

Since only upgrading of existing road would be needed to handle the increased traffic in lower Hat Creek, less removal of vegetation would be required. In addition, Highway #12 is located at lower elevations and, therefore, in the open ponderosa pine and Douglas-fir vegetation zones. Therefore, it does not remove the more sensitive higher Engelmann spruce association.

3.4.1.1 B Big Bar Creek

The upgrading of the existing dirt road would only moderately interfere with a number of sensitive vegetation units. These include: halophytic vegetation, surrounding all alkali-saline lakes, and riparian vegetation, around the lakes. Widening of the existing road should only take place in regions where it does not remove the above vegetation zones.

3.4.1.1 C Ashcroft

This short road leading into the Ashcroft plant traverses the bunchgrass and sagebrush vegetation. Immediate revegetation should be conducted in disturbed soils after construction.

3.4.1.2 Coal Transportation

3.4.1.2 A Harry Lake Conveyor System

This option has a short length (approximately 3 miles) and low impact on the vegetation. Only one small stream is crossed and the vegetation is not highly diverse. Open bunchgrass range exists around Harry Lake, however, the topography is not steep and no erosion of the fine-textured soils is envisioned. Where the stream is crossed, minimum damage to the vegetation on the stream bank is important.

3.4.1.2 B Transport to Existing Railways

Four routes have been proposed to transport the coal from the mine site to existing rail transportation. One possible route to the Ashcroft plant site consists of a new rail line to Oregon Jack Creek, plus a conveyor from there to the plant site. Placement of the conveyor in the valley bottom would disturb a large amount of riparian vegetation since the valley bottom is narrow and contains numerous small lakes and swamps which would have to be crossed. It is suggested that the conveyor be kept to lower side slopes of the valley to prevent disturbance to the creek bottom. Care would have to be exercised during construction and as little of the existing riparian vegetation as possible should be disturbed to prevent erosion and sedimentation to the creek.

The rail line to Carquile, along Hat Creek, parallels the lower creek for its entire length. Location of the proposed railway in the valley bottom would mean crossing Hat Creek many times because of its meandering nature. This would severely damage the riparian habitat with possible erosion and sedimentation problems to the stream. Locating the railway on the lower side slopes along the existing road seems more desirable. However, several steep bunchgrass slopes occur on alluvial fans along the corridor where erosion could occur. A revegetation programme should be carried out.

Physical and Natural Resources (cont'd)

The new rail line from the mine to Pavilion does not conflict with any sensitive vegetation units. Extensive agricultural lands, one Indian reserve, and Marble Canyon Park, are crossed. A steep slope south of Pavilion Lake may cause rock and organic debris to move down the slope and into Pavilion Lake during construction.

The conveyor to Glenfraser follows the Chipuin and Sallus creeks west to the B.C.R. railway. This corridor crosses much steep, rugged terrain above 5000 feet. A large number of side streams would have to be crossed. The proposed conveyor system and accompanying maintenance road would have severe impact on the flow regime and water quality of the streams (if much of the stream bank vegetation were removed) since these high elevation forests (Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone) provide much of the groundwater by precipitation and snow melt to the dry lower elevations. Flooding and stream bank erosion could be incurred during the high peak flow periods. This is especially true down Sallus Creek with its very steep slopes increasing the amount of disturbance. If this corridor is chosen, it would be imperative that as little vegetation be removed as possible, and a buffer strip left along the main stream course.

The new rail line from Clinton to the Big Bar Creek plant site interferes with a number of sensitive vegetation units. These sensitive units include halophytic vegetation surrounding alkali-saline lakes and riparian vegetation around lakes. The main disadvantage of this corridor is its length and removal of habitat.

TABLE 5

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON SENSITIVE VEGETATION UNITS

CORRIDOR ALTERNATIVES	RIPARIAN	STEEP BUNCHGRASS	HALOPHYTIC	SUBALPINE PARKLAND
HIGHWAY ACCESS ALTERNATIVES:				
Mine, Mine Mouth and Harry Lake Plant Highway #12	moderate	low	low	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	high	low	low	low
Big Bar Creek Plant Northwest from Clinton	moderate	low	high	moderate
Ashcroft Plant Highway #1	low	low	moderate	low
COAL TRANSPORTATION ALTERNATIVES:				
Harry Lake Plant (direct conveyor from mine to plant site)	low	moderate	low	-
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	high	low	high	-
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	high	low	high	low
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	high	moderate	low	-
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	high	moderate	moderate	-
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	moderate	moderate	low	-
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	high	low	low	low
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	high	moderate	low	-
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	high	moderate	moderate	-

Physical and Natural Resources (cont'd)

The new rail line from Carquile to the Ashcroft plant site extends from the confluence of Hat Creek and the Bonaparte River, south to the proposed thermal plant. This corridor traverses mostly open rolling bunchgrass rangeland. A major highway (Highway #1) already exists in the area. The impact of this corridor would be minimal on vegetation aspects.

3.5 Fish and Wildlife

The existing fish and wildlife data base in the Hat Creek vicinity is inadequate for proper comparative impact assessment among the different proposals. In particular, stream surveys are required for most of the potentially affected creeks. Also, seasonal patterns of ungulate movements in the area should be investigated. In this section, environmental analysis is restricted mainly to species of economic importance, such as fish, ungulates and waterfowl. There are two reasons for this. First, such species have the most specific information published for ths study area. Second, these species, especially fish and ungulates, are quite vulnerable to modifications in their environment. Fish are restricted to streams and lakes or portions thereof, and ungulates must move among widely separated habitats. Other species, such as mice, birds or invertebrates, can utilize smaller patches of habitat and can either live within one habitat association or can effectively locomote among several. For such species, removal of habitat is the primary offense adversely affecting their populations. Waterfowl falls into this category, and since nearly all of the good waterfowl habitat lies within the mine site itself or along existing railways, waterfowl considerations are not significant in comparison to fish and ungulate considerations.

Information was gathered from published information (listed in the Bibliography) and by personal communications with biologists familiar with the area. These were:

Wildlife: Mr. R. Ritsi of B.C. Fish and Wildlife (Kamloops)
Mr. R. Bradley of B.C. Hydro and Power Authority

Aquatic Resources: Mr. Kelly of the International Pacific Salmon Commission
Mr. Cartwright of B.C. Fish and Wildlife (Kamloops)
Mr. R. Fergusson of B.C. Hydro and Power Authority

Within the region studied, only blacktail deer (Odocoileus hemionus) and moose (Alces alces) are likely to be affected by the proposed transportation lines. Moose are of potential major concern only north of Clinton, where they are abundant. The most significant aspect of the life history of deer in the region is seasonal movement. Deer summer in a relatively large amount of wooded habitat at higher elevations. In winter, the deer must retreat to lower, drier areas, mainly along the Fraser and Thompson rivers, where the snow is not too deep. Two things appear to be critical to maintain deer populations in this region: maintenance of winter habitat and unobstructed migration routes.

The situation for moose is similar to that for deer, with a few differences. In the study area, moose are found primarily in the Marble Range. They summer mainly in the cooler, moister, higher zones in the mountains. In winter, they apparently move down to the Cariboo Aspen parklands to the northeast of the Marble Range.

None of the creeks and rivers in the study area, with the exception of the Fraser, Thompson and lower portion of the Bonaparte rivers are reported to have runs of anadromous fish. Resident rainbow trout (Salmo gairdneri) are likely to be the only species of any importance affected in the watershed systems. Probably Dolly Varden (Salvilinus malma) and mountain whitefish (Prosopium williamsoni) also occur in some of the larger systems such as Big Bar Creek and Hat Creek. Resident rainbow trout normally spawn in the spring and populations are most sensitive to disturbance, especially siltation, at this time. Dolly Varden and mountain whitefish spawn in the fall.

3.5.1.1 Highway Access

3.5.1.1 A Mine, Mine Mouth and Harry Lake

Regardless of the location of the thermal plant, an access road to the mine is required. Two alternatives are currently being considered: Highway #12, upgrading of existing highway, or a new highway along Cornwall and Medicine creeks.

Access by Medicine/Cornwall route is likely to have greater environmental impact for several reasons. Construction of new roads removes habitat. Removal of habitat adversely affects all species that potentially utilize it. This highway would cross many small tributaries to Cornwall and Medicine creeks as well as parallelling the two creeks. The potential impact to trout populations is great. A detailed stream study is necessary before a road is built along the Medicine/ Cornwall route. Additionally, the corridor bisects the Thompson Plateau. Any north-south movements of ungulates (deer or moose) would necessitate their crossing the highway, and a problem with road kills might develop.

Although this route is less favourable than the alternative of upgrading the existing highway, it is not unfavourable to highway construction. The area of the Thompson Plateau under consideration is believed to be relatively poor for ungulates and the primary movement of those ungulates would be altitudinal, hence mainly east-west and would be unlikely to cross the highway. Protection of aquatic resources is essential, however, and great care would have to be exercised in designed and constructing a highway through this corridor.

3.5.1.1 B Big Bar Creek

The upgrading of the present gravel road from the Big Bar Creek plant site to Highway 97 at Clinton would require a long route. This road, if built to the Department of Highways standards, would pass through relatively good deer and moose habitat. In addition, potential removal of lake and stream bank habitats may interfere with important habitats for smaller animals and waterfowl. Little interference with Big Bar Creek and its large population of resident rainbow trout would be aniticapted if the road is kept along the existing right-of-way of the gravel road.

3.5.1.1 C Ashcroft

Construction of the short access road into the plant would not interfere with any known wildlife habitat.

3.5.1.2 Coal Transportation

3.5.1.2 A Harry Lake Conveyor System

This would entail building an enclosed conveyor system approximately 3 miles long. The environmental effect of the system is expected to be minimal. The major problems associated with road and rail transport (i.e., dust and road kills) are eliminated or minimized. Since the line is shorter than road or rail lines, it can be in steep terrain and less habitat is removed. Noise can be effectively controlled with enclosed conveyors.

Conveyors have the disadvantage of potentially interferring with animal movements. The proposed line to Harry Lake parallels the major direction of ungulate movement in the area and the line is short enough so that animals could circumvent it. However, provision should be made to allow ungulates to cross over or under the conveyor. Ungulates tend to use the same paths habitually during their yearly migrations. Places where these paths cross proposed conveyors should be identified and provisions for ungulate passage should be incorporated into the final design for a conveyor.

3.5.1.2 B Transport to Existing Railways

The new rail line from the mine to Carquile passes longitudinally through a narrow strip of reasonably good (CLI Class 3) deer habitat, so the relative effect of the railway on that habitat would be great. Likewise, Hat Creet is significant for fish. Although extensive interference with fish and wildlife by the railway could possibly be avoided, any perceived interference by native peoples would constitute a real social impact. If the thermal station were at Ashcroft, an additional 20 miles of railway would need to be built. The same problems would arise in this section along the Bonaparte River as along the Hat Creek portion. Additionally, the extended rail line would pass near the lower portion of the Bonaparte River. Conflict between economic coal transport concerns and fisheries resource concerns should be studied in more detail.

The new rail line from the mine to Oregon Jack Creek appears environmentally preferable to the Hat Creek route. It is approximately the same length but does not pass through as much good ungulate habitat. Oregon Jack Creek is recorded as being intermittent; hence, it is not likely to be a significant fish stream. The conveyor from Oregon Jack Creek to the Ashcroft plant site would present a significant partial barrier to seasonal ungulate movements. Steps to alleviate this problem must be taken if this option is chosen. The problems that conveyors present to ungulate movement have been discussed in more detail with respect to the Harry Lake conveyor system.

The proposed railway to Pavilion would constitute about 21 miles of rails through steep terrain. The line is not likely to have a major impact on wildlife. Construction would cause serious local habitat disturbances because of the amount of cut-and-fill necessary to build a line through such steep terrain.

In this route, the railway should be built along the canyon walls, considerably above Pavilion Lake and Pavilion Creek. As long as reasonable care is used during construction, no significant affect on fish populations is anticipated in this portion. However, as the railway nears Pavilion, it would descend into the Pavilion Creek Valley. If the railway were designed such that it avoided the creek as much as possible and minimized the number of creek crossings required, the impact of the rail line on the aquatic resources could be kept at a minimum.

Physical and Natural Resources (cont'd)

The conveyor to Glenfraser over Chipuin and Sallus creeks would bisect the Clear Range between the mine and the Fraser River. It has the potential to isolate the upgulate population of the Clear Range into northern and southern components. Such isolation could have significant effects on the movement of ungulate populations. The number of animals possibly affected is not known, but it is not believed to be great. Nor can the efficacy of any proposed system of ungulate overpasses or underpasses along the conveyor line be estimated. Much more information on both summer and winter habitat usage of the Clear Range ungulates is needed to assess the impact of this proposal on wildlife.

This proposed conveyor line might also have an adverse affect on the trout populations in the Sallus-Chipuin creek system. Rainbow trout is the only salmonid species reported to be found in either creek system. Sufficient data are not currently available to allow assessment of fish populations in these creeks or to pinpoint sensitive areas within them.

A thermal plant at Big Bar Creek would require a new rail line to be constructed between Clinton and the Big Bar Creek site. Such construction would produce a relatively severe environmental effect. The corridor is long and most of it passes through what CLI* designates as relatively good (3 and 3W) deer and moose habitat. The corridor runs perpendicular to the major direction of annual ungulate (moose) movement and would intersect much of it.

* Canada Land Inventory

Physical and Natural Resources (cont'd)

Big Bar Creek apparently contains a large population of resident rainbow trout, although this resource is not heavily utilized by anglers. Potential for interference of the railway with aquatic resources, therefore, exists. More detailed stream surveys are needed before the potential impact of the proposed railway on the fisheries resource can be assessed.

TABLE 6

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON FISH AND WILDLIFE

CORRIDOR ALTERNATIVES	SENSITIVITY	TYPE OF IMPACT
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	low	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	moderate	many stream crossings; ungulate interference
Big Bar Creek Plant Northwest from Clinton	high	interference with deer and moose movement; many stream crossings
Ashcroft Plant Highway #1	low	-
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site)	low	-
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	high	many stream crossings; moderate moose interference
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	high	many stream crossings; high deer and moose interference
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	high	many stream crossings; moderate deer interference
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	low	-
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	low	-
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	moderate	many stream crossings; moderate deer interference
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	moderate	moderate deer and waterfowl interference
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	low	-

TABLE 7

CORRIDOR	TOTAL MILEAGE	MILEAGE THROUGH CLI 3 OR 3W UNGULATE HABITAT	NUMBER OF NEW STREAM CROSSINGS	NEW INTERFERENCE WITH SALMON	POTENTIAL INTERFERENCE WITH UNGULATE MOVEMENT	POTENTIAL WATERFOWL INTERFERENCE
HARRY LAKE CONVEYOR	approx 3	less 1	1	no	low (deer)	nil
HARRY LAKE ROAD	approx 15	less 1	few	no	nil	nil
OREGON JACK CREEK RAIL	20	9	few	no	moderate (deer)	nil
CARQUILE RAIL	20	20	few	no	very low (deer)	nil
MINE TO PAVILION	21	6	few	no	very low (deer)	nil
GLENFRASER CONVEYOR	17	1.5	many	no	moderate (deer)	nil
CARQUILE TO ASHCROFT RAIL	40	35	many	yes	low (deer)	nil
CARQUILE TO BIG BAR CREEK	104	97	many	no	moderate (moose)	very low
GLENFRASER TO BIG BAR CREEK	120	82	many	no	high (deer and moose)	very low
ASHCROFT/CLINTON CONNECTOR TO ROBERTS BANK	approx 200	approx 30	none?	no?	nil	yes
GLENFRASER TO SQUAMISH RAIL	approx 140	approx 14	none?	no?	nil	nil

4.0 PRESENT RESOURCE USE

4.1 Minerals and Coal

The Hat Creek region was never a very active area for exploration of base metal deposits. Within the region of the proposed transportation corridors, only minor base metal deposits are known.

In general, impacts of transportation corridors in relation to the mineral industry are beneficial. Access into remote areas generally accelerates interest in prospecting and could conceivably make marginal deposits more economical. The only negative aspect would be if a major utility and transportation corridor would go over a proposed mine and necessitate the re-location of the transportation facility in order to excavate the ore. The purpose of the following discussion is to list those mineral showings known within each transportation corridor and determine whether the chance for potential impact exists.

TABLE 8

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON MINING

CORRIDOR ALTERNATIVES	MINERAL OCCURRENCE
HIGHWAY ACCESS ALTERNATIVES:	
Mine, Mine Mouth and Harry Lake Plant Highway #12	no mineral occurrences known
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	chromium occurrence approximately 2 miles upstream from the Transcanada Highway but seems to be only a small localized occurrence
Big Bar Creek Plant Northwest from Clinton	no mineral occurrences known
Ashcroft Plant Highway #1	no mineral occurrences known
COAL TRANSPORTATION ALTERNATIVES:	
Harry Lake Plant (direct conveyor from mine to plant site)	no mineral occurrences known
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	no mineral occurrences known
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	no mineral occurrences known
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	localized chromium deposit west of Cache Creek
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	small epsomite deposit (magnesium sulfate) known south from the mouth of Oregon Jack Creek adjacent to Transcanada Highway
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	no mineral occurrences known
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	no mineral occurrences known
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	no mineral occurrences known
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	small epsomite deposit known south from the mouth of Oregon Jack Creek adjacent to the Transcanada Highway

4.2 Forestry

The productivity of the forests in the study area in terms of growth is generally classed as poor. This results from the limiting factors of precipitation and a relatively short growing season. However, there are patches of good productive forests in the area.

The amount of poor, medium and good productive forest along with the amount of non-forest for each of the proposed coal transportation corridors is shown in the following table. It can be seen from this table that only the conveyor to Glenfraser via Sallus Creek effects enough good productive site to be important. Most routes traverse a mixture of non-forest and poor site forests. Since clearing for construction of the railway or conveyor is one of the major construction costs, a route that passes through non-forest or open savanna-like forest stands is the most desirable, both economically and environmentally. Clearing costs are reduced and environmentally, windfirm damage and logging scars are eliminated. These open savanna-like stands usually develop on poor sites that cannot support dense tree stands.

The conveyor to Glenfraser via Sallus Creek is the only route that does not cross at least 50% non-forested land. Although 50% of its length is composed of poor productive site, 90% of it is in the Engelmann Spruce - Subalpine Fir Biogeoclimatic Zone, where the forest stands are usually very dense. Here, windfall could be a problem, especially in the younger lodgepole pine stands. With 42% of its length classed as medium productive site, it is also the most productive in terms of forest growth. The conveyor can be considered the least desirable in terms of forest values of the proposed routes.

Present Resource Use (cont'd)

Although information is available for only 30% of the total rail route from Clinton to the Big Bar Creek plant, aerial photographs indicated that the forest stands are quite similar and follow the same pattern as shown in the table. The length of the route (approximately 36 miles) is the least desirable factor, even though most of its length is composed of forests of poor productivity. The permanent loss of this much forest land would have a definite effect on the calculation of the allowable amount cut for the Big Bar PSYU (Permanent Sustain Yield Unit).

Since the other routes affect the forest base much less and do not interfere with that much highly productive forest, the decision on which of the remaining routes is the best should be placed on other environmental criteria.

TABLE 9

EVALUATION OF THE IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON THE FORESTRY VALUES

CORRIDOR ALTERNATIVES	GOOD	MEDIUM	POOR	NON-FOREST
HIGHWAY ACCESS ALTERNATIVES:				
Mine, Mine Mouth and Harry Lake Plant Highway #12	-	-	-	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	-	12% (1.75 mi)	30% (4.25 mi)	58% (8.25 mi)
Big Bar Creek Plant Northwest from Clinton	-	2% (0.50 mi)	80% (29.50 mi)	18% (6.00 mi)
Ashcroft Plant Highway #1	-	-	-	100% (0.50 mi)
COAL TRANSPORTATION ALTERNATIVES:				
Harry Lake Plant (direct conveyor from mine to plant site)	-	-	-	-
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	-	2% (0.75 mi)	62% (29.90 mi)	36% (17.80 mi)
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	-	10% (4.50 mi)	76% (34.25 mi)	14% (6.75 mi)
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	-	1% (0.25 mi)	3% (0.90 mi)	96% (28.90 mi)
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	-	5% (0.50 mi)	35% (4.10 mi)	60% (7.00 mi)
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	7% (0.75 mi)	-	25% (2.75 mi)	68% (7.50 mi)
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	-	42% (4.00 mi)	50% (4.75 mi)	8% (0.75 mi)
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	-	2% (0.25 mi)	3% (4.10 mi)	95% (7.00 mi)
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	-	5% (0.50 mi)	35% (4.10 mi)	60% (7.00 mi)

4.3 Agriculture and Grazing

The capability of the land to support agriculture was evaluated using Canada Land Inventory maps for agriculture. The following table exhibits the amount of land classed as good (1 to 3). Because of drought and low soil moisture-holding capacities, irrigation can increase the agricultural capability of the land. For this reason, the table includes the increase in agricultural capability due to irrigation where water status is a limitation. However, it is evident from the table that irrigation was not that effective in increasing the agricultural capability. It was effective mostly in bottomland sites where the dry climate and low soil moisture-holding capacity had the greatest effect. The majority of the sites crossed by the various corridors were more restricted by steep unfavourable topography and shallow soils and, consequently, irrigation would have little effect.

The new rail line from Carquile to the Ashcroft plant site was the only route that had a sufficient amount of high capability agricultural land with irrigation to be considered important in locating the coal transportation corridors. However, movement of alignment of this route to the west where topography allows would alleviate some of this impact on agricultural land.

The remaining corridors do not have a significant impact on prime agricultural land to constitute further consideration of this aspect.

Agricultural Land Reserves are land set aside by the B.C. Land Commission. Permits must be obtained before these lands can be crossed. Table 11 indicates the number of miles of Agricultural Land Reserve crossed by each of the proposed corridors and the percentage of the approximate length it

TABLE 10

DISTANCE IN MILES OF GOOD, MODERATE AND POOR AGRICULTURAL LAND CROSSED BY EACH CORRIDOR

CORRIDOR ALTERNATIVES	GOOD	MODERATE	POOR
HIGHWAY ACCESS ALTERNATIVES:			
Mine, Mine Mouth and Harry Lake Plant Highway #12	-	-	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	-	-	17.6 (17.6)*
Big Bar Creek Plant Northwest from Clinton	NO INFORMATION		
Ashcroft Plant Highway #1	-	-	-
COAL TRANSPORTATION ALTERNATIVES:			
Harry Lake Plant (direct conveyor from mine to plant site	-	- (.8)	- (2.2)
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	NO INFORMATION		
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	NO INFORMATION		
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	- (5.6)	- (4.0)	29.6 (37.6)
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	- (.4)	.4 (1.2)	10.8 (20.8)
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	- (1.0)	- -	12.8 (28.8)
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	-	-	9.5 (9.5)
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	-	-	12.0 (12.0)
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	- (.4)	.4 (1.2)	10.8 (20.8)

parenthesis indicates mileage with irrigation encompasses.

It is evident that both the rail line from Clinton the the Big Bar Creek plant site and the Harry Lake conveyor are totally within Agricultural Land Reserves. The conveyor from Oregon Jack Creek to the Ashcroft plant site and the rail line from the mine to Pavilion have the least impact.

Domestic grazing is the major use of the grasslands of interior British Columbia. Therefore, any development that removes land from grass production, greatly effects the grazing resource base. The amount of grazing land removed by each access and coal transportation corridor was evaluated simply by plotting existing open range lands from aerial photographs and maps. Existing grazing leases and permits were not investigated for the preliminary report.

All the corridors investigated had some effect on potential grazing land. However, the conveyor to Glenfraser via Sallus Creek and the road via Medicine and Cornwall creeks had the least effect, since they crossed mostly dense forest land at high elevations. The rail line to Oregon Jack Creek only affects grazing land for about 2 miles at its eastern terminus. The narrow steep valley restricts grazing opportunities. The rail line to Pavilion crosses mostly open savanna-like forests interspersed with several bunchgrass open ranges. These open forests provide fair grazing. However, the steep slopes above Pavilion Lake restrict grazing. The steep slopes along the new rail line to Carquile also restrict grazing. Numerous bunchgrass-covered alluvial fans along the corridor do provide some potential grazing land. The rail line from Carquile to the Ashcroft plant has, by far, the most affect on grazing land, since the corridor crosses only open bunchgrass range. Most of this land is now used for the purpose

TABLE 11

DISTANCE IN MILES OF AGRICULTURAL LAND RESERVE
CROSSED BY EACH CORRIDOR

CORRIDOR ALTERNATIVES	APPROXIMATE LENGTH (MILES)	AGRICULTURAL LAND RESERVE CROSSED (MILES)
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	-	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	14.0	4.8 (34%)
Big Bar Creek Plant Northwest from Clinton	-	-
Ashcroft Plant Highway #1	-	-
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site)	3.0	3.0 (100%)
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	48.0	40.0 (83%)
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	45.5	37.6 (83%)
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	29.6	12.0 (41%)
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	11.2	7.6 (14%)
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	12.4	2.4 (19%)
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	9.5	1.6 (17%)
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	12.0	4.8 (40%)
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	11.2	7.6 (14%)

Present Resource Use (cont'd)

of grazing. Consequently, the rail line from Carquile to the Ashcroft plant site has the greatest impact on grazing values. The rail line from Clinton to the Big Bar Creek plant site, to the north, crosses open bunch-grass rangeland for the last 4 miles of its length, while the rest of the corridor is in open forests that provide a minimal amount of grazing land. The total impact of this corridor is quite low except for the last 4 miles, where the impact is high.

The conveyor extending to Harry Lake is relatively short in length. However, the major portion of the line does cross grazing land, but because of the narrow width of the conveyor right-of-way (25 feet), little damage would be done, except for possible isolation of grazing land, if access across the conveyor is not provided.

TABLE 12

IMPACT OF THE ACCESS AND COAL TRANSPORTATION CORRIDORS ON AGRICULTURE AND GRAZING VALUES

CORRIDOR ALTERNATIVES	AGRICULTURE	GRAZING
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	-	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	low	low
Big Bar Creek Plant Northwest from Clinton	low	moderate
Ashcroft Plant Highway #1	low	low
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site)	low	moderate
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	low	moderate
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	low	moderate
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	high	high
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	low	low
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	low	low
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	low	low
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	low	moderate
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	low	low

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CORRIDOR ALTERNATIVES	AGRICULTURE	GRAZING
HIGHWAY ACCESS ALTERNATIVES:		
Mine, Mine Mouth and Harry Lake Plant Highway #12	-	-
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	low	low
Big Bar Creek Plant Northwest from Clinton	low	moderate
Ashcroft Plant Highway #1	low	low
COAL TRANSPORTATION ALTERNATIVES:		
Harry Lake Plant (direct conveyor from mine to plant site)	low	moderate
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	low	moderate
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	low	moderate
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	high	high
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	low	low
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	low	low
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	low	low
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	low	moderate
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	low	low

4.4 Water Use

All settled areas within the lower valleys of the Hat Creek region suffer severe drought for agriculture. At present, the two most dominant water uses are the consumption by communities, such as Cache Creek, Ashcroft and Clinton, and irrigation needs by farmers in the area. Most industrial waters are supplied by the Thompson system (see B.C. Research "Preliminary Environmental Impact Study of the Proposed Hat Creek Development").

The best corollary for water use for irrigation is knowing the rural settlement pattern and agricultural practises. Therefore, the rail line from Carquille to the Ashcroft plant site between the confluence of Hat Creek and the Bonaparte River could potentially interfere with most water licence holders.

No interference with water use is anticipated for the Big Bar Creek to Clinton corridor.

5.0 NOISE

5.1 Rail Noise

A diesel-powered railway would be the greatest source of noise of any of the modes of transportation. Diesel units have the highest magnitude in noise, as well as the most diverse noises, ranging from exhaust of diesel locomotive to wheel noises to warning devices, particularly horns and bells at level crossings. Most of the discussion on noise has been gleaned from the report of the Environmental Report on the Ashcroft-Clinton Rail Connection on noise and vibration conducted by Acoustical Engineering. According to their data, the area of influence of a diesel train is approximately one-quarter mile each side of the track. Attenuation of the noise over distance seems to be enhanced by the presence of noise deflectors. Rail cuts, earth berms and absence of tight curves and steep grades reduces noise considerably (Acoustical Engineering, 1975: pp. 94-96).

Rail noises can, however, be increased by deflection from cut banks in narrow, confined valleys or canyons. In this case, sound reflection can increase magnitude of sound. The most obvious example of noise exaggeration would be found in Marble Canyon.

Since sound travels in relatively straight lines, especially for the higher frequencies, rail cuts which are located above a listener, generally, reflects the noise upwards resulting in relatively lower noise levels for the listener below. In other words, for the rail line from Carquille to the Ashcroft plant site, where the proposed rail line would be at least 100 feet above the community of Cache Creek, the nature of the side cut could be designed such that all noise would dissipate upwards and not downwards into the community.

Noise (cont'd)

However, for communities such as the Bonaparte Indian Reserve, earth berms would be desirable to attenuate noise levels. For relatively steep and incised terrain, it is very difficult to engineer the railway right-of-way such as to dissipate noise levels and to direct them away from existing communities. However, in areas such as those near the conveyor to Glenfraser via Sallus Creek, between Big Bar Creek and Clinton, noise attenuation structures could be conceivably provided where necessary.

It would be very difficult to rank each corridor on the basis of its noise levels. However, the rail line from the mine to Pavilion and the rail line from Carquile to the Ashcroft plant site have the potential to generate noise levels which would affect adjacent communities.

5.2 Road Noise

The magnitude and nature of noise eminating from highways is generally lower than that eminating from railways. Road noise is again a function of engine noise, wheel noise and wind noise. Noise levels from highways are more erratic than those of a unit train. It should be emphasized that with present-day technology, muffler systems are being designed which reduce engine noise to acceptable levels. In future, truck movements could be less of a noise generator than previously.

For the present, the most important source of vehicle noise would be the movement of 32 truckloads per day for 2 to 2½ months to transport 50,000 tons of coal through the community of Bonaparte, Cache Creek and part of Ashcroft. It is recommended that these vehicles be allowed to operate only during day time.

No truck haul road is considered for supplying the thermal generating site with coal. Most noise levels would be generated in access roads to the mine and thermal generation facility.

5.3 Conveyor Noise

The lowest noise levels generated by a transportation facility would be that of the conveyor. Generally, just a low hum eminates from the facility because the idlers and conveyor belts are made up of plastic and rubber materials. In addition, the low noise level is steady and can blend into other background noises.

The conveyors close to Oregon Jack Creek would parallel a Native Indian community in a rather deeply incised valley. The low noise level is not seen as a real intrusion. However, the perceived noise intrusion by that community may outweigh even a technically low noise level.

6.0 DUST AND COAL DUST

All modes of transport truck, rail and conveyors, should have some form of surface-bonding agent, to prevent coal dust. For the purpose of the truck haulage between the mine and the C.N. or C.P. railway of 50,000 tons for the test burn, watering the coal maybe sufficient. However, this should be established by determining the time it takes for the coal to dry. If water is not adequate, chemical bonding agents should be used. Trucks and trains should have a washing facility to clean the vehicles when necessary.

Conveyors should only be considered if covered. In addition, coal may be kept moist to cut down on dust generation.

Road dust would be particular problem within the mine site. For traffic from mine to thermal generation or from mine to community, only paved roads should be used. However, as an intermediary measure, it may be desirable to wet road surfaces or to use a chemical bonding agent to prevent dust.

7.0 TEST BURN COAL SHIPMENT

50,000 tons of coal would be shipped to Alberta in order to conduct a coal test burn. This coal would be hauled by truck from the mine to either C.N. or C.P. at Ashcroft. Existing roads, such as Highway #12 and Highway #97, will probably be used to facilitate this transport. It is estimated that this would mean approximately 32 truckloads per 10 hour shift for 2½ months. This means that for 2½ months a loaded truck will pass through the community of Cache Creek every 10 minutes. At the same time, an empty vehicle would pass in the other direction. In order to avoid this noise imposition, the possibility of using Medicine Creek-Cornwall Creek Road should be explored.

8.0 ASSESSMENT AND RANKING OF CORRIDORS

The natural resources, including landform, geology, hydrology, soils, vegetation, fish and wildlife, were examined in a cursory manner in order to highlight their sensitivity towards the construction and operation of coal transportation facilities. Although many of these sensitivity ratings are value judgments, the majority of these judgments were based on the magnitude of the potential impact. In other words, desirable determinants of each natural resource, such as productivity or floristic diversity in vegetation, was isolated and if a large percentage of a floristically diverse and/or productive vegetation unit would be affected, that corridor would be rated as highly sensitive in relation to the other corridors. Obviously, all ranking is relative to the corridors discussed.

The concept of magnitude should be discussed in relationship to the concept of importance. A desirable or valuable component within a natural resource is only dealt with in a comparative, quantitative manner as discussed above. No attempt was made to establish the importance of, for instance, the presence of trout in a stream versus the intentions of operating a coal train through that watershed. However, a relative ranking using importance was done between, lets say, the presence of fish and the presence of deer. In these cases, a highly sensitive fish component was compared to a highly sensitive vegetation or wildlife component on an equal basis. It should be stressed that this comparison, although implying equal importance, is intended only as a first attempt at establishing relative ranking of all corridors. It is advisable for the reader to go back to those sensitivities which are high within each transportation corridor and gain an appreciation of their magnitude. For example, for the construction engineer, the presence of active slides in the new rail corridor from the mine to Pavilion maybe an absolute deterrent and ranking an active slide on equal footing with floristic diversity does not do justice to that fact.

Assessment and Ranking of Corridors (cont'd)

Reference to Table 13, Summary of Physical and Natural Resource Sensitivities towards the Access and Coal Transportation Corridors, shows as well the natural resource use. This includes soil use for agriculture and grazing, water use for domestic, irrigation and industrial purposes, as well as forestry and mining. Some of these components were not ranked for comparative purposes because, as discussed in the text of the report, they were inconclusive. The ranking of all corridors established the following order:

Highway Access Alternatives:

Ashcroft Plant - from Highway #1
Mine, Mine Mouth and Harry Lake Plant - Highway #12
Mine, Mine Mouth and Harry Lake Plant - Medicine/Cornwall
Big Bar Creek Plant - Northwest from Clinton

Coal Transportation Alternatives:

Mine Mouth Plant
Harry Lake Plant - conveyor direct from mine to plant site
Ashcroft Plant - new rail line to Oregon Jack Creek conveyor to plant
Roberts Bank Plant - new rail line to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant
Squamish Plant - new rail from mine to Pavilion, existing B.C.R. to plant
Roberts Bank Plant - new rail line from mine to Carquile, Ashcroft/Clinton Connector to C.N./C.P., C.N./C.P. to plant
Squamish Plant - conveyor to Glenfraser via Sallus Creek, existing B.C.R. to plant
Ashcroft Plant - rail line from mine to Carquile, rail line from Carquile to plant along Highway 97 and 1

Big Bar Creek Plant - rail line from mine to Carquile, Ashcroft/Clinton Connector to Clinton, rail line to plant site

Big Bar Creek Plant - conveyor to Glenfraser via Sallus Creek, rail over B.C.R. to Clinton, new rail line to plant site

Because the ranking was based primarily on the magnitude or total area affected, the longer transportation corridors, such as those to Big Bar Creek, rank the lowest. Conversely, the shorter transportation corridors from the mine to the thermal generation site, such as the Harry Lake plant site, rank the highest.

One other important fact to bear in mind is that the upcoming mine excavation will require considerable construction directly affecting Hat Creek. Therefore, the rail line from the mine to Carquile, which is located downstream from Hat Creek will accrue considerable changes. For the purposes of this discussion, the assumption was made that no changes would occur in the downstream portion of Hat Creek. If, however, a policy decision would be made by B.C. Hydro and Power Authority to put all transportation, access, and water diversion schemes into one drainge, the impact to that drainage would be high, but may save affecting other drainages, such as Oregon Jack Creek or Cornwall and Medicine creeks. If we assume an alienated lower portion of Hat Creek Valley, the following transportation corridors would rank higher:

Roberts Bank Plant - new rail line to Carquile, Ashcroft/Clinton Connector to C.N./C.P., C.N./C.P. to plant

Ashcroft Plant - rail line from mine to Carquile, rail line from Carquile to plant along Highways 97 and 1

Big Bar Creek Plant - rail line from mine to Carquile, Ashcroft/Clinton Connector to Clinton, rail line to plant site

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

In order to facilitate relative ranking of the highway access alternatives and coal transportation alternatives between the Hat Creek mine and various potential thermal generation sites, an environmental assessment was conducted. The environmental information was only brought to that level which made it possible to compare all highway and coal transportation routes. Various shortcomings of the data will be outlined in more detail in the recommendations. This section deals specifically with the physical and natural determinants.

Highway access alternatives for the 7 alternative thermal generation sites and the mine ranked in the following order:

* For the Ashcroft thermal plant, a short road access would have to be constructed from Highway #1, which is ranked as the most acceptable access road.
* The mine, thermal plant at mine mouth and Harry Lake plant would require upgrading of Highway #12 from Highway #97. The environmental ranking is second. It compares favourably with the construction of a new road over Medicine and Cornwall creeks which ranked third.
* For the Big Bar Creek thermal plant site, a relatively long access road from Highway #97 to Big Bar Creek showed the highest environmental impact.

Since an access road into the mine has to be constructed in any case, the above ranking order is somewhat deceptive. The mine, mine mouth plant and Harry Lake plant require the same access and, therefore, the combined environmental impact would be considerably less than a thermal generating location more distant from the mine. In terms of environmental impact, therefore, upgrading of Highway #12 from Highway #97 is the most desirable highway route.

Conclusions and Recommendations (cont'd)

For the coal transportation systems, 10 routes have been analyzed. These routes employ two modes of transportation which are rail and conveyor. The environmental impact of conveyors is generally less than that inflicted by rail. The reason is primarily due to a narrower right-of-way and greater location flexability of a conveyor system. In addition, shorter routes are favoured because less area is removed by each respective right-of-way.

* The environmental impact rating showed that mine mouth and Harry Lake plant sites would have be the most favourable coal transportation facility. They ranked 1st and 2nd respectively.
* For the Ashcroft plant site, the Oregon Jack Creek conveyor ranked 3rd. The Roberts Bank plant using the Oregon Jack Creek conveyor and C.N./C.P. ranked fourth.
* For the Squamish-Britannia plant, an all rail connection via Pavilion to B.C.R. ranked fifth. The all rail connection to the Roberts Bank plant via Carquile to the Ashcroft/Clinton Connector then via C.N./C.P. ranked sixth.
* The Squamish-Britannia thermal generation plant site using the conveyor via Sallus Creek, trans-shipped at Glenfraser to B.C.R. ranked seventh.
* An all rail connection from the mine to Ashcroft plant site via Carquile, Carquile to Ashcroft plant site ranked eighth.
* For the Big Bar Creek plant site, the all rail connection via the Ashcroft/Clinton Connector, then by rail to Big Bar Creek ranked ninth, followed by the conveyor via Sallus Creek, connecting to B.C.R. to Big Bar Creek thermal plant ranked last.

TABLE 13

SUMMARY OF PHYSICAL AND NATURAL RESOURCE SENSITIVITIES TOWARDS THE ACCESS AND COAL TRANSPORTATION CORRIDORS

CORRIDOR ALTERNATIVES	GEOLOGICAL SENSITIVITY	HYDROLOGICAL SENSITIVITY	SOILS SENSITIVITY	VEGETATION SENSITIVITY	FISH AND WILDLIFE SENSITIVITY	FORESTRY SENSITIVITY	AGRICULTURE SENSITIVITY	GRAZING SENSITIVITY	ENVIRONMENTAL RATING
HIGHWAY ACCESS ALTERNATIVES:									
Mine, Mine Mouth and Harry Lake Plant Highway #12	low	mod	low	low	low	low	low	low	2
Mine, Mine Mouth and Harry Lake Plant Medicine/Cornwall	mod	mod	mod	mod	mod	high	low	low	3
Big Bar Creek Plant Northwest from Clinton	low	mod	low	mod	high	mod	mod	mod	4
Ashcroft Plant Highway #1	low	low	mod	low	low	low	mod	mod	1
COAL TRANSPORTATION ALTERNATIVES:									
Harry Lake Plant (direct conveyor from mine to plant site)	low	low	mod	low	low	low	low	mod	1
Big Bar Creek Plant (rail from mine to Carquile, Ashcroft/Clinton Connector, rail to plant site)	mod	high	mod	high	high	high	low	mod	8
Big Bar Creek Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to Clinton, rail to plant site)	mod	mod	high	high	high	high	low	mod	9
Ashcroft Plant (rail from mine to Carquile, rail from Carquile to plant site)	low	high	mod	high	high	low	high	high	7
Ashcroft Plant (rail from mine to Oregon Jack Creek, conveyor to plant site)	mod	mod	mod	mod	low	low	low	low	2
Squamish Plant (rail from mine to Pavilion, B.C.R. to plant site)	high	low	high	mod	low	low	low	low	4
Squamish Plant (conveyor to Glenfraser via Sallus Creek, B.C.R. to plant site)	mod	mod	high	high	mod	high	low	low	6
Roberts Bank Plant (rail to Carquile, Ashcroft/Clinton Connector, C.N./C.P. to plant site)	low	high	mod	mod	high	low	low	mod	5
Roberts Bank Plant (rail from mine to Oregon Jack Creek, conveyor to Basque, C.N./C.P. to plant site)	mod	mod	mod	mod	low	low	low	low	3

The first 4 coal transportation corridors to various thermal generating plant sites employ a conveyor system as mode for coal transportation. The highest ranked, all rail system, is Pavilion to B.C.R. to the Squamish-Britannia plant site. In all instances, the construction of a rail link at the lower Hat Creek to Carquile showed relatively high environmental impact to Hat Creek and, in part, Bonaparte systems.

It should be stressed that combined transportation and utility corridors as well as the mining activity in upper Hat Creek may change the order of environmental ranking. In fact, a decision will have to be made as to whether to disperse access, transportation and utility facilities to occupy more than one valley into the Hat Creek mine, or whether to concentrate all these corridors into one valley. For example, if the lower Hat Creek from mine to Carquile is to be considered an "industrial corridor" with road, rail and possible transmission line facilities, the other valleys would be then unaffected by such facilities.

9.2 Recommendations

The data base of the specific Hat Creek area was primarily drawn from the report by B.C. Research and Dolmage Campbell, "Preliminary and Environmental Impact Study of the proposed Hat Creek Development" (1975). For the larger study region considered, the Canada Land Inventory and the B.C. Department of Agriculture Soil Survey maps, in conjunction with the Geological Survey of Canada geological map was found to be the best data bank. For vegetation, fish and wildlife, serious data gaps were encountered.

It is felt that the present environmental data is sufficient to at least determine the preferred access and coal transportation corridors to a "manageable" number. It is recommended, therefore, that the future detailed environmental assessment be confined to no more than 3 or 4 access and transportation routes.

Conclusions and Recommendations (cont'd)

Once the environmental impact on the physical and natural resource base is understood, it is recommended that environmental management procedures be established to allow for the mitigation and/or enhancement of the natural resources.

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APPENDIX E

SOCIAL REPORT

Social Aspects of the

Proposed Hat Creek Development

Transportation Study

Prepared for:

Swan Wooster Engineering Ltd.

By:

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February 1976

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I INTRODUCTION

This report covers the socio-economic implications of alternate transportation routes to B.C. Hydro's Hat Creek coal deposit. It is intended as a supporting document for the "Proposed Hat Creek Development - Transportation Study" prepared by Swan Wooster Engineering Co. Ltd. The principal objective of this socio-economic supplement is to assess the potential social impacts of the various routes in order to assist subsequent decisions regarding plant location and route selection.

The reader should appreciate that this study relates only to transportation routes. For a more comprehensive picture of the Hat Creek social and economic environment the reader is referred to the "Preliminary Environmental Impact Study of the Proposed Hat Creek Development".* The existing regional economic base, the social infrastructure, the underlying attitudes and concerns of local residents, and the major impacts of the mine and plant were well documented and need not be reiterated here. Furthermore, it is expected that future detailed environmental studies of the mine and the plant will examine impacts on the surrounding community in greater detail. The consultants' role for the present study has therefore been limited (in terms of budget, time and corresponding scope) to the immediate task of assessing the relative merits of various transportation corridors from the social viewpoint. The degree of detail provided is consequently in keeping with the advisory nature of the consultants' role. Depending upon the subsequent selection of a preferred route(s), additional analysis of impact investigation would be required.

Another point which should be clarified concerns the disciplinary orientation utilized. Although cultural and economic matters are occasionally referred to, the focus of attention is on social concerns.

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* by B.C. Research and Dolmage Campbell & Associates. for British Columbia Hydro and Power Authority - August 1975.

The arrangement of the material within this subreport is as follows:

- a discussion of selected aspects of the existing social environment.
- a summary of land, labour and operational requirements for various modes of transportation.
- a matrix outlining the comparative impact of proposed corridors and routes.
- a discussion of conclusions and special topics such as an airstrip and test burn haul.

II SELECTED ASPECTS OF THE EXISTING SOCIAL ENVIRONMENT

1. The Pattern of Human Settlement

The majority of people presently living in the area within commuting distance of the proposed mine reside in or about the communities of Ashcroft, Cache Creek, Clinton, and Lillooet. The population of these communities is given in Table 1 and the proximity to the mine-site can be appreciated by referring to the map in Appendix F. The village councils have expressed specific concerns regarding the proposed development but essentially are in favour of it and are anxious to see a committment made. They consider the expected increases in local employment and economic stimulus to be beneficial in bolstering their tax base and stabilizing (diversifying) the local economy.

As in the case of the mine itself, the thermal generating plant could be beneficial to these communities and consequently they are also very interested in its probable location. An interior site is clearly preferable to a coastal site. Beyond this, each community can cite attractive features which would induce many of the incoming population to take up residence in their particular community. Comparative commuting distances would obviously be one of the most important factors to influence settlement patterns. As a corollary, comparative commuting distances should be one of the major determinants for site selection.

Two of the proposed interior sites are in locations which could be of direct concern to other communities. The Ashcroft site would be within commuting range of existing residents in Spences Bridge, Lytton and Savona. Not many incoming employees would wish to live so far from the plant, but weekly or even daily commuting could be an acceptable alternative to existing residents who might otherwise face unemployment, underemployment or relocation of their household. Kamloops, of course, is too far away to affect more than a few weekly commuters.

Being the largest community in the interior, it is the regional centre for shopping and it would therefore benefit by the incremental affect of growth in neighbouring communities.

The Big Bar site presents special socio-economic circumstances. Seventy Mile House is the second closest existing community and along with Clinton could be expected to host new employees. Commuting distances are exceptionally long and bussing services would only partially alleviate the situation. A new community within 5 or 10 miles of the plant site would have to be given serious consideration. At the outset however, the merits of this alternative must be discounted to the extent that "instant" communities are generally regarded with less enthusiasm than the bolstering of existing communities. If this particular proposal is favoured for other reasons, however, a more detailed assessment of social impacts would be in order.

Population estimates for each of the communities mentioned is given in Table 1. Respective mileage to the alternative plant locations are given in the matrix contained in Section IV.

TABLE 1

COMMUNITY	ESTIMATED POPULATION (1975)	ECONOMIC BASE
Ashcroft	2,500	Mining, logging, ranching
Cache Creek	1,200	Transportation, tourism
Clinton	920	Logging, ranching, tourism
Lillooet	1,520	Tourism, mining, railway terminal
700 Mile House	225*	Sawmills
Spences Bridge	200*	Tourism, transportation
Lytton	500	Railway terminal, mixed farming, logging
Savona	670*	Sawmilling, ranching
Kamloops	58,900	Transportation, manufacturing, agriculture, tourism

*1971

Source: Journal of Trade & Commerce, April 1975 and Statistics Canada

People who reside along the proposed transportation corridors cannot be expected to share the same views as their urban counterparts. An improved highway may mean better access for business, shopping and travel, but with the accompanying large scale development, it also means increased traffic, noise, accidents, people congestion and a basic change in the rural character of the area. It may also mean a loss of productive land for grazing and agriculture. Both Upper Hat Creek valley ranchers and nearby Indian bands have expressed concerns along these lines, and their views would be shared by those residing in other potential transportation corridors.

The possible benefits of proposed railways are usually viewed as less immediate than specific problems associated with accessibility, cattle crossing hazards and the loss of productive land. Land alienation for possible roads and railway is presented in the comparative matrix (see Page 12). The number and location of corridor inhabitants are summarized in the matrix but are also described as follows:

Big Bar Creek Corridor (#5) - About 100 people live in the general area, mainly on cattle ranches. Some logging is done in the area but loggers mainly reside in Clinton. Limestone deposits are reported to be plentiful but none are being commercially worked at present.

Highway 12, Hat Creek to Pavillion (#3) - Approximately 125 members of the Pavillion Band live on their reserve at Pavillion and derive their livelihood from ranching and the Steel Bros. Ltd. limestone quarry on IR #3 near the Hat Creek junction. Additional permanent residents at Pavillion Lake probably number about 25. During summer, the resident population would constitute a several-fold increase.

Highway 12, Hat Creek to Carquile (#2) - About 25 members of the Bonaparte Band live on each of their two Hat Creek reserves (refer to map).

Hat Creek - Oregon Jack Creek (#1) - This corridor is inhabited by the Hat Creek valley ranchers and their families - about 50 people in total. Two reserves of the Oregon Jack Creek band are adjacent or near the proposed corridor but the 11 on-reserve members need not be directly affected.

Carquile - Ashcroft (#15) - This corridor crosses 1R#3 the main reserve of the Bonaparte Indian band in which about 125 members reside. It is presently bisected by Highway 97. The proposed Ashcroft - Clinton rail connection being planned by the CNR would also traverse this reserve.* At the time of writing, permission to survey has not been given by the band. The Village of Cache Creek is also adjacent or partially within the corridor. In paralleling Highway 1 to the proposed Ashcroft plant site, the corridor would also traverse 1R #2 of the Ashcroft band. About 40 members of the band live on the adjacent 1R #4.

2. Native Indian Reservations

The number and total area of land reserves for the potentially affected bands are given in Table 2.

TABLE 2

BAND	TOTAL POPULATION	ON RESERVE POPULATION	NO. OF RESERVES	APPROX. TOTAL ACREAGE	POTENTIAL CORRIDOR
Ashcroft	81	40	4	5,000	#15
Bonaparte	343	181	6	7,000	#2, #15
Pavillion	184	125	4	4,000	#3
Oregon Jack Creek	16	11	6	2,000	#1

At the time of writing, the Native Indian's position vis-a-vis the development, any further encroachment on their reserve land, and more fundamental concerns regarding land claim issues has not been established. Until such time as these matters are clearly resolved, corridors which traverse reserves have questionable impact and should be regarded accordingly.

* The basic Cache Creek - Clinton transportation corridor along Bonaparte River valley is not included within the scope of this study.

3. Parks and Recreation

Most of the land in the area of the minesite and proposed plant sites is rated by the Canada Land Inventory as having moderately low to moderate capability for recreation potential. A number of small Provincial Class "C" parks have been established in the area as indicated on the map in Appendix F. Most of the Provincial park reserves which happen to be located within proposed corridors are also shown.

Two areas merit special attention. Big Bar Lake has a Class "A" park with 60 camp sites and 25 picnic tables. The surrounding country is considered ideal for snowmobiling and winter sports. The Regional District of Thompson-Nicola reports a recent application for a recreational subdivision fronting Big Bar Lake. Because of the topography, however, new highways or railroads would have little difficulty fitting in with these scenic locations.

The situation in the Marble Canyon Park and Pavillion Lake area is more restrictive. Although there are only 8 camping units and 10 picnic tables at this park, many people consider the canyon setting to be among the most scenic in the province. The white walls of the exposed limestone hills form a dramatic backdrop for lakes of startling azure.

Most people would consider the requirements of a railway to be too severe for such a confined corridor. The present scenic value of the canyon would be threatened. The frequent movement and sound reverberation of 80-car unit trains through the canyon would probably be abhorrent to recreationists as well as local residents. A rail corridor would almost certainly be opposed by the Parks Branch.

III REQUIREMENTS FOR TRANSPORTATION CORRIDORS

1. Land

For planning purposes the following preliminary criteria have been used to estimate the extent of land alienation attributed to the transportation systems.

TABLE 3

	RIGHT OF WAY - FT.	AREA REQUIRED - ACRES/MILE	
		NEW	UPGRADED
Roads: -			
Highway 12	100	--	1
Cornwall-Medicine Creeks	100	12.5	--
Harry Lake Road	100	12.5	--
Big Bar Road	100	12.5	5
Conveyor Maintenance Roads*	na	na	--
Railroads:	100	12.5**	na
Conveyors:	200	25.0	na

* Conveyor maintenance roads largely included in conveyor right-of-way.
** Plus 25% allowance for Pavillion connector through Marble Canyon.

2. Labour

The estimated labour requirements to build and operate the mine and the plant, are given in Table 4. The primary interest in these estimates is that they suggest the order of magnitude of commuting traffic. It should be kept in mind, however, that project induced traffic would be influenced by the proximity of construction camps, the degree of commuter pooling, irregular staff, service and commercial callers, and tourist traffic to see the open pit mine in particular.

TABLE 4

	CONSTRUCTION	OPERATIONS
MINE	150	290
PLANT	470	250

The labour requirements to build and operate each of the alternative corridors is given on page 12. The primary interest in these estimates is that they provide a rough indication of the project's economic benefits from employment and magnitude of potential impacts on host communities.

3. Operations

The transport of coal by conveyor should not present significant social problems. A few people might object to the aesthetics of such a prominent structure as it approaches and crosses Highway 1 near Ashcroft. The design of the conveyor in this particular area would therefore merit special attention. The entire system could be totally enclosed to minimize dust and noise. Because a certain amount of low, continuous, mechanical background noise is unavoidable throughout the day it is important to note that the routes selected are basically uninhabited. The potential disturbance would only occur to the extent that adjacent property subsequently becomes built up.

The number of railway movements required is as follows:

TABLE 5

ALTERNATIVE PLANT LOCATIONS	RAIL CARS PER TRAIN	LOCOMOTIVES PER TRAIN	TRAINS PER DAY
Big Bar Creek	50	5	8
Ashcroft via Carquile	80	3	5
Oregon Jack Creek	20	2	20
Squamish/Britannia	91 - 98	8 - 9	3½
Roberts Bank	98	3	3¼

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The railway cars could be the open top variety normally used in unit train service for coal. To control dust a water spray could be used in transporting the coal to interior plant sites. Long-haul movements to a coastal plant site would require a special spray coating.

Potential noise problems from trains vary with train activity (i.e., frequency rather than length, shunting, pulling/braking, horns, etc.), topography (i.e., open, shielded or reverberant) and the number, proximity and circumstances of people affected. Applying these factors to the proposed rail corridors, several potential problems areas should be recognized.

- The frequency of train movements would be of great concern to a relatively few permanent residents in the Upper Hat Creek area.

- Permanent residents of Cache Creek and Bonaparte IR #3 are relatively numerous and merit special attention.

- Train movements through Marble Canyon are not in keeping with the tranquil nature of the setting. The number of people affected and the frequency of train movements may not be numerous, but the canyon walls may tend to contain echo sounds to an unpleasant degree.

It should also be kept in mind that in planning large-scale projects the need for social acceptance begins early. The degree or even existance of a real problem is often less important than the public's perception of potential problems.

IV SOCIAL IMPACTS OF SPECIFIC CORRIDORS

1. Guidelines for Evaluation

In order to provide a structural format for assessing the foregoing, a number of factors have been brought forward and organized in a tabular arrangement. By considering each alternate corridor component separately, an overall rating can be subjectively assigned based on the variables considered. The Social Impact Rating Matrix is presented on page 12. The guidelines used for rating are as follows:

- The greater the land alienation the more negative would be the rating - particularly for Indian reserves and parks.

- The more people residing in or adjacent to a railway corridor the more negative the rating.

- More people residing adjacent to an upgraded roadway could make the rating more positive. This is not a major factor however.

- The more jobs required to build and operate the transport system, the larger the economic impact and the higher the rating. This criterion is based on preliminary indications that the majority of people in the area feel that the benefits of economic growth tend to outweigh the attendant social problems. Note that the construction and operation of the mine and plant is excluded from the rating system.

- Commuting distances to nearby communities are probably the most important social criteria to distinguish preferences. There are two aspects to consider and special ratings are given for each. Minimization of commuting distances is most desirable, and corridor components are rated accordingly on a scale of minus 3 to plus 3. It is also desirable for employees to have a reasonable choice of communities in which to reside and it is equally

SOCIAL IMPACT RATING MATRIX

Plant Site	Corridor Number	Routing	Mode	Land Required - Acres Total	Indian Reserves	Park	Est. In Route Population Rail	Road
MINE:								
Alternative 1	2	Mino-Carquilo via #12	Road	15	8	-	NA	60
Alternative 2	7	Modicino-Cornwall	Road	200	-	-	NA	-
HARRY LAKE:								
Alternative 1	2	Plant-Mine	Road	40	-	-	NA	60
Alternative 2	7	Plant-Junction Modicine-Cornwall	Road	20	-	-	NA	-
Preference 3	-	(Direct)	Conveyor	70	-	-	-	NA
BIG BAR CREEK:								
Preference 1	5	Clinton-Big Bar	Road	250	-	Avoid	NA	100
Alternative 1 2+(8)+5	2	Mine-Carquile via #12	Rail	170	100	-	60	NA
	5	Clinton-Big Bar	Rail	510	-	Avoid	50	NA
Alternative 2 6+(12)+(13)+5	6	Mine-Glen Fr.	Conveyor	380	-	-	-	NA
ASHCROFT:								
Preference 1	-	Highway #1-Plant	Road	15	-	-	NA	20
Alternative 1 2+(15)	15	Mine-Ashcroft	Rail	230	40	-	1300	NA
Alternative 2	1	Hat Creek-Oregon Jk. Ck.	Rail/Conv.	400	-	-	50	NA
SQUAMISH/BRITANNIA:								
Alternative 1 3+(12)	3	Mine-Pavillion	Rail	250	80	25	150	NA
Alternative 2 6+(12)	6	Mine-Glen Fr.	Conveyor	380	-	-	-	NA
ROBERTS BANK:								
Alternative 1 2+(9)+(11)	2	Mine-Carquile via #12	Rail	200	100	-	60	NA
Alternative 2 1+(11)	1	Hat Creek-Oregon Jk. Ck. Basque	Rail/Conv.	400	-	-	50	NA

NOTES:

(1) Man-years total.

(2) Rankings allow for a mine mouth alternative with zero input, ambivalent impact, and subsequent ranking of 5.

(3) Route preferences shown in this column discount coastal sites because of relatively unattractive regional economic benefits.

Corridor Jobs			Mileage to Plant for Commuters				Mileage Impact						Corridor Rankings		
Const.[1]	Oper.	Conn.	Ash-Croft	Cache Ck.	Clinton	Lillooet	Commuter	Dist.	Special Affects	Component Rating	Corridor Rating	Comb. Rating	Coal[2] Transport	Roads	Combined
30	-	15.0	28	22	33	35*	-2	+3	Assume Lillooet-Pavillion Upgraded	LNI	LNI	LNI	-	4	4
30	-	16.0	18	22*	33*	35*	-1	-3	Assume shorter alternate routes used	MPI	MPI	MPI		3	3
15	-	16.0	35	29	40	42	-3	+2	Land is Incremental req't re mine Alt. 1	MNI	MNI	MNI	-	5	6
10	-	14.0	16	19	40	42	+1	+1	Land is incremental req't re mine Alt. 2	MPI	MPI	MPI		2	2
10	30	2.5	NA	NA	NA	NA	NA	NA		AMB					
50	-	41.0	77	71	46	57*	-3	-3	*Via Kelly-Jesmond/ 58 mi. to 70-Mile House Must consider new commu.	HNI				6	
30	NA	14.0	NA	NA	NA	NA	NA	NA	No Rail/Highway Conflict	LNI	AMB	HNI	7		8
	60														
50		40.0	NA	NA	NA	NA	NA	NA		LPI					
40	100	14.0	NA	NA	NA	NA	NA	NA		LPI	LPI	HNI	4		7
5	-	1.0	9	11	36	66	+3	+3	43 mi. to Lytton 20 mi. to Spences Bridge 35 mi. to Savona Assume additional lane for Hwy. #1 (not included).	HPI				1	
50	50	18.0	NA	NA	NA	NA	NA	NA	Two Reserves plus Cache Creek	HNI	HNI	LNI	9		5
60	60	24.0	NA	NA	NA	NA	NA	NA		LPI	LPI	MPI	2		1
30	50	14.0	NA	NA	NA	NA	NA	NA	Two Reserves plus Marble Canyon Park	HNI	HNI	HNI	10		12
40	90	14.0	NA	NA	NA	NA	NA	NA		LPI	LPI	LPI	3		9
30	40	17.0	NA	NA	NA	NA	NA	NA		LNI	LNI	LNI	8		11
60	80	25.0	NA	NA	NA	NA	NA	NA		LPI	LPI	LPI	1		10

desirable that as many communities as possible should participate in the development. The broader the likely distribution, the better the rating, again on a scale of minus 3 to plus 3.

On the basis of the foregoing, each of the corridor components has been given one of the following subjective ratings:

HPI - High Positive Impact
MPI - Medium Positive Impact
LPI - Low Positive Impact
AMB - Ambivalent
LNI - Low Negative Impact
MNI - Medium Negative Impact
HNI - High Negative Impact

2. The Comparative Matrix

Each corridor component is rated on its own merits. Components are then grouped to make up corridors which are also rated. Corridors are subsequently grouped to make up appropriate combinations and these are rated.

To conform to a ranking system similar to that utilized in the accompanying engineering and environmental reports, all of the various corridor ratings have been re-ordered to establish their position on scales of preference. One scale covers road routes and another covers coal transport routes. In order for the reader to better appreciate the interaction of these corridors, an overall ranking is also shown. It should be noted that the final ranking incorporates the concern for regional economic benefits. Although this concern may anticipate the work of future studies regarding the thermal generating plant, is also an integral part of the transportation question.

V SPECIAL CONCERNS

1. Conclusions

Preferred thermal generating plant sites and transportation routes would include:

- The Ashcroft site served by a combination of rail and conveyor via Hat Creek and Oregon Jack Creek.

- The Harry Lake site served by a new access highway via Medicine Creek and Cornwall Creek.

- The mine mouth site with the same access highway as above.

The least attractive transportation systems to interior plant sites are those which serve the Big Bar Creek site. The least attractive route to a coastal plant site is the one which is based on building a railroad from the mine to the BCR at Pavillion.

2. Airstrip

The village councils of Ashcroft and Cache Creek both support an application for an upgraded airstrip. The benefits to these communities are seen to be substantial for recreational as well as commercial flying. Flight traffic data are not normally compiled for small airstrips and the justification for improved facilities is therefore a matter of qualitative assessment. The following points tend to support the application:

- The present dirt airstrip is now well used with four or five aircraft on the field at most times. Two or three of these planes would be locally owned. The number of flights from the airstrip is expected to increase markedly in line with increased mining and industrial interest in the Ashcroft-Clinton corridor.

- The Highland Valley airstrip has recently been decommissioned and Ashcroft now has the closest public airstrip. With upgraded facilities, firms such as Bethlehem Copper Corp. Ltd. would probably find it more convenient than the Kamloops airport.

- Other potential commercial users include B.C. Hydro, B.C. Telephone, C.P. Transport, the R.C.M.P., Medivac, water bombers, chartered flights and emergency landings. Scheduled airline flights to Kamloops normally use the Kelowna airport as their primary alternative. Because the proposed site is closer to Kamloops than is Kelowna, ferrying passengers back to Kamloops from Ashcroft by road could save the scheduled airlines and passengers approximately one-half hour if the new facility can accommodate the larger planes.

- Local residents and others in the surrounding area would also benefit from an improved facility. The Ashcroft Aero Club now has a membership of about 25 or 30, some from fairly distant communities. Last year, 13 local people undertook flying lessons and all were successful in obtaining their pilots' license. It is expected that about 20 individuals will apply this year.

- The Ashcroft-Cache Creek area is also a natural destination for recreational flying from other locations. The Kamloops Flying Club for example report 72 members and about 35 associated aircraft that frequently call upon the Ashcroft airstrip. Evidently, 2 of their members use the strip for regular commuting.

- In summary, an improved facility would be of significant economic benefit to the area and it would enhance the recreational potential for many people.

3. Test Burn Haul

The movement of 50,000 tons of coal from the mine to a nearby loading point on the CNR could proceed without untoward public concern. About 30 round trips per day would be required within a 3 to 4 month period.

Assuming a 10 hour working day, trucks, either loaded or empty would pass any given point en-route at the rate of about one every 10 minutes. Road traffic and roadside residents would be affected but only to a minor extent. Congested and built-up areas should therefore be avoided if possible.

En-route spillage, noise, and traffic safety are not likely to become significant because of the small amount of coal hauled. However, special attention should be given to preventing dust and spillage. Tarpaulins should be mandatory and tail-gates should be sealed to prevent leakage. Before leaving the site for the road, the outside of the truck box should be cleaned (dusted, washed or broomed).

4. Mine and Plant Expansion

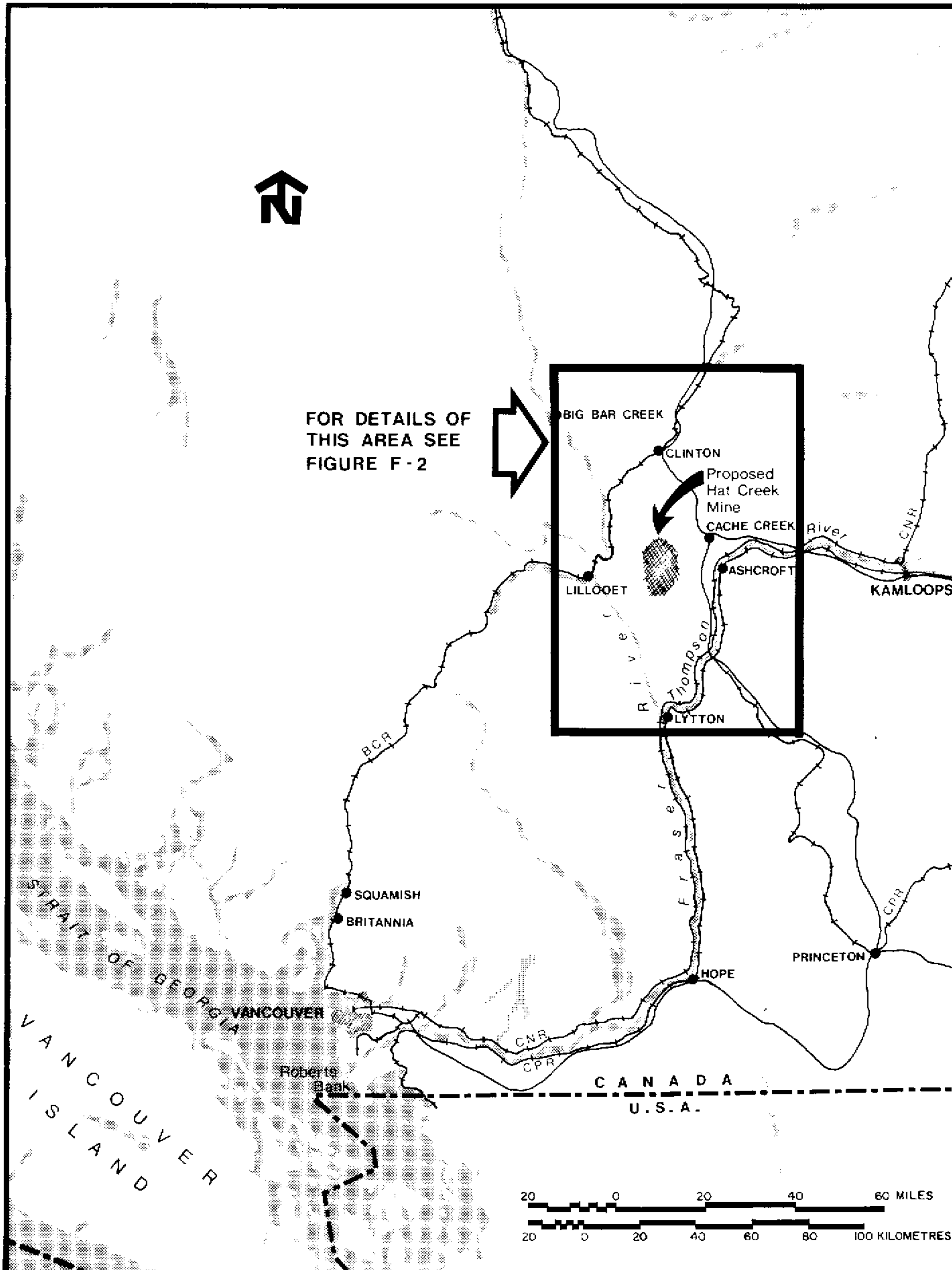
Expansion of the project would tend to accentuate positive and negative features of each transportation corridor. The exception might be land alienation for a railroad. Doubling the volume of coal movement could be accomplished by doubling the length, number or speed of trains rather than doubling the trackage. In general, however, the order of preference is not expected to change significantly. This conclusion is solely with reference to adjacent expansions of the mine and plant. It would not apply in a situation where the expanded mine served an interior thermal generating plant and a coastal plant. Nor would it apply to the expansion of a thermal plant which was based on obtaining coal (perhaps for blending) from other parts of the province. These questions would call for further study.

5. Multiple vs Alternate Access

In order to establish priorities and better appreciate the merits of various possible employee access roads, the focus of attention has been on alternative possibilities. If the proposed development did proceed however, there would be great pressure to upgrade a number of roads in the area. The opportunity for Lillooet to participate in the mining operation is contingent on the early upgrading of Highway 12. The Medicine Creek-Cornwall Creek road is recommended but it should be kept in mind that advantages accrue largely to Ashcroft. Highway 12 between the mine and Carquile should also receive some attention to facilitate prospective employees to the north. The increasing congestion on Highway 1 between Ashcroft and Cache Creek may require an additional lane even if the Hat Creek development did not proceed.

APPENDIX F

LOCATION PLANS



PROPOSED HAT CREEK DEVELOPMENT
KEY PLAN

SWAN WOOSTER ENGINEERING CO. LTD

FIGURE F-1

Canadian National Railways

22 January 1976.

File: 8000 - 7.1

Suite 2000,
777 Hornby Street,
VANCOUVER, B.C.,
V6Z 1S4.

Swan Wooster Engineering Company Limited,
1525 Robson Street,
VANCOUVER, British Columbia,
V6G 1C5.

Attention: Mr. D. Krefting

Dear Sirs:

Re: HAT CREEK COAL

This refers to your letter dated 5 January 1976, concerning a coal transportation study relative to the proposed Hat Creek Development.

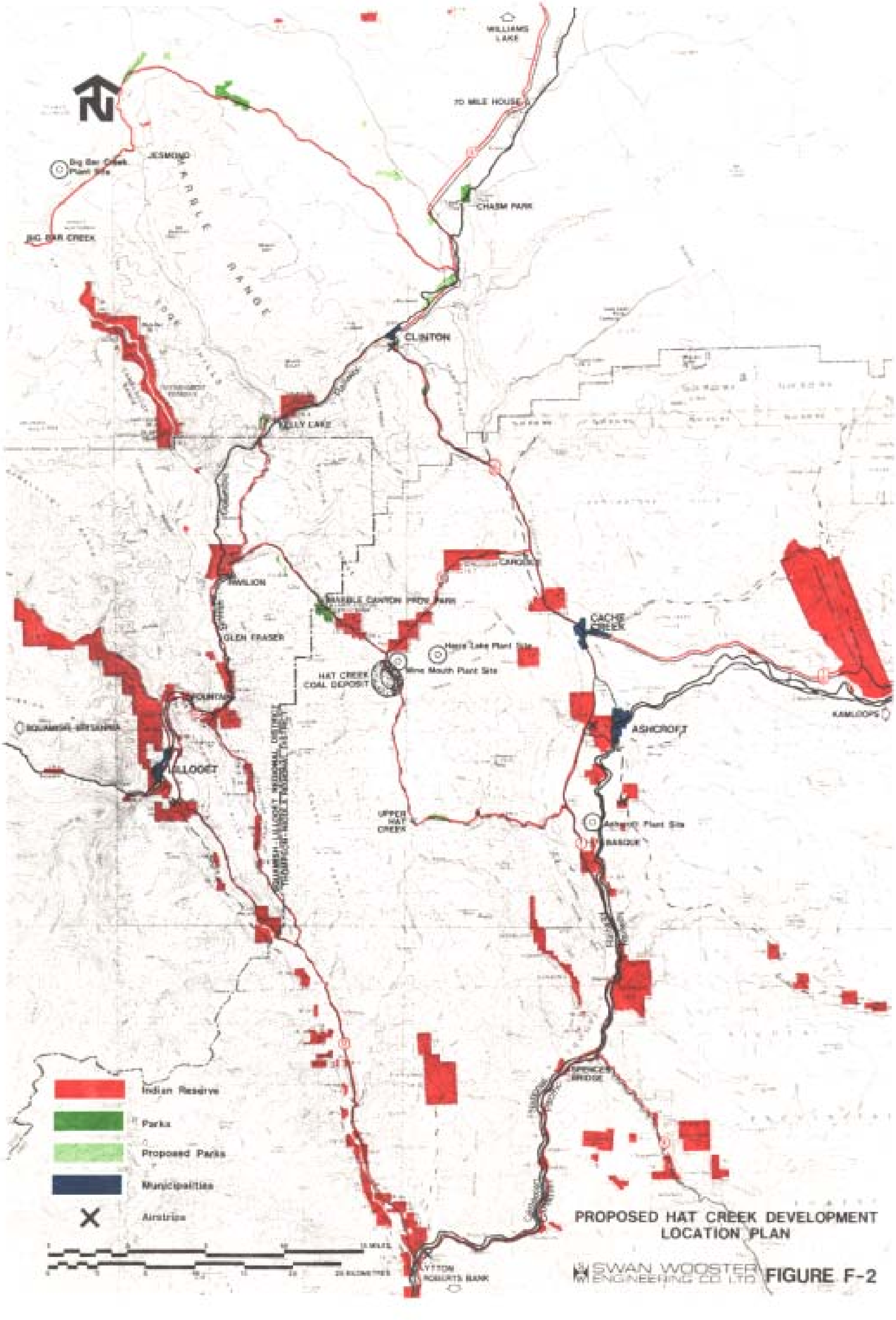
On 22 December 1975, CN submitted to the two Senior Governments two volumes entitled "Environmental Setting" and "Projected Route" relative to the proposed Ashcroft-Clinton Rail Connection. This Report was prepared by CN, acting as an agent of the Governments, and any distribution we think would originate from either the Railway Branch, MOT, Ottawa or the Department of the Environment, Victoria.

Field surveys are well in hand at the present time but until they are completed, grading and right-of-way costs cannot be calculated, thus Engineering estimates are not available. However, conjectured costs of the 40 mile line range from 45 to 60 million dollars.

We confirm that the maximum controlling gradients on the line will be 2.2% compensated north-bound and 1.0% compensated south-bound.

In our route projection of the Ashcroft-Clinton line, we have kept in mind the possibility of rail spur access to the coal deposits commencing about mid point on the line to a point marked "A" on your map. This seems feasible from the preliminary work which was done and what details we have can be provided if you wish.

.... 2



PROPOSED HAT CREEK DEVELOPMENT
LOCATION PLAN

FIGURE F-2