BC Hydro

KELLY LAKE - CHEEKYE TRANSMISSION LINE

STAGE 1

ENVIRONMENTAL STUDIES

July 1981

SIGMA RESOURCE CONSULTANTS LTD

SRCL 3387

PREFACE

(Prepared by B.C. Hydro)

Kelly Lake Substation to Cheekye Substation

Extra High Voltage Transmission Line

B.C. Hydro is planning a double circuit 500,000 volt transmission line between Kelly Lake substation in the general vicinity of Clinton and Cheekye substation near Squamish.

This report, entitled "Kelly Lake-Cheekye Transmission Line Stage I Environmental Studies," prepared by Sigma Resource Consultants, provides detailed environmental information on the project. It has been prepared in accordance with the provincial government's Environment Land Use Committee's Guidelines for Linear Development issued in March 1977 and is one of three reports prepared for the Stage I transmission line route selection study.

An engineering report entitled "Kelly Lake-Cheekye 500Kv Double Circuit Transmission Line - Route Location Report," prepared by B.C. Hydro, is publicly available as a companion document to this environmental study. The engineering report examines and evaluates all technically feasible routes in the study area and particularly emphasizes transmission line design, construction, maintenance and security.

A Project Summary Report, which combines information from both the above reports, is being widely distributed as the primary discussion document for public review. The summary report will also contain information on why the project is needed and how this project ties into B.C. Hydro's existing system.

Following public discussion and comment on the project based upon the above reports, the Stage I study program will be concluded by the preparation of an Addendum to the Project Summary

Report. This Addendum will incorporate information obtained through public discussions, identify Hydro's final route preference and provide guidelines for impact mitigation as well as transmission line design and construction.

The ultimate decision on this project will be made by the provincial government through an application by B.C. Hydro under Section 18 of the Utilities Commission Act.

Anyone wishing further information on this project is invited to contact Community Relations Department, B.C. Hydro, 970 Burrard Street, Vancouver, B.C. V6E 1Y3, or telephone (collect) to 663-2404.

15 June 1981

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INTRODUCTION

In order to expand transmission capacity between power generating sites in northern B.C. and load centres in the Lower Mainland and on Vancouver Island, B.C. Hydro is proposing to construct a 500 kilovolt double circuit transmission line from Kelly Lake, near Clinton, to Cheekye, just north of Squamish. At the request of B.C. Hydro, this report has been prepared by SIGMA Resource Consultants, in conjunction with Talisman Land Resource Consultants, to assist in the selection of an appropriate location for the line.

The study is intended to conform to the Stage 1 level of assessment as outlined in the "Guidelines for Linear Development", issued by the B.C. Environment and Land Use Committee. The purpose of the study was to assess the potential environmental impacts associated with use of alternative corridors for the transmission line, and to recommend a preferred corridor from an environmental point of view. The technical and economic aspects of the proposed transmission line were studied by B.C. Hydro, and are documented in a separate report. The full Terms of Reference for this study are included in this report as Appendix I.

Study Participants

The overall management of the study was undertaken by K.G. Farquharson. Project coordination and report preparation was the joint responsibility of R.A. Culbert and K. Warren. Responsibility for the different components of the study were as follows:

Terrain Analysis	P. Christie J. Bunning	Talisman
Wildlife	W. Biggs	Talisman
Vegetation/Forestry	J. Standish	Talisman
Geotechnical Aspects	N. Skermer	
Aquatic Resources	D. Turpin	SIGMA
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Recreation/Visual	K. Warren	SIGMA
Land Use/Minerals	K. Warren	SIGMA
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The consultants wish to express their appreciation of the assistance offered to them by Messrs. J. Batho, P.Eng., D. Cowley, P.Eng. and B. Hooper of B.C. Hydro; and to the staff of the Squamish-Lillooet Regional District, Resort Municipality of Whistler, Village of Pemberton and of the Indian Bands from Kelly Lake to Squamish for their cooperation; and to the many individuals, within and without government who offered information and assistance.

SUMMARY

INTRODUCTION

B.C. Hydro proposes to construct a 190 km double-circuit 500 kilovolt transmission line between Kelly Lake substation, near Clinton, and Cheekye substation, near Squamish, to increase transmission capacity in anticipation of growth in demand for electricity on Vancouver Island and the Lower Mainland.

In October 1980, B.C. Hydro commissioned SIGMA Resource Consultants to complete a study to identify feasible corridors between Kelly Lake and Cheekye, assess the potential impacts resulting from their use, and identify a preferred corridor, based on consideration of environmental and social aspects, in accordance with the requirements to the Stage 1 level of the ELUC "Guidelines for Linear Development". The technical and economic factors are addressed in a separate report by B.C. Hydro.

A corridor is defined as a strip of land of varying width within which at least one feasible route can be located. Feasible corridors were identified in consultation with B.C. Hydro, who stipulated that all corridors must pass through their proposed substation at Creekside, leading to the network shown in

Figure 3.1. Potential corridors through Garibaldi Park were excluded and one on the south side of Anderson Lake rejected because of the very steep unstable slopes.

The assessment of environmental and social conditions was made by a team with knowledge of agriculture, forestry, vegetation, terrain, fisheries, wildlife, recreation, heritage resources, and land use. Field work consisted of ground and helicopter reconnaissance. Meetings with community representatives were held in order to explain the nature of the project and studies pertaining to it. Groups contacted included: the Lillooet Tribal Council, Whistler and Pemberton Municipal Councils, Squamish-Lillooet Regional District, the Mt. Currie, Anderson Lake, Seton Lake, Bridge River, Fountain, Pavilion, Cayoosh Creek, Squamish and Kelly Lake Indian Bands, and the Birkenhead Ratepayers Association.

RESOURCE AND ENVIRONMENTAL ISSUES

The area studied extends from the dry lands of the Lillooet area, through the climatic transition zone along Anderson Lake, to the coastal zone near Pemberton. The whole region is extremely mountainous and most valleys are narrow and V-shaped often resulting in congestion of roads, railway, settlement and transmission lines in the narrow valley bottom.

Terrain conditions were important in assessment of the corridors. The south side of Seton Lake has many areas of marginal stability, making it an unacceptable corridor. The Cayoosh canyon has so many slide and avalanche paths, that it is not a suitable route for a transmission line. The flood threat in the Squamish valley and severe gullying on the many fans of the tributary creeks make that valley unattractive for a major transmission line.

SUMMARY

The B.C. Government desires to reduce loss of productive forest land. The most productive forest land is in the Callaghan and Squamish Valleys; other areas of note are the Pemberton area and Mission Ridge.

Agriculture is an issue on the benchlands east of the Fraser where irrigation has been hindered by existing transmission lines and in the narrow valley between D'Arcy and Pemberton, where land use is also affected by existing lines.

Areas of importance to wildlife are the deer and sheep ranges in the Fraser Canyon and the Camelsfoot Range, the Cayoosh Valley, the wetlands of the Whistler area and the Soo Valley and the alpine areas in the Soo/Squamish divide. The major issues identified are the possible extension of road access into the Camelsfoot Range and the Soo/Squamish divide.

The study area includes many river and lake systems of high importance to salmon. Sensitive areas are spawning channels in the Seton River and Gates Creek, natural spawning areas in the Bridge River, Portage Creek, Birkenhead and Lillooet Rivers. Indian food fisheries exist on the Fraser, Bridge and Seton Rivers, Portage Creek and the Lillooet, Birkenhead and Squamish Rivers. Important sports fisheries exist in the lakes at Whistler and the Lillooet, Cheakamus and Squamish Rivers. Areas of greatest sensitivity to changes in water quality are the Birkenhead River, Gates Creek, lakes at Whistler and the Cheakamus River.

The recreation potential of much of the study area is high, with heavy use by tourists and local recreationists. Tourist use focusses on Whistler and the Squamish-Pemberton corridor with a probable extension to Lillooet when the Duffey Lake Road is improved. Concerns relate largely to possible reduction in

recreational appeal due to the visual impact of the line, and penetration of undeveloped areas of high recreation capability such as the Callaghan/Rainbow Mountain area.

The 50 m+ double circuit towers are more prominent than the 230 kV towers or 500 kV single circuit towers which they might often parallel. The most visually sensitive areas are Pemberton and Whistler, other sensitive areas are the Fraser River crossings, the Bridge and Cayoosh Valleys, Anderson Lake, Gates/Birkenhead Valley, and the Soo and Callaghan Valleys and alpine areas.

The study area has many archaeological and historic sites. Most occur along the Fraser River, Seton Lake, Anderson Lake, and near Pemberton.

Most land is still held by the Crown, but many important areas are private. Indian reserves occur in locations that could be affected by the project in the Fraser, Bridge, Seton, Birkenhead, Lillooet and Squamish Valleys. Most land with agricultural potential has been alienated especially in the Fraser, Birkenhead and Lillooet Valleys. Valley floor lands from Green Lake through Whistler to Garibaldi are mostly privately held.

SOCIAL ISSUES

Major social concerns identified in the study area are:

- Interference with agricultural practices on the benchlands east of Fraser River
- Extension of roads in Camelsfoot Range affecting use by Indian hunters
- Proximity to residences in Gates/Birkenhead Valley

- Impacts on Village of Pemberton; visual, proximity to school, and further dissection of the valley and agricultural land
- Possible interference with future airport at Pemberton
- Visual impact in Resort Municipality of Whistler

ANALYSIS

Selection of a preferred corridor was achieved by elimination of segments that were considered least satisfactory for a transmission line, followed by comparative analysis of the impacts of use of remaining pairs of alternate corridors within each of the three sub-regions of the study area. The total network was reduced by eliminating the alternate with more severe impacts, leading to the definition of a preferred corridor by elimination. The network is shown in Fig. S-1.

The Seton Lake segment was eliminated because of its very steep terrain with many areas of marginal stability. Visual impacts would be high and potential fisheries impacts in the Seton River are very high.

The Cayoosh Creek corridor was eliminated as inferior to the Anderson Lake corridor because of the steep terrain with many avalanche and slide paths, the high visual impact of towers in the narrow valley, and the impacts on forestry, fish and wildlife. The more open terrain along Anderson Lake, which already accommodates four transmission lines, can more easily absorb the extra visual impact of larger towers that would replace one of the existing 230 kV lines.

With elimination of the Seton Lake and Cayoosh Creek segments the Pavilion/Fountain segment became redundant and the pre-

ferred corridor from Bridge River to Creekside is that along the north side of Anderson Lake.

From Kelly Lake to Bridge River three feasible corridors exist, following Antoine or Applespring Valleys, or the existing 500 kV line. Comparing the corridors in Antoine and Applespring Valleys, the former was preferred as it is slightly shorter and offers a better crossing of the Bridge River Valley.

Comparing the Antoine corridor to that along the existing 500 kV line the latter is preferred on environmental and social grounds provided that the impact on the agricultural lands east of the Fraser can be limited through use of the existing right-of-way. Use of this corridor results in only incremental environmental impacts and avoids major changes in the Camelsfoot Range and Bridge River Valley, and an additional crossing site in the Fraser Canyon.

It had been suggested that for reasons of line security, the two circuits should be placed on single circuit towers over Mission Ridge and that the single circuits should be separated. On environmental grounds it is strongly preferred that the lines not be separated, but remain in parallel crossing over Mission Ridge, thus avoiding the Bridge River Canyon.

From Creekside to Cheekye there are three major options to compare; use of the existing right-of-way; bypassing Whistler by a short loop west of Rainbow Mountain; and bypassing Whistler by a long loop through the Soo and Squamish Valleys.

It was concluded that the short bypass of Whistler would be less desirable on environmental grounds than use of the

existing right-of-way through Whistler as the bypass would have very high visual impact in the high quality alpine area west of Rainbow Mountain and in the Callaghan Valley. Both of these areas are part of the recreation endownment of the Whistler complex and will inevitably be developed to complement Whistler as a year-round recreation resort. If the bypass were used it would not eliminate transmission lines through Whistler, as the 500 kV and at least one of the 230 kV lines would still remain. Much of the impact of the transmission lines to the visitor occurs on the drive to Whistler and when viewing the valley from the mountains. Use of the bypass would do little to modify these impacts and would only do so at the expense of impacts on a high quality recreation area.

Use of the long loop through the Soo and Squamish Valleys was also considered to have a greater environmental impact than replacement of the line through Whistler because of much greater length, very high impact on forestry, severe visual impact in the Soo/Squamish divide, the importance of the Squamish fishery, and flooding and erosion problems in the Squamish Valley.

Use of the existing corridor from Creekside to Cheekye is therefore recommended subject to careful route selection in the Lillooet Valley, through Whistler and the Cheakamus Valley.

CONCLUSION

Use of the existing corridor from Kelly Lake to Cheekye is preferred on environmental grounds over opening new corridors, subject to careful route selection to minimize the following potential adverse impacts:

- impact on agriculture in Fraser and Gates/Birkenhead Valleys
- impact on residences in Gates/Birkenhead Valley
- visual impact at Pemberton
- visual impact in Creekside/Cheekye section
- impact on wetlands and lakes in Whistler

SIGNIFICANT ENVIRONMENTAL ISSUES

1 Potential interference with irrigation systems and further alienation of farm land.

2 High visual impact when viewed from road, railway and Downing Provincial Park.

3 New crossing sites create new hazard for small planes on popular flight path through Fraser Canyon.

4 Camelsfoot Range is important range for deer, and provides valuable native food hunting opportunites. Crossing of Bridge River on Applespring corridor encounters steep slope on west side of river; view of spectacular river erosion scarp near Moha stands to be impaired by transmission line crossing at Antoine Creek.

5 Further aquisition of settlement lands required, increase in visual impacts, near Lillooet.

6 Seton River has important salmon spawning channels which could be impaired by siltation.

7 Use of split circuits aggravates loss of forest land.

8 Revegetation in alpine and subalpine areas of Mission Ridge has proven difficult in past, leading to erosion. Further work will require caretul attention to revegetation.

9 Bridge Canyon is highly scenic and has many areas of instability. Visual impact of line would be severe. Potential terrain changes may endanger road.

10 South side of Seton Lake is very steep, high probability of slope failure and soil erosion. Route would have high visual impact from BCR and Shalalth and high potential for disturbance of heritage sites.

11 Cayoosh Canyon is very steep and narrow, high potential hazard from avalanche and slides; topography restricts line location to valley floor, thus incurring high potential for visual impact from road.

12 Cayoosh Range is important for deer, goat, grizzly bear and sheep, the values and potential for disturbance are much higher than along Anderson Lake.

13 Forestry values are moderately high west of Duffey Lake as compared to Gates Lake area.

14 Route is in subalpine area, careful revegetation will be necessary.

15 The north side of Anderson Lake has many local areas of steep unstable terrain, and creek gullies. These can be avoided with careful location of towers.

16 Gates Creek spawning channel is highly vulnerable to siltation from upstream construction activities.

17 Small settlements in narrow Birkenhead/Gates valley are already severely restricted by transmission lines, road, railway and rivers. Flexibility in route location is limited, resulting in potential visual impacts.

18 Corridor (a) adds third crossing of valley and creates high visual impact on steep hillside west of Pemberton.
Corridor (b) utilizes 2L1 ROW, therefore minimizes disruption of terrain and need for additional ROW. However, visual impacts are greater than for option (c), as 2L1 ROW lies adjacent to Highway 99 at the entrance to Pemberton, and crosses over schoolyard at Signal Hill Elementary School. Corridor (c) follows adjacent to existing 5L42 line, east of Pemberton. Visual impacts are minimized as this corridor is farthest from town and highway. Airport expansion needs further study to determine if there would be a conflict with desired approach path.

19 Wet, organic terrain occurs in lower Soo Valley, very unstable slopes (talus and rock slides) in upper elevations. Loss of forest land substantial as compared to Whistler corridor, potential wildlife disturbance.

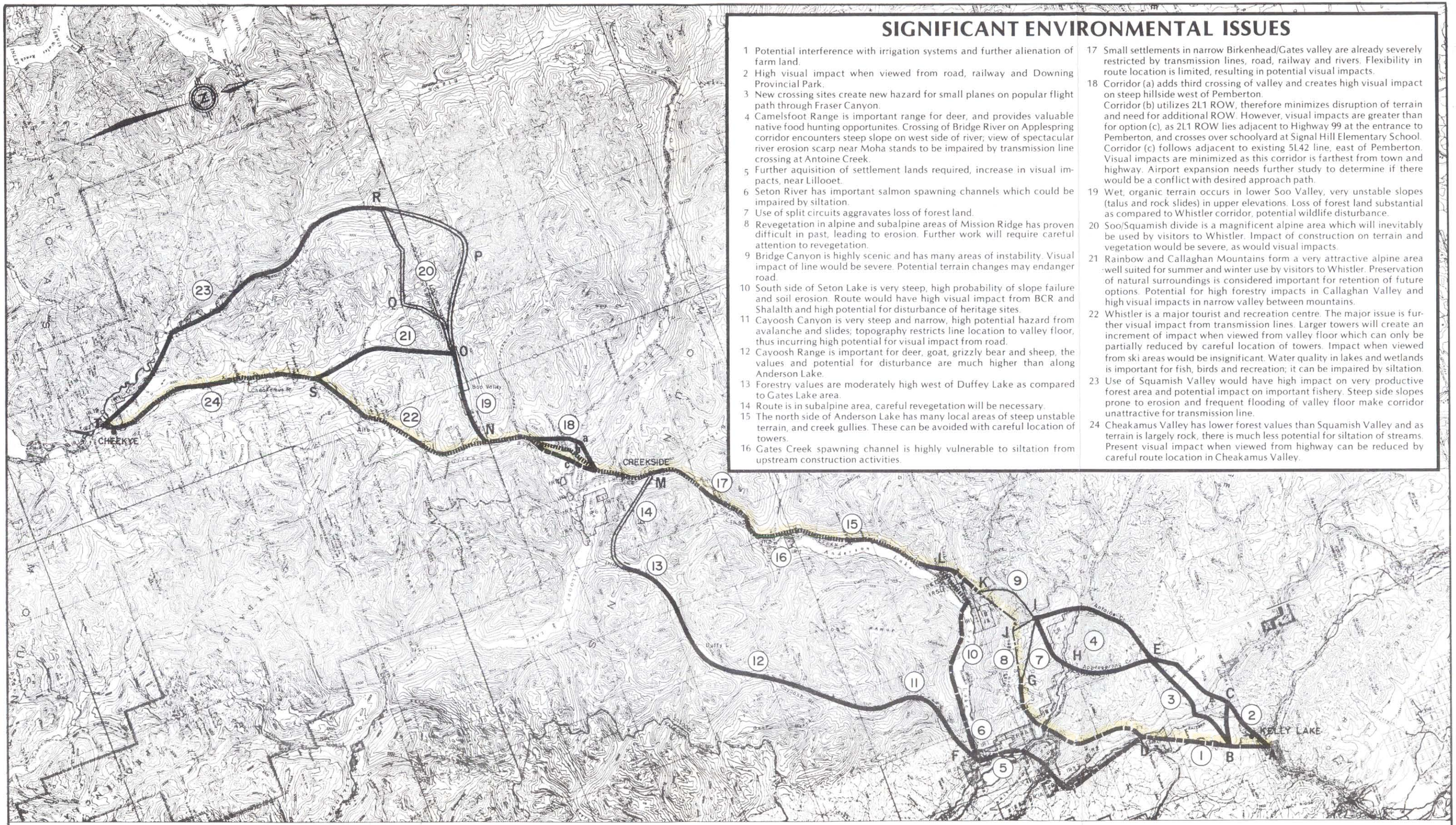
20 Soo/Squamish divide is a magnificent alpine area which will inevitably be used by visitors to Whistler. Impact of construction on terrain and vegetation would be severe, as would visual impacts.

21 Rainbow and Callaghan Mountains form a very attractive alpine area well suited for summer and winter use by visitors to Whistler. Preservation of natural surroundings is considered important for retention of future options. Potential for high forestry impacts in Callaghan Valley and high visual impacts in narrow valley between mountains.

22 Whistler is a major tourist and recreation centre. The major issue is further visual impact from transmission lines. Larger towers will create an increment of impact when viewed from valley floor which can only be partially reduced by careful location of towers. Impact when viewed from ski areas would be insignificant. Water quality in lakes and wetlands is important for fish, birds and recreation; it can be impaired by siltation.

23 Use of Squamish Valley would have high impact on very productive forest area and potential impact on important fishery. Steep side slopes prone to erosion and frequent flooding of valley floor make corridor unattractive for transmission line.

24 Cheakamus Valley has lower forest values than Squamish Valley and as terrain is largely rock, there is much less potential for siltation of streams. Present visual impact when viewed from highway can be reduced by careful route location in Cheakamus Valley.



LEGEND:	Single Circuit	Double Circuit
Using new Right-of-Way		
Using existing Right-of-Way		
Adjacent to existing Right-of-Way		
Environmentally Preferred Corridor	SHOWN WITHOUT COLOUR	
Other Corridors Reviewed		

0 5 10 15 20 MI
0 5 10 15 20 25 30 KM

Scale 1:250,000

NOTE-Locations of deviations from 2L1 ROW along preferred corridor are preliminary and approximate.

KELLY LAKE - CHEEKYE 500 KV LINE

SUMMARY OF ENVIRONMENTAL ISSUES

FIGURE S-1

CHAPTER 1

THE PROJECT

This study is concerned with one possible transmission connection between the Kelly Lake substation near Clinton and the Cheekye substation near Squamish. Electric power generated on the Peace River is transmitted southwards to Kelly Lake; from Kelly Lake, power is further transmitted south via one 500 kV transmission line (5L42) to the Meridian substation in Coquitlam and one to the Ingledow substation in Surrey. The existing 5L42 circuit between Kelly Lake and Meridian substations is planned to loop into Cheekye substation in 1982. In addition, there are two 230 kV transmission lines between Kelly Lake and Bridge River Terminal (2L90 and 2L91), and two from Bridge River to Cheekye (2L1 and 2L2). There is also a 360 kV transmission line (3L2) from Bridge River Terminal to Pemberton where it then turns southward down Lillooet Lake toward Chilliwack (refer to Figure 1.1).

The purpose of the proposed double circuit 500 kV line, designated 5L46, is to increase the 500 kV transmission capacity between Kelly Lake and Cheekye from the existing single circuit (5L42) to three circuits by 1988. The rationale for placing two circuits on one tower is to reduce new right-of-way requirements, especially for that portion between Bridge River Terminal and Cheekye.

Between Bridge River Terminal and Cheekye, it may be feasible to locate 5L46 on existing rights-of-way, thus keeping new right-of-way requirements to a minimum. Current planning, if this corridor option is selected, is to locate 5L46 on one of the existing 230 kV rights-of-way, specifically 2L1. This would mean dismantling the existing 2L1 structures for all or part of the line, and erection of the new double circuit structures on its right-of-way, usually with different tower spacing.

THE DOUBLE CIRCUIT 500 KV LINE

A typical line tower for the proposed double circuit 500 kV transmission line is illustrated in Figure 1.2. The final design for the towers, configuration of wires etc. is not yet complete, however it is useful to compare basic characteristics with those of the existing 230 kV and single circuit 500 kV lines as shown in Fig. 1.2.

The height of the new towers will be in the order of 50 meters, as compared to 22.5 meter for the 230 kV line, and 25 to 42 meters for the existing 500 kV transmission line.

The 230 kV line is distinguished by the three single wire conductors, carried by each tower. In contrast, the proposed 5L46 line, carrying two 500 kV circuits, will require 18 conductors which will be suspended in bundles of three from three cross-arms on the towers. The average spacing between towers will be 400 m, depending on topography, as compared to the 300 m average spacing of the 230 kV towers.

The right-of-way required for the 5L46 line will not, in general, be substantially different from that required for the

EXISTING BC HYDRO ELECTRICAL SYSTEM

Kelly Lake – Cheekye

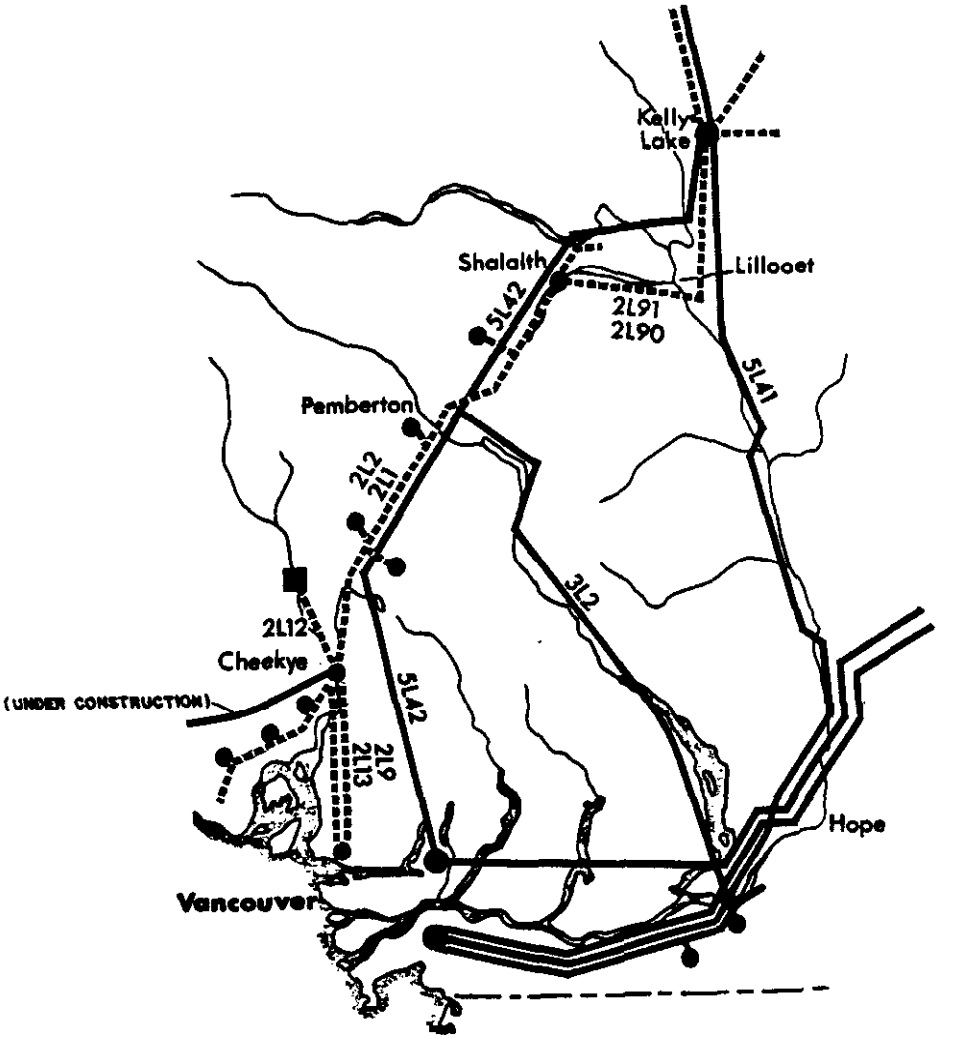


FIGURE 1.1

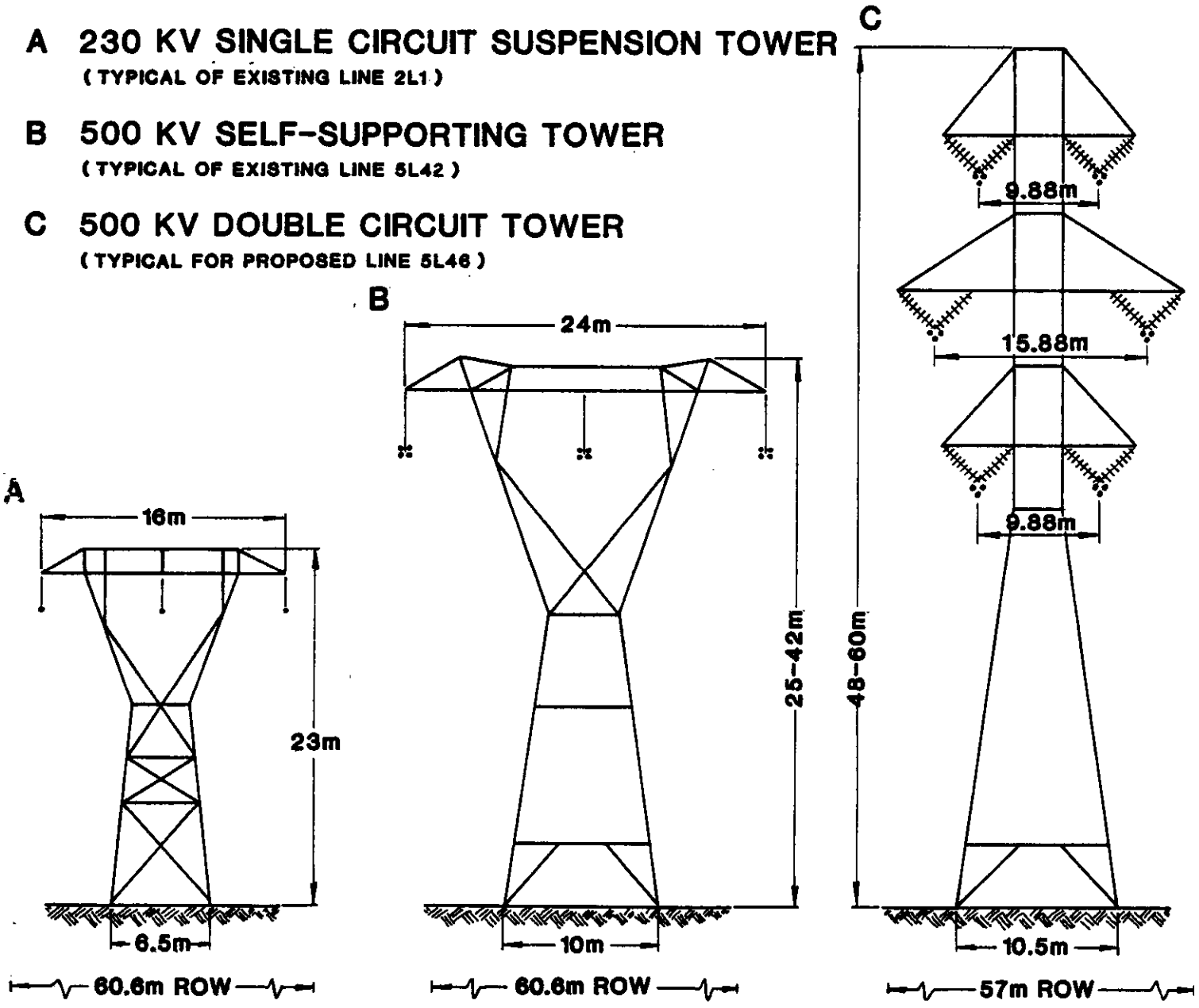
existing 2L1 right-of-way which is approximately 60 meters wide.

In some locations, such as crossing over Mission Ridge, B.C. Hydro currently plans to "split" the double circuit line on one set of towers into two, single circuit lines on separate sets of towers similar to those of 5L42. The reason for this is the extreme climatic conditions on the top of Mission Ridge, where wind and icing can be severe.

A 230 KV SINGLE CIRCUIT SUSPENSION TOWER
(TYPICAL OF EXISTING LINE 2L1)

B 500 KV SELF-SUPPORTING TOWER
(TYPICAL OF EXISTING LINE 5L42)

C 500 KV DOUBLE CIRCUIT TOWER
(TYPICAL FOR PROPOSED LINE 5L46)



NOTES 1. Information supplied by BC Hydro.
2. Angle structures are usually different from those shown.

LINE TOWER CONFIGURATIONS

FIGURE 1.2

CHAPTER 2

THE STUDY AREA

The proposed 500 kV transmission line crosses three distinct geographical regions between the Kelly Lake substation, located just south of Clinton, and the Cheekye substation, near Squamish.

Kelly Lake is situated in the southwestern portion of the Interior Plateau in the Cariboo region, and is characterized by a dry climate with hot summers and cold winters. Vegetation typically found in this region includes open Ponderosa pine forests and bunchgrass. Cheekye is located at the head of Howe Sound, and is characterized by a milder, wetter coastal climate, and productive forests of Douglas fir and hemlock with dense underbrush.

Between the Interior Plateau region and the coastal region is a less obvious "transition zone" where the coastal forests thin out and become interspersed with pines and other types of vegetation associated with a drier climate.

For purposes of discussion throughout the report, the study area has been divided into these three regions as shown in Figure 2.1:

* Kelly Lake to Seton Lake, which exhibits most of those features typical of the Interior Plateau;

* Seton Lake to Pemberton, the "transition zone" between the Interior Plateau and the Coastal area;

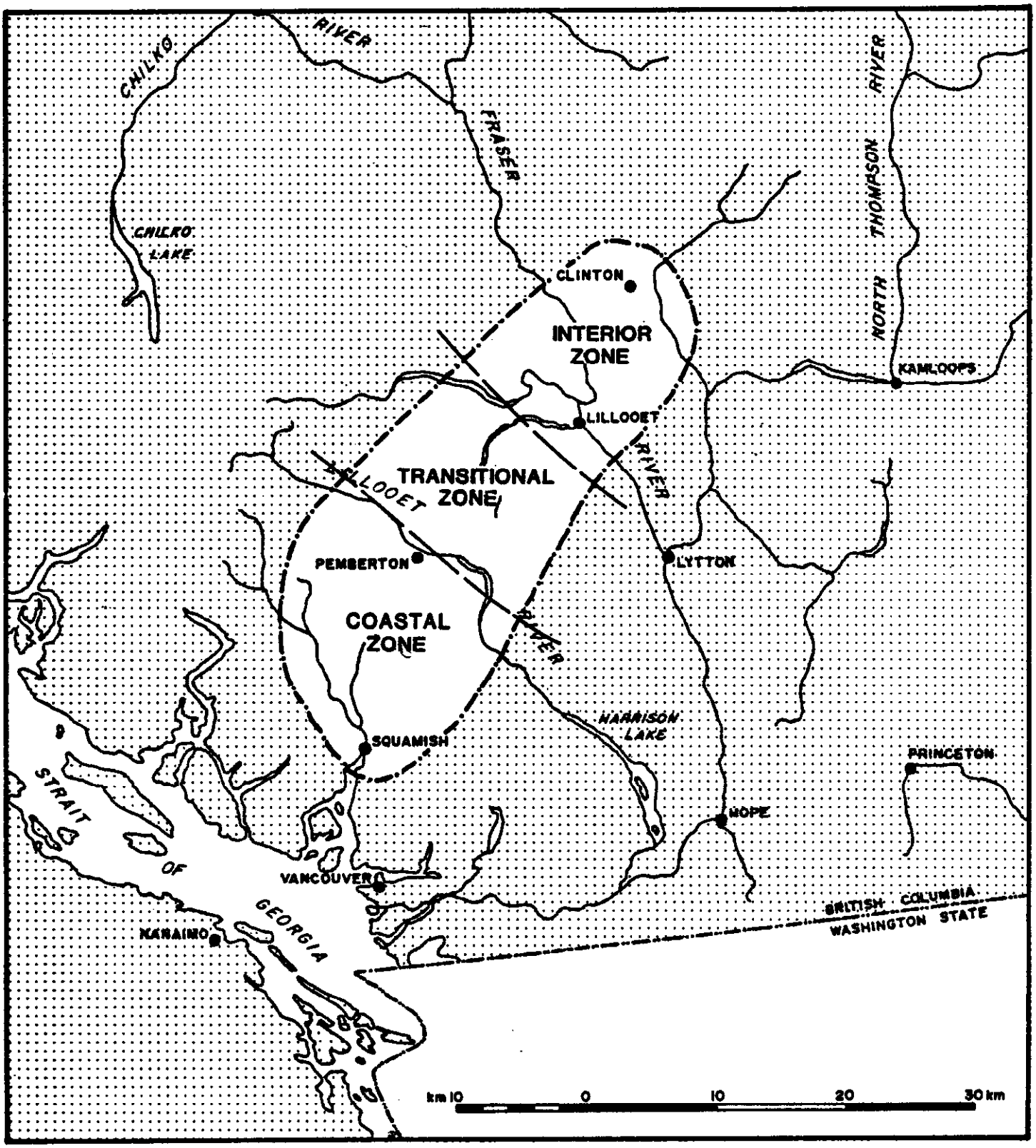
* Pemberton to Cheekye, which can broadly be described as being typical of the southern B.C. coastal area.

Climatic differences beween these regions are quite marked, as illustrated by the following data:

* the interior region around Kelly Lake and Lillooet has an average annual precipitation of 30 to 40 cm, and between 140 to 180 frost-free days. Average daily temperatures range between 20° and 22°C during summer, and reach -10° and -15° during winter.

* the milder coastal climate receives an annual average of 150 to 250 cm of precipitation, mostly in the form of rain, and has 180 to 220 frost-free days.

Besides obvious climatic differences and corresponding changes in natural vegetation patterns, the study area exhibits great variation in terrain. The area between Kelly Lake and Lillooet consists of rolling, hilly topography, cut down by rivers and incised by gullies as a result of fluvial action. The Fraser River canyon is the major physiographic feature in this area. Between Lillooet and Cheekye, the study area traverses a series of mountain ranges and valleys trending in a northwest/south-east alignment, such as the Camelsfoot, Shulaps, Cayoosh and Coast Ranges, and the Lillooet Valley, with only a few valleys such as those of Anderson Lake and Cayoosh Creek cutting across the prevalent trend.



STUDY AREA

FIGURE 2.1

GEOLOGY AND PHYSIOGRAPHY

The geology and physiography of the study area has not been described and mapped in detail. The following section is a brief outline extracted from existing information and depends heavily on the publication entitled Landforms of British Columbia by S. Holland (1976) and on Geological Survey Canada maps (references 92J and 42).

Kelly Lake to Seton Lake

This portion of the study area lies within the Marble, Camelsfoot and Clear Ranges of the Fraser Plateau and to a lesser extent the Shulaps Range of the Coast Mountains.

In general the Marble, Camelsfoot and Clear Ranges are characterized by abrupt transitions between the ranges which are associated with major faults. Relief on the western side is pronounced with elevations exceeding 2000 metres, but becomes more moderate on the eastern side where it is transitional to the Fraser Plateau. The major rivers in this area (Fraser, Bridge and Yalakom) are all bedrock controlled and coincide with major faults dividing the mountain ranges. The well-jointed sedimentary bedrock formations of these ranges facilitate deep gullying by most tributary streams.

The Marble Range east of the Fraser River and north of Marble Canyon is characterized by castellated peaks and ridges of pale grey Upper Permian limestone of the Cache Creek Group. Most of the area involved with the corridor alternatives lies on the transitional plateau which consists of Miocene or Pliocene olivine basalt flows covered by stony, glacial till.

The Camelsfoot Range lies west of the Fraser River and east of the Bridge and Yalakom Rivers. Above the Fraser River there is a wide level formation of Miocene basalt flows which is actively eroding along the Fraser escarpment. In the area of Antoine and Applespring Creeks the range forms a series of steep sided parallel ridges and peaks of Lower Cretaceous sedimentary formations of the Jackass Mountain Group. Fault lines occur parallel to the main Fraser-Yalakom Fault. These fault areas appear to be associated with areas of moderate to high geological hazard.

The Clear Range lies east of the Fraser River and south of Marble Canyon. It is characterized by a steep ridge above the Fraser River on the western side and a more moderate slope to the east towards Hat Creek. This range consists of weak Tertiary clay shales over a granitic core. The weakness of these shales is evident in the numerous debris slides occurring throughout the range.

The Shulaps Range of the Coast Mountains lies west of the Yalakom Fault and north of Seton Lake. Most of this range is Triassic sedimentary rock with more metamorphosed equivalents forming ridges to the east of Mission Ridge. However, the area of Mission Ridge crossed by the existing transmission lines and alternative transmission line corridors is a granodiorite formation which appears to be less jointed and more stable than the foliated metamorphic and sedimentary formations.

Surficial deposits throughout the Kelly Lake to Seton Lake section form a consistent pattern. Elevated fluvioglacial terraces occur along the Fraser River and, to a lesser extent, the Bridge River. These terraces vary greatly in texture and are extensively eroded. On valley walls or mountain sides stony, coarse textured, glacial till and colluvial deposits

occur in varying depths but become consistently shallower or absent along ridge tops.

Seton Lake to Pemberton

The Anderson Lake corridor follows a fairly typical glaciated valley with steep walls rising to elevations between 1500 and 2000 metres. Bedrock formations are predominantly Triassic sedimentary and metamorphic rock in the vicinity of Anderson and Seton Lakes. On the north side of the valley from D'Arcy to Creekside, Triassic igneous, metamorphic and pyroclastic formations of the Cadwallader Group predominate. On the south side of the valley from Devine to Spetch, granodiorite and quartz diorite predominate with a major sedimentary formation of the Tyaughton Group occurring in the vicinity of Eight Mile Creek. A major rock slide hazard has been associated with this sedimentary formation.

Surficial deposits consist of an eroded glaciofluvial terrace along the north shore of Anderson Lake with shallow colluvial-till deposits on the mountain sides at higher elevations. Through the Gates and Birkenhead valleys isolated floodplain deposits occur along the valley floor with colluvial and alluvial deposits extending from the valley walls. A morainal deposit occurs along most of the lower valley walls but the bedrock is frequently exposed.

The Cayoosh Creek valley is also glaciated. However it is much narrower northeast of Duffey Lake. The valley walls rise to elevations between 1500 and 1800 metres.

Most of this area east of Duffey Lake is predominantly Triassic sedimentary and metamorphic rock formations of the Bridge River

Group with some granodiorite inclusions. West of Duffey Lake the granodiorite and quartz diorite formations predominate.

Surficial deposits east of Duffey Lake consist primarily of shallow colluvial and morainal deposits over the bedrock. West of Duffey Lake the valley widens and morainal deposits are deeper on the valley floor.

Pemberton to Cheekye

The valley between Pemberton and Cheekye represents one of the major drainages of the Pacific Ranges. The valley walls rise on both sides to a series of mountains peaks with elevations exceeding 2000 metres. Quartz diorite and granodiorite is the predominant bedrock formation with major exceptions being the basalt flows associated with Callaghan Creek and Daisy Lake. Similar flows are associated with Garibaldi Lake and the upper reaches of Rubble and Culliton Creeks.

Creeks draining into the valley are characteristically narrow and very steep sided. In places the trellis type pattern of drainage is parallel to regionally developed sets of joints and faults (Holland, 1976).

Significant floodplain deposits occur in the Pemberton Valley and to a lesser extent the lower Cheakamus Valley. Some moraine and fluvial fan deposits occur on the lower walls of the valley and on the valley floor. However, the valley walls are primarily exposed bedrock with shallow deposits of till and colluvium in depressions. Talus slopes, debris flows and rock slides are common throughout the valley.

The Squamish Valley is physiographically similar to the Cheakamus Valley except in the lower half of the valley there are extensive level floodplain deposits through which the Squamish river meanders.

The upper reaches of the Squamish, Callaghan and Soo valleys are predominantly quartz diorite bedrock formations with volcanic and metamorphic formations. Surficial deposits are primarily colluvium with some floodplain and organic deposits in the lower Soo River Valley.

HISTORY

The entire study area was glaciated during the last major ice advance of the Pleistocene Age, restricting the accessibility of the area for early human occupation. Scientific evidence indicates that the study area has been potentially available for human habitation for approximately 10,000 years.

Settlement was first established by the Salish Indians who originally occupied a vast territory extending across southern B.C. The Salish consist of two major subgroups, the Interior Salish and the Coastal Salish. The Interior Salish established early settlement patterns that were closely related to their seasonal quest for food, utilizing the rivers and creeks during the spring, late summer, and concentrating on high, well-drained terraces during the winter. The Coastal Salish traditionally occupied Howe Sound, and the Squamish and Cheakamus valleys, living in semi-permanent villages along the river banks.

European settlement did not start until the Hudsons Bay Company was granted a licence to trade with the Indians in 1812. This period of trading was followed by an immense influx of people during the 1850's when the Cariboo Gold Rush was at its height. Permanent settlement in the interior region occurred shortly thereafter with the establishment of cattle ranching in the Kelly Lake/Lillooet area.

The first permanent settlers moved into the Lillooet Valley in the early 1880's, primarily attracted by farming opportunities and mineral prospecting followed shortly by permanent settlement in the Squamish Valley. Small scale prospecting has continued in the Lillooet/Bridge River area since the early gold discoveries.

Subsequent events that occurred in the study area were the construction of the Howe Sound-Pemberton Valley and Northern Railway in 1907, and completed through to Lillooet in 1914 as the PGE Railway; the opening of the Pioneer and Bralorne mines in 1932, the completion of the first phase of the Bridge River hydroelectric project in 1946 which required construction of the first transmission lines through the Whistler area, and the development of the access road for those lines. This road eventually became Highway 99 which in turn permitted the development of Whistler as a winter sports and resort area.

Current Settlement Patterns

Improved access throughout the study area led to growth in logging, mining and agricultural activity. All of these resource-based activities are prevalent today, though more recently recreation and tourism has added significantly to growth and community development, particularly in the Howe Sound/Whistler/Pemberton region.

Four major communities are located within the study area, namely Lillooet, Pemberton, Whistler and Squamish. Several smaller communities exist between the south end of Seton Lake and Pemberton, such as Seton Portage, D'Arcy, Birken and Mt. Currie.

Lillooet has an estimated (1976) population of 2,200, and is projected to increase marginally to 2,500 in 1981. Evans Products Ltd., B.C. Rail and the Ministry of Highways provide the major source of employment in the area. Future growth possibilities have been tied to tourism, based on the assumption that the Duffey Lake Road will be upgraded to all-weather standard and will be promoted as part of the Nugget Tour Route (see Chapter 9). Such a plan, combined with upgraded tourist facilities in Lillooet, would attract tourists to the area, providing a more diverse and stable economic base for Lillooet.

Settlement in the surrounding region between Kelly Lake and Lillooet is largely associated with ranching and farming, and native communities on some of the Indian Reserves along the Fraser, Bridge and Fountain valleys.

Between Lillooet and Pemberton, settlement is restricted to a few recreational homes along the shores of Seton and Anderson Lakes, and to the low-elevation land at Seton Portage and along Gates Creek and the lower Birkenhead valley. Hobby farms are scattered along the narrow valley between D'Arcy and Pemberton.

The Village of Pemberton (estimated population of 3,400 in 1979) is situated at the junction of Highway 99 and the Lillooet Valley. The Valley is largely utilized for farming, producing seed potatoes for export and hay and grains for local

use. Logging occurs in the higher elevation areas northwest of Pemberton, and represents the primary economic activity in the valley, followed by agriculture. Expansion of the Village itself is constrained by the ALR boundaries (see Map 2) and by restrictions imposed by the floodplain of the Lillooet River. Growth prospects in the community are associated with three factors:

1) rising land costs in Whistler which will create a further increase in demand for property in the Pemberton area, particularly for commercial and residential purposes;

2) the potential development of a geothermal plant at Meager Creek;

3) the proposed improvement to the Duffey Lake Road, and expansion of the airport to serve regional traffic destined for Whistler, both of which would create a substantial demand for tourist-related services at Pemberton.

As sufficient vacant land is still available within the Village boundaries, it is anticipated that the bulk of this growth in the short to medium term will be accommodated by infilling of existing lots. It is expected that most of the new development will occur southeast of the village core, towards the highway and airport.

The Resort Municipality of Whistler is located roughly 112 km north of Vancouver, along Highway 99. Whistler presently has a permanent population of approximately 2,000; peak skier capacity is projected to be approximately 23,500 skiers per

day by 1986/87. Present land use patterns within Whistler consist of several subdivisions distributed along the valley floor. Since the inception of its status as a Resort Municipality in 1975, strict policies have been adopted to attempt to concentrate residential and commercial development in three high density areas: the Gondola Skier Staging Area; Whistler Village; and the Blackcomb Bench Skier Staging Area.

Present forecasts predict a 300 percent increase in the number of beds available in the Whistler Valley by 1986/87. The Village will absorb the bulk of this development, and will provide some 54 acres of tourist accommodation, commercial facilities and privately-owned condominiums. In summary, it is expected that land development in the vicinity of Whistler will continue rapidly, primarily in the Village itself, but also throughout the various subdivisions along the valley floor as vacant lots are built upon.

Logging will continue to be a major economic influence in the region, with particular emphasis on the Soo and Callaghan drainages.

Between Whistler and Squamish, scattered settlement exists along Highway 99, such as that at Garibaldi. Some of the residences at Garibaldi have recently been purchased by the Provincial government as part of the plan to remove people from the threat imposed by the possibility of a major slide from the Barrier, and flooding and debris flows from Rubble Creek.

The new Cheekye substation which forms the terminus for the proposed transmission line is located north of Squamish. It is separated by a road from the existing substation. The land surrounding the substation is vacant, with the nearest residences located roughly one kilometer north of the substation.

In summary, the proposed line between Kelly Lake and Cheekye traverses areas which have been occupied by people for a very long time; and whose present inhabitants are still largely dependent on the character and productivity of the land. Furthermore, the study area includes what is probably the first serious attempt to create a major destination resort in British Columbia.

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CHAPTER 3

CORRIDOR OPTIONS

For this type of route analysis a corridor is generally assumed to be a strip of land of uniform character within which it would be possible to locate one or more feasible routes. In the typical mountain terrain of the study area, transmission line location is generally restricted to the valley floor and lower mountain slopes due to difficulty of construction and maintenance, and environmental damage associated with construction in alpine areas. In this study, therefore, the term is considered to include the valley floor and lower slopes, unless otherwise stated, even though they have different ecological characteristics.

At the outset of the study, B.C. Hydro stated that the proposed 5L46 line must connect with the proposed Creekside substation, to be located in the general vicinity of Pemberton. The choice of location for Creekside was beyond the terms of reference for this study; in fact, at the time of writing this report, a final choice on the location of Creekside had not yet been made by B.C. Hydro, but is provisionally established near Spetch.

The Creekside substation is intended to link proposed northern transmission lines (bringing power south from the Stikine and

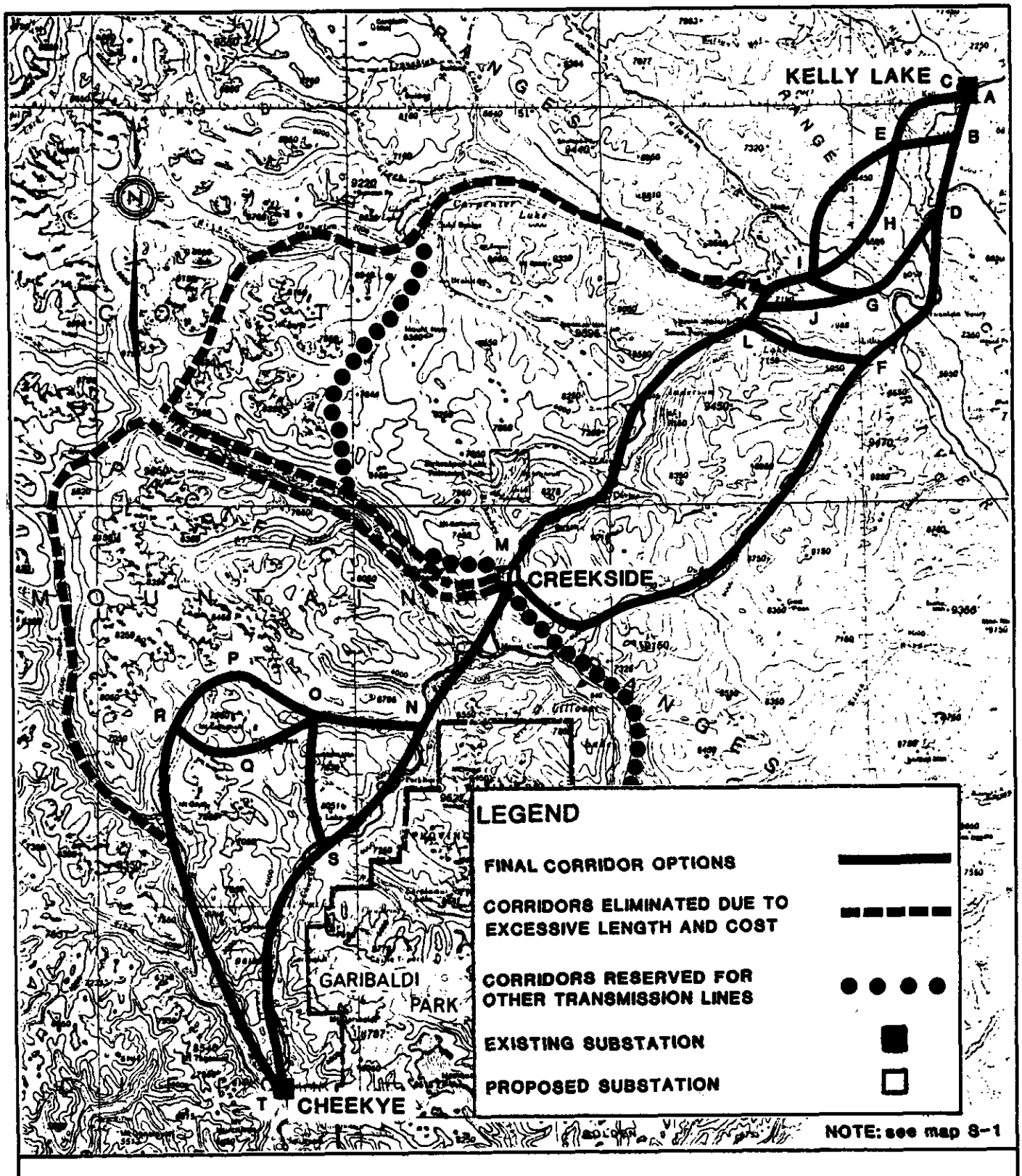
Liard generating sites), the proposed Creekside-Ingledow transmission lines (transmitting power south to Surrey) and the proposed double circuit line between Kelly Lake and Cheekye (see Figure 3.1). Thus, the number of corridor options available for this project was initially limited to those that could be readily linked to the Creekside substation near Pemberton.

Several other facts were considered at the outset of the study that determined the location of feasible transmission line corridors. These were:

1) Garibaldi Provincial Park, located along the east side of the Cheakamus Valley, was considered an absolute constraint to corridor location;

2) the Hurley Creek valley is reserved for the proposed northern transmission lines; therefore a corridor following the Bridge River Valley to Gold Bridge and continuing south via Hurley Creek towards Pemberton, was not a possibility for this project; and

3) a corridor similar to that described in (2), but continuing beyond Gold Bridge along Carpenter and Downton Lakes, crossing through to the Lillooet Valley and continuing south towards Creekside and a similar loop in the Lillooet, Meagher, Elaho and Squamish Valleys were rejected on the basis of extreme length and cost. It was originally thought that these two loops could have been a single corridor from Bridge River to Squamish but the necessity of linking to the proposed Creekside substation near Pemberton, however, would require two long parallel lines in the Lillooet Valley. Such a lengthy corridor was not considered to be a viable alternative, and was not addressed in this study.



CORRIDOR ALTERNATIVES FOR

PROPOSED 500kV DOUBLE CIRCUIT TRANSMISSION LINE

Kelly Lake - Cheekye

FIGURE 3.1

Figure 3.1 shows all of the remaining feasible corridors between Kelly Lake and Cheekye that were considered for the purposes of this study, as well as those corridors described above that were rejected for the reasons stated. Table 3.1 gives the approximate distances between nodes for all segments which were studied. The following paragraphs describe the feasible corridor options in each of the three geographic regions of the study area.

KELLY LAKE TO SETON LAKE

Three broad corridors were considered between Kelly Lake and Seton Lake: a northern corridor via either Antoine or Applespring Creeks; a corridor adjacent to the existing 5L42 transmission line from Kelly Lake to Bridge River Terminal; and a southern corridor, more or less following 5L41 along the east side of the Fraser River, and crossing over Fountain Ridge towards Lillooet.

The Applespring/Antoine corridors and 5L42 corridors involve crossings of both the Fraser and Bridge Rivers, traversing both the Camelsfoot and Shulaps Ranges west of the Fraser River, and crossing over Mission Ridge before descending to Seton Lake near the Bridge River Terminal. The Fountain Valley corridor crosses the Fraser River south of its confluence with the Bridge River near Lillooet. This route would avoid crossing over the Camelsfoot Range and Mission Ridge as it would continue southwards either along Cayoosh Creek or follow the existing 2L90 and 2L91 transmission lines along the south side of Seton Lake, crossing the lake near Shalalth. Such a route would add a fourth transmission line on the east side of the Fraser River adjacent to the existing 5L41, 2L90 and 2L91 lines.

TABLE 3.1

CORRIDOR SEGMENT LENGTHS

Segment	Name	Length (km)
A-B	Kelly Lake East	5.0
A-C	Kelly Lake North	9.5
B-C	Kelly Lake South	6.0
B-D	Marble Range	12.5
B-E	Camelsfoot South	18.6
C-E	Camelsfoot North	13.6
D-F	Pavilion-Fountain	34.5
D-G	Pavilion-Mission Ridge	24.0
E-H-I	Applespring	20.0
E-I	Antoine	17.4
F-L	Seton Lake	22.0
F-M	Cayoosh Creek	75.0
G-I	Mission Ridge North	8.0
G-J	Mission Ridge South	7.0
I-J	Mission Pass East	2.5
I-K	Bridge Valley	12.0
J-K	Mission Pass East	9.5
K-L	Mission Pass West	6.5
L-M	Anderson Lake	51.0
M-a-N	Pemberton -a	19.4
M-b-N	Pemberton -b	18.0
M-c-N	Pemberton -c	17.1
N-O	Soo Valley	15.5
N-S	Whistler Valley	32.0
O-P-R	Mt. Callaghan North	37.5
O-Q-R	Mt. Callaghan South	27.5
O-S	Callaghan Creek	20.5
R-T	Squamish Valley	50.0
S-T	Cheakamus Valley	31.0

Note: Lengths shown may vary from those shown in B.C. Hydro's technical report as this report was prepared first and differs slightly in node location and as lengths were measured without accurate definition of angle points.

At present, there are no transmission lines in either Antoine or Applespring corridor, and only limited road access into Antoine Creek valley; both would require the acquisition of new right-of-way, mostly from the Crown, although the Applespring corridor also crosses the Bridge River Indian Reserve (IRI). The 5L42 corridor and the southern corridor via the Fraser Valley/Fountain Ridge area would both require additional right-of-way through private and Crown land, mostly adjacent to the existing B.C. Hydro rights-of-way.

SETON LAKE TO CREEKSIDE

Only two feasible corridors were considered between Seton Lake and Creekside substation: the Anderson Lake corridor along the north side of the lake; and the Cayoosh Creek valley, following the Duffey Lake Road towards Pemberton. The possibility of utilizing the south shore of Anderson Lake was rejected at an early stage due to the extremely steep and unstable terrain conditions along that side of the lake.

The two feasible corridors present a classic choice between utilizing the heavily committed Anderson Lake corridor and populated valley between D'Arcy and Pemberton, or constructing a major transmission line through the only accessible valley in the study area which is presently devoid of transmission lines. The Anderson Lake corridor presently accommodates four transmission lines: 5L42 (500 kV), 3L2 (360 kV), 2L2 and 2L1 (230 kV).

The steep sides of the Cayoosh Creek valley between Lillooet and Duffey Lake limit the corridor to the valley bottom and lower slopes. From Duffey Lake, the line would cross over the drainage divide into Joffre Creek, then turn north towards

Creekside in the valley of Spetch Creek by way of an alpine pass. The latter portion of this route could involve splitting the double circuit line into two, single circuit 500 kV lines because of the steep, hazardous terrain.

PEMBERTON TO CHEEKYE

Three corridor options were considered between Creekside substation and Cheekye substation. The most direct corridor follows the existing transmission lines along Highway 99, through the Whistler area, continuing south along the Cheakamus Valley to Cheekye.

Several possibilities were considered to avoid the Resort Municipality of Whistler; a short loop via the Soo Valley, crossing into the Callaghan Valley by a pass west of Rainbow Mountain, and returning to the existing lines at the confluence of Callaghan Creek and the Cheakamus River; and a much longer loop that would continue to the headwaters of the Soo River, crossing into the upper Squamish Valley and following that valley to Cheekye. A sub-option that was also considered would cross through to the Squamish Valley via the upper Callaghan drainage.

The most direct corridor between Pemberton and Squamish accommodates three transmission lines (2L1, 2L2 and 5L42), B.C. Railway and Highway 99. In order to minimize new right-of-way requirements and interference with land use in the vicinity of Whistler, B.C. Hydro has proposed to utilize the 2L1 right-of-way wherever possible for the new 5L46 transmission line, unless relocation can result in a better alignment.

The alternative corridors that would effectively avoid Whistler cross into areas which are wholly or partially inaccessible by road, and are devoid of transmission lines.

At Pemberton, the proposed transmission line must cross the Lillooet Valley; this could be accomplished in three ways: utilize the existing 2L1 right-of-way; follow adjacent to the existing 5L42 right-of-way; or create an entirely new right-of-way that would cross the valley just north of Pemberton, crossing the steep ridge west of Pemberton to rejoin the existing 2L1 right-of-way near Tisdall.

CHAPTER 4

TERRAIN ANALYSIS

Very little terrain/soils information exists over most of the study area. The only published soils and landform map within the study area covers NTS-1:50,000 map sheet 92I/13, which includes the area from the confluence of the Bridge and Fraser Rivers north to Kelly Lake. This coverage extends approximately 8 kilometers west of the Fraser River and covers the corridor alternatives on the east side in the vicinity of Pavilion. For the Cheekye to Pemberton corridor and Lower Squamish Valley, preliminary terrain analysis and terrain hazard information was gathered largely through air photo interpretation with a limited amount of field checking.

Terrain hazards and potential impacts from construction and maintenance of the proposed double circuit line have been mapped at 1:125,000 scale for the width of the valley including the corridor (see Map 1). The width of the band indicating impact severity does not indicate corridor width.

Potential terrain impacts result primarily from three activities during transmission line construction, namely: right-of-way clearing, access road construction, and tower footing construction.

The corridor segments were assigned a high, medium, or low potential impact rating, as shown on Map 1, based on the following criteria:

1) a high potential impact rating is assigned where evidence of existing terrain hazards indicate the terrain is unstable. Instability usually occurs where loose surficial deposits lie on a steep slope, jointing and faulting in the bedrock lies parallel or nearly parallel to a steep slope, and where erodible surficial deposits (generally fine textured) on a steep slope are subject to saturation or concentrated water flows. In the study area, these conditions are often indicated by the presence of debris slides, rock slides, talus deposits, organic soil deposits, and erosion gully networks. In high hazard areas, transmission line construction is likely to result in a significant increase in the occurrence of major slope failures and erosion, the effects of which extend beyond the width of the right-of-way.

2) a moderate potential impact rating is assigned to corridor segments where there is no visible evidence of terrain instability indicated by existing major terrain hazard features. However, the topography and nature of the surficial deposits or bedrock indicates that transmission line construction is likely to cause significant slope failures and/or erosion which may extend beyond the right-of-way. Some moderate impacts can be controlled by special engineering measures.

3) A low potential impact rating is assigned to terrain features where the impact of transmission line construction is considered to be negligible. Under proper construction methods, minor slope failures or erosion will

be confined to the right-of-way, and standard soil conservation practices will be sufficient to mitigate most impacts.

KELLY LAKE TO SETON LAKE

Kelly Lake East (AB)

Kelly Lake substation (A) is located on a fluvial fan associated with Gabriel Creek where it joins Kelly Creek. The fan is well drained gravel and sand with level to 5% slopes. Between A and B the terrain consists of deep, coarse textured, stony moraine with bedrock outcrops occurring at the highest elevations. Deep creek drainages divides the area into a series of ridges with slopes ranging between 35 and 45%.

Moderate impacts can be expected on the steeper creek valley sides where access road construction may cause bank failures and erosion, most of which can be mitigated by reducing cutbank slopes where possible and revegetating soon after disturbance.

Kelly Lake North (AC)

From Kelly Lake substation to the north end of Kelly Lake the corridor transects an area of bedrock controlled, stony, sandy moraine on a 25% to 30% slope. Along the north side of Kelly Lake to C the terrain is steep with slopes usually exceeding 45% with shallow, stony, coarse textured colluvial deposits over bedrock.

Most of this segment is subject to moderate potential impacts due to minor slope failure and erosion arising from access road

construction in the shallow soils on the north side of Kelly Lake.

Kelly Lake South (BC)

In this segment there are two significant terrain types. The first is the near level to moderately sloping, deep, sandy morainal deposits in the vicinity of B and immediately west of B. The second is the steep valley of Kelly Creek. This valley has extremely steep walls consisting of loose colluvium over rock. Debris slides and erosion are common features of these slopes.

The potential for terrain impacts on the undulating plateau deposits west of B is low. High impacts could occur on the Kelly Creek valley sides from increased slide and erosion activity associated with access road construction.

Marble Range (BD)

This segment lies almost entirely on a deep, rolling ablation deposit of moderately well drained stony moraine, of medium to coarse texture. Towards D the effect of erosion along the Fraser River and Pavilion River has increased the slope to between 40% and 50% although the surficial materials are essentially the same.

Potential impacts along this segment are low due to stable materials and moderate topography. In the vicinity of D where slopes are greater, erosion on access road cutbanks may occur and mitigation measures such as revegetating artificial slopes should be taken.

Camelsfoot South (BE)

Between B and the Fraser River canyon the corridor segment crosses terrain consisting of well drained, medium textured, stony moraine on slopes ranging between 15% and 30%. Along ridge tops the deposits are shallow with the bedrock close to the surface.

The walls of the Fraser Canyon consist of a coarse textured rubbly colluvial veneer and colluvial fan deposits overlying an extremely steep bedrock escarpment. This colluvium is loose, unstable and subject to slides and erosion.

On the west side of the Fraser Canyon immediately above the escarpment the corridor crosses a hummocky, stony, fluvio-glacial deposit associated with Farrar Creek. The remainder of the segment consists of high ridges of the Camelsfoot Ridge deeply eroded by the watersheds of McKay Creek and Slok Creek. The tops of the ridges consist of well drained stony medium textured moraine over sedimentary bedrock with slopes ranging between 10% and 30%. Along ridge crests the bedrock may be very close to the surface and occasionally exposed. The more steeply sloping sides of the creeks are stony colluvial veneer deposits over bedrock. The bedrock may be exposed and some rock fall is associated with these exposures.

The Fraser Canyon on both sides of the river is an area of high hazard and potential impact due to the extreme slopes and loose colluvial surface. Active slides and erosion occur frequently throughout the area and any construction activity is very likely to trigger significant slope failures. Above the canyon on the plateau areas on both sides of the Fraser River canyon low impacts can be expected due to the nature of the surface deposits and the moderate terrain. A high hazard area

associated with upper McKay Creek is subject to slope failure however this area could be easily avoided.

Camelsfoot North (CE)

On the east side of the Fraser River this corridor segment descends 1220 meters and consists almost entirely of a loose rubbly colluvial veneer overlying a sedimentary bedrock escarpment with slopes between 30% and 60%. At lower elevations dissected fluvioglacial terrace deposits of loose, stony sands and gravels occur. Both the colluvial and glacial fluvial deposits are subject to slides and gully erosion.

The west wall of the Fraser Canyon consists of a stony colluvial veneer overlying a steep bedrock escarpment. At the base of the escarpment the colluvium has formed an apron of coalescing fans at slopes ranging between 15% and 30%. This apron has a veneer of highly erodable aeolian loam overlying the colluvium and is characterized by numerous erosion gullies.

Immediately above the canyon the corridor crosses a wide near level plateau consisting of a stony, medium textured till overlying a basalt flow bedrock. This basalt is eroding along the eastern edge and debris slides extend down the sides of the Fraser Canyon.

The remainder of this segment corridor consists of a series of ridges dissected by deep creek channels. The ridge tops are stony, medium textured till overlying bedrock which is exposed or close to the surface along the ridge crests. The sides of the creek channels consist of stony colluvium and morainal deposits overlying bedrock which may be exposed on extremely steep slopes.

Both sides of the Fraser River canyon represent a high terrain hazard due to the loose, unstable nature of the colluvial and fluvioglacial deposits. Slides and erosion features are numerous on both sides of the canyon and any construction activity will greatly increase the chance of slope failures.

On the west side of the Fraser above the river canyon low impacts can be expected over most of the corridor due to the moderate slopes and stable surficial deposits.

Pavilion-Fountain (DF)

The corridor between D and F follows the Fraser River except where it crosses Fountain Ridge to avoid a large bend in the Fraser River.

The Fraser Valley between Pavilion and Fountain Ridge is characterized by gently sloping (5% to 10%) elevated fluvioglacial terraces. Over most of these terraces is a surface veneer of aeolian loam which is very easily eroded and often characterized by erosion gullies. Lacustrine silts and bedded sands also occur in the surface veneer of the terraces. The underlying fluvioglacial deposits are rapidly drained and exceedingly stony. These terraces are dissected by creek channels draining the west side of the Clear Range. The terrace scarp is extremely sloping, gullied colluvium with isolated bedrock exposures at river level.

Above the terraces are the toe slopes of the Clear Range consisting of rapidly drained, stony, medium textured, morainal deposits overlaid by a stony colluvial veneer of till origin. The weakly structured sedimentary bedrock may be exposed on very steep slopes. Large slide deposits occur between Gibbs

and Fountain Creeks and consist of deeply eroded, stony clay, and sand debris.

Fountain Ridge is an extremely steep, bedrock controlled formation with surficial deposits of bouldery, coarse textured colluvium of till origin. Surficial deposits are shallow and exposed bedrock is evident at the crest of the ridge. Talus and some rock falls are evident on both sides of the ridge. Where the corridor crosses the Fraser River just south of the Bridge River confluence there is a narrow fluvioglacial terrace, as previously described, on both sides of the Fraser River.

On the west side of the Fraser River the elevated, fluvioglacial terraces differ from those previously described in that the deep creek channels dissecting the terraces on the east are generally absent.

The valley sides above the terraces on the west side are extremely steep, bedrock controlled formations with surficial deposits of stony, coarse textured colluvium of till origin. Deep creek gullies show evidence of minor slope failures and slides.

To the southwest of Lillooet, at the base of the steeply sloping valley sides colluvial and fluvial apron deposits of stony gravels occur.

Most of this segment runs through landforms susceptible to moderate impacts. These landforms are the fluvioglacial terraces associated with the Fraser River and the colluvial-fluvial apron deposits which occur between the terraces and the steep valley sides. Road construction that disrupts drainage and vegetative cover could result in serious erosion. Avoid-

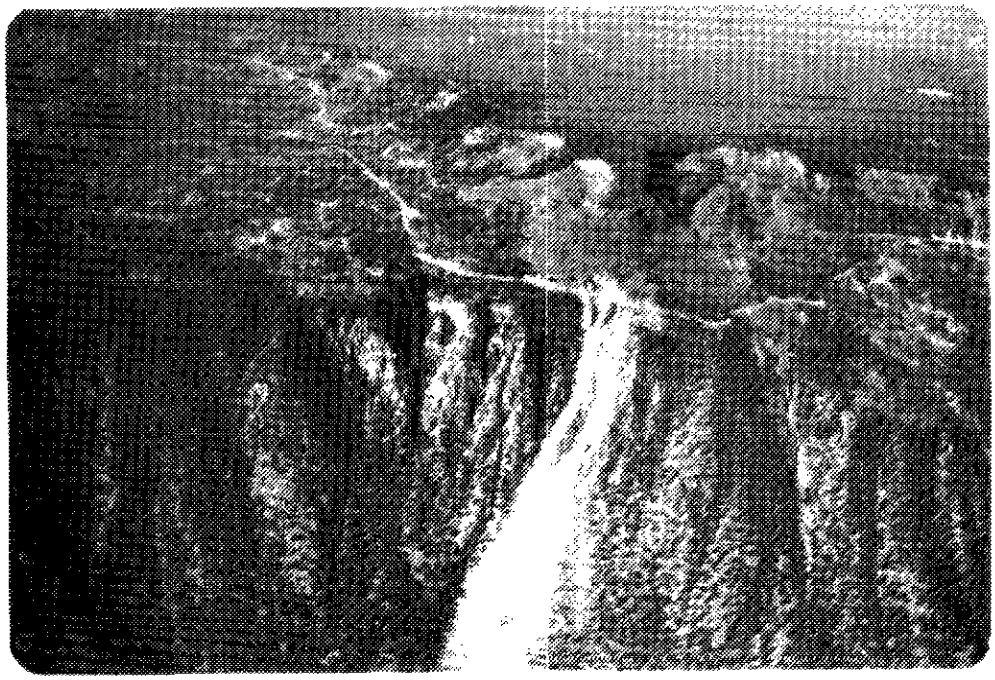


PHOTO 1. Slide path on the west side of the Fraser River crossing on the northern Camelsfoot option (segment CE).

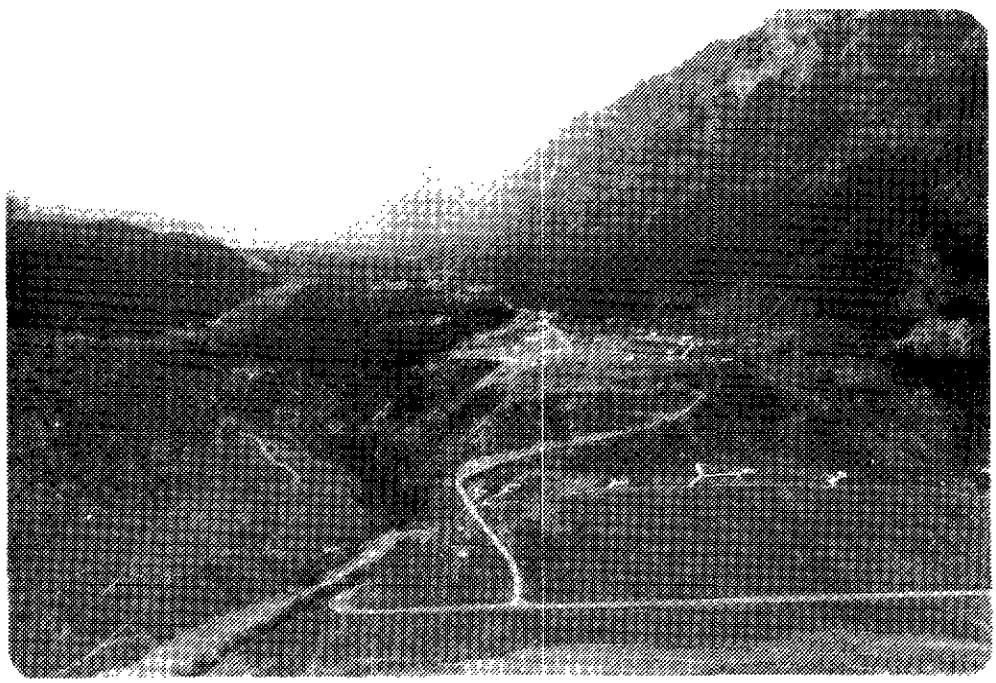


PHOTO 2. Fountain Indian Reserve looking east up Fountain Creek. Option DF would cross farmlands on benches in foreground.

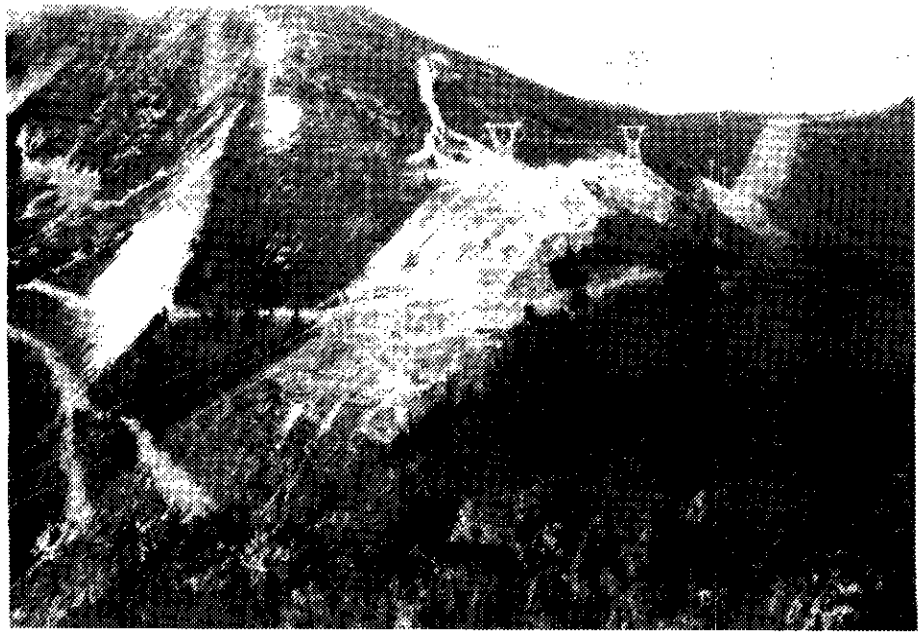


PHOTO 3 .Mission Ridge. Note extensive scarring of landscape from earlier construction. Revegetation difficult on steep subalpine slopes. Location of 5L46 adjacent to right of way reduces need for new access road.

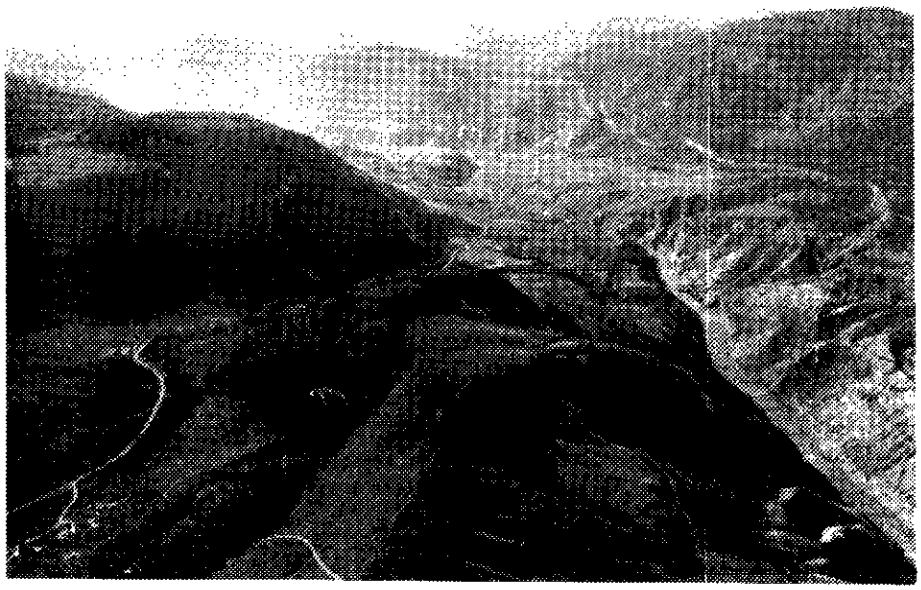


PHOTO 4 .Fraser canyon looking south over Pavilion; preferred crossing would parallel existing lines, crossing river mid-right of photo.

PHOTO 5 .Fraser crossing on northern Camelsfoot option (segment CE). Note gullied and eroding terrain

ance of highly erodable landforms by careful route selection and expeditious revegetation would lessen impacts considerably. The loose nature of these deposits may also result in slope failures in road cutbanks, and reduction in slope and reseeding should be undertaken.

The high impact and hazard landforms are the steep slopes of the fluvioglacial terrace scarps and creek channels. Any disturbance of the scarp face will lead to increased erosion. The bedrock controlled valley sides exhibit generally unstable surficial deposits and rock falls, loose talus and rock slides are common occurrences. The steepness of the topography and rapid down-slope drainage will greatly increase the slides and erosion if the surface is disrupted by road construction or the vegetation removed.

Some special hazards are noteworthy in this area. The Pavilion landslide is still active and slow movement has been detected between the deposit area and the source area. The downward movement makes these clay shale deposits unsuitable for any permanent structures.

The Gibbs Creek mud slide is of significance because the creek sides are still unstable and because similar preslide conditions exist at Sallus and Keatley Creeks representing a potential downstream hazard. It should also be noted that the same weak Tertiary clay shales of the Pavilion slide are found in the upper drainages of Sallus, Keatley and Gibbs Creeks.

Pavilion-Mission Ridge (DG)

This segment runs between Pavilion (D) and the northeast flank of Mission Ridge (G). The terrain between the Fraser River at

D and Bridge River consists of bedrock underlying a stony, medium textured morainal deposit. On deeply eroded creek and river sides exposed rock is common and stony colluvial deposits of varying thickness occur on the toe slopes.

From Bridge River to G the morainal deposits blanket the underlying bedrock to greater depths than between D and Bridge River. Slopes tend to be more moderate at lower altitudes but creek valleys become steeper and the surficial deposits shallower at G.

The highest potential impacts occur primarily between D and Bridge River. Impacts will be greatest on the steep river valley sides of the Fraser and Bridge Rivers and the very steep creek valley slopes draining into those rivers. Any access road construction and clearing of vegetation will aggravate the existing slide and erosion hazards. Over the remainder of this area moderate impacts can be expected where disturbance of the surficial deposits could result in minor slides and erosion.

Between Bridge River and G low terrain impacts are expected from line construction and maintenance except for a steep unstable area of Moon Creek where high impacts can be expected.

Applespring Creek (EHI)

This segment follows Applespring Creek in crossing the Camelsfoot Range. The terrain in the vicinity of E consists of stony, coarse textured morainal deposits over bedrock. Exposed rock knolls are common along ridge tops. Slopes range from 20% to 35% in valley bottoms and increase to greater than 55% on upper slopes.

Applespring Creek valley cuts across several parallel mountain ridges. These ridges consist of colluvial and morainal deposits over bedrock which is close to the surface or exposed over much of the valley. These exposed bedrock areas appear to be the result, in part, of tectonic faulting and are exfoliating and producing extensive talus deposits.

At the crossing of the Bridge River there is a deep gravelly fluvial deposit overlain by a silty, sandy, surface deposit on the east bank. This deposit is terraced and is eroding at some locations.

The west bank has an extremely steep rock face with a thin colluvial veneer over some of the surface. This cliff rises 750 metres above the river at near vertical slopes. From the top of this cliff extending west to I is a gently rolling deep, coarse textured morainal blanket with some rocky ridges lying parallel to the Bridge River. Slopes range between 15% and 20%.

The main area of high potential impacts lies in Applespring Creek Valley where an extensive fault area of exposed bedrock appears to be eroding rapidly. Associated with this are numerous talus and colluvial deposits, some of which show evidence of sliding. Construction activity will increase the slide potential and vegetation removal will lend further erosion of surficial colluvial deposits. The remainder of Applespring Creek is subject to medium impacts due to potential slides and surface erosion. The high cliff on the Bridge River can be avoided and west of Bridge River to I potential impacts are rated low.

Antoine Creek (EI)

This segment follows Antoine Creek in crossing the Camelsfoot Range and is very similar to segment EHI.

Antoine Creek cuts across a series of parallel mountain ridges. These ridges are steep sided and consist of colluvial and morainal deposits over bedrock which is close to the surface or exposed on most ridges. A high, near vertical, exposure of bedrock cutting across the valley is the result, in part of tectonic faulting and is exfoliating and producing extensive talus deposits.

On the east side of Bridge River an elevated fluvioglacial terrace composed of well drained, deep gravelly sandy deposits occurs. The terrace scarp is very steep and actively eroding.

The west of Bridge River valley is composed of morainal veneer over bedrock with 45% to 55% slopes and shows evidence of active, minor slides. South of the Bridge River is a wide moderately sloped upland, crested by a low ridge which extends almost to I. Surficial deposits are composed of stony, coarse textured moraine overlying bedrock and are moderately well to imperfectly drained.

In the vicinity of I the terrain becomes steeper and there is evidence of colluvial action indicating some instability in the surficial deposits.

The main area of high potential impact lies in Antoine Creek Valley where the exposed bedrock of the major fault area appears to be eroding rapidly. Associated with this area are numerous colluvial and talus deposits and some evidence of debris slides. Construction of roads and towers may trigger

further slide activity. The terrace scarp of the fluvioglacial deposits beside the Bridge River are also a high potential hazard as the river is continuously undercutting the scarp causing slope failures.

The remainder of Antoine Creek Valley is subject to medium impacts from road construction due to a potential slide hazard.

South of Bridge River low impacts can be expected.

Mission Ridge S North (GI)

Most of this corridor segment is composed of well drained, stony morainal deposits overlying bedrock. Topography is excessive in the vicinity of G but moderates to 15% to 30% thereafter. Towards I the corridor crosses the end of an abrupt, steep sided ridge which runs roughly parallel to most of this segment. This ridge consists of stony colluvial veneer deposits over bedrock which is exposed or very close to the surface over much of it's length.

Low potential impacts occur over much of this route, but moderate impacts such as rock fall may result from access road construction over the ridge.

Mission Ridge South (GJ)

This corridor runs parallel to Mission Ridge on the north side. For approximately the first 3 km west of G the corridor transects an extremely steeply sloping colluvial veneer deposits overlying bedrock. The surficial deposits are unstable and numerous slides are evident in this area. The

remainder of this segment consists of stony morainal deposits overlying moderately sloping bedrock ridges. These surficial deposits are stable and there is no evidence of debris slides or erosion.

The first 3 km portion of this segment is a high hazard area as indicated by the debris slides. (One of which may stem from previous transmission line activity.) Low potential impacts exist over the remainder of this segment.

Bridge Valley (IK)

With the exception of Mission Pass and a small area around I this segment is characterized by extremely steep, exposed bedrock mountain sides with bouldery, stony colluvial fluvial aprons on the toe slopes. Talus deposits and rock slides are common throughout. The Bridge River valley floor is very narrow and fluvial deposits associated with the river are shallow and stony.

In the vicinity of I the bedrock has an overlying stony, sandy morainal deposit on 40% to 50% slopes and appears to be stable. However, where the bedrock is exposed and the slopes exceed 55% talus and slides are evident.

Mission Pass is a deep "V" shaped valley with creeks draining into Carpenter Lake. Surficial deposits are stony, sandy moraine on 35% to 45% slopes. The bedrock is close to the surface and is occasionally exposed.

Potential impacts along most of this segment are rated high due to existing erosion and evidence of unstable surficial deposits throughout with the exception of Mission Pass and the vicinity of I. Active rock slides occur frequently in the Bridge River canyon and rock fall is common throughout. Vegetation removal and access road construction will further increase the instability of these deposits and erosion and rock slides will result.

In Mission Pass previous construction activity and logging has resulted in minor surface soil erosion. This erosion could be alleviated through revegetating disturbed areas and cutbanks.

Mission Ridge West (IJ)

This segment is in an area of deep, well drained, stony, sandy moraine overlying bedrock. The slope over most of the area ranges between 35% and 45%. Exposed bedrock, talus deposits, shallower morainal deposits and steeper slopes are associated with the ridge tops.

Moderate to high potential impacts are associated with the shallow, erodible surficial deposits of the ridge tops and increased instability in talus deposits and rock falls can be expected if they are disturbed by construction activity.

Mission Pass East and West (JKL)

Most of this segment involves crossing Mission Ridge which is a very steep, bedrock dominated landform with exposed bedrock at the highest elevations and surficial deposit composed of stony, sandy moraine and colluvium over bedrock on the lower slopes.

Rock slides, talus and avalanches occur on some slopes in the area surrounding the corridor however the selected corridor shows little evidence of serious hazards.

In the vicinity of K the surficial deposits are predominantly stony, sandy moraine over bedrock. The topography is less steep and the surficial deposits appear to be stable.

Between K and L at Whitecap Creek the corridor segment consists of a gravelly, sandy fluvioglacial terrace. This deposit is generally very deep however intermittent bedrock ridges are located between drainage gullies and most of the surficial deposit is deeply eroded towards Seton Lake.

High potential impacts and existing hazards occur at the highest elevations of Mission Ridge just west of J. Vertical rock faces, talus deposits and very steep slopes are subject to increased slide and colluvial action when disturbed. The location of the proposed corridor to the north of this area as indicated by the location of J avoids the high impact area.

Moderate potential impacts occur on the remainder of this area due to the steepness of the terrain features and shallow, loose surficial deposits which are susceptible to erosion on disturbance.

Seton Lake (FL)

The substation at F is located on a fluvial deposit composed of bouldery, sandy gravel that is generally level, well drained and stable.

The south side of Seton Lake is formed by an extremely steep bedrock formation with a shallow colluvial deposit covering most of the surface. Slide paths and avalanche tracks are common and there is evidence of previous, massive slope failures.

Between Seton Lake and L at Seton Portage is a deep stony sandy morainal deposit on slopes of 35% to 40%. These deposits are well drained and appear to be stable.

At F there is a potential major slide area on the north valley side overlooking Seton Canal. A massive slope failure would spread debris across the valley floor.

The south side of Seton Lake represents a high natural hazard. There is evidence of active slides and massive slope failures along this side of the lake. Any disturbance to the vegetation or surficial deposits will greatly increase the risk of slope failure.

The impacts on the area between Seton Lake and L should be moderate with surficial erosion due to access road construction the main concern.

SETON LAKE TO PEMBERTON

Cayoosh Creek (FM)

Aerial photographs covering this corridor section were not made available for this study and the assessment of this segment was made on the basis of an overview flight and by driving the road which runs the length of the corridor.

From F to Duffey Lake the Cayoosh Valley floor is extremely narrow and the valley sides extremely steep.

From F to Mt. Rohr the dominant terrain type consists of shallow, stony morainal deposits over bedrock which is often exposed at the surface. Avalanche tracks, talus slopes, landslides and rockfalls are common features of the upper elevations of the valley sides and often extend to the valley floor. Intermittent pockets of deep, stony, coarse textured fluvioglacial deposits and stony, moderately coarse textured morainal deposits occur throughout this corridor segment and are most extensive where the valley bottom widens particularly south of the Gott Creek and in the vicinity of Duffey Lake. At the southwest end of Duffey Lake the valley bottom is wide and deep, stratified, fluvioglacial deposits are mixed with stony, coarse textured moraine. A fairly extensive wetland with deep organic deposits occurs approximately 8 kilometers west of Duffey Lake.

The avalanche tracks are generally associated with narrow drainage channels arising in the exposed bedrock of the mountain peaks. These channels are often separated by bedrock ridges. As these channels descend to the valley floor they widen and the alluvial fans formed at their base often coalesce to form a deep, excessively bouldery apron bordering the valley floor. This is a very common terrain feature along most of the Cayoosh Creek Valley including the shores of Duffey Lake.

The Joffre Creek portion of this segment has steeply sloping valley sides, mantled by deep, excessively bouldery and coarse textured morainal deposits with intermittent bedrock outcrops which become more common ascending the valley walls.

At the lower end of Joffre Creek the corridor turns sharply west and descends an extreme steep, unstable mountain face which has been deeply eroded by slides and rock fall.

Most of this corridor segment involves high terrain hazards associated with avalanching, rockfalls and debris slides. Potential impacts are high throughout this corridor because vegetation removal and access road construction would result in increased erosion and slide activity.

Anderson Lake (LM)

The Village of Seton Portage is located on a narrow floodplain deposit much of which has been encroached upon by coalescing fluvial fans on both sides.

From Seton Portage to D'Arcy the corridor follows the western side of Anderson Lake. There are two dominant terrain features of this valley side; the bedrock dominated upper slopes which are overlain by a thin veneer of colluvium over much of the surface area with slopes usually exceeding 55% with avalanche tracks, talus slopes, rock falls, and rock slides as common features; and a deep fluvial-colluvial apron deposited on the lower slopes extending to the lake. These deposits are well drained, stony, gravelly sandy deposits on slopes averaging between 30% and 40%. They are deeply dissected by creek gullies extending into Anderson Lake and are slightly terraced with a steep scarp at the lake shore.

Between D'Arcy and Creekside, the Birkenhead River valley is a typical glaciated "U" shaped valley with extremely steep, bedrock dominated sides which may be overlain by shallow colluvial deposits. These steep valley walls are broken by

major side valleys which are steep sided but have a deeper surface deposit of moraine on the lower slopes and valley floor. These side valleys are associated with Spetch Creek, Birkenhead River north of Gramson Place Creek, Blackwater Creek and Halymore Creek.

The second feature of this section of the corridor is the deep colluvial-fluvial apron which occurs along much of the lower slopes of the valley on both sides and in places extends completely across the valley. Fluvial fans associated with major creeks are included in this apron. The deposits are deep, well drained, loose, bouldery, gravelly sandy deposits with slopes ranging from 20% to 35% or more.

The third feature of this section is the valley floor which is associated with floodplain deposits of the Birkenhead and Gates Rivers. Nowhere are the deposits very wide or deep and they consist of pervious stony, gravelly sand with slopes usually less than 10%. In places the water table is perched close to the surface by underlying bedrock and drainage is impeded resulting in the formation of some organic deposits. The most significant area of poor drainage and organic soils occurs between Gates and Devine.

Along the entire length of this segment most of the upper sides of the valley from L to M are classed as high hazard and high potential impact areas. Characteristic of these valley sides is a continuous series of avalanche tracks, rock slides, talus slopes and narrow creek gullies subject to flash floods and debris flows.

Of particular importance is the slide hazard off the mountain south of Gates Lake. The unfavourable orientation of the rock in this mountain has already resulted in major sliding and there is further potential for a major massive failure.

PHOTO 6 . Anderson Lake looking northeast; north side of lake presently utilized by four transmission lines; south side of lake is very steep, therefore unsuitable for transmission lines.

PHOTO 7 . Duffey Lake along the Cayoosh Creek corridor. Steep slopes, avalanche chutes are characteristic of area; key wildlife habitat on lower south-facing slopes. No transmission lines are located along the corridor, although some logging has occured.

On the west side of Anderson Lake, McGillivray and Connel Creeks represent a high risk at lake level due to flash floods and debris flows which are funnelled by the steep sides of the creek channel. Similar conditios to these exist on the north side of Gates Lake.

The entire east side of Anderson Lake from Lost Valley Creek to Wade Creek is very unstable and a massive rock slide into Anderson Lake could occur. For this reason any development on the west side should be kept a reasonable height (30 metres) above the lake level to avoid possible damage from wave run-up.

Moderate potential impacts occur on the colluvial-fluvial aprons associated with the lower valley sides. When disturbed these loose, coarse textured deposits are subject to erosion and minor slides on steeper sites. Vegetation removal and access road construction could result in substantial surface erosion and expeditious reclamation is recommended.

The organic deposits associated with the floodplain deposits of Birkenhead and Gates Rivers are subject to high potential impacts on disturbance due to the compactability of the organic deposits and disruption of the moisture regime. Most of these deposits can be avoided in this corridor segment.

PEMBERTON TO CHEEKYE

Pemberton Options (MaN, MbN, McN)

This corridor segment runs from Creekside (M) on the Birkenhead River to the Soo River confluence (N) passing directly over the Pemberton Valley.

Between Creekside and Lillooet River the corridor consists of deep, sandy morainal deposits overlying bedrock ridges. Along the north wall of the Pemberton Valley the bedrock slopes steeply to the Pemberton Valley floor and there is evidence of rock fall and talus on these slopes.

The Lillooet River floodplain in the vicinity of MaN and McN is level to slightly depressional and consists of poorly drained silts and sands with an overlying organic deposit in depressional areas. Segment MbN includes the Lillooet River floodplain deposits previously described and also consists of well drained sandy and gravelly fluvial deposits associated with One Mile Creek.

The Green River valley between Pemberton and the Soo River confluence is characterized by steep bedrock controlled side walls which are primarily exposed with colluvium collecting in depressions and along toe slopes. Drainage is generally rapid and slopes range from 30% to 60%. Large exposed talus deposits, avalanches, and rock slides are a common feature of the bedrock formations of this segment.

The valley floor is narrow and characterized by deep, stony fluvial deposits associated with Green and Soo rivers and Rutherford Creek. Lesser alluvial fan deposits are associated with the various other creeks draining the valley walls.

The fluvial deposits are rapidly drained but infiltration may be restricted due to the proximity of the bedrock. They are also subject to extensive erosion when the creeks and rivers are in full flood.

A special feature of this area is the Nairn Falls slide which consist of loose, rubbly debris deposited across the valley bottom. Most of these slumped deposits are stable however where slopes exceeds 30% they are subject to failures and erosion.

The entire east side of the Green River Valley in the vicinity of Mount Currie is a high hazard area and numerous avalanches and rock slides occur along the mountain side. Especially hazardous are the overlapping rock slides opposite the confluence of the Soo River which show evidence of continuous downward movement. There is also potential for further massive slope failures which would result in debris sweeping across the valley.

Another high hazard area is the extremely steep bedrock terrain associated with segment M-a-N on the west side of the Green River, which is subject to rock fall, and debris slides.

The recent flood in Rutherford Creek resulted in major erosion of the fluvial deposits at the confluence with the Green River and damaged the existing transmission line indicating a potentially high hazard associated with these types of deposits in the immediate proximity of the rivers and creeks.

Moderate potential impacts can be expected on fluvial fan, colluvial and slide deposits on the valley floor where access road construction may result in slope failures and erosion.

The floodplain of the Lillooet River is generally subject to low potential impacts however organic deposits are high potential impact areas and should be avoided in the area where minor route alignment changes should make this possible.

Whistler (NS)

This segment of the corridor lies between the Soo River confluence (N) and McGuire (S) on the Cheakamus River.

From N to the north end of Green Lake bedrock controlled landforms predominate in the valley bottom. On valley sides exposed bedrock also predominates with some intermittent areas of shallow, coarse textured moraine or colluvium with slopes ranging between 20 and 40%.

Between Alta Lake and Green Lake there is an extensive organic deposit with an associated high water table. Other valley floor deposits around Alta and Green Lakes are probably stony, debris flow deposits from Fitzsimmons, Nineteen Mile Creek and Sixteen Mile Creek.

Most of the Cheakamus River Valley is dominated by bedrock controlled landforms in which at least half the area is composed of exposed rock and the remainder is covered by coarse textured morainal deposits of varying depths. Small, localized, overlying deposits of fluvial origin consisting of sands and gravels are associated with the Cheakamus River and minor creeks draining the rock dominated upland. Shallow fluvial deposits associated with Millar Creek are poorly drained as the water table is perched on underlying rock.

At the junction of Callaghan Creek with the Cheakamus River there are several deposits of floodplain and fluvial fan material on both sides of the river and creek. These deposits appear to be deep, well drained sands and gravels ranging from level to 10% in slope.

A potentially high hazard area occurs where the Cheakamus River enters the corridor on the east side of the valley where a deeply eroded creek gully and an area of general surface instability subject to rock fall and erosion occurs.

Also between Alta Lake and Green Lake there is an extensive organic deposit in which the water table is at or near the surface. Construction impacts will be high if the organic deposits are disturbed.

From N to Green Lake both the east and west sides of the valley are a complex of large rock and earth slides, numerous talus slopes, avalanche tracks and deeply eroded stream beds. Some of these features extend into or across the valley floor and all represent high hazards to transmission line construction and line construction and maintenance could result in high impacts due to increased erosion.

Other sources of high potential impacts are Fitzsimmons Creek and Twenty-one Mile Creek. Both have steep and actively eroding sides which could, in the instance of a large slide damming the creek, eventually result in a flash flood and debris flow of considerable force descending the creek channels.

Wedge Creek represents a similar hazard to that described for Fitzsimmons and Twenty-one Mile Creeks. However, the possibility of debris flows and flash floods is enhanced by possible massive icefall into Wedge Lake resulting in a wave of water surging downstream (Skermer pers. comm.).

Most of the valley floor has moderate potential impacts associated with colluvial aprons and fluvial fans which will be subject to erosion and slope failure if disturbed for access road construction.

Cheakamus Valley (ST)

Corridor segment ST, follows the Cheakamus River Valley between McGuire (S) and Cheekeye (T) and is approximately 30 km in length.

Between McGuire and the north end of Daisy Lake a widening of the valley floor occurs and coincides with the basaltic lava flows associated with Callaghan Creek Valley. The lava flow bedrock landform is particularly hummocky in this area and small lakes and organic deposits occur in most depressions. The granitic bedrock landforms are mostly bare rock and frequent talus slopes but some areas have shallow morainal and colluvial veneers.

At the north end of Daisy Lake a continuous bouldery talus apron with a slope of 50% or more forms on the west shore and then hooks around the north end of the lake enclosing an area of well drained floodplain and fluvial deposits associated with Brandywine Creek.

On the west side of Daisy Lake lava flows and quartz diorite bedrock with shallow veneers of colluvium are dominant. An area of slightly deeper surficial material occurs near the north end of the lake and appears to represent a depressional area in the bedrock at the edge of the lava flow where it meets the granitic rock. The unconsolidated materials are coarse textured and pervious however the bedrock impedes drainage and most of this area is wet and some organic deposits occur. On the east side of Daisy Lake morainal deposits are generally deeper over the granitic bedrock however rock outcrops and talus deposits are common, usually at higher elevations. The weathered surficials are permeable but the unweathered till is highly compacted and impervious so subsurface drainage is restricted.

Between Rubble Creek and Culliton Creek the floodplain deposits are narrow and all but disappear except for small isolated pockets. The exposed bedrock extends to the creek edge and the narrow aprons of talus lying parallel to the river occur frequently in this area. At Rubble Creek there is a wide fan extending across the valley created by massive rock and debris flows associated with the Barrier at the head of Rubble Creek and were deposited at various times, the last being about 130 years ago. These deposits consist of poorly sorted cobbles and boulders. Some areas in the centre of the slide have only a thin cobbly layer over existing morainal materials. Slopes range from 5% to 20% elsewhere on the deposit. Permeability is high through the flow deposits although underlying layers may be less pervious.

Where Culliton Creek enters the Cheakamus there is a small fan of bouldery, sandy gravelly deposits with slopes ranging from 20% to 30%.

The Cheakamus River Valley has the typical "U" shape of a glacially formed valley and differs from the Squamish River Valley in that it has a very limited floodplain. The valley walls rise to mountains on both the east and west sides.

The Cheakamus Valley floor and valley sides are dominated by exposed quartz diorite bedrock. Minor deposits of colluvium collects in cracks and depressions but represents a very small percentage of the landform. Thicker deposits of compact sandy moraine occur in some side valleys, however bedrock control remains a dominant feature. On steeper slopes talus aprons occur characterised by very large boulders.

The valley floor between Cheekye and Culliton Creeks is a narrow floodplain of very permeable sandy gravels with slopes usually less than 5%. Despite the permeability of these deposits, subsurface drainage is restricted by the high water table associated with the Cheakamus River.

Another feature of the valley floor is an almost continuous apron of colluvium which occurs at the base of the steep bedrock dominated valley sides and the floodplain. This colluvium consists of rubble and very large rocks on slopes ranging from 30% to 50%.

There are three areas of potentially high hazard in this segment. Although no direct impacts on these areas will result from transmission lines construction, the destructive potential of all three is considerable.

A high potential hazard occurs at Cheekye where mud flows could originate from a large area in the upper watershed of the Cheekye River. Mud flows surging down the river bed could represent a hazard to the substation located on the Cheekye fan. The magnitude of the mud flows and possible triggering mechanisms have been studied by the Ministry of Environment (Woods; P.J. Memorandum 1976).

High potential hazards also occur at Culliton Creek and Rubble Creek where earth and rock flows could result from massive collapses of unconsolidated materials into the drainage channels. The Rubble Creek hazard has been studied in detail by the B.C. Ministry of Highways (1978). The hazardous area at Culliton Creek has no previous history of massive earth flows however conditions in the upper watershed of Culliton Creek are similar to those of the Barrier on Rubble Creek and represent a similar risk. Early in 1981 a period of high precipitation

resulted in major flooding of Culliton Creek. This resulted in a complete washout of the highway and a major rechanneling through much of the alluvial fan at the creek confluence with the Cheakamus River. Although there was no damage to the existing transmission lines, future flooding could threaten the security of any new lines.

Moderate potential impacts exists mainly on alluvial creek fans which are generally unstable and when disturbed by construction or the removal of vegetation can be expected to erode. These fans occur at various locations along this segment.

In other areas moderate potential impacts occur where minor slope failures and erosion can be expected on cutbanks and road surfaces.

SQUAMISH VALLEY ALTERNATIVES

No terrain or soils data exist for these segments and aerial photographs were not made available for this study. The following description and impact assessment was compiled on the basis of an overview helicopter flight without the benefit of any site information.

Soo Valley (NO)

Corridor segment NO encompasses the lower portion of the Soo Valley. The entrance to the Soo River valley near the confluence with Green River is a restricted passage between high bedrock ridges which comprise the sidewalls of the Green River Valley. In the vicinity of the valley entrance and a few kilometers to the west the valley sidewalls are extremely steeply

sloping and are composed dominantly of exposed bedrock with extensive talus slopes composed of extremely large boulders.

Continuing west the gully becomes "U" shaped, the typical form of deep glaciated valleys. The toe slopes are composed of deep bouldery and stony, coarse textured, compacted glacial till overlain by a veneer of loose, bouldery and stony till. The toe slopes are generally less than 30% increasing to between 40% and 60% up-slope. The deep blankets of glacial till progressively thin out up-slope and the surficial materials appear to be more colluvial in nature with a higher component of coarse, angular bedrock fragments. Intermittent bedrock ridges extend into the valley bottoms and talus slopes are common along both valley sides. In the upper part of this segment towards N the meandering stream cuts through wetlands comprised of deep organic deposits. These wetlands are interspersed with fluvial deposits laid down by the meandering streams. In places the talus material and rockfall debris extends onto the perimeter of the wetlands.

High potential impacts are associated with the extensive talus deposits and rock slides which are common among the extensive bedrock outcrops of the valley sides. Similarly the wetland units are subject to high impacts if disturbed by construction activity. However, it appears that it would be possible to avoid the wetland areas as well as deposits of unstable fluvial and talus material by establishing the line on the north side utilizing the bedrock outcroppings and ridges which extend into the valley floor.

Callaghan Creek (OS)

This corridor segment extends from the middle reaches of the Soo River through the vicinity of Callaghan Falls to the confluence of Callaghan Creek with the Cheakamus River near McGuire. Between the Soo River and Callaghan Falls the corridor follows a deep V-shaped valley with extremely steep side slopes composed dominantly of exposed bedrock and talus boulders. Surficial deposits are extremely shallow and appear to be dominantly colluvium with a high component of angular bedrock fragments. From the vicinity of the falls south to McGuire the surficial materials are deeper and are dominantly bouldery, coarse textured glacial till with intermittent bedrock ridges and outcroppings. Many steep gullies have been cut into the surficial material by small tributary streams.

Moderate to high impacts occur throughout this corridor segment associated with the erodible, steeply sloping surficial deposits and the talus and rock slides which present a high hazard. Most of the high hazards and potential impacts could be avoided by careful placement of transmission towers.

Mt. Callaghan North and South (OPR and OQR)

These corridor segments extend from the middle reaches of the Soo River around Mt. Callaghan, to the south and north respectively, into the upper reaches of the Squamish River. The largest portion of these segments lies within the alpine environment in an actively glaciated or very recently glaciated environment. Extensive talus slopes, bedrock outcrops and large boulder fields are common throughout as are small intermittent glacial lakes fed by glaciers which lie at higher elevations along both of the alternatives.

The exceptionally rugged terrain and recent deposition of the surficial material along these corridor segments indicates potentially high impacts could be expected from transmission line construction and maintenance in this area. Avoidance of hazardous areas would be extremely difficult and mitigation of impacts very difficult and expensive.

Squamish Valley (RT)

This corridor segment extends from the upper reaches of the Squamish River south to Cheekye. Aerial photographs and reconnaissance level terrain information were available for the lower half of this segment only. The upper reaches of the Squamish River were flown by helicopter and no site information was gathered for this portion of the corridor segment. In the vicinity of R the terrain is very similar to that described in the Callaghan Mountain segments and similar impacts could be expected.

Proceeding south in the vicinity of the headwaters of the Squamish River the valley sides are steeply sloping and deeply incised by erosional gullying of tributary streams. Surficial materials are deep, bouldery, coarse textured glacial till with areas of intermittent bedrock outcrop and talus slopes. From the headwater area south to High Falls Creek the Squamish River floodplain is relatively narrow (.5 kilometers) and consists primarily of recent fluvial bars and islands within the river channel; bedrock outcrops and talus slopes extend to the edge of the narrow floodplain.

From High Falls Creek south to Cheekye the valley floor consists of a wide, level floodplain through which the river meanders. The valley rises abruptly and very steeply on both

the east and west sides. The floodplain consists of very permeable sands and gravels but subsurface drainage is restricted and a high water table occurs throughout.

Common features of the Squamish River floodplain are pointbar deposits, active side channels, ox-bows or sloughs, and organic wetlands. The organic soil deposits are deep fens with a water table at or near the surface. They occur primarily between Cheekye and Pilchuck Creek.

Where major creeks emanate from the steep valley sides large fluvial fans form and encroach upon the floodplain. These fans consist of angular stone fragments and sub-rounded gravel deposits and have slopes ranging from 15% to 35%. Major fan deposits occur at Lovely Water Creek and at an unnamed Creek draining the north face of Alpha Mountain.

The valley sides are predominantly steep slopes usually in excess of 50% and are composed of quartz diorite bedrock at the surface with intermittent, unconsolidated materials consisting of stony colluvium and talus aprons with large boulders up to 2 or 3 meters.

Common hazards throughout the valley sides are the deeply incised creek gullies, avalanche tracks and rock slides.

Many high hazard areas occur along this corridor segment, primarily on the steep valley wall and particularly at higher elevations. Lower slopes appear to be more stable, however, the presence of extensive talus slopes indicates potentially hazardous conditions. Any disturbance due to construction on the lower slopes could lead to slope failure and rock falls as well as surficial erosion, particularly across the tributary creek fans.

The floodplain deposits are stable and the main hazard is seasonal flooding. High potential impacts are associated with the organic deposits that occur in depressional areas and moderate potential impacts are associated with the fluvial fan and apron deposits that extend onto the valley floor and which are susceptible to surface erosion and slumping if disturbed.

A period of high rainfall early in 1981 caused widespread flooding throughout the Squamish River floodplain. This flooding led to extensive damage to vegetation and most creek fans were deeply scarred; large portions were completely washed out.

ACCESS

The degree to which access road construction results in impacts on terrain depends on the availability of existing access, and the ease with which new roads can be constructed in areas that are not presently accessible. Many of the corridor segments reviewed in this study do not require further road access as they follow other transmission lines (along Anderson Lake for example). In other areas, linear road access may exist, but the nature of adjacent terrain may prohibit construction of access to the actual tower locations, such as in the Cayoosh Creek canyon.

Table 4.1 is a summary of those corridor segments where access road construction would include significant terrain disturbance, noting that only part of the segment or particular terrain feature may be subject to impact.

TABLE 4.1
TERRAIN DISTURBANCE
SEGMENTS WHERE SIGNIFICANT TERRAIN DISTURBANCE WOULD OCCUR FROM CONSTRUCTION OF ACCESS ROADS

SEGMENT	DESCRIPTION
AC	- blasting of bedrock required for road construction; may increase potential for rock falls on steeper slopes.
CE and BE	- Fraser River crossings: although there is some existing access, further disturbance of loose surface deposits on steep topography increases potential for slope failures on both sides of cut banks.
DF	- road construction across Fountain Ridge; loose surficial deposits on steep slopes; also disruption of drainage patterns could cause serious erosion. - Fraser River crossing not as difficult as CE or BE, however terrace bank on east side of river consists of unstable surficial material subject to erosion.
DG	- most of route has access as it follows existing transmission lines; Fraser River crossing similar to CE and BE, but slopes are not as steep; road construction on west side of Fraser must cross incised creek gullies subject to erosion and some debris slides.

TABLE 4.1 (Continued)

SEGMENT	DESCRIPTION
EI (Antoine Creek)	- crossing of fault zone consisting of shattered bedrock and unstable surface materials increases potential for continuous slides resulting from road continuous slides resulting from road construction.
EHI (Applespring Creek)	- similar to Antoine Creek (fault zone encountered); west bank of Bridge River is extremely steep, consisting of shallow deposits. Road construction would require some blasting which could result in rock falls.
IK (Bridge River Canyon)	- active rock slides and faulted rock structure exist throughout canyon. There is existing access for most of distance, but new access may be required depending on tower location.
GJ (Mission Ridge)	- new road construction has potential for increasing slope failure along Mission Ridge.
FL (Seton Lake)	- fractured bedrock, extreme slopes along south side of lake; disturbance of surface would cause severe slope failures.
FM (Cayoosh Creek)	- at the east end of valley near Seton Lake are very deep morainal deposits on

TABLE 4.1 (Continued)

SEGMENT	DESCRIPTION
	steep slopes - these are subject to rapid erosion and sliding, especially where road cuts into sidehill. Between Seton Lake and Duffey Lake, the existing road has caused rock fall and slope failure; any new access would increase potential for these impacts.
	- impacts between Joffre Creek and Creekside would be moderate if route follows top of bench; one area of concern is in vicinity of Spetch Creek where steep slopes, adverse bedrock formation would be subject to slides if a road was constructed.
NOS, OPR and OQE (upper Soo/ Callaghan Valleys)	- in higher elevations, thin surficial deposits and lots of talus occur; road construction in talus would create potential for continuous slides.
RT (Squamish Valley)	- creek fans and some steep colluvial deposits other than talus are subject to erosion, bank failures and disrupted drainage. Existing road access is subject to washouts; potential for increased erosion with road construction.

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CHAPTER 5

FORESTRY AND VEGETATION

The study area encompasses seven biogeoclimatic zones[1] between Kelly Lake and Cheekye: the Coastal western hemlock zone, the Mountain hemlock zone, the Interior Douglas fir zone, the Montane spruce zone, the Engelmann spruce - subalpine fir zone, the Ponderosa pine - bunchgrass zone and the Alpine tundra zone. The first part of this chapter presents an overview of vegetation, forest capability and forestry use for each of the three subregions of the study area. Since most of the area is forest vegetation (with the exception of alpine areas and some disturbed and settled areas in the lower elevations) it seems logical to treat forestry and vegetation in a complementary overview.

Impacts on vegetation are covered in a very general way, as a more detailed evaluation of potential impacts would require extensive field work as well as prior knowledge of the actual alignment of the transmission line in each corridor. The time and budget constraints of this study did not permit either;

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[1]Biogeoclimatic zones, as used in this report, follow the current B.C. Ministry of Forests Research Division's classification.

hence impacts on vegetation are discussed in terms of the biogeoclimatic zones, their sensitivity to disturbance and length of recovery time after disturbance. Discussion of the vegetation/forestry resource by biogeoclimatic zones and subzones is deemed appropriate for the level of detail required for a Stage 1 study and for the mapping scale used (1:125,000). Potential forestry impacts are discussed at the end of the chapter.

KELLY LAKE TO SETON LAKE

Natural Vegetation

Five interior biogeoclimatic zones occur in this region: the Ponderosa pine - bunchgrass, the Interior Douglas fir, the Montane spruce, the Engelmann spruce - subalpine fir and the Alpine tundra. The natural vegetation of each of the zones is summarized in Table 5.1.

As shown in the table, the warm, dry valley bottoms of the Fraser and Bridge Rivers are occupied by the sparse Ponderosa pine forests. At slightly higher elevations, a dry subzone of the Interior Douglas fir zone occurs, characterized by Douglas fir - pinegrass communities as well as the presence of ponderosa pine, bluebunch wheatgrass and kinnikinnick in dry habitats. Above elevations of approximately 1000 m, a wetter subzone occurs that is characterized by denser stands of Douglas fir and lodgepole pine, with pinegrass, twinflower and other shrubs and herbs in the understory. The Montane spruce zone can be regarded as a transitional zone between the Montane forests of the higher elevation Interior Douglas fir zone and the subalpine forests of the Engelmann spruce - subalpine fir zone. These dense coniferous forests grade into a subalpine parkland at an elevation of approximately 1700 m. Above is the subalpine tundra, usually found above an elevation of 2200 m.

TABLE 5.1

BIOGEOCLIMATIC ZONES
KELLY LAKE TO SETON LAKE

ZONE AND APPROXIMATE ELEVATION/RANGE[1]	CHARACTERISTIC PLANT SPECIES[2]	PRINCIPAL TREE SPECIES[3]
Ponderosa Pine - Bunchgrass: Valley bottom to elev. 600 m	ponderosa pine bluebunch wheat-grass prairie Koeleria	ponderosa pine (Douglas fir)
Interior Douglas Fir: elev. 600 m to 1400 m	Douglas fir pinegrass	Douglas fir (lodgepole pine) (spruce) (ponderosa pine)
Montane Spruce: elev. 1400 m to 1600 m	Engelmann spruce lodgepole pine grouseberry heart-leaf arnica	Engelmann spruce lodgepole pine (Douglas fir) (subalpine fir)
Engelmann Spruce - Subalpine Fir: elev. 1600 m to 2200 m	Engelmann spruce subalpine fir blueberry species Sitka valerian	Engelmann spruce subalpine fir (lodgepole pine) (whitebark pine)
Alpine Tundra: elev. 2200 m and above	lupine cinquefoil grasses	none

Footnotes

1. Elevations are approximate and may vary throughout the study area by as much as plus or minus 200 m.

2. Based on the most current available information from Annas and Coupe (1979), Mayes and Yee (1980) and Mitchell (1980).

3. Species in parentheses are not found throughout the zone or are found only in particular habitats.

Existing Vegetation

Several areas between Kelly Lake and Seton Portage depart from the general descriptions of natural vegetation. Much of the lower elevation land (below approximately 1000 m) along the Fraser River is in pasture or otherwise cultivated. Some extensive areas of pasture also occur in the vicinity of Pavilion, Fountain Valley and on the Diamond-S Ranch just east of Moran.

Vegetation along the existing transmission line rights-of-way from Pavilion is dominated by domestic grasses, accompanied by junipers and small pines. Below an elevation of approximately 1000 m, bluebunch wheatgrass, pasture wormwood, rocky mountain juniper, and ponderosa pine occur. Vegetation adjacent to the right-of-way is dominated by bluebunch wheatgrass and pinegrass with open stands of Douglas fir and ponderosa pine as well as some pasture land.

Above an elevation of 1000 m, vegetation along the right-of-way is dominated by domestic grasses with scattered prickly rose, willows, kinnikinnick and lodgepole pine seedlings. Adjacent vegetation is predominantly pasture. Several groves of trembling aspen also occur. North of the Diamond-S Ranch, moderately dense stands of Douglas fir and lodgepole pine occur with pinegrass and twinflower in the understory. Northerly aspects are dominated by denser forests of Douglas fir, lodgepole pine and spruce with pinegrass in the understory.

Vegetation Sensitivity

Revegetation following disturbance may be slow in lower elevation areas, particular on steep, south-facing slopes due to

higher temperatures and limited soil moisture. Revegetation at higher elevations in the subalpine and alpine zones is conversely hampered by low temperatures, a long snowpack duration and a short growing season.

Forest Capability and Use

The greatest forest capability occurs in the higher elevations of the Interior Douglas fir zone, in the Montane spruce zone and in the lower elevations of the subalpine zone. The lower elevation lands (below 600 m or so) and valley bottoms have low forest capability; most land at these elevations is used for grazing or other forms of agriculture.

Three public sustained yield units (PSYU's) occur in this region. The Yalakom and Botanie PSYU's are administered by the Kamloops Forest Region of the B.C. Ministry of Forests; the Big Bar PSYU is administered by the Kamloops and the Cariboo Forest Regions. Inventory information for these PSYU's is summarized in Table 5.2; the PSYU boundaries are shown on Map 2.

SETON LAKE TO PEMBERTON

This region represents the "transition zone" between the interior and coastal regions of the study area. It is dominated by two interior biogeoclimatic zones; the Interior Douglas fir and the Englemann spruce - subalpine fir along with the treeless alpine tundra. The eastern limit of the coastal western hemlock and mountain hemlock zones occurs near Gramsons along the Birkenhead River, and near the western end of Duffey Lake in the Cayoosh watershed.

Natural Vegetation

The natural vegetation in the region, as shown in Table 5.3, is strongly influenced by two major climatic transitions: the coastal-interior transition and an altitudinal transition. The transition from coastal to interior climate is reflected not only by the change in the composition of plant communities, but also by the change from dense coniferous forests near Pemberton to the open stands of Douglas fir and ponderosa pine with a ground cover of grasses (near the Bridge River).

Altitudinal transition in the Interior is characterized by open forest and parkland communities in the lower elevations, dense forests in the mid-elevations and subalpine areas, giving way to treeless zones as the alpine tundra is approached (see Table 5.4).

A somewhat similar transition occurs in the coastal zones, from the dense coniferous forests of the coastal western hemlock zone at lower elevations, to the subalpine forests and parklands of the Mountain hemlock zone, and the treeless alpine tundra. (These zones are discussed more fully in the description of the Pemberton-Cheekye region.)

Existing Vegetation

Existing vegetation throughout this region closely reflects the natural vegetation. Major exceptions occur in many clearcut logged areas in the Cayoosh Creek and Mission Ridge areas, and in areas which have been cleared for transmission line and road rights-of-way. Several low elevation areas have been cleared for settlement; such as the Pemberton Valley, Birkenhead River

TABLE 5.2

FOREST INVENTORY DATA
KELLY LAKE TO SETON LAKE

P.S.Y.U.	MATURE VOLUME (m^3)	TOTAL PRODUCTIVE AREA (ha)	ALLOWABLE ANNUAL CUT COMMITTED (m^3)
Yalakom	53,396,930	364,751	511,720
Botanie	36,884,250	348,711	371,240
Big Bar	47,422,860	561,221	444,500

Source: B.C. Ministry of Forests, Annual Report, Year Ended December 31, 1979.

TABLE 5.3

BIOGEOCLIMATIC ZONES - SETON LAKE TO PEMBERTON

ZONE[1]	CHARACTERISTIC PLANT SPECIES[2]	PRINCIPAL TREE SPECIES[3]
Interior Douglas Fir	Douglas fir false boxwood pinegrass	Douglas fir
very dry, lower elevations	Douglas fir pinegrass	Douglas fir lodgepole pine (spruce)
very dry, higher elevations	Douglas fir lodgepole pine twinflower pinegrass	Douglas fir lodgepole pine (spruce)
dry, western, lower elevations	Douglas fir ponderosa pine birchleaf spirea pinegrass	Douglas fir ponderosa pine (Engelmann spruce) (western red cedar)
dry, western, higher elevations	Douglas fir lodgepole pine false boxwood pinegrass	Douglas fir lodgepole pine (ponderosa pine) (Engelmann spruce) (western red cedar)
coast transitional	Douglas fir western hemlock white pine black blueberry false boxwood	Douglas fir western hemlock (western red cedar) (amabilis fir) (white pine) (lodgepole pine) (Engelmann spruce)
Engelmann Spruce - Subalpine Fir Forest	Engelmann spruce black blueberry Pleurozium schreberi (moss)	Engelmann spruce subalpine fir (lodgepole pine)
very dry, southern, forest	Engelmann spruce subalpine fir lodgepole pine grouseberry Sitka valerian	Engelmann spruce subalpine fir lodgepole pine

TABLE 5.3 (Continued)

ZONE[1]	CHARACTERISTIC PLANT SPECIES[2]	PRINCIPAL TREE SPECIES[3]
dry, southern, forest	Engelmann spruce subalpine fir black blueberry white rhododendron Sitka valerian one-sided winter-green	Engelmann spruce subalpine fir (lodgepole pine) (whitebark pine)
coast transitional, forest	Engelmann spruce amabilis fir subalpine fir black blueberry	Engelmann spruce subalpine fir amabilis fir (lodgepole pine) (whitebark pine) (western red cedar)
Engelmann Spruce - Subalpine Fir Parkland	Engelmann spruce subalpine fir red heather	(Engelmann spruce) (subalpine fir)
Mountain Hemlock (Interior transitional)	mountain hemlock amabilis fir false azalea black blueberry stiff clubmoss Rhytidiopsis robusta (moss)	mountain hemlock amabilis fir (western hemlock) (whitebark pine)
Alpine Tundra	moss heather red heather trailing azalea mountain spirea (note: zone has not been described in detail, particularly for interior regions)	none
Coastal Western Hemlock (Interior transitional)	western hemlock deer fern bunchberry foam flower Rhytidiopsis robusta (moss)	western hemlock amabilis fir Douglas fir (western red cedar) (Sitka spruce)

Notes:

1. Descriptions are based on subunits of zones in order to indicate the coastal-interior and altitudinal transitions which occur.

2. Source: Courtin, 1980 and Mitchell, 1980.

3. Species in parentheses are not found throughout the zone or are found only in particular habitats.

and Gates Creek valleys and in the vicinity of several smaller settlements such as D'Arcy, Seton Portage, Shalalth and Retaski.

In the rights-of-way along the lower Birkenhead River vegetation consists predominantly of native grasses, bracken and shrubs such as waxberry, thimbleberry, Douglas maple and some small bigleaf maple. Scattered conifers such as white pine, Douglas fir and western hemlock also occur near the rights-of-way. Mixed, open to moderately dense stands of Douglas fir, western red cedar and black cottonwood occur closer to the river.

Along Gates Creek towards D'Arcy, mixed second growth stands of Douglas fir, western red cedar, white birch, bigleaf maple and red alder occur along the valley floor. Black cottonwood and western red cedar predominate in wetter sites.

Vegetation within and adjacent to transmission line rights-of-way on the south facing slopes above Anderson and Seton Lakes is dominated by shrub communities with scattered Douglas fir and ponderosa pine. Shrub-size trembling aspen and white birch along with red osier dogwood, *Ceanothus* spp. and false boxwood are also found.

Vegetation Sensitivity

The degree to which vegetation is sensitive to disturbance is strongly affected by site specific factors such as site moisture and soil nutrient regimes, soil stability and exposure. These are difficult to generalize over a region as large as that between Seton Lake and Pemberton.

The steep, dry slopes with southern exposures occuring at lower elevations of the Interior Douglas fir zone along Anderson and

TABLE 5.4

APPROXIMATE ALTITUDINAL RANGE OF BIOGEOCLIMATIC ZONES IN THE SETON LAKE TO PEMBERTON REGION

ZONE	APPROXIMATE RANGE IN ALTITUDE (m a.s.l.)
Interior Douglas Fir	valley bottom to 1400
Engelmann Spruce - Sub-Alpine Fir, Forest	1400 to 1700
Engelmann Spruce - Sub-Alpine Fir, Parkland and Alpine Tundra	1700 to 2200+
Coastal Western Hemlock	valley bottom to 1200
Mountain Hemlock, Forest	1200 to 1800
Mountain Hemlock Parkland and Alpine Tundra	1800 to 2400+

Seton Lakes are some of the most sensitive sites in this region. High elevation areas in the subalpine parkland and alpine tundra are also quite sensitive to disturbance because of prevailing climatic conditions (e.g., short growing season, low temperatures, high snowfall and long duration of snow cover). Areas subjected to periodic avalanches or mass wasting are particularly sensitive.

Forest Capability and Use

Generally speaking, areas with the highest capability for forestry occur in the middle elevation range of the Interior Douglas fir zone and lower extent of the subalpine forests, particularly in coastal transition areas such as that found along the Cayoosh Creek drainage and between Pemberton and D'Arcy along Gates Creek. Similarly, the ease and rapidity of revegetation is frequently the greatest in these same areas. Forest capability, however, does vary considerably on a site to site basis for reasons concerning available moisture and nutrients in the soil, exposure, soil stability, etc.

Two public sustained yield units (PSYU's) occur in this region - the Yalakom and the Soo. The Yalakom PSYU is administered by the Kamloops Forest Region and the Soo PSYU by the Vancouver Forest Region of the B.C. Ministry of Forests. Inventory information for these PSYU's is summarized in Table 5.5.

Currently, the Cayoosh Creek drainage and Mission Ridge area northwest of Lillooet are important sources of timber for mills at Lillooet. Due to the relatively severe deficits in timber supply projected for this region (BCMF, 1980b), any further reduction of the forest land base would, in general, be perceived as having a significant and permanent impact on the forest industry.

TABLE 5.5
FOREST INVENTORY DATA - SETON LAKE TO PEMBERTON

P.S.Y.U.	MATURE VOLUME (m^3)	TOTAL PRODUCTIVE AREA (ha)	ALLOWABLE ANNUAL CUT COMMITTED (m^3)
Soo	74,842,120	212,692	584,810
Yalakom	53,396,930	364,751	511,720

Source: B.C. Ministry of Forests, Annual Report, Year Ended December 31, 1979.

PEMBERTON TO CHEEKYE

Natural Vegetation

Three biogeoclimatic subzones are included within this portion of the study area: the Coastal western hemlock zone, the Mountain hemlock zone, and the Alpine Tundra (see Table 5.6). Most of the corridors reviewed lie within the Coastal western hemlock zone, although the Mountain hemlock and Alpine Tundra would be crossed in the upper Soo, upper Callaghan and upper Squamish drainages.

The Coastal western hemlock zone extends from valley bottoms to elevations of 1000 m in the south and 1200 m in the north. The vegetation consists of dense coniferous forest dominated by western hemlock. Characteristic plant species and principal tree species are presented in Table 5.6.

The dry subzone of the Coastal western hemlock zone occurs south of latitude 49°54'N and below elevations of approximately 650 m. Characteristic species are broadleaf maple, arbutus, Pacific dogwood, Douglas fir, salal, Oregon grape, red huckleberry and the moss Stokesiella oregana. The natural vegetation on zonal sites is characterized by dense stands of western hemlock and Douglas fir accompanied by the mosses Hylocomium splendens and Rhytioliadelphus loreus.

The wet subzone of the Coastal western hemlock zone occurs above the dry subzone, between approximately 650 and 1000 m elevation. Characteristic species for this subzone include amabilis fir, Alaska blueberry, ovalleaf blueberry and trailing rubus. Natural vegetation on zonal sites is characterized by dense stands of western hemlock and amabilis fir accompanied by Alaska blueberry and the moss Rhytidiadelphus loreus in the understory.

North of latitude 49°54'N, a more interior-like climate (e.g., shorter growing seasons and greater snowfall) affects the natural vegetation. The natural vegetation on zonal sites is characterized by dense forests dominated by western hemlock with foamflower, queen's cup and the moss Rhytidiopsis robusta. Although Douglas fir still occurs, it usually exhibits relatively poor vigour. Amabilis fir is more prevalent, particularly at elevations above 650 m.

The Coastal western hemlock zone is potentially the most productive zone in the province for tree growth. North of latitude 49°54'N, the more interior-like climate would usually result in somewhat reduced productivity, although data to support this theory are not currently available. Production of browse species for wildlife is generally low except in special habitats such as wetlands, riparian habitats and steep slopes with shallow to bedrock soils, or in disturbed areas.

Revegetation following site disturbance is generally rapid except on unstable slopes or sites with very shallow soils. On very productive sites, such as alluvial flats or seepage sites on lower slopes, brush control can be a significant problem in maintaining rights-of-way.

TABLE 5.6

BIOGEOCLIMATIC ZONES[1]
PEMBERTON TO CHEEKYE

ZONE	CHARACTERISTIC PLANT SPECIES[2]	PRINCIPAL TREE SPECIES[3]
Coastal Western Hemlock Zone	western hemlock deer fern bunchberry Plagiothecium undulatum (moss) Rhytidiadelphus loreus (moss)	western hemlock Douglas fir (western red cedar) (grand fir) (amabilis fir) (Sitka spruce)
Mountain Hemlock Zone	mountain hemlock amabilis fir yellow cedar false azalea black blueberry stiff clubmoss Rhytidiopsis robusta (moss)	mountain hemlock amabilis fir yellow cedar (western hemlock) (subalpine fir)
Alpine Tundra	moss heather red heather trailing azalea mountain spirea alpine clubmoss Alaska clubmoss	none

Footnotes

1. Biogeoclimatic zones following the current B.C. Ministry of Forests' classification (Annas and Coupe, 1979; Courtin, 1980; Klinka, et. al.; Mitchell; 1980)

2. From Klinka, et. al., 1979.

3. Species in parenthesis are not found throughout the zone or are found only in particular habitats.

The Mountain hemlock zone is a coastal subalpine zone occurring above elevations of about 1000 m in the south and 1200 m in the north. The forested subzone is characterized by dense forests of mountain hemlock, amabilis fir and yellow cedar (see Table 5.1). The parkland subzone, occurs above 1100 m elevation in the south and 1400 m elevation in the north. The upper limit of the parkland subzone varies in elevation between approximately 1450 and 1600 m. Vegetation on zonal sites in the forested subzone is characterized by dense stands of mountain hemlock and amabilis fir with Alaskan blueberry and black blueberry in the understory. The parkland subzone is characterized by forested clumps of mountain hemlock with white rhododendron and black blueberry in the understory, interspersed with open areas dominated by heathers, mountain spirea and other shrubs and herbs. North of latitude 50°N, the more interior-like climate is reflected in the vegetation, for example, by the occurrence of subalpine fir.

Although generally less productive than the Coastal western hemlock zone, the forested subzone of the Mountain Hemlock zone has relatively high forest capability. Revegetation following disturbance is retarded to some degree by shorter growing seasons, long duration of snow cover and heavy snowfalls as compared to the Coastal western hemlock zone. Forest productivity and ease of recovery after disturbance decrease with increasing elevation. Forest productivity is marginal and tree regeneration slow and difficult in the parkland subzone. Productivity and rapidity of revegetation would also be expected to decrease in the more interior-like climate north of latitude 50°N.

Due to the adverse climatic conditions prevailing throughout most of the year and the paucity of browse, the Mountain Hemlock zone does not provide critical habitats for most

ungulates. Some forested areas may, however, provide winter range for mountain goats.

The Alpine Tundra is a treeless alpine zone occurring above the subalpine Mountain hemlock zone. Characteristic plant species are presented in Table 5.6. Revegetation following site disturbance can be very slow in the Alpine Tundra, thereby increasing the potential for erosion on sensitive terrain. The alpine areas provide important seasonal habitats for a variety of wildlife.

Existing Vegetation

The foregoing descriptions give a general picture of the natural vegetation characteristic of the region between Pemberton and Cheekye. Many areas, however, have been disturbed by logging, land clearing, fires, right-of-way clearing and road construction so the existing vegetation often differs considerably from the natural vegetation.

Forests composed of combinations of black cottonwood, broadleaf maple, red alder, Sitka spruce, true firs, western hemlock, Douglas fir and western red cedar predominate in the bottomlands along the Squamish and lower Cheakamus Rivers. Some typical understory species include Douglas maple, thimbleberry, trailing blackberry, waxberry, swordfern, maidenhair fern and mosses of the Mniaceae family.

The corridor along the Cheakamus River, roughly between Culliton Creek and Lucille Lake, consists of a complex of disturbed sites with mainly shallow to bedrock soils. Immature western hemlock is the dominant species over much of the area, interspersed with the occasional immature Douglas fir.

Scattered Douglas fir veterans also occur, particularly in areas which have been severely burned. On drier sites, immature lodgepole pine, Douglas fir and western red cedar are common. In draws and some seepage sites, deciduous species such as cottonwood, maples, alders and willows are common.

Some very rocky sites in the Cheakamus Canyon have a sparse cover of immature Douglas fir accompanied by the occasional white pine; the trees are confined to scattered pockets of soils and are accompanied by salal, black blueberry, red huckleberry, false boxwood, twinflower, prince's pine and bracken. Open areas often support a dense cover of bracken. Rocky areas with little or no soil are dominated by false boxwood with a high cover of mosses, such as Rhacomitrium canescens, Polytrichum commune and Polytrichum juniperinum, and lichens of the Cladina and Stereocaulon genera. Botrychium sp. and scattered willows also occur.

Near the south end of Daisy Lake, a lodgepole pine - moss (Rhacomitrium spp.) - lichen (Cladina and Stereocaulon spp.) plant community occurs on shallow soils developed over lava flows. Sites with deeper and moister soils also support scattered Douglas fir, red huckleberry salal, false boxwood and twinflower.

Sites on deeper soils, usually derived from morainal parent materials, support immature forest stands dominated by western hemlock.

Much of this region has been clearcut logged within about the past ten years. Parts of the Squamish River valley, lower Callaghan Creek, the upper Cheakamus River, the west side of Alta Lake, the vicinity of Green Lake, the Rettel area, the lower Soo River valley and Rutherford Creek have all been logged.

Forest Capability and Use

This region includes the Soo Public Sustained Yield Unit (PSYU) and Tree Farm Licence (TFL) 38 held by Empire Mills Ltd. Inventory information for these two forest management units is summarized in Table 5.7.

The Soo and Callaghan drainages are two, major potential sources of mature timber remaining in the Soo PSYU. Currently, there is one timber sale licence (T.S. A08722, blocks A and B, held by Richmond Plywood) and one timber sale harvesting licence (TSHL A08750, Chart 2, held jointly by A & R Logging Ltd., MacMillan Bloedel Industries Ltd., and Canadian White Pine Co. Ltd.) in the Soo River drainage. While there are currently no specific plans to develop access further into the Soo, it is very probable that the remaining mature stands will be exploited and access will therefore be extended.

There are currently two timber licenses in the lower end of the Callaghan drainage (TL 8086 and TL 8087) containing mature stands of hemlock, balsam, cedar and cypress. Pacific Forest Products (formerly Pacific Logging Co.) intends to log much of the drainage. The Ministry of Forests would like to see the drainage exploited, but are also very concerned about the recreational use and conflicts with the proposed downhill and cross-country ski developments. Given the tight timber supply situation in the Soo PSYU, it is the consultant's opinion that much of the drainage will be logged; however strong protests from recreational users and conservation groups could restrict timber exploitation.

Other major sources of mature timber in this sub-region are the Squamish River and Rutherford Creek drainages.

Within the next thirty years, when mature timber is expected to be depleted, timber supply from the Soo PSYU is expected to be reduced from present levels. In addition, increased public concern over preserving areas in a natural state for recreation may become increasingly important in this region, and could impose further limits on timber supply in the Soo PSYU (B.C. Ministry of Forests, 1980). Projections for TFL 38 are not presently available; however, for TFL's in the Vancouver Forest Region in general, a falldown in wood supply is predicted to occur within about 40 years (B.C. Ministry of Forests, 1980).

FORESTRY IMPACTS

Method of Assessment

Principal impacts on forestry resulting from transmission line construction and maintenance relate to the permanent loss of the forest land base and growing stock. Impacts resulting from soil erosion associated with access roads are discussed in Chapter 4. Conflicts with present forestry use may also arise, but it is likely that these can be resolved prior to right-of-way clearing by allowing for timber removal by existing licensees. Conflicts with present use are difficult to identify until a precise alignment and construction schedule are known.

The transmission line corridors pass through four public sustained yield units (PSYU's) and one Tree Farm Licence (TFL); (the Big Bar, Botanie, Yalakom and Soo PSYU's, and TFL No. 38. Tight timber supplies are forecast for the near future for all of the PSYU's (B.C. Ministry of Forests, 1980b). Little detailed information on the future timber supply is available, however foresters and licence holders can be expected to argue strongly for minimizing losses to the forest land base.

TABLE 5.7

FOREST INVENTORY DATA
PEMBERTON TO CHEEKYE

UNIT	MANAGED BY:	TOTAL PRODUCTIVE AREA (ha)	TOTAL MATURE VOLUME (m^3)	ALLOWABLE ANNUAL CUT COMMITTED (m^3)
T.F.L. 38	Empire Mills Ltd.	52,427	-	263,380
S00 P.S.Y.U.	B.C. Ministry of Forests, Vancouver Forest Region	212,692	74,842,120	584,810

Source: B.C. Ministry of Forests, Annual Report, Year ended December 31, 1980.

Potential impacts along the possible corridors were evaluated on the basis of the following criteria:

* forest capability according to climate and general terrain and soil considerations (ie. biogeoclimatic zones and dominant terrain types such as alluvium, deep morainal parent materials, shallow to bedrock soils, etc.)

* existing forest cover (ie. mature timber, immature timber and non-forested types)

* the forecast timber supply situation in the various forest management units

* present forest land use for timber production

* amount of clearing required for the proposed transmission line

These criteria were inferred from the following sources:

* a reconaissance flight of the corridors

* examination of updated forest cover maps

* examination of aerial photographs (1:50,000 scale)

* examination of 1:250,000 scale Landsat satellite imagery

* limited field checking

* interviews with government and industry representatives.

In most cases the potential impacts for the alternative corridors were apparent from their biophysical characteristics (eg. biogeoclimatic zones, forest cover, terrain) and general knowledge of forestry use for timber production. Consequently, detailed studies of forest use and tenure were not done. Comparison of the alternative corridors in the Pemberton-Cheekye region, where forest capability is highest in the study area, warranted more detailed investigation of the potential impacts for the various corridor options.

Due to the reconnaissance nature of field work, and the fact that the corridor boundaries were not precisely defined, a detailed, quantified comparison of the individual corridor segments was not attempted. Instead, a five-class rating system was applied to each segment based on the criteria discussed previously; the five classes of impact are: high, moderately-high, moderate, moderately-low, low. They are shown for the various corridor options on Map 2. Note that the width of the band on the map showing impact severity is for illustrative purposes, and does not bear any relationship to corridor width.

Kelly Lake to Seton Lake

Potential impacts in the Kelly Lake to Seton Lake region ranged from low to moderate, depending on differences in forest capability associated with climatic and edaphic limitations as well as differences in forest cover, as discussed previously in the regional forestry descriptions.

Corridor segments AC and AB are rated equally (moderate), though impacts along AB may be reduced if existing rights-of-way are followed. Forestry impacts would be miminal along the

eastern segments (BD, DG and DF) as forest capability is less, and these corridors generally follow existing rights-of-way. The western corridors, crossing the Camelsfoot Range and passing through Antoine or Applespring Creeks (segments CE, BE, EI and EHI) would result in moderately low forestry impacts.

The potential impacts along the corridors crossing over Mission Ridge are rated moderate to moderately-high. This area supports relatively productive subalpine forests that are important sources of timber for local mills. Segment GI crosses an area of relatively high forest cover value, as compared to GJ which follows adjacent to an existing right-of-way. If split circuits are used over Mission Ridge, impacts on forestry would be greater than with the double circuit structures, simply because additional alienation of the forest land base is involved with two rights-of-way, as opposed to one. The corridor with least potential impact between Kelly Lake and Seton Lake is, therefore, that paralleling 5L42, or that paralleling 2L90 and 2L91 to the east end of Seton Lake, as most of the land is utilized for purposes other than forestry, such as agriculture, transportation etc., or has relatively low forest capability.

Seton Lake to Pemberton

More favourable climatic conditions and higher forest cover values result in high impact ratings along the Cayoosh Creek and Joffre Creek drainages (segment FL).

North of the confluence of Cayoosh and Melvin Creeks, in the drier, interior zones, impacts are moderately-low due to relatively low forest capability and forest cover values. This area is covered by the northern third of segment FM and all of segment FL along the south side of Seton Lake.

The corridor along the northwest side of Anderson Lake to Creekside (segment LM) received a low impact rating for the following reasons:

* relatively low forest capability due to the drier, interior climate

* low capability because of the presence of shallow, rapidly-drained soils, particularly on southern exposures

* negligible forest cover values

* the existing 2L1 right-of-way will be utilized for most of the corridor, including that portion south of D'Arcy where forest capability is relatively high.

In conclusion, the Anderson Lake corridor (LM) would result in little impact on the existing forest land base, whereas the Cayoosh Creek corridor (FM) would result in a reduction of the forest land base which could aggravate projected tight timber supplies in the Soo and Yalakom PSYU's.

Pemberton to Cheekye

Compared to the other regions of the study area, forest capability and forest cover values are generally high, and timber production constitutes a major land use, and significant economic activity in this region. Currently there are ten active timber sale harvesting licences, nine active timber sale licences, two timber leases and one tree farm licence in the region.

The relatively high forest values and tight timber supplies in the region mean that any proposed reduction to the forest land base should be thoroughly documented and justified.

The corridors passing through the Soo River and Callaghan Creek drainages (NO and OS) encounter some relatively extensive stands of old growth hemlock, balsam (true firs), red cedar, yellow cedar and Douglas fir. The corridor along the Squamish River Valley (RT) covers alluvial flats and lower slopes in the coastal western hemlock zone which may have the greatest forest capability in this region; most of this corridor passes through Tree Farm Licence No. 38. It also includes some immature stands within Timber Sale Harvesting Licence A01298 and Timber Sale Licence A09793. Impacts along these corridors (NO, OS and AT) are rated high.

Two proposed corridors connecting the Soo River valley to the upper Squamish River (OPR and OQR) pass through high elevation (Alpine Tundra zone) areas but also include some subalpine forests. Forestry impacts are moderate. Impact could vary appreciably, however, depending on the actual route alignment. For example, if the wetlands in the upper Soo Valley are followed, little impact on forestry would result (however, this would have to be weighed against potential impacts on the wetlands).

Minimum forestry impacts would occur along the corridor extending from the junction of the Soo and Green Rivers, to Alta Lake and along the Cheakamus River to Cheekye (NST). The reasons for this are several:

* Forest capability is limited along much of the corridor by shallow to bedrock soils and rock outcrops;

* Forest cover values are low compared to the Squamish River, Soo River and Callaghan Creek areas;

* Existing right-of-way can be used for a substantial portion of the distance; and

* No mature timber types within existing forest tenures are encountered.

It should be noted that a small area (about 2 hectares) of mature Douglas fir, hemlock and lodgepole pine occurs along the corridor between Alpha and Nita Lakes (just south of Alta Lake). This area has been reserved from timber harvesting for recreational use. However, this small stand could probably be avoided with careful route selection.

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CHAPTER 6

AGRICULTURE

The assessment of potential impacts on the agricultural land resource due to transmission line construction and maintenance and the selection of a preferred corridor alternative was based largely on existing information combined with a limited program of field reconnaissance. Maps, at a scale of 1:50,000, depicting British Columbia Land Inventory (BCLI) land capability for agriculture ratings and present land use within the Agricultural Land Reserves (ALR) of the study area, were the primary data source for the agricultural assessment.[1]

Stereoscopic interpretation of recent aerial photographs was used to update the base data provided by the SSCA maps and to augment this data in areas outside the ALR. A brief program of field checking mapped information and air photo interpretation, was undertaken both on the ground and by helicopter reconnaissance. From this work it was determined that the Agricultural Land Reserve encompassed all of the commercial agricultural activity within the study area and that only limited areas have been brought into production subsequent to 1977. Map 2 presents the base information which accompanies the following assessment. An impact rating index has not been

[1]B.C. Select Standing Committee on Agriculture (1977). (SSCA)

prepared for agriculture as this is very dependent on farming practice and can result in double counting where land with agricultural capability is used for tree production. Impacts are discussed on a site specific basis.

POTENTIAL IMPACTS

Transmission line construction and maintenance through arable lands generally has a low to moderate impact on existing or potential agricultural use. In the study area the highest agricultural impacts are in areas where sprinkler irrigation system movements and operational safety are affected by the tower and line locations. This impact can sometimes be avoided by locating towers on non-arable lands adjacent to or between arable areas. Another direct long term impact is loss of arable land due to the provision of access routes. Again this can largely be avoided by selective placement of the access roads and towers on non-arable land.

Short-term impacts on arable lands result where soils are subject to compaction and/or erosion when disturbed by the use of heavy equipment used in transmission line construction and maintenance. These adverse effects can largely be mitigated by proper equipment handling and rehabilitating affected areas once the line is established.

The laying of irrigation pipes within the electromagnetic field of a transmission line will set up an induced current along the pipe. The current greatly increases metal corrosion particularly in aluminum irrigation pipe.

In addition, labourers moving the pipe may receive shocks or electrocution, if when the pipe is moved, it comes

too close to the wire. This danger is applicable to low hanging transmission wires.

Automated systems are also subject to increased corrosion. In addition, their use is restricted by the placement of towers and guys which may interfere with transporting the wheel pipe across a field.

High pressure "gun" systems are least affected and are the most suitable means of irrigating under transmission lines provided the wires are out of range of the spray plume. However these guns need large volume, high pressure water supplies which may not be available or may require very costly pump installations.

More indirect impacts are associated with the loss of opportunity for the construction of farm buildings or other permanent installations on transmission line rights-of-way and potential damage to crops and livestock which could result from the use of herbicides in right-of-way maintenance.

The highest potential impacts in the study area are associated with lands classified as arable (classes 1 to 5).

For the purposes of this study, transmission line location over class 6 and 7 lands is considered to have low impacts on agricultural cropping use as class 6 lands are suitable only for grazing and class 7 lands are non-arable. Although the establishment of a right-of-way over any lands restricts the future use of that land, particularly the ability to establish permanent structures on it, it is difficult to establish the degree to which this might affect an agricultural operation as alternative lands for uses other than cropping are almost always available. The impact assessment is therefore limited

to the determination of possible effects on the arable land resource, both for lands presently in production and lands which have been determined to be capable of sustaining crop production.

In agricultural areas where cattle ranching relies largely on the availability of grazing lands, right-of-way clearing and maintenance may create a beneficial effect in that previously low capacity forest land may be opened up and seeded to forage species which increase carrying capacities for grazing. Within the Kelly Lake to Seton Lake region of the study area, the clearing and establishment of the new right-of-way could provide an increased grazing land for some ranchers.

Map 2 shows the agriculture impact assessments for the corridors which were studied. Table 6.1 summarizes potential agricultural impacts from transmission line construction and maintenance and gives possible mitigative measures; the following assumptions were made:

* Existing access will be used where possible.

* Tower locations will avoid arable land (both cultivated and not cultivated) where non-arable land alternatives exist.

* Where an impact occurs as a result of transmission line activity mitigation will be attempted by B.C. Hydro or compensation will be paid to the land holder.

* Compensation for crop loss will vary according to the nature of the crop and the duration of the impact.

TABLE 6.1

AGRICULTURAL IMPACTS

TRANSMISSION LINE ACTIVITY	AGRICULTURAL IMPACT	MITIGATION OR COMPENSATION
Right-of-way clearance	Disruption of cropping operations	avoid cropping season, compensation
	Disruption of fencing	repair fences
Access road construction	Loss of arable land	compensation
	Soil compaction and rutting	renovate soil
	Crop loss	avoid cropping season, compensation
Tower construction	Loss of arable land	compensation
	Crop loss	avoid cropping season, compensation
	Interruption of existing irrigation equipment; loss of options for future irrigation system design	compensation
Vegetation control	Crop and animal loss from use of herbicides to control vegetation on surrounding right-of-way	selective pesticide program adjacent to and on agricultural lands
		reseed using grass species suitable for grazing
Line maintenance	Crop loss	avoid cropping season
	Soil compaction	avoid use of heavy equipment off permanent access routes, renovate soil
Unexpected events (surface erosion, slides)	Crop loss	compensation
	Soil loss	renovate soil

* Agricultural cropping activities are allowable uses on the right-of-way with the only exception being tree fruit and nut production.

KELLY LAKE TO SETON LAKE

This section is the most agriculturally significant area of the three sections between Kelly Lake and Cheekye. Extensive areas of the elevated, glaciofluvial terraces associated with the Fraser River and some of the soils associated with the deep morainal deposits on the high plateau between Pavilion and Kelly Lake are rated class 4 or better.

The elevated terraces of the Fraser River are mostly cultivated for irrigated alfalfa hay production with the exception of small farms near Lillooet where tree fruits and vegetables are grown. The soils range in texture from silt to sand and are often stony about 1 metre below the surface. These deposits are subject to severe gully erosion and all require irrigation to support cultivation.

The higher capability lands of the upland plateau between Kelly Lake and Pavilion is used for irrigated forage production and the remainder is for livestock grazing. The availability of irrigation water is the main limiting factor to crop production on the better soils.

Kelly Lake East (AB)

On the south side of the Kelly Lake substation this corridor segment crosses .75 kilometers of class 4 land used for non-irrigated pasture. A narrow strip is presently spanned by the

existing transmission lines. No impacts are expected if the agricultural land is spanned.

Kelly Lake North (AC)

This corridor segment crosses 3 kilometers of ALR rated as 80% class 4 and 20% class 3 under irrigation. Only 40% of the area is presently in agricultural use which consists of pasture for grazing and a small area of hay production. Moderate to high impacts could occur; however, with selective tower placement these could be avoided.

Kelly Lake South (BC)

No ALR lands are involved in this segment, however, part of the area around C is utilized for grazing and right-of-way clearing and reseeding to grass species would provide increased grazing values.

Marble Range (BD)

This corridor segment is approximately 13 kilometers in length, approximately 12 of which transect a large ALR unit which covers most of the undulating upland plateau to the northeast of the confluence of the Pavilion and Fraser Rivers.

The arable lands of this ALR parcel are dominantly class 2 and 3 with climatic, stoniness and topographic limitations. The fringe areas of the unit are class 6 and 7 with topography and stoniness limitations.

The Diamond S Ranch, located between Kelly Lake and Pavilion on the east side of the Fraser River, encompasses most of this ALR unit extending to the ALR unit on the south side of the Pavilion River and includes most of the arable lands on the east side of the Fraser River south to Fountain IR3. The ranch is approximately 3600 ha and produces alfalfa, barley and grass/legume hay. It supports a cattle herd of approximately 2,000 head. In addition, the Ranch holds extensive grazing rights to the surrounding Crown rangelands.

Approximately 90% of this corridor segment crosses class 4 and better land. Approximately 15% of it is class 2 lands in irrigated forage production. Most of the remaining lands within the ALR portion of the corridor are class 3 lands under forest and grassland/pasture. Less than 10% of the ALR lands transected by this corridor alternative are class 6 and 7.

At present two 500 kV (5L41 and 5L42) transmission lines and two 230 kV transmission lines (2L90 and 2L91) pass through this ALR unit and over the deeded and cultivated lands of the Diamond S Ranch. These existing lines constrain agricultural development where the towers are located on arable lands and prevent the use of automated irrigation equipment in the fields where towers are located, resulting in the use of costly, manually laid pipes (Termuende; pers. comm.).

Potential impacts due to the construction and maintenance of a new transmission line adjacent to the existing lines are rated as high due to the interference with existing irrigated agricultural practices, the constraints imposed on further development of the arable lands.

If, for example, the existing right-of-way across the Diamond S Ranch is widened to accommodate a fifth transmission line, the

PHOTO 8. Looking north over Diamond S Ranch between Kelly Lake and Pavilion. 5L41, 5L42, 2L90 and 2L91 presently cross ranch.

use of wheeled systems will be further restricted. The use of high pressure guns would be technically feasible; however, it is estimated that a 300-400 hp pump would be needed to draw the necessary water volume from the Fraser River to supply it at the correct pressure.

Other effects are possible soil damage arising from construction and access road provision and the lost opportunity for the construction of farm buildings on the land within the right-of-way.

The rights-of-way have been seeded to grasses suitable for grazing and this represents a benefit to agriculture.

Camelsfoot South (BE)

This corridor segment is approximately 18.6 km long and would involve the establishment of a new right-of-way. Approximately 30% (5.6 km) of this segment crosses ALR land in four separate units. Two of these units, representing 65% of the ALR land crossed, are class 6 and used for grazing. The remaining area is utilized as pasture and is rated class 3 and 4 (irrigated rating) but is unimproved at present. Low impacts are associated with this segment.

Camelsfoot North (CE)

This corridor segment is 13.6 km long and crosses two ALR units representing 20% of the segment length. 75% of this area is rated class 6, and is used for unimproved grazing. The remainder is class 3 (irrigated rating) and is used for pasture. Low impacts are associated with this segment.

Pavilion-Fountain (DF)

This corridor segment involves four separate ALR units on the east side of the Fraser River. The entire segment is approximately 35 km in length of which 14 km crosses ALR land. Of the ALR land involved approximately 35% (5 km) is class 4 or better of which approximately 10% is class 1 and 2 land presently being used for irrigated alfalfa production. The remaining ALR lands are class 5 and 6 and are used for grazing. Moderate impacts will occur in this segment as expansion of irrigated forage areas will be restricted. Soil compaction from heavy vehicles and equipment could also result.

Remaining Segments

No ALR land is encountered in any of the remaining segments between Kelly Lake and Seton Lake: Pavilion-Mission Ridge (DG); Antoine Creek (EI); Applespring Creek (EHI); Seton Lake (FL); Mission Ridge North, South, and East (GI, GJ, IJ); Bridge Valley (IK); Mission Pass East and West (JK, KL).

SETON LAKE TO PEMBERTON

The Pemberton Valley is the most important agricultural area in this corridor section. Between Lillooet Lake and Pemberton Meadows the fluvial soils of the valley have been dyked and drained and are cultivated for seed potatoes and forage for beef production. The soils of this area are dominantly agricultural capability class 2 improving to class 1 with drainage.

At Seton Portage there are some small holdings producing tree fruits, vegetables and forage, located on the alluvial deposits

between Seton and Anderson Lakes. Between D'Arcy and Gates some of the fluvial deposits of the Gates River are utilized for small scale forage production for on-site use by livestock.

Anderson Lake (LM)

There are 5 ALR units in this segment all lying between D'Arcy and Creekside. Of the 51 km total length of the segment only 5 km (9%) is ALR land. In the vicinity of Gates the corridor involves 4 km of class 4 land, of which half is used for grass forage production for a small farm. The remainder is grazed or unused. The other ALR units involved are not presently used for agriculture. As the existing right-of-way will be used in this segment no further permanent impacts are expected, however care must be taken not to debilitate agriculturally capable soils during construction.

PEMBERTON TO CHEEKYE

Agricultural production is very limited in this area with only 21% of a total of 790 hectares within the ALR under cultivation. Most of this cultivation is forage production associated with small hobby farms.

Extensive areas of agricultural capability class 4 land occur in the floodplain of the Squamish River. However, the high flood risk and high cost of land clearing, dykes and drainage will probably restrict agricultural development for many years.

Most of the land used for agriculture in the Cheakamus and Green River Valleys occurs on gently sloping alluvial fans and morainal deposits at the base of the valley wall. These soils

are dominantly class 5 and 6 with stoniness and fertility limitations.

Pemberton (MaN)

This segment crosses the Pemberton Valley and involves 1-1/4 km of ALR land. The agricultural land in this area is class 1 (improved) and is drained and irrigated. Agricultural use is presently seed potato and forage production.

Moderate potential impacts occur in this segment as crop losses due to soil compaction and disrupted irrigation and crop management can be expected.

Pemberton (MbN)

This segment involves 1.6 km of agricultural land in the Pemberton Valley, all of which is rated class 2. Land use is primarily grazing for beef cattle and a small portion is used for forage production. The existing right-of-way skirts the edge of the productive land and moderate impacts involving some minor crop damage may occur at the time of construction but this can be minimized by avoiding construction during the growing season.

Pemberton (McN)

This segment involves 2 km of Pemberton Valley ALR, all of which is class 1 and 2 land. Approximately half of this area is used for forage crops or seed potatoes and the remainder is pasture used for grazing. Of the four towers presently con-

structed in this segment three occur in cultivated, drained and irrigated cropland. Any additional construction will have a substantial impact but if the existing tower locations are used, impacts can be reduced by avoiding construction during the growing season. Any widening of the existing right-of-way would encroach on farm buildings.

Squamish Valley (RT)

This segment, through the Squamish Valley, crosses 20 km of ALR land all class 2 and class 4 associated with the Squamish River floodplain. None of this land has been developed for agriculture due to the high cost of clearing and dyking. However, this does not exclude the possibility of future development and the location of a transmission line through these potentially arable lands would constrain agricultural development.

Cheakamus Valley (ST)

Approximately 4 km of this segment crosses ALR land. None of this land is presently used for agriculture although some grazing may occur along the right-of-way. Low potential impacts are associated with this segment.

Remaining Segments

No agricultural lands are encountered in any of the remaining segments: Soo Valley (NO), Callaghan Creek (OS), Whistler (NS), Callaghan Mountain North and South (OPR, OQR).

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CHAPTER 7

WILDLIFE RESOURCES

The wildlife study was conducted to identify areas of importance to wildlife along the various alternate corridors, and to assess the relative impacts of transmission line location on wildlife. Many species of wildlife exist in the study area; however, for purposes of this report, only those species with particular sensitivity to disturbance, economic importance, rare or endangered status, and recreational value were considered.

Information on wildlife resources was gathered from several sources. These included interviews with regional wildlife biologists, habitat protection biologists and conservation officers in Regions 2 and 3 (B.C. Fish and Wildlife Branch). Several field trips were conducted in October, 1980, and included both aerial reconnaissance and ground checking.

For the purposes of corridor selection, the assessment of impacts on wildlife resources from the proposed transmission line was confined to a qualitative judgement based on limited field work and discussion with informed personnel with responsibility for wildlife and wildlife habitat management. This level of assessment was felt to be adequate to fulfill the requirements

of the Stage I ELUC "Guidelines for Linear Development". The relative importance of wildlife values for each corridor option are illustrated on Map 3. Again the width of the impact rating band does not indicate corridor width.

Several potential effects of transmission lines were considered in the assessment of relative impacts on wildlife. These are:

- clearing, road construction and vegetation management on new rights-of-way will generally have greater impact on wildlife than location of the transmission line on, or adjacent to existing rights-of-way;

- right-of-way clearing for transmission lines may result in the alteration of wildlife habitat. It is recognized, however, that these changes are not always negative, such as in those areas where additional "edge" habitat is created that often provides good browse for deer and upland game birds; areas with a greater diversity of vegetation are generally more important to wildlife than homogeneous vegetation (e.g. mature coniferous forest).

- increased access to presently inaccessible wilderness areas may have long-term effects on most wildlife species, primarily through population reductions due to increased hunting pressure and loss of habitat;

The following paragraphs describe the wildlife resources in the three geographical regions between Kelly Lake and Cheekye, and identify areas where significant impacts on wildlife are likely to occur.

KELLY LAKE TO SETON LAKE

Several types of wildlife habitat occur in this region, with wildlife utilization being largely determined by snow depth, vegetation, land use, slope and exposure.

The lands on the east side of the Fraser River are fairly dry, and form the border between the Fraser Plateau and the Coastal Mountains. Bighorn sheep utilize the grassy, open slopes on the east side of the Fraser River within this portion of the study area. At present, access to this sheep winter range is very limited.

Deer and mountain goat are found throughout the Camelsfoot Range, west of the Fraser River. Little inventory data exists for this area. However, Slok Hill, Antoine and Applespring Creek areas are considered to be important for deer, mountain goat and possibly sheep (P. Holman, pers. comm.). Road access to the higher elevations of the Camelsfoot Range, particularly in the vicinity of Antoine and Applespring Creek, is not available. This could explain why wildlife populations have remained relatively high in these areas.

Mission Ridge is crossed by the existing 5L42 transmission line. Prior to the opening up of access (due to logging, roads and transmission line rights-of-way) Mission Ridge supported numerous goat and deer. Populations have since declined from increased hunting activity and human disturbance. Deer hunting still occurs on Mission Ridge, but hunting for goats has been closed for several years in an attempt to re-establish the former goat populations (P. Holman, pers. comm.).

The Pavilion to Mission Ridge segment would parallel the existing 5L42 line for most of the distance, although some

disturbance to the fragile subalpine habitats in the higher elevations along Mission Ridge would occur.

Between Kelly Lake and Pavilion, the proposed corridor crosses the Marble Range, parallel to the existing 5L42 right-of-way. Additional clearing through this area will result in the loss of deer habitat. Much of the Marble Range northeast of Pavilion is utilized by hunters.

South of Pavilion towards Lillooet, and along the south side of Seton Lake, wildlife values are reduced. However BCLI mapping reveals that the lower slopes of the Fountain Ridge are used by deer as winter range.

In summary, the Camelsfoot/Mission Ridge area has significant value for wildlife, therefore impacts from transmission line construction and operation are potentially greater. Loss of deer and mountain goat habitat in the Antoine and Applespring Creek drainages and on Slok Hill, increased access into the Camelsfoot Range, and the disturbance of a Bighorn Sheep range near Moran are some of the major wildlife concerns in this area.

As Mission Ridge is presently crossed by a transmission line, and access is already available, the impacts of the proposed line would be considered as incremental. Thus, use of the corridor that parallels the existing 5L42 transmission line between Kelly Lake/Pavilion/Mission Ridge is considered to have relatively low potential impact on wildlife in this area.

The Pavilion to Fountain option that crosses the Fraser River near Lillooet and traverses the south side of Seton Lake would incur fewer impacts than those options which cross Camelsfoot Range. The southwest end of Seton Lake, however, has been

mapped by the BCLI as deer and goat winter range. Loss of winter range, and the potential for increased wildlife disturbance due to improved access into the Fountain Ridge area would be of concern.

SETON LAKE TO PEMBERTON

Two broad corridors were examined between Seton Lake and the Creekside substation near Pemberton: Anderson Lake and Cayoosh Creek.

The Anderson Lake option follows the north side of Anderson Lake, continuing towards Pemberton via Gates Creek and the lower reaches of the Birkenhead River. The north side of Anderson Lake, though previously cleared for several transmission line rights-of-way, nevertheless provides important deer and mountain goat winter range. The slopes above Anderson Lake are also important native food hunting areas; access into these areas is via the Blackwater Creek Road and McGillivray Creek. Throughout the valley bottom and lower slopes along Gates Creek and the Birkenhead River, diverse habitats for birds and other mammals were found.

The Cayoosh Creek option follows the Cayoosh Creek valley to Duffey Lake, over the Cascade divide and down Joffre Creek to Pemberton. Deer are common throughout the area; the lower slopes and logged areas above Joffre Creek are important deer winter range. Mountain goat utilize the grassy slopes and avalanche chutes; grizzly bears have also been observed on these chutes, and black bears are common throughout the area (P. Holman, pers. comm.).

Between Duffey Lake and Lillooet Lake, the second growth forest of mixed vegetation types likely provides diverse habitats for several non-game species. Wetlands at the headwaters of Cayoosh Creek, for example, and shrub/grasslands found in the avalanche slide areas provide important nesting and feeding areas for upland game birds, passerine species, and a variety of small mammals.

A mixed-wood forest occurs on the south facing slopes above Mt. Currie. This area is mapped as deer winter range. These slopes between Creekside and Lillooet Lake are probably important deer hunting areas, particularly for native Indians in the surrounding region (R. Lawrence, pers. comm.).

In summary, the north side of Anderson Lake has been greatly disturbed through clearing for transmission line, thus the replacement of an existing line with the proposed transmission line is perceived as having an incremental effect on wildlife values in this area. In contrast, the Cayoosh Creek/Duffey Lake option is particularly important, not only for the diversity of wildlife habitat, but also for the opportunities offered for viewing wildlife. Additional access along the lower slopes of the Cayoosh Creek valley, and consequently increased disturbance by human activity will potentially have a much more severe impact on wildlife than that for the Anderson Lake option. It was concluded, therefore, that the wildlife values of the Cayoosh Creek/Duffey Lake corridor are substantially greater than those of the Anderson Lake corridor.

PEMBERTON TO CHEEKYE

Three corridor options were considered between Pemberton and the Cheekye substation near Squamish.

The most direct corridor option would follow the existing transmission lines through the Green River and Cheakamus River valleys, and the settled area around Whistler. Wildlife values through this area are generally low as a result of residential and rural development in the vicinity of Pemberton and Whistler, and because of the multitude of transportation, power and communication corridors through this valley.

The major wildlife concerns between Pemberton and the Soo River are the possible loss of deer winter range near Rutherford Creek and the potential disturbance to waterfowl at Green Lake. These concerns are common to all corridor options between Pemberton and Cheekye and appear to be avoidable at the route selection stage.

Wetlands, important for a variety of waterfowl, are found along the valley floor, such as those located between Brandywine Falls and McGuire and at the north end of Alta Lake. Green Lake is also utilized by migratory and nesting waterfowl (R. Lawrence, pers. comm.). The less developed areas between Green Lake and Pemberton, along the Green River, and between Lake Lucille and Cheekye are likely used by deer and a few goats.

Two alternate corridors were suggested to skirt the development at Whistler, thus avoiding the visual problems of a larger transmission line through this recreational resort. These options are located in the Soo, Callaghan and Squamish valleys on the west side of Whistler.

Wildlife values in these valleys are high (B. Harris, pers. comm.). Road access is limited to the lower elevations in the Callaghan Creek valley, and for a short distance into the Soo River valley. Deer, goat, and possibly moose occur in this

area. A fairly extensive complex of wet meadows and bogs occurs along the lower portions of the Soo Valley, and could be used as a stop-over point and/or nesting area for a variety of ducks, geese and swans. Snow depths may be prohibitive, but there is a reasonable likelihood that the Soo Valley wetlands are used by moose, as moose have been observed in the Rutherford Creek valley farther north (B. Harris, pers. comm.). The upper elevations of the Soo and Callaghan drainages are also used by grizzly and black bear. The Callaghan Valley is particularly popular for deer hunting due to its accessibility to Lower Mainland hunters.

The most indirect corridor would follow the Soo Valley to its headwaters in the subalpine and alpine areas, and continue westward to join the Elaho and Squamish River valleys. The subalpine and alpine areas between the upper Soo Valley and the Elaho Valley are particularly sensitive wildlife habitats. Other significant wildlife areas occur at the confluence of the Elaho and Squamish Rivers, which is an important mountain goat range, at the confluence of Ashlu Creek and the Squamish River, and along the Squamish Valley where important deer winter range occurs.

The existing corridor through the Whistler area would entail the least disturbance to wildlife, as much of the wildlife in this area has been displaced by roads, railway, transmission lines, residential and commercial development. Adverse effects on wildlife in this corridor will undoubtedly occur in a minor way, but pale by comparison to the Soo/Callaghan and Squamish/Elaho options.

Both the loops that avoid Whistler have high wildlife values, contain a diversity of wildlife habitats, and are important for local hunting. The Soo Valley/Callaghan option is shorter than

that utilizing the Elaho and Squamish Valleys, and would therefore likely result in somewhat lesser impact on wildlife.

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CHAPTER 8

FISHERIES

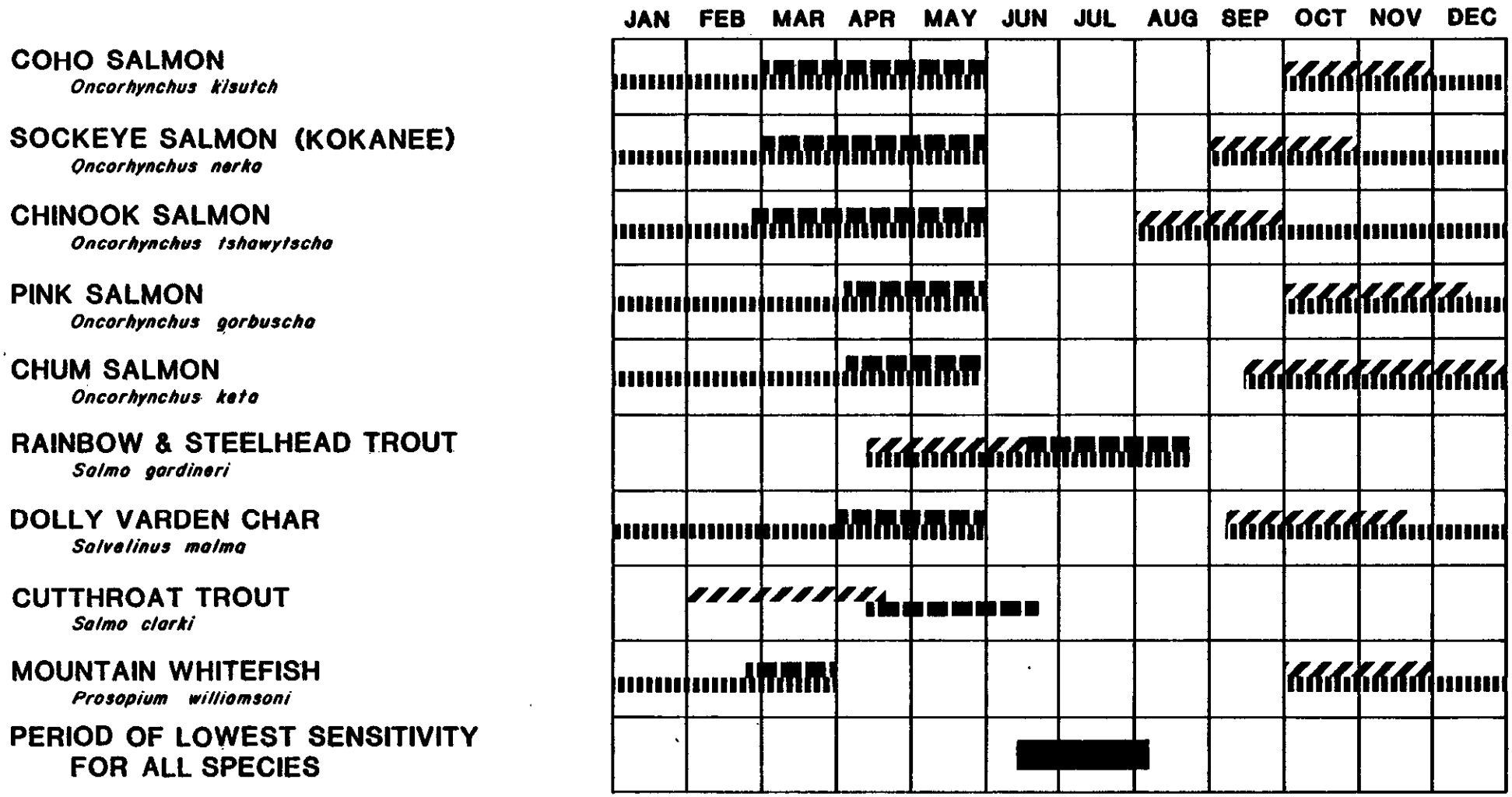
Two major watersheds - the Fraser and the Squamish Rivers - are located within the study area. Both of these river systems are salmon producers; the Fraser River is the most significant in the Province. Numerous salmon migration routes, spawning streams, rearing areas and fisheries enhancement facilities are located along the various possible transmission line corridors. The region affected is also noted for its important native Indian food fishery and a highly productive and much utilized sports fishery.

A wide variety of anadromous (sea-going) and freshwater fish species are found within the study region. All five species of Pacific salmon frequent portions of both watersheds, as do steelhead trout and coastal cutthroat trout. The major freshwater species are kokanee, rainbow trout, Dolly Varden char and mountain whitefish. Figure 8.1 summarizes the life cycles of all major species found in the study area.

KELLY LAKE TO SETON LAKE

The Kelly Lake to Seton Lake region is restricted entirely to the Fraser River drainage. The rivers and streams that are

LIFE CYCLE CHARACTERISTICS OF THE MAJOR FISH SPECIES IN THE STUDY AREA



NOTE· This table represents the "usual" period of occurance of life cycle events for the major fish species in the Study Area. It should be recognized that there is frequently variation in the timing of these events , and therefore in the estimated period of lowest environmental sensitivity.

FIGURE 8.1

affected by the possible corridors in this region are listed in Table 8.1.

Salmon Escapement and Spawning

The Kelly Lake-Bridge River region includes three important spawning areas and one of the Province's major salmon migration routes - the Fraser River. Migratory stocks moving up the Fraser River consist mainly of Sockeye salmon, but there are also significant numbers of other salmon species with the exception of Chum salmon. Major spawning runs are found in the lower Seton, lower Bridge and Yalakom Rivers. Escapement values for these and other rivers are reported in Table 8.2.

The lower Seton River is the major spawning river in the region with escapements up to 390,000 fish. Spawning takes place in the lower Seton River in two spawning channels operated by the International Pacific Salmon Fisheries Commission. There is also some spawning in the lower reaches of Cayoosh Creek below the falls. The Seton River is also an important migration route for salmon which spawn in Gates and Portage Creeks. These stocks pass the Seton River dam by way of a fish ladder.

The two spawning channels on the Seton River have a total available spawning area of 22,492 m^2. These channels are used only during odd years by pink salmon, and have the capability to produce approximately 24 million fry.

Seton Lake is an important rearing area for the Sockeye salmon that spawn in either Gates or Portage Creek. Most of the fry from Gates Creek migrate through Anderson Lake and rear in Seton Lake, in spite of the higher zooplankton abundance in Anderson Lake. It has been assumed, therefore, that the

TABLE 8.1
WATERCOURSES AFFECTED BETWEEN KELLY LAKE AND SETON LAKE

CORRIDOR	WATERWAY	PARALLEL (//) and/or CROSSED (X)
Kelly Lake East (AB)	Kelly Lake	//
	Kelly Creek	//
Kelly Lake North (AC)	Kelly Lake	//
	Kelly Creek	// and X
Kelly Lake South (BC)	Kelly Creek	X
Camelsfoot South (BE)	Fraser River	X
	McKay Creek	X
Camelsfoot North (CE)	Kelly Creek	// and/or X
	Fraser River	X
	McKay Creek	X
Marble Range (BD)	Pavillion Creek	// and X
Pavilion-Fountain (DF)	Tributaries to:	
	Fraser River	//
	Fountain Creek	X
	Fraser River	X
	Seton River	X
	Seton Lake	//
Pavilion-Mission (DG)	Fraser River	X
	Slok Creek	X
	Bridge River	X
	Dickey Creek	//
Mission Ridge South (GJ)	Moon Creek	X
	Camoo Creek	X
Mission Ridge North (GI)	Moon Creek	X
	Camoo Creek	X
Applespring Creek (EHI)	Applespring Creek	// and/or X
	Bridge River	X
	Camoo Creek	X
Antoine Creek (EI)	Antoine Creek	// and/or X
	Bridge River	X
Bridge Valley (IK)	Bridge River	//
	Carpenter Lake	//
Seton Lake (FL)	Cayoosh Creek	X
	Machute Creek	X
	Seton Lake	//
	Spider Creek	X
	Portage Creek	X

TABLE 14.2

IMPACT COMPARISON - ANTOINE (ACEIJKL)
AND PAVILION (ABDGJKL) CORRIDORS

	RATING OF ADVERSE IMPACT	
FACTOR	ANTOINE	PAVILION
Terrain	5	2
Vegetation	4	2
Agriculture	1	3
Fisheries	2	3
Forestry	1	2
Wildlife	5	1
Visual	4	2
Recreation	3	1
Land Use	2	3
Heritage	1	2

Note: Rating scale is 1 to 5, low to severe.

rearing potential of Anderson Lake is not available to Sockeye salmon (IPSFC 1972).

The Bridge River run is a large run which can consist of as many as 40,000 fish. Most of these fish spawn below the confluence of the Bridge and Yalakom Rivers. Although fish utilize the Bridge River up to the Terzaghi Dam, the intermittent flows over the dam mean that the spawning areas upstream of the Yalakom River are not always accessible, and that seeded stock frequently dry out when flows over the dam are stopped. The dam itself forms a migration barrier to fish as there are no fish ladders.

In comparison to the Bridge or Seton Rivers, the Yalakom River does not constitute a major salmon spawning area. Sockeye salmon, which used to frequent the Yalakom River, have not been observed since 1968 (Brown et al, 1969).

Native Indian Food Fisheries

Important native food fisheries are located on the Fraser, Bridge and Seton Rivers (Portage Creek), of which the most significant is that on the Fraser River. Areas of particular importance are located at the mouths of the Seton and Bridge Rivers. The fishery at Portage Creek (Seton Portage) is of minor importance when compared to these other two areas. Catch records over the last four years are given in Table 8.3.

TABLE 8.3

NATIVE INDIAN FOOD FISHERIES DATA FOR THE FRASER RIVER FROM TEXAS CREEK TO CHUM CREEK

(Includes Bridge River, Seton River and Portage Creek)

Year	Pieces
1976	32,000
1977	53,070
1978	24,015
1979	54,521

Sport Fisheries

Sports fisheries in the Kelly Lake-Seton Lake region are highly productive, and are of major significance in a regional context. The major species taken are rainbow trout, Dolly Varden, mountain whitefish and steelhead trout.

Kelly Lake contains resident rainbow trout, and has been stocked with additional rainbow trout in order to support local recreational demand.

The Bridge and Yalakom Rivers support a major sports fishery, yielding Dolly Varden, mountain whitefish, rainbow and steelhead trout. The Yalakom River is less productive than the Bridge River; the most productive sports fishing area is at the confluence of the Bridge and Fraser Rivers.

The Seton River also supports a varied sports fishery, the most important species being steelhead. The most productive area on the lower Seton River is at its confluence with the Fraser River.

The B.C. Fish and Wildlife Branch is making an effort to enhance steelhead stocks in the Seton River system. At the present time, the success of the stocking programs in Gates Creek and the effects downstream on the Seton River are unknown.

The lower reaches of Cayoosh Creek are also fished for steelhead; rainbow trout and Dolly Varden, and possibly mountain whitefish are also taken. Steelhead are restricted to the lower reaches of the creek as they are unable to pass the falls approximately 1 km upstream of its confluence with the Seton River. This area has become quite popular for sports fishing

over the past several years. Table 8.4 reports steelhead sports fishing data, obtained over the last five years for major rivers and streams in the study area.

SETON LAKE TO PEMBERTON

The water courses affected by the proposed Anderson Lake and Cayoosh Creek corridors are shown in Table 8.5.

Salmon Escapement and Spawning

The Seton/Anderson Lake system and its tributaries, such as Gates Creek, support large populations of salmon, primarily Sockeye but also Coho, Chinook and pink. There are two major spawning areas in this system, the Seton River at Seton Portage, and Gates Creek, located at the headwaters of Anderson Lake. For detailed escapements see Table 8.2.

Gates Creek is the site of a salmon spawning channel operated by the International Pacific Salmon Fisheries Commission. Most of the Gates Creek and Seton Portage sockeye stocks rear in Seton Lake rather than Anderson Lake (IPSFC 1966).

The Birkenhead River, a tributary to Lillooet Lake, is a major Sockeye producer, as well as producing modest amounts of Coho or Chinook. Table 8.2 gives salmon escapement values for this river as well as for Poole Creek, a small tributary to the Birkenhead. This creek is utilized by Coho.

Recently, a small Chinook hatchery came into operation at the confluence of Owl Creek and the Birkenhead River. This will serve to increase the Chinook salmon yield on the Birkenhead River.

TABLE 8.4

STEELHEAD SPORT FISHING DATA

	YEAR	NUMBER OF ANGLERS	ANGLER DAYS	KILLS	RELEASES	CATCH PER UNIT EFFORT (Number/ Day)
Birkenhead River	78/79	6	25	0	0	0
	77/78	14	23	0	3	0.125
	76/77	11	75	11	3	0.2
	75/76	13	40	0	0	0
	74/75	10	46	7	0	0.154
Bridge River	78/79	69	599	74	22	0.161
	77/78	46	441	38	0	0.086
	76/77	81	549	41	41	0.150
	75/76	48	419	48	13	0.149
	74/75	46	527	39	3	0.081
Cayoosh Creek	78/79	21	144	31	0	0.222
	77/78	13	261	34	3	0.145
	76/77					
	75/76					
	74/75					
Cheakamus River	78/79	680	3,164	161	342	0.160
	77/78	805	3,841	199	361	0.146
	76/77	764	4,593	260	465	0.158
	75/76	846	3,510	248	143	0.112
	74/75	923	4,747	302	384	0.145
Cheekye River	78/79	48	109	3	3	0.059
	77/78	43	67	0	0	0
	76/77	26	48	0	0	0
	75/76	29	99	0	0	0
	74/75	39	117	0	0	0
Green River	78/79	6	9	3	0	0.333
	77/78	5	7	0	0	0
	76/77					
	75/76					
	74/75					
Lillooet River	78/79	54	200	3	0	0.016
	77/78	42	158	24	6	0.191
	76/77	56	398	15	0	0.038
	75/76	116	683	71	4	0.111
	74/75					

Source: Fish and Wildlife Branch, Steelhead Harvest Analysis (1974-79).

TABLE 8.4 (Continued)

	YEAR	NUMBER OF ANGLERS	ANGLER DAYS	KILLS	RELEASES	CATCH PER UNIT EFFORT (Number/ Day)
Seton River	78/79	9	64	0	0	0
	77/78	4	27	1	16	0.75
	76/77	22	116	3	0	0.032
	75/76	7	56	4	0	0.077
	74/75	39	776	14	0	0.018
Squamish River	78/79	1,018	4,993	339	612	0.191
	77/78	1,044	4,293	261	456	0.169
	76/77	957	5,481	224	208	0.081
	75/76	1,136	4,974	827	516	0.27
	74/75	926	4,190	515	354	0.208

TABLE 8.5

WATER COURSES AFFECTED BETWEEN SETON LAKE AND PEMBERTON

CORRIDOR SEGMENT	WATER COURSE	PARALLELED AND/OR CROSSED
Cayoosh Creek (FM)	Cayoosh Creek	// and X
	Copper Creek	X
	Cinnamon Creek	X
	Downton Creek	X
	Goat Creek	X
	Melvin Creek	X
	Duffey Lake	//
	Joffre Creek	// and X
	Birkenhead Lake	X
Anderson Lake (LM)	Whitecap Creek	X
	Seton River (Portage Creek)	//
	Connel Creek	X
	Anderson Lake	//
	McGillivray Creek	X
	Gates River	// and X
	Gates Lake	//
	Poole Creek	// and X
	Birkenhead River	// and X
	Owl Creek	X

Native Indian Food Fisheries

There is only one licensed Indian food fishery in this region; that is at Portage Creek, at Seton Portage.

Sports Fishing

This region encompasses several highly productive sports fishing areas.

The Cayoosh Creek corridor is served by road access from Lillooet and Pemberton. The Duffey Lake/Cayoosh Creek system contains stocks of Dolly Varden, rainbow trout and mountain whitefish. Most of the stocks are quite small with few fish over two pounds. The best fishing in the system is located at the north end of Duffey Lake at the outflow of its two major tributaries.

The Anderson Lake/Seton Lake system provides varied sport fishing and is of major regional importance. Rainbow trout, Dolly Varden and mountain whitefish are fished in both the lakes and tributaries. Gates Lake also supports Kokanee salmon. Recent attempts by the Fish and Wildlife Branch to introduce steelhead trout to Gates Creek may create a major steelhead fishery in this area. Such a fishery could develop into one of major recreational importance due to its proximity to the greater Vancouver area.

The Birkenhead system provides a wide variety of fishing opportunities. Birkenhead Lake is known for its rainbow trout and Dolly Varden. The Birkenhead River, in addition to being fished for Rainbow trout and Dolly Varden, is also fished for

Chinook salmon and steelhead trout. It is a popular, easily accessible, fishing area for Lower Mainland anglers.

PEMBERTON TO CHEEKYE

The Pemberton to Cheekye region is situated in both the Fraser and Squamish River drainages. The area encompasses important Indian food fisheries, sports fisheries and salmon spawning areas. A list of the potentially affected waterways in this region is given in Table 8.6.

Salmon Escapement and Spawning

The upper Lillooet River is utilized by spawning Chinook and Coho salmon. Upon emergence the fry migrate downstream and rear in either Lillooet or Harrison Lakes. Coho escapement can be as high as 15,000.

The lower reaches of both Pemberton Creek and the Green River are also important spawning areas. The upstream migration of anadromous fish in both streams is prevented by waterfalls (see Map 3d). Maximum escapement for Pemberton Creek is about 400 Coho salmon while the maximum for the Green River is 2,500 Coho. A small run of Sockeye is also associated with the Green River.

The Squamish River and tributaries are utilized by Chinook, Coho, pink and Chum salmon. The upstream limit of migration on the Squamish is 1 km north of its confluence with the Elaho River.

The Squamish River has a higher escapement than any other system potentially affected by the Kelly Lake-Cheekye transmission line. Maximum reported escapements are in the range of 15,000 Coho, 75,000 pink, 75,000 Chinook and 200,000 Chum. These stocks have a very major effect on commercial and sports fishing in the Strait of Georgia and Howe Sound.

The lower reaches of the Elaho River are accessible to salmon but it is doubtful whether any spawning takes place. It is felt that salmon in the Elaho may return to the Squamish to spawn. Accurate enumeration of migrants or spawners is impossible due to the high suspended sediment loads in the Elaho River (Frank Wheeler, pers comm).

The lower reaches of Ashlu Creek are also accessible to salmon; migration further upstream is prevented by a waterfall.

The lower reaches of the Cheakamus River also support salmon, particularly pink and Chum salmon. A narrow canyon approximately 14.5 km upstream from its confluence with the Squamish River, acts as a migration barrier to all anadromous fish.

Other small tributaries to the Squamish/Cheakamus system are utilized by salmon. Access is usually restricted to the lower reaches of the tributaries. Most of the rearing of juveniles takes place in the lower Cheakamus and Squamish Rivers. Table 8.2 summarizes escapement data for these rivers and streams.

At present, floating Chinook rearing pens are being used in the Squamish River at the Daisy Lake tailrace (Brian Harris, pers comm). This will enhance both commercial, sport and domestic fishing in the Squamish River, Howe Sound and surrounding waters.

TABLE 8.6

WATER COURSES AFFECTED BETWEEN
PEMBERTON AND CHEEKYE

CORRIDOR SEGMENT	WATERWAY	PARALLELED AND/OR CROSSED
Pemberton Options (MN)	Lillooet River	X
	Pemberton Creek	X
	Green River	// and X
	Rutherford Creek	X
Whistler (NS)	Green River	// and X
	Soo River	// and X
	Green Lake	//
	Alta Creek	X
	"wenty Mile Creek	X
	Alta Lake	//
	Millar Creek	// and X
	Cheakamus River	X
Soo Valley (NO)	Soo River	// and X
Callaghan Creek (OS)	Callaghan Creek	// and X
Mt. Callaghan North (OPR)	Upper Soo River	// and X
Mt. Callaghan South (OQR)	Upper Soo River	X
	Callaghan Lake	//
Squamish Valley (RT)	Squamish River	// and X
	Turbid Creek	X
	Shovel Nose Creek	X
	High Falls Creek	X
	Ashlu Creek	X
	Sigurd Creek	X
	Mawby Creek	X
	Tantalus Creek	X
	Pillchurch Creek	X
	Elaho River	X
Cheakamus Valley (ST)	Callaghan Creek	X
	Cheakamus River	// and X
	Brandywine Creek	X
	Daisy Lake	//
	Culliton Creek	X
	Swift Creek	X
	Cheekye River	X

The Department of Fisheries and Oceans are also looking at the possibility of constructing a salmon hatchery on a tributary to the Cheakamus River north of Cheekye. This hatchery would produce Coho, Chinook and Chum salmon.

Native Indian Food Fisheries

Two major food fisheries are found in the Pemberton/Cheekye region. One is located on the Lillooet River near Pemberton and the other on the Squamish River.

There is no catch data available for the Pemberton area (Ian McCormick, pers comm). The fishing is restricted primarily to the Lillooet River mainstem and consists of Coho, Chinook and Sockeye salmon.

The Squamish Indians fish the Squamish River, with Coho and Chum salmon making up the majority of the catch. The catch figures for this fishery are reported below.

TABLE 8.7

NATIVE INDIAN FOOD FISHERIES DATA FOR THE SQUAMISH RIVER

YEAR	CHINOOK	COHO	CHUM	PINK	TOTAL
1977	950	5,600	3,000	2,300	11,850
1978	400	6,600	5,500	Off Year	12,500
1979	450	5,800	5,000	100	11,350

Source: Frank Wheeler (pers. comm.)

Sport Fishing

Sport fishing in the Pemberton/Cheekye region merits considerable attention, due to the close proximity of the region to the populated Lower Mainland area, and the development of the municipality of Whistler as a year round recreational resort. Maintenance of sport fishing potential will be viewed as a key issue by review agencies.

Sport fishing occurs along the entire length of the Green River. Rainbow trout and Dolly Varden are the most common catches, but the whole system is only moderately productive. In the area below Nairn Falls, steelhead are occasionally taken (see Table 8.4).

Detailed fisheries information on the Soo River and Rutherford Creek are not available; as a result, their sport fishing capability cannot be accurately assessed. Both creeks are virtually inaccessible, and consequently are not fished. It is probably reasonable to assume that the Soo River has at least moderate capability for sports fishing, but Rutherford Creek, with a steep gradient, may not supply adequate fish habitat.

As well as supporting Dolly Varden and rainbow trout, Green Lake is known to contain self propogating stocks of kokanee. Green Lake is also on the Fish and Wildlife Branch rainbow trout stocking program.

Alta, Nita and Alpha Lakes are all fished heavily. The major species taken are Dolly Varden, rainbow trout and kokanee. These lakes are also stocked by the Fish and Wildlife Branch.

Callaghan Lake, at the headwaters of Callaghan Creek, offers some of the best natural stock fishing in the Squamish/Whistler

area. Of primary importance are the presence of large rainbow trout and Dolly Varden. This lake is not being stocked and appears capable of handling the mild to moderate fishing pressures asserted on it. Access is by way of a fair quality logging road.

Callaghan Creek has a low sport fishing potential. It has a steep gradient and low habitat diversity.

Daisy Lake is also a reasonable sport fishing lake for rainbow trout. The Cheakamus River between Daisy Lake and the Canyon offers some fishing potential but due to the great demands on this system as a result of its proximity to the highway, poor yields are realized.

Below the Cheakamus canyon anadromous fish became available, primarily Coho and Chinook salmon, but also steelhead and cutthroat trout. The steelhead fishery in the Cheakamus River is a major one accounting for 500 catches a year (see Table 8.4).

The Squamish River supports a highly productive sport fishery, including species such as steelhead, cutthroat and rainbow trout, Coho and Chinook salmon, and Dolly Varden. Fishing is concentrated below the junction of the Elaho and Squamish Rivers. Table 8.4 shows the steelhead harvest analysis data for the Squamish and Cheakamus systems. The Squamish River can account for up to 900 steelhead catches a year and is of particular importance to fishermen from the Lower Mainland due to its close proximity and accessibility.

TRANSMISSION LINE LOCATION AND CONSTRUCTION CONCERNS

The fisheries concerns associated with transmission line and access road construction are outlined below under three major headings: Habitat Alteration, Facilitated Harvest and Pollution Hazards.

Habitat Alteration

Migration barriers can prevent the successful upstream migration of spawners, thereby preventing them reaching spawning areas, and may also interfere with successful downstream migration of fry. In addition, barriers restrict the habitat available for use by resident species.

Migration barriers can be created in a number of ways. These include poor culvert installation during access road construction, ground slumping as a result of vegetation removal, and log and debris jams as a result of improper clearing practices.

Quality deterioration of spawning beds affects the survival of incubating eggs and lowers the capacity of the system to support fish. Disturbances to the beds can occur as a result of surface runoff from the cleared alignment, poor culverting and access road construction. Crossing of streams with heavy equipment should be avoided as this can cause serious siltation problems which may affect spawning areas.

Changes in nutrient (NO_3^-, NO_2^-, NH_4^+ and PO_4) and dissolved gas (O_2, CO_2) concentrations can result through enhanced leeching due to right-of-way clearing and through changes in algal photosynthetic rates attributed to increased suspended sediment (i.e. turbidity).

Loss of bank vegetation can decrease the terrestrial insect input into the streams, often an important food source for fry. Loss of bank vegetation can also alter the shade characteristics of the stream, an important factor in fish habitat suitability.

Pollution Hazards

B.C. Hydro uses several herbicides for the maintenance of rights-of-way (Table 8.8). Introduction of these herbicides to streams can have a direct effect on fish (Woodward, 1976; Henningman, pers comm) or indirectly through curtailing algal production and general food chain disruption.

Hydrocarbon introduction can be caused by driving vehicles through creeks, and through the improper handling of gasoline, diesel fuel, oil and grease. Hydrocarbons can result in acute and chronic effects on members of the aquatic ecosystem.

Facilitated Harvest

Construction of new access roads and new transmission line corridors can result in improved accessibility into otherwise inaccessible areas. The potential increase in sport fishing may seriously deplete the natural fish populations.

Operation and Maintenance

The impacts of operation and maintenance of transmission lines is small as compared to actual construction. If major maintenance is required (ie. tower replacement) the same effects

TABLE 8.8

HERBICIDES USED ON B.C. HYDRO RIGHTS-OF-WAY

TORDON 101	- liquid mixture of 10 oz picloram and 4 oz 2,4-D per gallon
TORDON 10K	- solid pellets of 10 percent picloram
2,4-D ESTER	- liquid 2,4-D in various concentrations
2,4-D AMINE	- liquid 2,4-D in various concentrations
KRENITE	- liquid form of fosamine
HYVAR X-L	- liquid form of bromacil
DYCLEER 4.8-O.S.	- liquid form of dicamba

Note: The above herbicides are used on public land only after approval by permit of the regulatory agencies which is presently the Administrator, Pesticide Control Act. B.C. Hydro's use of herbicides is performed in accordance with conditions specified on the permit and the pesticide label.

that can be precipitated during construction may occur. The only potential effects of high voltage transmission line operation are those caused by the electromagnetic field on fish. These effects are poorly understood, but could include behavioural changes and an interference with migratory instincts.[1]

Deactivation and Abandonment

The impacts of deactivation and abandonment of the proposed transmission line would be minimal provided the line is not salvaged. If the line is removed then the impacts and implications would be similar to those involved in construction.

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CHAPTER 9

RECREATION AND VISUAL RESOURCES

Recreation in the study area encompasses a wide range of activities, including hiking, camping, fishing, hunting, downhill and cross-country skiing, canoeing and sightseeing. In addition to the variety of recreational activities offered, the warm summers and mild winters characteristic of the coastal region, and the warm, dry summers in the interior region permit many forms of recreation to occur on a year-round basis.

The selection of a preferred corridor for the proposed transmission line, and the assessment of potential impacts on outdoor recreation resources resulting from transmission line construction and operation, was based primarily on published information, supplemented by a limited amount of field work done in the fall of 1980. The British Columbia Land Inventory maps, at a 1:250,000 scale, showing land capability for outdoor recreation, were the primary source of data for the recreation assessment. Additional published information, such as the Provincial NTS Maps (scales 1:100,000 and 1:125,000), B.C. Forest Service maps, and several reports published by government ministries were also drawn upon. Contact was also made with provincial, regional and community representatives in order to upgrade published information. Published information

on recreational use of the various corridor alternatives was very scarce, and where it did exist (such as for Garibaldi Park, Whistler Mountain), did not allow for any meaningful comparisons of the corridors.

Information on visual resources throughout the study region was extremely limited. Moreover, it was considered at the outset of this study that any discussion of effects of transmission line location on visual resources, at the stage of corridor selection, could only be of a general nature. Thus, the assessment of visually sensitive areas along the corridor alternatives is purely subjective, and is based entirely on a limited number of field observations from the ground and the air. A detailed assessment of visual impacts is more appropriate at the route selection stage, once a broad corridor for the transmission line has been established. For the purposes of this study, visually sensitive areas were identified on the basis of the following broad considerations:

1) proximity of transmission line to existing/proposed transportation corridors

2) level of public use of transportation corridors (i.e. traffic flows on Highway 99, along Anderson Lake, Duffey Lake Road)

3) extent to which it would be possible to avoid or minimize visual impact on the landscape through careful route alignment (i.e. steep, narrow valleys would generally have fewer routing options than broader, flatter terrain)

4) presence of visually interesting natural or man-made features

5) proximity to settlement.

POTENTIAL IMPACTS

The effects of transmission line location on recreation resources relate primarily to the potential for visual impairment, and the potential for new or improved access into otherwise inaccessible areas.

Enjoyment of the natural surroundings is usually an important component of most outdoor recreation activities; thus, the choice of location for a transmission line should reflect concern for the preservation of scenic values.

New or improved access into an area may be viewed as either a positive or negative effect. For some, increased access into an area otherwise less accessible may be considered as a benefit in the short term, whereas that same feature may ultimately result in overcrowding, and/or depletion of the resource due to increased hunting or fishing activity, thus detracting from the quality of the recreational experience. The construction of a transmission line could also result in the loss of habitat for wildlife, or siltation of spawning or rearing areas in streams. These effects could potentially reduce populations, and consequently limit opportunities for hunting and fishing over the longer term.

A discussion of the recreation opportunities and areas of visual sensitivity along the corridor options is provided in this chapter and illustrated in Map 4. The width of the impact rating band does not indicate corridor width.

KELLY LAKE TO SETON LAKE

Corridor options between Kelly Lake and Seton Lake cross the open Ponderosa pine forests and rolling grasslands of the

Marble and Camelsfoot Ranges. Opportunities for outdoor recreation, with the exception of hunting and fishing, are generally limited.

Downing Provincial Park is located at Kelly Lake, just south of the substation. The lake is a popular site for local sports fishermen. It contains resident rainbow trout and is stocked with additional trout to support growing recreational demand. The only other lake with significant recreational potential is Seton Lake which provides opportunities for boating and fishing. Sports fishing opportunities elsewhere in the region are numerous; the confluence of the Fraser and Bridge Rivers, and the confluence of the Seton and Fraser Rivers are the most productive fishing areas in this region. Seton Portage Historic Park is located at Seton Portage, but is well removed from the transmission line corridor.

Hunting opportunities between Kelly Lake and Seton Lake are concentrated in the higher elevation areas of the Camelsfoot and Marble Ranges. The headwaters of Applespring and Antoine Creeks in the Camelsfoot Range are important deer hunting areas, and represent significant native food hunting opportunities as well. Road access into the upper elevations of these creeks is not presently available; the importance of preventing further access into these areas was a major concern expressed by the local native population, in order to limit hunting pressure on the deer populations. Other significant hunting opportunities exist in the Marble Range, northeast of Pavilion and the Diamond S ranch. Access is available throughout most of this area, by way of gravel roads and the existing transmission line rights-of-way. Concern over public use of these roads where they cross through privately owned land and the Pavilion Reserve was expressed by the local residents.

The BCLI outdoor recreation capability maps show no Class 1 areas (very high capability), although there is one Class 2 site at the confluence of the Bridge and Fraser Rivers. Several sites with moderate capability are located along the banks of the Fraser River and along the shores of Seton Lake. Much of the shoreline of Seton Lake has limited recreation potential due to the very steep side slopes, the lack of available road access, and the presence of the B.C. Rail track along the north side.

Opportunities for tourism in the region are significant. The town of Lillooet, situated on the Fraser River at the junction of Highway 12 and the Duffey Lake Road is projected to become a primary regional tourism center along the proposed Nugget Tour Route (Ministry of Tourism, 1980). This tour route will provide a two to three day trip from Vancouver to Pemberton via Highway 99, Pemberton to Lillooet via the Duffey Lake Road, and Lillooet to Vancouver via Highway 12 and Highway 1. The extent to which this tour route will be utilized by tourists will partly depend on the timing of improvements to the Duffey Lake Road. In the long term, however, it is reasonable to expect that Lillooet will become a major tourist service centre in the region.

The Fraser is one of the more popular rivers for commercial rafting expeditions in B.C. This form of recreation has rapidly gained popularity in B.C., and attracts tourists from elsewhere in Canada and the United States. It has been suggested that Lillooet could become a focus for rafting expeditions in the future (Village of Lillooet, Official Community Plan, Jan. 1980 - draft).

Visual Concerns

The key areas of visual sensitivity occur along those corridor segments that are presently accessible, and are in close proximity to settled areas. Between Kelly Lake and Seton Lake, the following corridor segments were identified as being visually sensitive:

Segment AC: The transmission line would traverse the steep side slopes west of Kelly Lake, above Downing Provincial Park, and would be visible from the lake and road surrounding the lake.

Segment DF: This segment follows the Fraser Valley south of Pavilion to the outlet of Seton Lake. For most of the distance, it would be in close proximity to Highway 12 and the BCR mainline north of Lillooet. In addition, this corridor traverses settled areas along the east bank of the Fraser River, crossing the Fraser near Lillooet, and traversing the steep side hill behind Lillooet. The larger towers and numerous conductors of 5L46 would likely be quite visible throughout this segment.

Segment FL: An additional transmission line along the south side of Seton Lake would be highly visible from the settled area at Seton Portage, as would the lake crossing to the north side of the lake near the Bridge River Terminal.

Segment IK: This segment follows the narrow, very steep Bridge River canyon up to Terzaghi Dam. The access road to Seton Portage is by way of the Bridge River canyon, representing some of the most dramatic scenery in the region that is presently accessible by road. As such, the

presence of a transmission line along the canyon would constitute a major intrusion into the scenery, and visual impacts would be difficult to minimize through such restrictive terrain (see photo 10).

Segment EI: The proposed crossing of the Bridge River near the mouth of Antoine Creek represents one of the more interesting views of the Bridge River valley encountered along the road. Of particular interest is the large erosion scarp on the north bank of the Bridge River, just south of its confluence with the Yalakom River (see photo 9). A crossing downstream of Antoine Creek would reduce the visual impact in this area.

SETON LAKE TO PEMBERTON

Only two transmission line corridors were identified in this portion of the study area. The northern option follows the northwest side of Anderson Lake to D'Arcy, continuing along the Gates Creek and Birkenhead valleys to Pemberton. The second option follows Cayoosh Creek from its junction with the lower Seton River to Duffey Lake, and from there crosses into the Lillooet Valley near Joffre Creek.

Recreation opportunities along Anderson Lake are quite limited due to the steep terrain along both shores, limited road access, the presence of the B.C. Rail along the north shore of the lake, and the presence of several transmission lines above the railway tracks. The Anderson/Seton Lake system supports a varied sports fishery, and is of regional importance in this context.

The BCLI mapping for this area shows only two areas with moderately high capability for recreation: Seton Portage, a lowlying bridge of land between Seton and Anderson Lakes, is rated Class 2 with potential for camping and beach activity; and the south end of Anderson Lake, also rated as Class 2 with similar potential. There are a few sites with moderate recreation potential scattered along the shoreline, but the majority of this corridor is rated as having low capability for outdoor recreation.

South of D'Arcy, the major opportunities for recreation are associated with sports fishing in the Gates Lake system. Rainbow trout and kokanee are found in the lake, and recent attempts by the Fish and Wildlife Branch to introduce steelhead to Gates Creek may create a significant steelhead fishery in this area. Such a fishery could have additional significance due to the proximity of Gates Lake to the Vancouver population.

Birkenhead Lake Park is the only established park in proximity to this corridor option, and is accessed by a road along Blackwater Creek. The Birkenhead system provides a variety of fishing opportunities, and has become a popular fishing spot for Lower Mainland anglers. The river is also popular for kayaking and canoeing. Hiking trails are poorly developed in this area, the only notable exception being the trail over McGillivray Pass which connects Bralorne to Anderson Lake. This is used for hiking and cross-country skiing.

Hunting activity along Anderson and Seton Lakes is quite limited, though both the Seton and Anderson Lake Bands utilize the Shulaps, Bendor and Cayoosh Ranges for hunting.

Recreational capability along the Duffey Lake corridor is rated as moderate, and is primarily related to sports fishing in

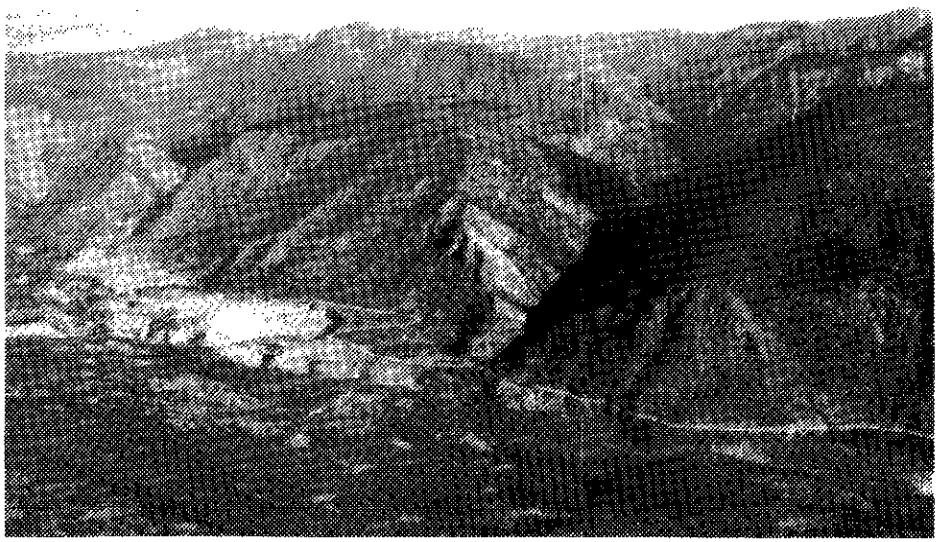


PHOTO 9 .Antoine Creek Valley near junction of Yalakom and Bridge Rivers. Note steep slopes of Antoine Valley (photo right); also large river meander. Crossing of Bridge River may impair scenic quality of Bridge canyon and river meander.

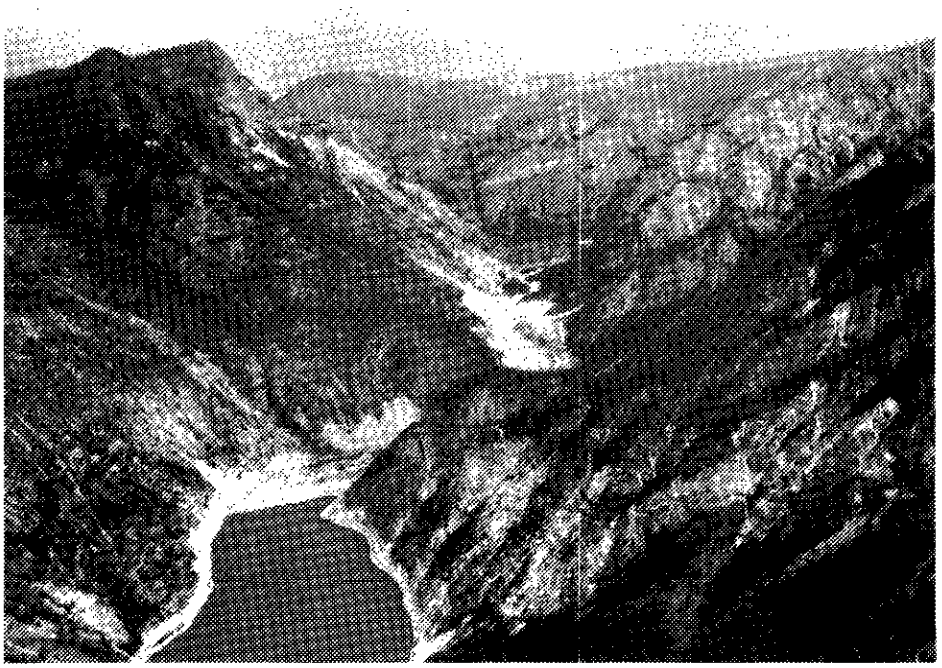


PHOTO 10 . Bridge River canyon below Terzaghi Dam is a visually sensitive area. Steep,narrow canyon restricts transmission line location to valley floor and lower slopes, continually visible from the road.

Duffey Lake and Cayoosh Creek. The road provides access into some noteworthy deer hunting areas in the Cayoosh Range; otherwise opportunities are rather limited, and only a few developed recreation sites, provided by the B.C. Forest Service, exist along the corridor.

The road itself provides some interesting sightseeing opportunities, and is being promoted by the B.C. Government as a tour route between Vancouver and Lillooet as discussed previously. The Duffey Lake Road is the only road within the study area that is presently not paralleled by transmission lines or other, major land-altering activities. The entire corridor, and particularly the steep, narrow valley along Cayoosh Creek is highly sensitive to visual impairment. In comparison, the corridor along Anderson Lake is traversed by four transmission lines, thus the replacement of the existing 2L1 right-of-way with the proposed 5L46 line can only be regarded as an incremental intrusion into an already heavily impacted landscape. The situation along Gates Creek, Gates Lake and the Birkenhead Valley is more of a visual concern, mostly because the valley is quite narrow, thus limiting the flexibility for route location within the valley. Moreover, several permanent and temporary residences are located along the valley floor, thus the replacement of the existing 230KV transmission line with the much larger, double circuit 500KV structures represents further visual intrusion into the landscape.

PEMBERTON TO CHEEKYE

The Squamish/Pemberton region contains some of the highest quality recreational land in the province, within easy access of the Lower Mainland population.

Pemberton is located approximately 40 km northeast of Whistler in the Lillooet Valley. Most of the valley floor is cultivated, presenting an attractive rural landscape flanked by scenic mountain ranges. The scenic quality of the valley are an important component of its recreational potential, and the Village Council has recognized the need to preserve these qualities in their Official Community Plan.

Two Provincial Parks are situated close to Pemberton; Nairn Falls Park is a Class A Provincial Park located along the Green River south of Pemberton, and Pemberton Park, a Class C park is located immediately south of the village boundaries adjacent to Highway 99. Both parks are presently infringed upon by transmission line rights-of-way.

Pemberton will undoubtedly be affected by the development of Whistler as a year-round destination resort. As well, the future promotion of the Nugget Tour Route via Highway 99 and the Duffey Lake Road, the potential development of a geothermal plant at Meager Creek, and the proposal to expand the Pemberton airstrip to serve as a regional airport for Whistler will provide substantial impetus for the expansion of Pemberton as a regional tourism service centre (Southwest Tourism Development Report, July 1980).

The Resort Municipality of Whistler is situated adjacent to Garibaldi Park, and serves two of the largest downhill skiing complexes in North America, with a projected peak capacity of 23,500 skiers per day.

The Whistler area is being aggressively promoted as a major destination resort, and has received substantial financial aid from the province in this effort. The Town Centre is situated at the base of Whistler and Blackcomb Mountains, and will

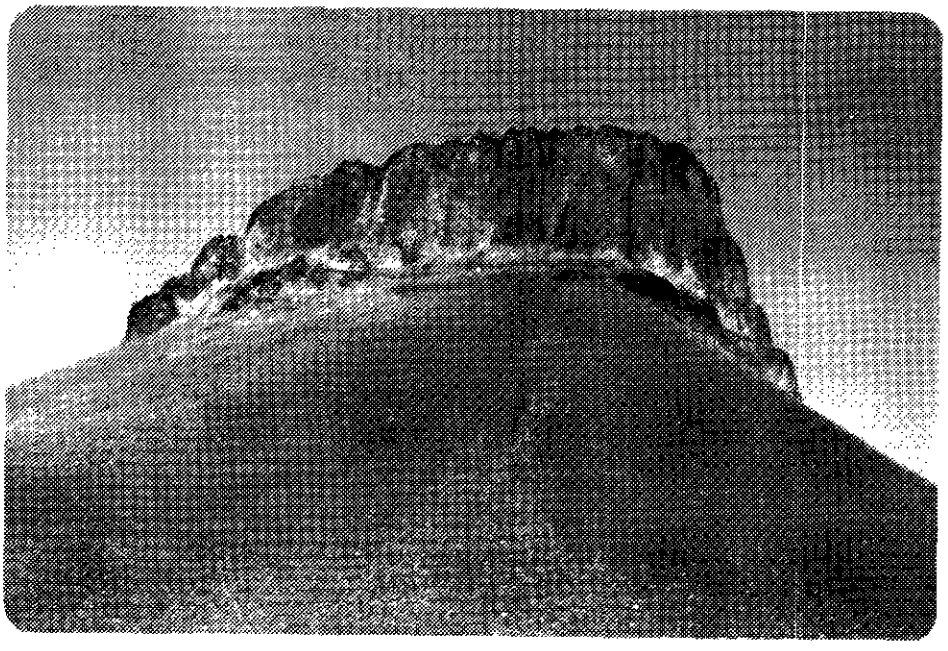
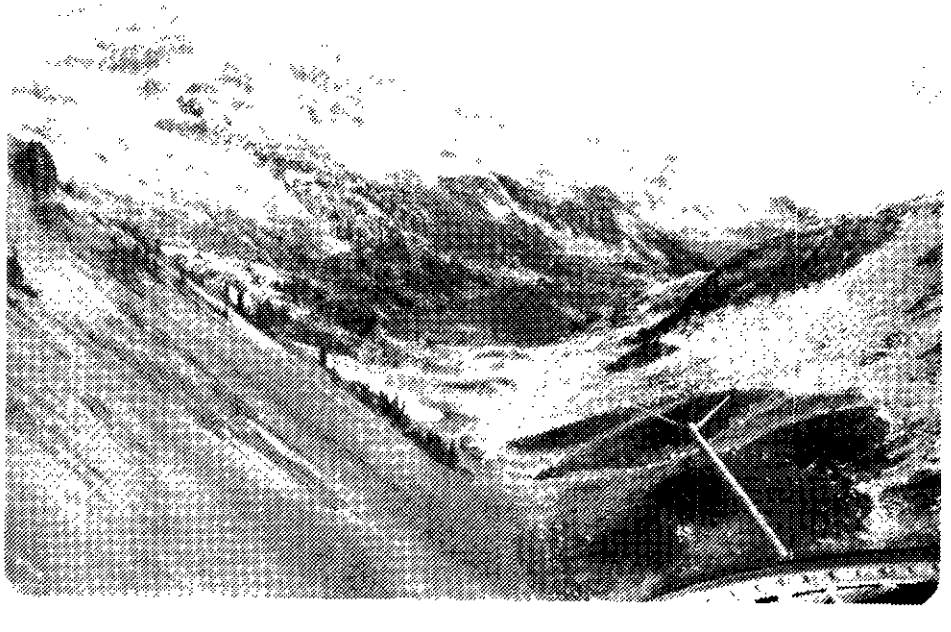


PHOTO 11 . *Volcanic cone at* the headwaters of the Soo River.



PHOTOS 12 and 13. Alpine areas in upper Soo and Callaghan Valleys are very scenic, and highly sensitive to visual impact.

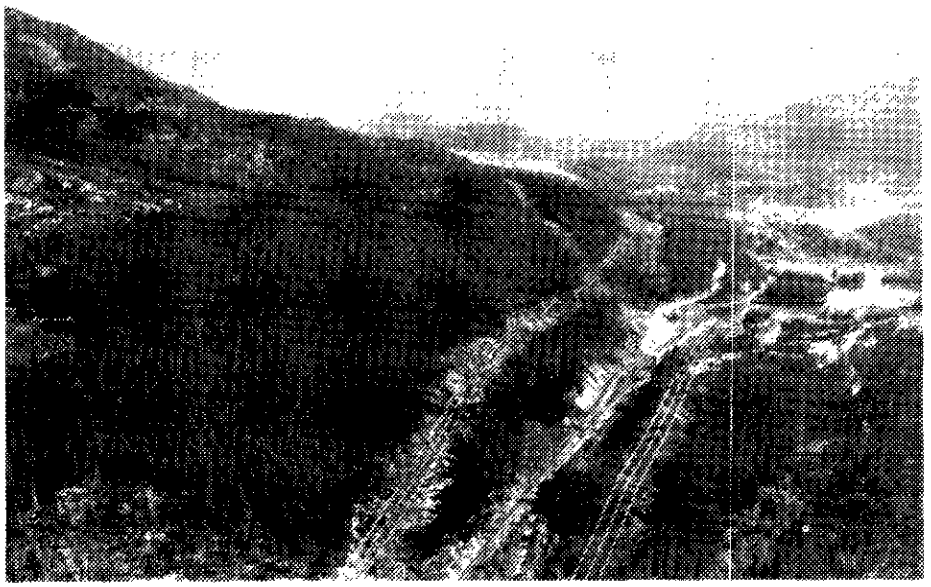


PHOTO 14 .Looking north at Whistler. The 2L1 right of way is in centre of foreground.

PHOTO 15 .Soo/Callaghan divide alpine vegetation and talus.

PHOTO 16 .Looking west over Tarn Lake south foot of Mt. Callaghan.

provide ammenities for tourists and local residents. Eventually, over 4,000 persons will be accommodated in the immediate Town Centre area.

In addition to the Whistler/Blackcomb complex, other recreation developments have been proposed over the past few years, the most recent being a proposal for a large downhill skiing facility in the Callaghan Valley, and a cross-country skiing lodge in the Callaghan Lake area. The Provincial Parks Branch has also indicated an interest in the area surrounding Callaghan Lake, although at the present time, this interest has not been expressed as a formal park proposal. Both logging and mining occur in the Callaghan valley, and the Forest Service has expressed a desire to incorporate the Callaghan drainage into a Provincial Forest, thus giving management responsibilities to the B.C. Forest Service. As a result of unresolved land use conflicts, the Provincial Government established a government reserve around the Callaghan Mountain area, preventing any land development within the boundaries of the reserve.

The significance of the Callaghan Valley to Whistler is related to the need for alternative forms of outdoor recreation in close proximity to the resort center. Clearly, if Whistler is to succeed as a major, year-round resort, opportunities for activities other than downhill skiing will have to be developed. The Callaghan Valley represents the only major opportunity for low elevation recreation in this area that is presently accessible by road.

Though downhill skiing will undoubtedly continue to be the primary recreational asset, other forms of recreation are available. Five freshwater lakes in the valley provide opportunities for swimming, sailing, windsurfing and fishing.

The Cheakamus River upstream of the canyon is used for white-water kayaking.

Green, Alta, Nita and Alpha Lakes are fished heavily, mostly for Dolly Varden, rainbow trout and kokanee. All are on the Provincial Fish and Wildlife stocking program. Sports fishing is also available along the entire length of the Green River. The Soo River and Rutherford Creek are not fished due to poor access, though the Soo is rated for moderate fishing potential in its lower reaches. Rutherford Creek, however, has a steep gradient and may not support many fish. Callaghan Lake, south of Whistler, offers some of the best natural stock fishing in the Whistler region, and appears capable of handling the moderate fishing pressure put on it. Due to Whistler's close proximity to Vancouver, and its development as a year-round destination resort, maintenance of the sports fishery in this valley will be regarded of major importance by both local residents and visitors.

The Ministry of Lands, Parks and Housing acquired private land at Brandywine Falls for development as a provincial park several years ago. No development has yet taken place.

The Daisy Lake reservoir, located 15 km south of Whistler, currently provides camping facilities and limited sports fishing. Numerous hiking trails are available through Garibaldi Park, and in the alpine areas south of Rainbow Mountain and Mt. Callaghan.

Garibaldi Provincial Park, whose boundaries include a large expanse of the Coast Mountains, attracts many visitors from the Lower Mainland and elsewhere. Due to its proximity to the Greater Vancouver area, the Park is one of the most heavily utilized in B.C. Activities in the Park focus upon moun-

taineering, hiking, camping and fishing in the alpine regions during the summer; in winter, the alpine areas are used for ski touring and helicopter skiing.

Hunting in the Squamish/Pemberton region occurs in the Callaghan Creek Valley, the Elaho Valley, and in the vicinity of the confluence of Ashlu Creek and the Squamish River. Most of these areas are important for deer, although a few goat are occasionally taken. The Callaghan, Elaho and Ashlu Valleys are probably the most important hunting areas in the study area, simply because they are most accessible to Vancouver hunters.

Recreational opportunities in the Squamish and Elaho Valleys are of lesser significance than the Whistler area, and are largely associated with sports fishing and hunting. Alice Lake and Birchenhead Lake have heavy day and weekend use in summer.

Squamish River has high fisheries capability, as it supports steelhead, trout, coho and chinook salmon and Dolly Varden. The steelhead fishery is especially productive, accounting for up to 900 steelhead catches per year. The Elaho River is not as productive for salmon due to a migration barrier located a short distance upstream of its confluence with the Squamish. Road access up the Squamish Valley makes the river especially attractive to fishermen and recreational canoeists from the Greater Vancouver area.

Squamish currently serves as a minor service centre for visitors to Whistler. It is expected that the expansion of Whistler as a destination resort, and the expected increase in tourist traffic along Highway 99 will tend to emphasize Squamish's role as a regional service centre for travellers.

Visual Concerns

Within the entire study area, visual concerns are probably the greatest for the corridor options between Pemberton and Cheekye. The reasons for this relate primarily to the fact that the Squamish/Whistler/Pemberton corridor is a major transportation route, includes the communities of Whistler and Pemberton, and encompasses, or provides access to some prime recreational land within close proximity to the Lower Mainland region. The key areas of visual sensitivity are described below:

Birkenhead/Gates Creek Valley: Transmission line location in this narrow, steep-sided valley is constrained by existing development, such as farms, road, railway and existing transmission lines. The steep topography on the adjacent sidehills forces line location on the valley floor. Potential visual impacts are severe, due to the lack of flexibility in line location.

Pemberton Options (Segments MaN, MbN, McN): The Lillooet Valley near Pemberton is presently crossed by three transmission lines, (2L1, 2L2 and 5L42). 2L1 and 2L2 cross the town near the junction of Highway 99 and Portage Road, and go through the Signal Hill Elementary School yard. Replacement of line 2L1 with the larger double circuit 500KV towers would add to the visual disruption which has occurred at the entranceway to Pemberton (see Figures 9.1 and 9.2). The option to cross the valley west of Pemberton (MaN) would involve an entirely new right-of-way, and would serve to cut up the valley visually and physically even more than at present. The third option (McN) would be to locate the proposed line adjacent to 5L42, east of the town and Highway 99, and cross over

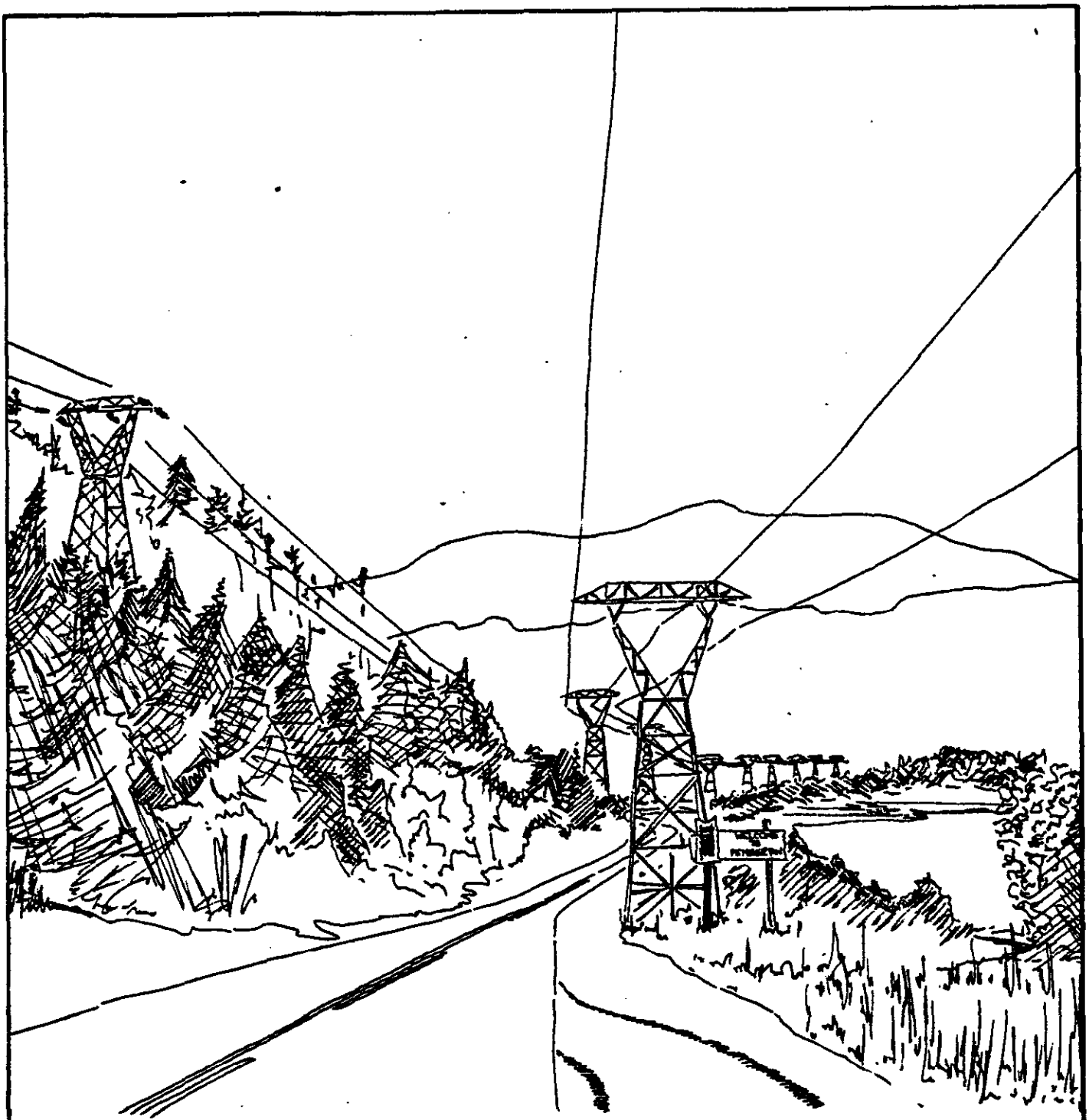
Signal Hill. In this case, the transmission line crossings of the valley would be more concentrated than with a western option, the removal of 2L1 through the school yard and adjacent to Highway 99 would be a visual improvement (although 2L2 would remain), and the 5L46 line adjacent to 5L42 would be least visible from the highway and the town itself. The McN option was, therefore, much preferred over either of the other options. Figure 14.2 shows the locations of these three options relative to the existing transmission lines. Visual impacts between Nairn Falls and at the mouth of the Soo River cannot be determined until a route is selected.

Soo Valley-Callaghan Creek (Segment NOS): The higher elevations around Rainbow Mountain are highly scenic alpine areas popular with hikers, presently unspoiled and inaccessible by road. The location of a transmission line along this corridor option would result in a severe encroachment into an otherwise pristine environment. Photos on p. 161-162 are examples of the alpine scenery typical of the higher elevations in the Soo/Callaghan valleys.

Segments OPR and OQR: The upper portions of the Soo and Callaghan valleys are also very scenic alpine areas, although at present, access to these areas is very limited. In the longer term, however, these alpine areas represent a valuable recreational resource, particularly as they are not too distant from the resort of Whistler, and within reach of the Vancouver metropolitan area. In view of this, it was considered that a transmission line located in either corridor would result in a fairly major visual intrusion into the landscape, in comparison to use of the Whistler corridor as discussed below.

Whistler/Cheakamus corridor (Segments NS and ST): There are presently three transmission lines (5L42, 2L1 and 2L2), Highway 99, and the B.C. Railway located in this corridor, as well as numerous subdivisions along the valley floor, and extensive clearing on the valley sides resulting from logging practices and ski runs. If this corridor was utilized by the proposed line (5L46), current plans indicate that the new line would replace the existing 2L1 line, and to a large extent remain within the existing right-of-way. Given these conditions, location of 5L46 through the Whistler Valley would entail removal of the 2L1 structures, which would be replaced with larger towers and more conductors. It should be recognized that if the proposed line were to utilize any of the corridor options that bypass Whistler, such as NOS, it is uncertain that the existing 2L1 line would be removed. Thus, while recognizing that several visually sensitive areas occur along the Whistler/Cheakamus corridor, such as between Alpha and Green Lakes, and between Daisy Lake and Brandywine, it is judged that the visual intrusion of the double circuit 500 kV line that would replace an existing 230 kV circuit would be less serious than those that would result if the line was located in any of the corridor options that avoid Whistler. These other options are still in a comparatively unspoiled state, have very limited access, and represent a valuable recreational and scenic resource which has important future potential for Whistler.

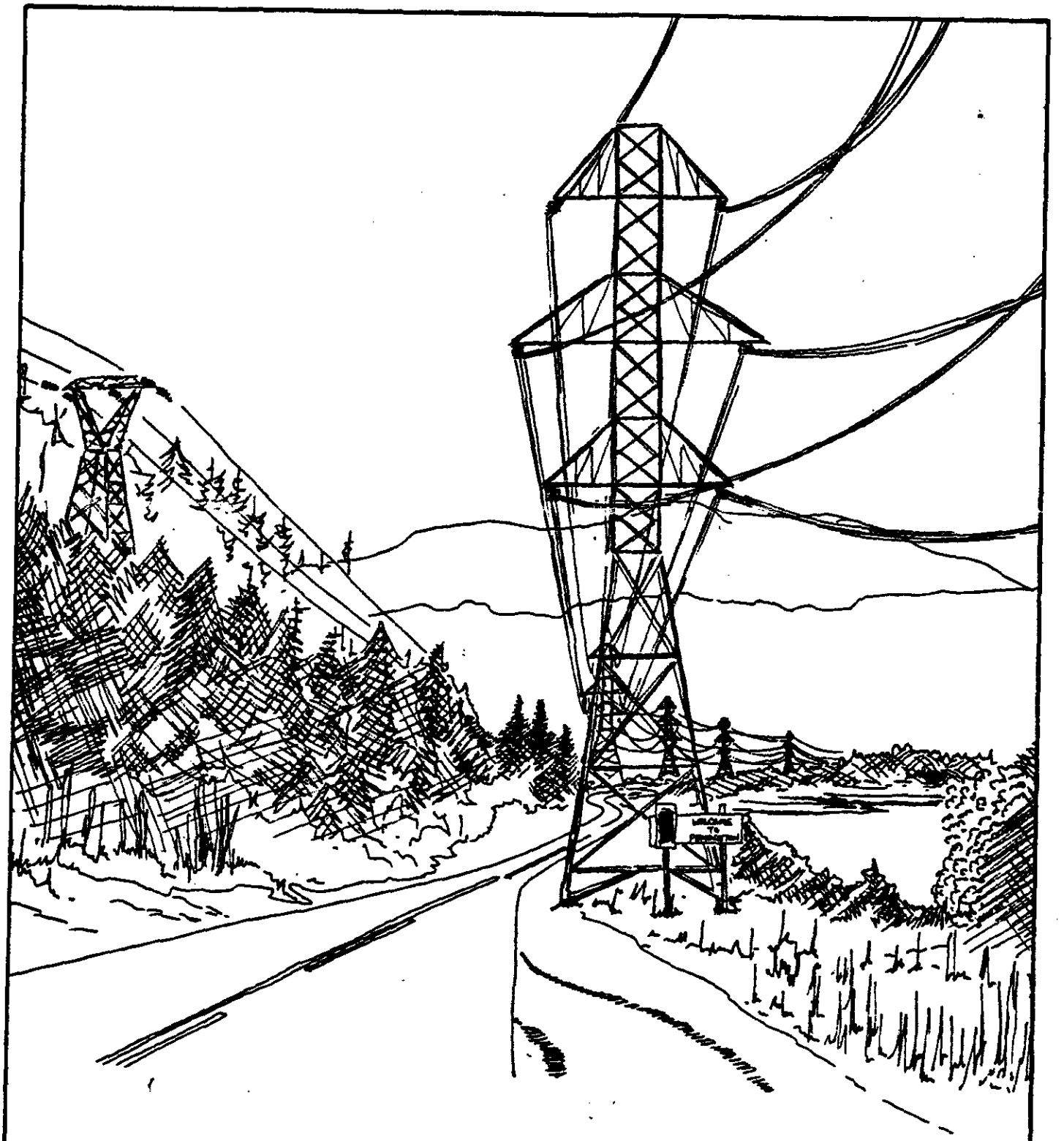
Other visually sensitive areas are the Bridge River crossing at the confluence with Antoine Creek, the Bridge River Canyon, and much of the Duffey Lake corridor, particularly in the canyon section at the east end of the valley. Visual impacts in the Bridge Canyon and along the canyon sections of the Cayoosh



Existing 2L1 Circuit At Entrance To Pemberton

(2L2 is located at left of drawing)

FIGURE 9.1



Visual Effect of Replacing
2L1 Line by 5L46 at Entrance to Pemberton

FIGURE 9.2

Canyon would be difficult to avoid as little flexibility exists for tower and line location.

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CHAPTER 10

HERITAGE RESOURCES

The term "heritage site" refers to any particular piece of land, including that covered by water, which has historic, architectural, archaeological, paleontological or scenic significance to the Province of British Columbia (Heritage Conservation Act 1977:1). Heritage sites are assigned an identifying "Borden number" under which basic descriptive data are filed in the Provincial inventory. "Borden numbers" identify a small geographic area with reference to any standard map of Canada. Sites located within any given Borden block are then given sequential numbers. A total of 19 Borden blocks[1] are transected by the proposed transmission routes.

A five-fold rating system has been utilized to illustrate the heritage resource potential or probability of sites being present along the alternate transmission corridors. This system is based upon the following criteria:

* the presence of known heritage sites on, or in close proximity to the corridor;

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[1]DlRt, DkRs, DlRs, EaRs, EaRr, EdRp, EbRr, EbRq, EcRp, EdRo, EeRo, EeRn, EeRm, EdRl, EeRk, EeRl, EfRk, EfRl.

* an evaluation of physiographic features which have known relationships to heritage sites, such as terraces, benches, major river and lake shores, plateaus, etc.;

* an assessment of the potential for site occurrences as indicated by historical reference;

* an assessment of existing disturbance and its effects upon various types of heritage resources.

Ratings of High, Medium to High, Medium, Low to Medium and Low were assigned to each corridor segment. These, along with previously recorded heritage sites, are shown on Map 4.

This assessment of heritage resource potential is quite general, as factors which influence the potential of site occurrence and the potential of site discovery have been found to vary considerably within individual segments. A discussion of the types of sites likely to be encountered is provided, along with a description of site potential for each of the corridor segments addressed in this study.

SITE TYPES

There are fourteen site types found within the study area.

Isolated Finds

Isolated finds refer to single artifacts (any object modified by man). These are typically sites of limited significance and can be expected to occur virtually anywhere along the corridor options.

Burial Sites

Burial sites in the Study Area tend primarily to be found in the lower river valleys. Four basic types are known to occur, namely:

* Talus Burials: associated with loose sand or gravel talus slopes particularly in the Fraser River Valley area;

* Cairn Burials: associated with rock cairns which have been constructed atop the burial proper;

* Prehistoric Internment: unmarked burials dating to the prehistoric period (ca. pre-1812). Sometimes associated with other site types such as circular depressions;

* Historic Internment: burial areas marked with grave stones and/or picket fences suggesting a historic or post-European contact age (post 1812).

Pictographs and Petroglyphs

Pictograph sites or rock paintings are usually associated with rock cliff faces and thus appear primarily along the lower river valleys. These are more likely to appear along the middle Squamish River Valley, Seton Lake/River area and the lower Cayoosh Creek Valley.

Petroglyph sites or rock carvings are also known to occur within the study region, primarily in the Fraser River area, and are usually associated with major creek confluences.

Fishing Stations

Fishing stations are normally associated with late summer activities along the valley bottoms of the major rivers (i.e. Fraser, Bridge, Squamish and Lillooet Rivers).

Circular Cultural Depressions

Circular cultural depressions are of three types, each associated with three separate activities within the study region. The first are house-pits or the remaining depression resulting from the construction and later abandonment of semi-subterranean winter houses. These sites are very common along the upper terraces of the Fraser River but usually do not extend into areas in excess of 760 m above sea level. For this reason, this particular type of circular depression is not expected to occur along corridors at higher elevations in the Marble, Camelsfoot, and Cayoosh Ranges, nor above 760 m in elevation in the Mission Ridge area.

The second type of circular cultural depression is the "cache pit" evidencing the remains of the small bark-lined storage cellars recorded ethnographically for the Lillooet and Shuswap. Cache pits are most likely to be located relatively close to the winter house as they were built for storage of winter food. It is possible for this type of site to be found at higher elevations than the previous house pit sites.

The third type of circular depression is one which falls between the cache pit and house pit in size. These are depressions evidencing the remains of "earth ovens" used during the processing or roots, shoots, and pine nuts. This type of site was the most common type of depression site recorded in the Upper Hat Creek Valley (Beirne and Pokotylo 1979), and may

be found above 760 m in elevation. The corridor crossing the Marble Range from Kelly Lake to Pavilion can be expected to contain this type of site although it should also be anticipated anywhere in the Shuswap-Lillooet territory.

Circular cultural depressions of the types discussed above were not utilized by the Squamish Indians and thus are not expected to occur west of the Green River Valley.

Lithic Scatters

Lithic scatters are represented by quantities of lithic debris resulting from the manufacture of stone tools. These sites are usually the remnants of small temporary camp sites utilized during hunting and root gathering or may simply represent stopping points between destinations. This type of site can be expected to be the most common site type in areas above elevations of 760 m.

Middens

Midden sites represent the remains of past habitational activities on the coast. They are most often characterized by quantities of shell, bound together by black greasy soil, rock and ash (shell midden). No middens are as yet recorded in the Squamish Valley. However, Barnett (1955:31) does record a number of village sites along the Cheakamus and Squamish Rivers suggesting associated middens may be present.

Rock Shelters

Rock shelters represent past habitation activities associated with rock overhangs, caves or crevices. Such sites may be present in the Squamish or Cheakamus Valleys as well as in the steeper mountainous zones.

Quarries

Quarry sites represent specific locations where raw material was procured for the manufacture of stone tools and native dyes or paints (i.e. ochre). It should be noted that a prehistoric aboriginal obsidian quarry is known to exist somewhere in the Garibaldi area. Although the corridors do not pass through that area specifically, volcanic activity has been noted in the Mt. Callaghan region (Holland 1976). It is possible that obsidian-bearing lava flows have occurred here as well.

Mythological

This type of site is very difficult to assess as it represents a specific site location held sacred by local native peoples for supernatural reasons. Only one such site is known to exist within the areas of interest, and is well removed from the transmission line corridor.

Trails

A number of historic and prehistoric trails are known to be present within the general Study Area. Portions of these trails, still visible today, may be transected.

Mat Lodges

Mat lodges constructed during the spring and fall hunting and berry picking activities may be present. Evidence of these is expected to be difficult to find.

Historic Buildings

A number of sites relating to historic mining, ranching, and early farm settlement can be expected in the Study Area. These sites may include log cabins, cabin or other building foundations, sluice boxes, placer trenches, mine shafts, etc.

SITE LOCATIONS

At present, 390 heritage sites have been recorded within the 19 Borden blocks transected by the proposed transmission corridors. The majority of these fall within the Seton-Anderson Lake and Fraser River Valley zones, and have primarily been recorded within the past decade (Bates and McMath 1976, Burnip and Hardern 1975; Kautz and Routley 1974; Richards 1978; Rittberg 1976; Rousseau 1979; Sanger 1961; Scott and Bates 1975; Sneed and Smith 1977; Stryd 1974; Stryd and Hills 1972; Wales 1974; Wales and Murray 1975).

A search of the Canadian inventory of historic buildings and Provincial inventory of designated historic sites showed no such sites along the proposed transmission routes. The 390 heritage sites recorded on the provincial inventory showed the following distribution:

* 60% (234) are circular cultural depressions;

* 16.9% (66) are classified as temporary prehistoric campsites (lithic scatters, isolated finds);

* 8.7% (34) were burial sites;

* 6.7% (26) are historic, including 8 historic fishing localities;

* 4.3% (17) are rock art (5 petroglyphs; 12 pictographs);

* 1% (4) contain both historic and prehistoric components;

* the remaining 2.3% (9) is composed of miscellaneous sites classed as mythological, rock shelter, trails, quarry, mat lodge, etc.

Heritage resource potential is described for the individual corridor segments within each of the three broad regions of the Study Area. The segments are labelled for reference on Map 5 which illustrate the heritage potential along the various corridor options.

KELLY LAKE TO SETON LAKE

Kelly Lake East (AB)

This segment is characterized by open forest indicative of the Ponderosa pine-bunchgrass biogeoclimatic zone on the valley slopes and uplands, and open bog and swamps associated with Kelly Lake on the valley floor.

No known sites are recorded in close proximity to the corridor, and heritage resource potential is considered low, with the exception of the drier areas bordering the bog zone. Heritage resource potential along the steep slopes of the Marble Range is low; however small benches may have moderately high potential for the occurrence of lithic scatters, earth ovens and isolated finds associated with prehistoric campsites.

Along the gently rolling uplands of the Marble Range, potential for the occurrence of prehistoric campsites is considered to be moderately high.

Overall, this segment is rated as having medium heritage resource potential, with site types indicative of prehistoric campsites (lithic scatters, earth ovens) most likely to occur.

Kelly Lake North (AC)

Environmental characteristics are similar to segment AB with approximately half of this segment characterized by the low, relatively level valley floor on the north side of Kelly Creek. One large prehistoric village site is known to occur in close proximity to this corridor, and others of the circular depression type can also be expected particularly on terraces or benches associated with Kelly Creek and the areas bordering Kelly Lake. It is also possible that burial sites associated with the known village site may occur. These may take the form of talus burials near the base of the valley slopes.

The relatively steep side slopes have a low rating but small knolls or benches can be expected to contain sites associated with prehistoric camping activities.

In summary, the AC segment has a medium to high heritage resource potential.

Kelly Lake South (BC)

Most of this segment can be described as the rolling uplands of the Marble Range south of Kelly Creek, and has a moderate resource potential as described for the upland portion of segment AB. The steep valley side slopes on both sides of Kelly Creek has a low to moderate rating as described above for similar terrain in segments AB and AC. For a short distance, the segment crosses the Kelly Creek valley floor which has a low resource potential due to wet terrain and the narrowness of the valley.

The overall heritage rating for this segment is medium, with prehistoric sites such as lithic scatters, isolated finds and earth ovens being the primary site type anticipated.

Marble Range (BD)

This segment extends southward across the rolling uplands of the Marble Range dropping fairly steeply along a ridge toward the confluence of Pavilion Creek and the Fraser River. Approximately one-quarter of the area appears to cross open grassland in the vicinity of Gillon Creek. No heritage resources have been recorded along this segment.

Heritage sites associated with prehistoric camping activities can be expected along this segment. This is especially true for the areas on both sides of Gillon Creek and the ridge above Pavilion Creek. Potential sites along this segment may have

been previously impacted by the construction of the existing transmission lines which would be paralleled by the proposed transmission line.

Segment BD is rated as having a medium to high potential for heritage resources.

Camelsfoot South (BE)

Terrain characteristics along this segment range from gently rolling highlands on the Marble Range to very steep valley side slopes along both sides of the Fraser River, to more gently sloping country above 760 m in elevation on the west side of the Fraser River. No recorded heritage sites are present along this segment; however, three prehistoric village sites are in the general vicinity on the west side of the Fraser River (EfRl-3 - 60 house pits; EfRl-3 - 15 house pits and EfRl-23 - 14 house pits). The proposed transmission line also crosses portions of the Old Lillooet-Chilcotin trail recorded during the 1896 land survey of lots 2977 and 2978 (H.C.B. 1980).

The BE segment is rated to have a medium to high heritage resource potential. Anticipated heritage resources might include prehistoric circular depressions of both the house pit and cache pit type particularly along the open grassland benches on the west side of the Fraser River; prehistoric cabins and trails, again associated with the early Lillooet-Chilcotin trail on the west side of the Fraser River; and prehistoric campsites (isolated finds, lithic scatters, earth ovens, cache pits) in the higher areas on both sides of the Fraser River above 760 m in elevation.

Camelsfoot North (CE)

Heritage resource potential for this segment is considered to be medium. Anticipated resources are similar to those described for segment BE. The grass-covered benches and gently sloping terrain above the elevation of 1000 m on the west side of the Fraser River are expected to have the greatest resource potential, with the steep side slopes on the east side rated as low to medium.

Pavilion-Fountain (DF)

This segment parallels existing transmission lines extending from the north side of Pavilion Creek southward to the south side of Seton River near the mouth of Cayoosh Creek, crossing the Fraser River above the town of Lillooet. The majority of this segment has undergone major development with the construction of Highway 12, the P.G.E. railway, several transmission lines, settlement associated with ranching and the establishment of the town of Lillooet.

Numerous heritage resources have been previously recorded in the vicinity of this segment. In fact it contains one of the highest concentrations of known heritage sites in the entire Study Area. Virtually all site types are represented. Fourteen sites fall along the existing transmission line corridor. These include one burial site (EfRl-14); six lithic scatters (EeRl-29, 105, 108, 173, 174, and 181); three historic cabins (ErRl-129, 130, 144); and four circular depression sites including house pits and cache pits (EeRl-40, 76, 119, 179).

In consideration of the above, this segment has been given a high heritage resource potential rating.

Seton Lake (FL)

A number of heritage sites are known to exist along the south side of Seton Lake. Seven of these are on, or in close proximity to, the existing transmission lines (EdRl-16, 23; EeRm-1, 13, 14; EeRn-57, 69). All of these sites are of the circular depression type including both house pits and cache pits. Other such sites may be present.

Segment FL has been given a high heritage resource potential.

Pavilion-Mission Ridge (DG)

The majority of this segment is restricted to relatively steep side slopes. One recorded heritage site (EfRl-2), a single house pit, appears to be on or very near the proposed corridor on the west side of the Fraser River crossing. Early survey reports for lots 294, 295 (1897) mention the presence of historic cabins. Similar features are mentioned in survey notes for lots 4943 (1921) and 4358 (1915) although recent visits to these lots suggest they were destroyed by previous transmission line construction (H.C.B. 1980). Two additional heritage sites (EeRl-132, 133) containing house pit and cache pit features are recorded on a bench along the south side of Bridge River. One of these (EeRl-133) is located on the edge of the existing transmission line right-of-way.

Heritage resource potential along this segment ranges from low to moderately high. Medium to high ratings are assigned for the Fraser River crossing, Slok Creek crossing, Bridge River crossing and the relatively level highland area in the vicinity of Lots 4943 and 4358 between Blackhill Creek and Bridge River. The overall heritage potential rating of this segment is considered medium.

Antoine Creek (EI)

Terrain along this segment is characterized by steep slopes of the Camelsfoot Range, and the descent to the Bridge River via Antoine Creek. No heritage resources are recorded for this segment and its resource potential rating is considered low. Heritage resources which might occur include those associated with prehistoric campsites (lithic scatters, isolated finds), particularly in areas of breaks in the steep side slopes.

The Bridge River crossing has a medium potential for the presence of heritage sites.

Applespring Creek (EHI)

This route option descends the south slope of the Camelsfoot Mountains via the Applespring Creek Valley, crossing over terrain similar to that described for the Antoine Creek segment.

One heritage site (EeRm-8) consisting of a house pit and five cache pits is recorded in the lower Applespring Creek Valley. The area near the Bridge River crossing has a moderately high potential for the presence of heritage resources, as noted for segment EI, however the majority of this segment has been rated low.

Mission Ridge (GJ; GI; JK)

All of these segments are situated along Mission Ridge, and are generally characterized by steep slopes at high elevations. No heritage resources have been recorded along any of these

segments, and resource potential is considered to be low in all cases. Sites that might occur are likely to be associated with small, temporary prehistoric campsites, such as lithic scatters or isolated finds. All segments have been assigned a low heritage rating.

Bridge Valley (IK)

No heritage resources have been recorded along this segment. The two crossings of Bridge River and the section along Carpenter Lake have a moderate to high potential for the occurrence of prehistoric sites. The section through Mission Pass may contain historic sites related to the 1898-1912 pack-horse trail from Mission Station on Seton Lake to the Bridge River Valley (H.C.B. 1980).

Segment IK has been assigned a medium to high heritage resource potential.

SETON LAKE TO PEMBERTON

Cayoosh Creek (FM)

This segment follows the Cayoosh Creek Valley around Duffey Lake, entering the Pemberton Valley via Joffre Creek. The terrain along this route is very rugged with about 60% situated on very steep valley side slopes.

No heritage resources are recorded along this corridor. Early mining activities associated with gold discoveries in 1886 in the vicinity of Lot 482 and the Golden Cache claim (Lot 390) in 1896 are worthy of note. Survey reports dating to 1886, 1897-1900 mention existing wagon roads, trails, millworks, etc.

Prehistoric sites are not expected to be common, although, the Lakes Lillooet Band did include Cayoosh Creek to Duffey Lake in their hunting territory (H.C.B. 1980).

In consideration of the above, this segment has been given a medium heritage resource potential rating. Potential prehistoric sites are expected to be sparse and associated with temporary camping activities, and are most likely to occur in the lower Cayoosh Creek area and around Duffey Lake. Historic sites associated with mining activities are expected to occur and will have a higher visibility.

Anderson Lake (LM)

A large number of heritage resources have been recorded along the north side of Anderson Lake, of which at least six are situated close to the existing transmission lines. These include a burial site (EeRn-19); three cache pit sites (EeRn-26, 27, 50) and two house pit sites (EeRn-10, 17).

Eleven heritage sites have been recorded in the Birkenhead Valley with at least one (EcRq-2) located within the proposed corridor. EcRq-2 is an isolated find. The other ten sites consist of nine circular depression sites and one pictograph site.

The early Harrison-Lillooet road (1860) passes through the Birkenhead Valley and sections of the original road are still visible in some areas. Historic sites associated with this road may be present.

This segment has been assigned a high heritage resource potential with both prehistoric and historic sites expected to occur.

PEMBERTON TO CHEEKYE

Pemberton (MN)

The majority of this segment crosses the Lillooet Valley near Pemberton. No known heritage resources are recorded along this segment.

A medium resource potential is assigned to this segment based on the local physiographic conditions. The area of greatest sensitivity is considered to be the Lillooet River crossing.

Whistler (NS)

Terrain characteristics along the Whistler Valley range from steep side slopes to relatively uneven valley bottom terrain. Much of this area has been logged and developed for residential and tourist use, likely destroying many potential sites. One heritage site has been recorded near Green Lake, consisting of one house pit and the remains of an historic cabin.

This segment is situated in one of the few natural passes between Squamish and the Lillooet River Valley. This was recognized as early as 1858 when Joe McKay was assigned to survey it as a possible access route to the Cariboo gold fields. It is possible that this route was used for trade between the Squamish and Lillooet Indians in prehistoric times, although prehistoric sites are not expected to be dense nor easily located. A low to medium heritage potential rating has been assigned.

Cheakamus Valley (ST)

This segment is characterized by the steep side slopes and uneven valley floor along the upper portions of the Cheakamus River, broadening out into a more level floodplain of the lower Cheakamus at Cheekye. Most of this corridor has been previously disturbed through road and rail construction, extensive logging and transmission line construction.

No heritage resources have been recorded along this segment; however reference has been made to an ethnographic village on the Cheakamus River in the vicinity of Cheekye (Burnett, 1955:31). Aboriginal trade routes and early historic trails may have existed along this route as described for segment M-R.

This segment is considered to have a low to medium heritage resource potential.

Soo Valley and Callaghan Creek (NOS)

This segment is characterized by steep, rocky side slopes of the Soo and Callaghan Valleys, and the swampy valley floor along the lower reaches of the Soo River. No heritage resources have been recorded along this corridor option, and heritage resource potential is considered to be low.

Mt. Callaghan North (OPR)

This segment extends approximately 14 km from the upper Soo River valley to the upper Squamish River valley north around Mount Callaghan. Terrain is very rugged and heritage resource potential is expected to be very low.

Mt. Callaghan South (OQR)

This segment offers an alternate to segment OPR around the south side of Mount Callaghan. As with the previous segment, terrain characteristics are very rugged and heritage resource potential is considered to be very low.

Squamish Valley (RT)

This segment follows Squamish River valley. Terrain characteristics of the upper valley are very rugged, but the valley broadens below Ashlu Creek. Only one heritage site has been recorded in the Squamish Valley above the Cheakamus River. This is a pictograph site (DlRt-1). Friesen (1980:23) mentions a reported burial site near the confluence of Ashlu Creek with the Squamish River although no specific data are available. Barnett (1955:31) refers to at least seven ethnographic villages along the Squamish River between Elaho Creek and the mouth of the Cheakamus River.

Heritage resource potential of this segment above Elaho Creek is considered to be very low. In light of the references to potential sites below Ashlu Creek, that portion of this segment is considered to have a medium resource potential.

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CHAPTER 11

SETTLEMENT ISSUES

For the purposes of selecting a preferred corridor for the proposed transmission line, the review of land status in the study area was limited to identifying the extent of alienated land along the corridor options. Information was obtained from the NTS map series, 1:125,000 or 1:100,000 scale, which show private land, Provincial Parks, Indian Reserves and other major status features, and updated where possible by personal knowledge. The Ministry of the Environment advised that no Ecological Reserves are affected in the study area. This information was used as the basis for Map 5.

Broadly speaking, the valley bottom land throughout the study area is held in private ownership as this has historically represented the accessible, arable land in the region.

The benchlands on both sides of the Fraser River between Pavilion and Lillooet, the valley bottom between D'Arcy and Pemberton, and the area between Green Lake and Garibaldi along Highway 99 consist largely of alienated land. In contrast, the corridors crossing over the Camelsfoot Range and Mission Ridge are mostly located on Crown land, with the major exception of the Bridge River Indian Reserve which extends along the Bridge River, from Moha to its confluence with the Fraser.

Several Provincial Parks are situated on, or in close proximity to, some of the corridor options: Downing Provincial Park at Kelly Lake, Seton Portage Historic Park, Birkenhead Lake Park, approximately 25 km northwest of Devine, Pemberton Park and Nairn Falls Park, south of Pemberton on Highway 99, and Garibaldi Park, the largest Provincial Park in the study area. Both Pemberton and Nairn Falls could be directly affected by the project, if it was decided to utilize the existing 2L1 right-of-way in this area. Nairn Falls is a Class A Provincial Park, bordering the existing 2L1 and Highway 99 on its west side, and crossed by the 5L42 line near the Green River. Pemberton is a Class C Provincial Park immediately south of the Village, and is crossed by the highway, and both 2L1 and 2L2 transmission lines. The Parks Branch holds land at Brandywine for future development as a park.

A government reserve has been placed on the area surrounding Callaghan Lake, preventing any form of land development within it. The boundaries of the reserve are shown on Map 4; the corridor options west of the Whistler Valley would infringe upon this reserve. The reserve was put into effect in 1971, largely as a result of several land use conflicts which have yet to be resolved. These include:

1) the Forest Service would like the area to be designated as Provincial Forest, thus under Forest Service management;

2) two ski development proposals which are currently under review; and

3) Parks Branch has an interest in the area immediately surrounding Callaghan Lake as a potential park site.

The location of a transmission line through this government reserve would undoubtedly complicate the existing land use conflicts, particularly if the area is developed as a major skiing/recreational facility in the future.

The entire study area, with the exception of that portion near Kelly Lake, is situated within the Squamish Lillooet Regional District. Discussions with District representatives indicated that a Settlement Plan is presently being prepared for that area between Pemberton and Lions Bay; in addition, an Official Community Plan is being prepared for Squamish, and that for Whistler Municipality is being updated. Unfortunately, none of these were completed at the time of writing.

The Village of Pemberton has an Official Community Plan, from which certain land use concerns were identified with regards to the location of the proposed transmission line, namely:

1) if 5L46 is located adjacent to, and west of the 5L42 right-of-way, the new right-of-way would infringe upon Pemberton Provincial Park, and a small area of residentially and tourist/commercially zoned land within the Village boundaries.

2) if the existing 2L1 right-of-way was utilized, virtually no new right-of-way would be required. However, the 2L1 ROW crosses through a much greater portion of land within the Village, most of which is zoned for residential use, with highway commercial use along the Highway 99 and Portage Road. The 2L1 line crosses behind Signal Hill School, and both major roads that form the entrance to the town. The 2L1 ROW also crosses through a substantial portion of Pemberton Provincial Park.

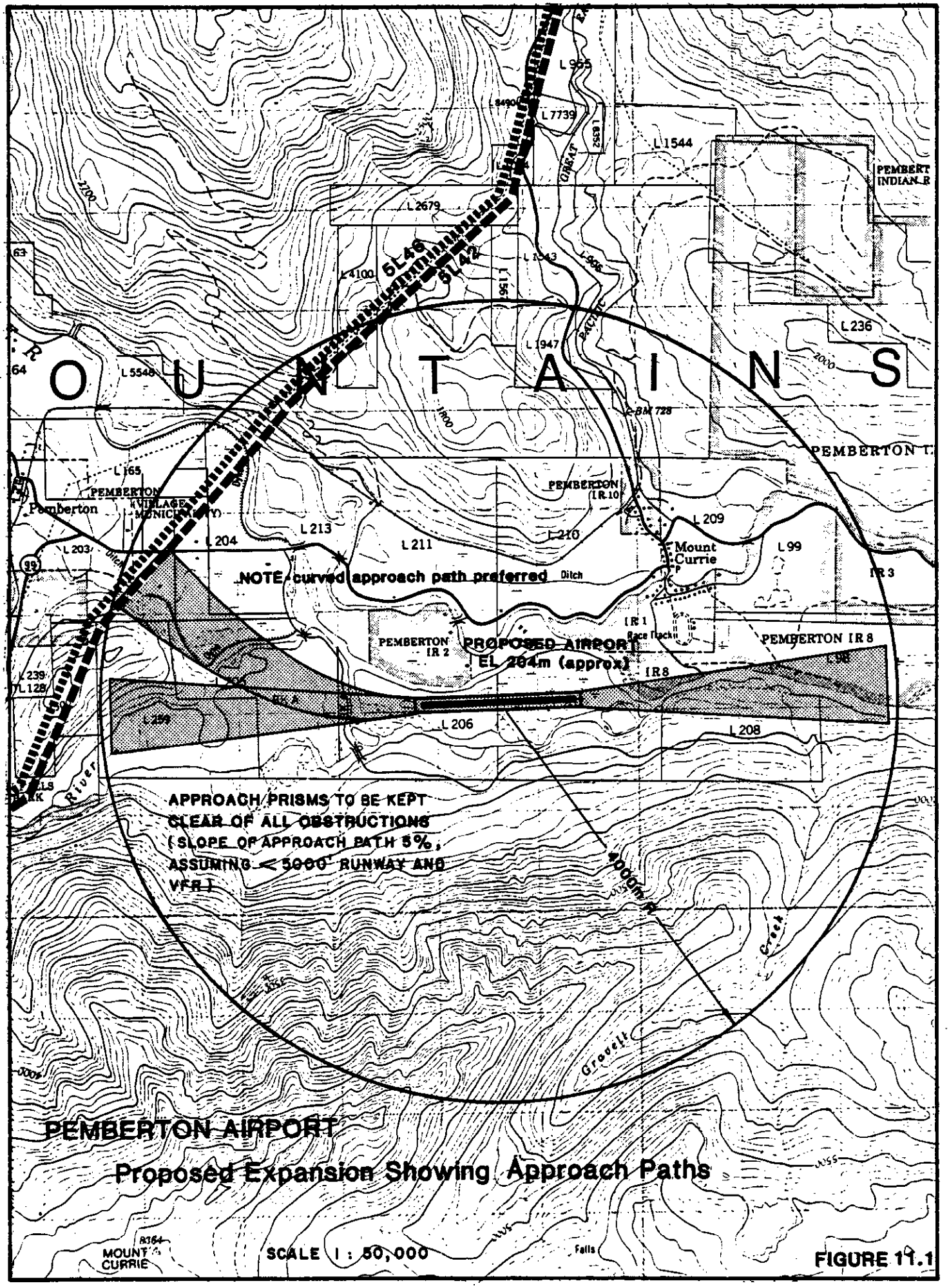
TRANSPORTATION

Airport Facilities

There is a recent proposal to upgrade the existing airstrip at Pemberton to accommodate regional air traffic, particularly a service for tourists from the Vancouver International Airport to the Resort Municipality of Whistler, and for the Forest Service as a base for water bombers. Consultants retained by the Ministry of Transportation, Communications and Highways examined several possible sites that could serve the Whistler area, and it is evident from recent discussion that the Pemberton site is the most favoured.

Further to this matter, it has come to the attention of B.C. Hydro that the favoured western approach path for the proposed airstrip at Pemberton may be infringed upon by the existing 5L42 line, and possibly by the proposed 5L46 line if this were located adjacent to 5L42 across the Lillooet Valley. Figure 11.1 illustrates the approximate location of the transmission lines relative to the approach zone. It has not yet been determined whether the higher towers and conductors of 5L46 would be within the approach path as established by the Federal Ministry of Transportation, as the exact dimensions of these structures are not known. At this time, however, it is estimated that the 5L46 structures would be approximately 10 m below the flight path of approaching aircraft as defined in MOT standards.

Airport facilities also exist at Squamish and Lillooet, but these would not be directly affected by any of the alternative corridors.


O U N T A I N S
PEMBERTON AIRPORT
Proposed Expansion Showing Approach Paths
NOTE curved approach path preferred
PROPOSED AIRPORT
EL 204m (approx)
APPROACH PRISMS TO BE KEPT
CLEAR OF ALL OBSTRUCTIONS
(SLOPE OF APPROACH PATH 5%,
ASSUMING < 5000' RUNWAY AND
VFR)
SCALE 1 : 50,000
FIGURE 11.1
Pemberton
PEMBERTON (VILLAGE MUNICIPALITY)
PEMBERTON IR 10
PEMBERTON IR 2
PEMBERTON IR 8
Mount Currie
IR 1
IR 3
IR 8
Race Track
Ditch
Creek
River
Falls
MOUNT CURRIE
PEMBERTON INDIAN R
PEMBERTON I.
5L46
5L42
400m
L 204
L 213
L 211
L 210
L 209
L 206
L 208
L 99
L 236
L 1544
L 1947
L 2679
L 4100
L 5548
L 165
L 203
L 239
L 128
L 7739
L 955
C.B.M. 728

Transmission lines can be hazardous to aircraft, particularly in areas that are heavily utilized by smaller planes. Within the study area, the Fraser River valley is probably the most utilized flight corridor, and as such, any additional transmission lines crossing the valley would pose a certain level of additional risk to aircraft, depending on the distance from the existing crossings. Presently, there are three transmission lines (5L42, 2L90, 2L91) crossing the Fraser River within the study area; it would be preferred, therefore, if the proposed 5L46 transmission line cross the Fraser in close proximity to one of the existing crossings, preferably 5L42.

Highways

The major highway routes are shown on Map 4. Highway 99 is presently a two-lane highway which is being upgraded between Squamish and Whistler. There will undoubtedly be greater pressure to upgrade the section between Pemberton and Whistler if the proposed airport is constructed, as this would add significantly to commuter traffic in the area. THe highway is a popular scenic tourist route.

At present, the Ministry of Highways has no published plans to upgrade the Duffey Lake Road, though it is likely that over the long term, this road will be steadily improved to handle the projected increases in tourist traffic. This road forms part of the Nugget Tour Route as discussed in Chapter 9, and if it is promoted as a tourism feature in B.C., there will undoubtedly be heavier use of it. Presently it is a 2-lane, gravel road.

Railways

The B.C. Rail mainline from Vancouver to the interior of B.C. runs through the study area, frequently paralleling the corridor options between Squamish and Kelly Lake and offering a very scenic journey to tourists.

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CHAPTER 12

MINERAL RESOURCES

Information on mineral resources was provided by the Ministry of Energy, Mines and Petroleum Resources, and has been used as the basis for Map 5, showing mineral potential and claims in the study area. No further investigation of mineralization was undertaken as the existence of undeveloped mineral bodies is generally not a restraint to location of a transmission line. Restraints arise only if large open pit mines are contemplated, or if subsurface mining were to result in the risk of settlement of the ground surface.

Of note are the large areas of mineralization in the Callaghan, Cheakamus, Soo, Fitzsimmons and Rutherford drainages. These areas are classified as having geologic environments highly favourable to mineralization, with known deposits of lead, copper, silver, zinc and gold. Extensive mineral claims exist throughout the Callaghan Valley and east of Daisy Lake; the only producing mine in the study area, Northair Mine, is located approximately 15 km up the Callaghan Creek Road. Less extensive staking is evident in several of the side valleys to the Whistler/Pemberton corridor, such as the Soo, Fitzsimmons, Twenty-one Mile and Rutherford Valleys.

Mineral potential throughout most of the interior regions of the study area is less significant, however no information is presently available for the Camelsfoot Range/Lillooet area.

Scattered claims exist along Mission Ridge (some of which include portions of the 5L42 right-of-way), along the north side of Anderson Lake, Owl Creek, and Van Horlick Creek which flows into Duffey Lake.

Mineral claims generally are not considered to pose a restraint to transmission line location. The extent of active claims in the study area is shown on Map 5, and was reproduced from 1:50,000 scale Claims Maps of the Department of Energy, Mines and Petroleum Resources. It can be seen from the map that most of the corridors have been staked to some degree; the most extensive staking occurs through the Callaghan Valley, and at the south end of Seton Lake.

Gravel is an important resource throughout the study area, as it is required for all major construction activities. Most deposits are located in creek fans, such as that at Whistler Town Centre and at Function Junction near Whistler. In general, such deposits are well defined and should be avoided during route location as they are very likely to be developed.

Where large gravel deposits occur, as in the benches along Anderson Lake, there is less of a potential conflict with line location as gravel pits can be located so as not to interfere with the transmission line.

Significant deposits of gravel exist in terraces of the Bridge River and Anderson Lake, and in creek fans from D'Arcy to Garibaldi.

Basalt rock is quarried by B.C. Railway near Brandywine for use as ballast. Blasting restrictions will limit proximity of transmission lines and must be considering during route location studies.

REFERENCES

B.C. Dept. Mines and Petroleum Resources, and Geological Survey of Canada, Dept. Energy, Mines and Resources. Mineral Deposit - Land Use Map. 92G (1977); 92J (1975); 92P (1977).

B.C. Ministry of Energy, Mines and Petroleum Resources. Mineral Claims Inventory. Records of claims available through Gold Commissioner.

CHAPTER 13

EXPRESSED PUBLIC CONCERNS

During the course of this study, and discussion with various individuals, community and regional representatives, several issues were raised concerning the proposed double-ciruit 500 kV transmission line. The nature of these concerns are summarized below.

Land Alienation

Considerable concern has been expressed over the further alienation of private land for new right-of-way requirements for the project, particularly in that area between Kelly Lake and Seton Lake. All of the possible corridors in this area would require acquisition of some additional right-of-way from private landowners.

If the existing 5L42 transmission line is paralleled from Kelly Lake to Mission Ridge, a total of five transmission lines would have to be accommodated in the corridor through the Pavilion Reserve and the Diamond S Ranch.

Access to Camelsfoot Range

Antoine and Applespring Creek valleys are important hunting areas for the native communities between Kelly Lake, Lillooet and Bridge River. If the construction of a transmission line in these areas served to greatly increase public access to the Camelsfoot Range, it would be a matter of considerable concern to these people. It is recognized that forestry operations will push roads high into these valleys but forest roads would not reach the alpine areas. It is strongly recommended that should a corridor across the Camelsfoot Range be selected, no access road be constructed into the alpine area or to connect the roads on the east and west sides of the range.

Biological and Other Effects

The issue of potential biological effects resulting from proximity of residences or workplaces to high voltage transmission lines was raised on several occasions, and is of particular concern in those areas where the proposed 5L46 line passes very close to residences. This occurs between D'Arcy and Pemberton where the existing 2L1 right-of-way would be used by the proposed 5L46 line for most of the distance. The 2L1 line is located along the valley floor, crossing over private property and close to people's homes. Residents in this area expressed concern about long term effects of the electromagnetic field on health, and about the much more obvious effects of induced current on farming equipment, fences and buildings located under or close to transmission lines. The Squamish Indian Band expressed similar concerns over location of lines through their Cheekye Reserve.

The assessment of potential biological effects from high voltage transmission lines is a technical matter beyond the terms of reference of this corridor location study and such concerns will be addressed directly by B.C. Hydro.

CHAPTER 14

COMPARISON OF CORRIDOR OPTIONS

This chapter describes the process and rationale that led to the selection of a preferred corridor for the proposed transmission line. The project is some 190 km long and traverses three distinct ecological and climatic zones. It was considered inappropriate, therefore, to attempt to compare alternative corridors over their total length as the necessary numerical system of comparison would tend to hide some of the real differences. It was agreed within the consulting team to derive the preferred corridor through identification of the preferred option within each of those portions of the study area lying between the nodes of Kelly Lake and Seton Portage, Seton Portage and Creekside, and Creekside and Cheekye by a process of elimination of less favourable corridors. This process was simplified by the quick realisation that only one acceptable corridor exists between Seton Portage and Creekside.

The following analysis of the corridor options describes the major environmental concerns for each corridor segment, and outlines the process of elimination of individual segments that eventually reduced the corridor network to a single, preferred corridor. In some areas, only one corridor was defined, usually where the existing transmission line right-of-way provided an appropriate location for the proposed line, or where there

was no reasonable alternative. In such a case, a description of any significant concerns along that segment is provided.

INITIAL REFINEMENT OF THE NETWORK

Certain corridor segments were eliminated at an early stage of the corridor assessment, specifically that along the south side of Seton Lake, and that utilizing the Cayoosh Creek/Duffey Lake Valley. The main reasons for their elimination are described below (the bracketed letters refer to the corridor node designations as shown on Maps 1 to 5).

Seton Lake (FL)

This segment is on very steep terrain along the south side of Seton Lake, and already accommodates two wood pole, 230 kV lines (2L90 and 2L91).

Terrain: Evidence of active slides and massive slope failures along this side of the lake indicate that any further disturbance to vegetation or surficial materials will greatly increase the risk of slope failure; excessively steep terrain is typical along lakeshore.

Fish: Siltation from any slope failure could, at a critical time of year, have a major adverse impact on spawning channels in the Seton River.

Visual: Additional clearing along the hillside above the lake would be quite visible from Shalalth and Seton Portage; an additional crossing of the lake would add to the visual impact at the south end of the lake.

Heritage: A number of heritage sites have been identified on the south shore of Seton Lake, giving this corridor a high potential for impact.

Access: Construction of the 500 kV line would require construction of an access road compounding the impact for the four previous factors.

Decision: It was concluded that use of this segment was environmentally inappropriate on the basis of the above considerations.

Cayoosh Creek (FM) vs. Anderson Lake (LM)

Terrain: Most of the Cayoosh Creek valley east of Duffey Lake poses extremely hazardous conditions for a transmission line due to steep topography, unstable surface deposits and high avalanche potential; the area between Joffre Creek and Creekside is also extremely steep, has several areas of rock slides and talus indicating unstable surface material, and requires use of a pass above 1800 m.

The upper slopes along the west side of Anderson Lake are characterized by steep slopes traversed by avalanche chutes, talus slopes, rock slides and narrow creek gullies subject to flash floods and debris flows, such as those of McGillivray and Connel Creeks. The lower slopes consist of loose-textured deposits subject to erosion when disturbed. There is potential for a massive slope failure off the mountain south of Gates Lake. Compared to the Cayoosh Creek option, however, adverse terrain conditions along Anderson Lake can be more readily avoided and experience with security of existing lines has been satisfactory.

Forestry/Vegetation: Areas of coastal forest with associated higher forestry values occur west of Duffey Lake; this timber is important for expansion of a mill in Lillooet, or possibly coastal mills, as forecast timber supplies in both regions are generally tight. Forestry values along Anderson Lake are low as it is in the less productive transition zone; most of valley bottom between D'Arcy and Pemberton is privately owned and has been cleared for agricultural and settlement purposes, and therefore has lower forestry production.

Wildlife: Wildlife values are much greater along Cayoosh Creek as compared to Anderson Lake. Deer, mountain goat, sheep and grizzly bear utilize the upper, grassy slopes of the Cayoosh Range. Disturbance to land along the north side of Anderson Lake, and settlement along the Gates Creek valley has greatly impaired wildlife values in the Anderson Lake corridor.

Fisheries: The Anderson/Seton Lake system and the Birkenhead River have much higher fisheries values than the Cayoosh Creek/Duffey Lake system; however, utilization of the existing ROW along Anderson and Seton Lakes will minimize any potential impact to fish resources, whereas potential for impact along Cayoosh Creek, though less significant, is not easily avoided during construction. The net impact is worse along the Cayoosh Creek option.

Recreational/Visual: The proposed Nugget Tour Route along the Duffey Lake Road will likely become popular for tourists in the region. This road represents the only transportation corridor in the study area that is not presently used for transmission lines. A transmission line beside the road in this narrow constricted valley

would undoubtedly create severe visual impacts. The Anderson Lake corridor, on the other hand, is part of a wide panoramic landscape of the lake and surrounding mountains, in which the visual impact of the existing transmission lines is somewhat lessened. Visual impacts between D'Arcy and Pemberton would be more significant due to space constraints along Gates Creek and the Birkenhead River, although careful route selection could reduce this problem.

Settlement: No private land exists along the Cayoosh Creek option. Potential impact on settled land is substantial along Anderson Lake and the Gates Creek Valley where most of the valley bottom is privately owned. The communities of Shalalth, Seton Portage, D'Arcy, Birken, Gramsons, as well as several Indian Reservations would all stand to be affected by the project, though these could be minimized by utilizing the 2L1 right-of-way wherever feasible.

Heritage: The Cayoosh Creek segment has a low to moderate potential for the occurrence of heritage sites; historic sites associated with early mining activities are expected to occur. The Anderson Lake corridor has numerous recorded sites, of which at least six are situated close to the 2L1 right-of-way. This corridor has been rated as having high heritage resource potential, with both prehistoric and historic sites expected to be present.

Agriculture: Small scale farming occurs between D'Arcy and Creekside, mostly production of forage crops for local use. No agricultural land exists along the Cayoosh Creek option.

Decision: The Cayoosh Creek corridor presented terrain hazards of such severity as to preclude its use for a transmission line. In addition, the probable impacts on the forest, wildlife, and visual resources are markedly higher than those resulting from use of the Anderson Lake corridor. It was concluded, therefore, that the Anderson Lake corridor was the only acceptable corridor leading to Creekside.

It was recognized that the Anderson Lake corridor is not without difficulties - these pertain largely to the incremental visual impacts and disturbance to settled areas along the Gates Creek Valley. It was considered, however, that the potential impacts of locating 5L46, much of which would be within an existing right-of-way, would be far less significant along Anderson Lake than would occur along the Cayoosh Creek Valley, which has not yet been scarred or otherwise disturbed by major, land-altering activities such as clearing, railway or transmission line developments, logging patterns are less obtrusive.

Pavilion - Fountain (DF)

Discussion: Having eliminated both the Cayoosh Creek segment (FM) and the segment along the south side of Seton Lake (FL), segment DF becomes redundant. In any case, locating a transmission line along the Fraser River between Lillooet and Pavilion would incur substantial community impact at Lillooet, and would have impacts on agricultural land on the benches above the east side of the Fraser River. Agriculture impacts would be relatively severe due to the limitations transmission lines impose on the use of large wheel irrigation systems throughout the

valley. Visual concerns are apparent too, as the line would parallel Highway 12 and the railway for most of the distance.

Having concluded that the terrain hazards and environmental impacts associated with the Seton Lake and Cayoosh Creek segments are so great as to preclude their use, the preferred corridor is identified from Seton Portage to Creekside. The remaining task is that of finding the preferred option for the two sections from Kelly Lake to Seton Portage and Creekside to Cheekye.

KELLY LAKE TO SETON PORTAGE

Three corridors remained for further consideration between Kelly Lake (A) and Seton Portage (K). These involve crossings of both the Fraser and Bridge Rivers, and crossing over Mission Ridge. The southern option would parallel the existing 5L42 line, the other two would utilize either the Antoine or Applespring Creek valleys. These corridors were compared by identifying the preferred option where alternate segments exist.

The sequence requires the comparison of the Antoine and Applespring segments to determine a preference, then selection of the preferred option from Kelly Lake to node E at the start of the Antoine and Applespring segments. This then permits comparison of the preferred corridor through Antoine or Applespring with the existing corridor.

Applespring (EHI) vs. Antoine (EI) Corridors

The Antoine option is approximately 2.5 km longer than the Applespring option between Nodes E and I. Both options traverse rugged terrain that is presently inaccessible by road, or that has limited road access (i.e. Antoine Creek). The impacts associated with use of each are discussed and then compared in Table 14.1.

Terrain: The terrain on the east side of the Bridge River to node (E) is almost equally difficult for both alternatives. Each valley is V-shaped and the route would have to run over a series of ridges on the north side of the valley. Construction of access roads would be difficult with much terrain alteration. A tectonic fault zone with unstable rock cliffs exists approximately 6 km east of the river in each valley, and marks the realistic limit of road construction.

There is a steep slope with high impact potential on the west bank of the Bridge River on the Applespring alternative. The east bank on both crossings of the Bridge River poses a potentially high terrain impact if construction were to accelerate erosion of the surface deposits. On balance there is very little difference between the Applespring and Antoine corridors from a terrain standpoint. The crossing of the Bridge River in the Antoine corridor appears to be better than that in the Applespring corridor; the better crossing of the Bridge River, and some existing access road gives a marginal preference to the Antoine corridor.

Fisheries: Neither Antoine nor Applespring Creeks are important for fisheries. There is a potential for surface erosion at the confluence of each with the Bridge River.

Forestry: Both corridors have relatively low forestry values. No preference exists.

Wildlife: Both valleys are valuable wildlife habitats. Construction of, or improvement to, access roads in either valley would increase the hunting pressure on the deer, sheep and mountain goat. Use of either option is undesirable from a wildlife management standpoint. However, if construction and line maintenance are carried out without the construction of new access roads the wildlife impacts could be reduced to an acceptable level.

Visual: The main visual impacts for both options would be at the Bridge River crossings. There is a spectacular river meander near the Moha Road junction at the confluence of the Bridge and Yalakom Rivers. This location represents one of the best viewpoints along this road, and stands to be visually impacts if the transmission line crossing of the Bridge River is located at the mouth of Antoine Creek (see Photo 9).

Land Use: Both corridors are located over undeveloped Crown land, except for the Bridge River Indian Reserve on the Applespring corridor.

Agriculture: Only grazing values exist along either corridor; these will not be adversely affected if disturbed land is seeded after construction.

Heritage: Potential in both corridors is low.

TABLE 14.1

IMPACT COMPARISON - ANTOINE AND APPLESPRING SEGMENTS

FACTOR	RATING OF ADVERSE IMPACT	
	ANTOINE	APPLESPRING
Terrain	4	5
Vegetation	3	3
Agriculture	1	1
Fisheries	1	2
Forestry	1	1
Wildlife	4	4
Recreation	3	3
Visual	3	2
Land Use	1	1
Heritage	1	1

Note: Rating scale is 1 to 5, low to severe.

Decision: Provided that construction of access roads does not extend beyond that needed for forestry, and assuming that good wildlife habitats are protected wherever possible, use of either of Applespring or Antoine corridors is acceptable. A slight preference was noted for the

Antoine corridor on the basis of its lesser terrain impacts resulting from construction on steep slopes, and better crossing of the Bridge River; however the visual impacts are greater for the Antoine corridor crossing of the Bridge River than for the Applespring Creek option. Measures to mitigate visual impacts at the crossing site on the Bridge River should be studied carefully if this corridor is selected.

The Kelly Lake Triangle (ABC vs. AC)

Two possibilities were studied between Kelly Lake substation, A, and node C on the Camelsfoot alternative. The ABC alternative is 11.0 km compared with 9.5 km for the direct AC route. ABC bypasses Kelly Lake to the south and follows the existing rights-of-way from Kelly Lake south to node B (5.0 km). AC is very close to the north side of Kelly Lake and involves a new right-of-way up a steep hillside above Downing Park.

Alternative ABC is the preferred route because it avoids the steep hillside and bypasses the Kelly Lake/Downing Park area. The visual impact of AC would be severe, due to terrain alteration and exposure along a ridge crest.

The Camelsfoot Alternatives (BE) vs. (BCE)

The two remaining possibilities between nodes B or C and the headwaters of either Applespring or Antoine Creeks (node E) involve crossing the Fraser River and the eastern part of the Camelsfoot Range: BE is the more southerly option of 18.6 km; and BCE is the slightly longer northerly alternative of 19.6 km.

Terrain: Both routes involve difficult crossings of the Fraser River. The northern route avoids areas of high impact gully erosion west of the Fraser near Slok Creek, making it preferable to the southern alternative. Construction of access roads on the marginally stable steep slopes would create erosion and possible slumping.

Vegetation restoration after construction would be very difficult in this arid zone, particularly on any slump areas.

Wildlife: Both routes cross areas of good deer and sheep habitat in the Camelsfoot Range and Fraser Canyon. The impacts will be high with both alternatives if access roads connect the Fraser Valley roads to the alpine areas and the Bridge Valley.

Heritage: The southern option has medium to high heritage resource potential while the north is rated low to medium.

Decision: The northern Camelsfoot route (BCE) is marginally better because it avoids the area of gully erosion west of the Fraser and has lower heritage potential. Wildlife and forestry values are similar for both options; potential impacts on wildlife are similar for both.

The preferred northern alternative from Kelly Lake (node A) to Mission Ridge (node I), is ABCEI, a total distance of 42.0 km.

The Pavilion Alternative (ABDGIJ)

The Pavilion option was compared with the northern alternative discussed in the previous paragraphs. Between Kelly Lake (A) to node (I) on Mission Ridge via Pavilion there is little

difference in length as compared to the northern alternative via Antoine Creek.

The Pavilion option follows the four existing transmission line rights-of-way (5L41, 5L42, 2L90, 2L91) south from Kelly Lake substation to the Pavilion Indian Reservation. It then branches south and west paralleling 5L42 across the Fraser and over the Camelsfoot Range, across the Bridge River and up Mission Ridge to Node G. From G it is proposed to use two, single circuits to nodes I and J.

The major difference between the Pavilion option and the northern Camelsfoot option is that the Pavilion option follows established rights-of-way through accessed, settled land, whereas the northern Camelsfoot option would mean opening up relatively inaccessible areas. The central issue, then, was the trade-off between further utilization of an existing corridor (Pavilion) and the opening up of an entirely new corridor. The potential impacts in the corridor are discussed below and the corridor compared with the Antoine Corridor in Table 14.2.

Terrain: There are no major terrain problems between Kelly Lake and Pavilion (ABD). Between Pavilion and Bridge River, the highest potential terrain impacts occur on the steep valley slopes. Access should be restricted to that which exists for 5L42 unless the split circuits diverge from the existing route. By contrast the terrain difficulties in the Antoine corridor are severe.

Agriculture: The Pavilion route has the only significant agricultural land use between Kelly Lake and Seton Portage. Rangeland and irrigated forage crops are found between nodes B and D, on the Diamond S Ranch, and on the

Pavilion Reserve. The majority of this segment is within a large unit of the Agricultural Land Reserve.

The four existing transmission lines presently restrict use of wheeled irrigation systems on the irrigated forage lands. A fifth line would compound these difficulties. As well, the aesthetic value of the ranchland has already been severely depreciated by the existing lines. A fifth line would have to be located east of the existing line, to avoid the Diamond S Ranch buildings. A cross-over would be required at node D, to follow the 5L42 line. The agricultural impacts on the Pavilion option are severe compared to the northern Camelsfoot option.

Settlement and Visual: The Diamond S Ranch and the Pavilion Indian Reserve are crossed by the Pavilion option. An additional transmission line, with much larger towers and numerous conductors represents a significant visual impact on the landscape, and may require additional right-of-way through private land. The northern Camelsfoot option, however, is located mostly on unsettled Crown land, thus incurring minimal impact on settled areas but creates a further visual intrusion into a highly scenic area of the Fraser Canyon and adds a new hazard for small planes.

Wildlife: The existing access roads already have created negative impacts on wildlife by providing an easy means of transport for hunters and drivers of all-terrain vehicles. Uncontrolled use of the road from Pavilion is a cause of concern to the Pavilion Band.

Notwithstanding any of the above, from a wildlife perspective, the use of an existing corridor is preferable to

one that penetrates an area not otherwise likely to be accessed as it does not increase hunting pressure or increase management problems.

Fisheries: The Pavilion corridor follows the major river while the Antoine corridor crosses the ridges between. The Pavilion corridor will have the potential for greater impacts from erosion.

Forestry: Forest productivity is low along both corridors up to Mission Ridge due to the arid conditions, but as the Pavilion route is longer in total, and crosses the more productive land of Mission Ridge, it clearly has more impact.

Vegetation: The Antoine corridor crosses the Fraser Canyon in an area where major terrain disturbance is highly probable and revegetation very difficult due to the arid conditions, in addition it crosses areas of such alpine vegetation. The Pavilion corridor is all at low level and relatively little ground disturbance is anticipated.

Revegetation: Use of the Pavilion corridor will have an incremental adverse impact on the existing disturbed vegetation along the corridor. Use of the Antoine corridor will have a much greater adverse impact due to the new crossing of the Fraser and the traverse of alpine and subalpine areas in the Camelsfoot Range.

Heritage: The Pavilion corridor has a greater heritage potential as more of it is along the rivers at low elevation while the Antoine corridor is largely on the mountain ridges.

TABLE 14.2

IMPACT COMPARISON - ANTOINE (ACEIJKL)
AND PAVILION (ABDGJKL) CORRIDORS

	RATING OF ADVERSE IMPACT	
FACTOR	ANTOINE	PAVILION
Terrain	5	2
Vegetation	4	2
Agriculture	1	3
Fisheries	2	3
Forestry	1	2
Wildlife	5	1
Visual	4	2
Recreation	3	1
Land Use	2	3
Heritage	1	2

Note: Rating scale is 1 to 5, low to severe.

Decision: Severe terrain difficulties are encountered along the northern Camelsfoot option, in the Fraser Canyon and Antoine Creek Valley. The increased access in the Camelsfoot Range would have a severe impact on wildlife and create a major new visual intrusion into the scenic Fraser Canyon.

The longer Pavilion route has more favourable terrain, but a fifth transmission line would compound the existing agricultural and aesthetic impacts on the Diamond S Ranch and the Pavilion Reserve, and take more forest land out of production, albeit land of low productivity.

The Pavilion option is preferred, particularly if further alienation of private land (most of which is in the ALR) between nodes B and D be kept to a minimum. Several suggestions that would accomplish this are offered, namely:

1) utilize double circuit structures to carry both 230 kV circuits (2L90 and 2L91) in a single right-of-way, thereby allowing 5L46 to utilize the vacant right-of-way;

2) put 5L41 and 5L42 on double circuit towers in a single right-of-way, thereby allowing 5L46 to utilize the vacant right-of-way;

3) investigate whether route options exist east of the Fraser, other than adjacent to the existing lines, which would reduce impact on agriculture on Diamond S Ranch and Pavilion Reserve.

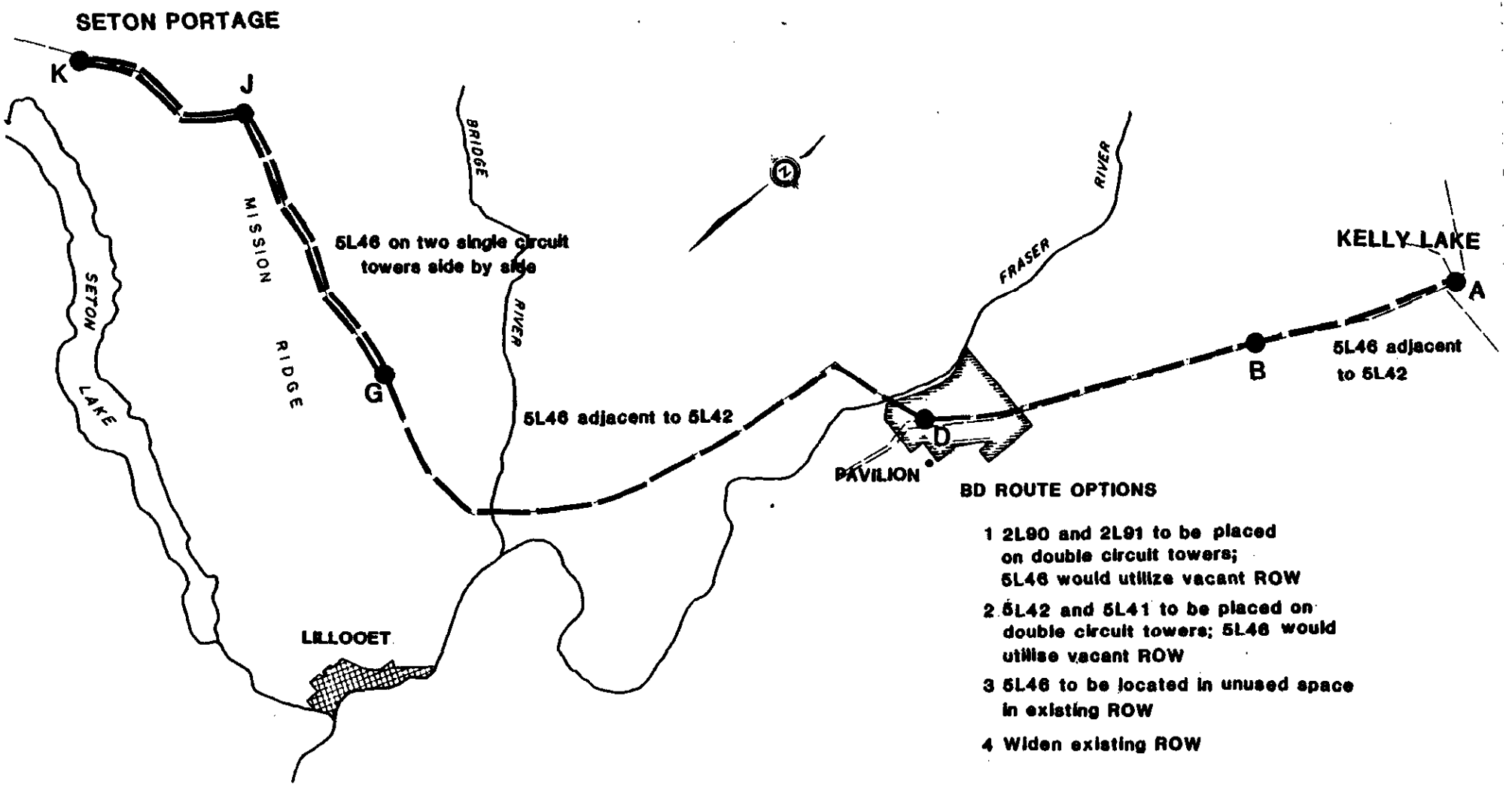
Mission Ridge to Seton Portage

B.C. Hydro proposed to split the two circuits of 5L46 and locate them in separate corridors over Mission Ridge because of the severe climatic conditions on Mission Ridge. For the Pavilion corridor, the double circuit would split onto separate towers at node G; one circuit was proposed to follow 5L42 (GJK) and the other to utilize a new right-of-way farther north (GI), descending into the Bridge Canyon and rising up to node K. A short double circuit segment (6.5 km) would complete the section to node L at Seton Portage.

For the Antoine corridor the circuits would split at node I west of the Bridge River; one circuit would go over Mission Pass (IJK) and the other would utilize the Bridge Canyon alternative (IK).

There are no major settlements, agricultural, recreational, heritage or fisheries concerns on Mission Ridge. The Bridge Canyon has a medium to high heritage rating and there are potential visual and fisheries impacts. Wildlife impacts are considered to be low, particularly if the existing 5L42 right-of-way is paralleled as the goat population of Mission Ridge has already been drastically lowered as a result of improved access. Thus, further disturbance from construction of new lines can only be considered as an incremental adverse impact.

Bridge Canyon has a high potential terrain hazard. Both the Mission Ridge segments (GI and GJ) have areas of potential terrain hazards. Conditions are more favourable in Mission Pass (JKL) and are rated as moderate potential hazard. Forestry impacts on the lower part of Mission Ridge are rated moderate to moderately high. The higher impacts would occur in segment GI, any route adjacent to the 5L42 line would have a lesser impact.



RECOMMENDED CORRIDOR

Kelly Lake – Seton Portage

FIGURE 14.1

Decision: The Bridge Canyon is characterized by steep resistant rock faces. It is agreed that secure sites for towers can probably be found which are not subject to rock fall though all are probably subject to some risk. The visual impact of a 500 kV line through the Bridge Canyon would be very high. The use of segment IK is not recommended for these reasons. From the environmental point of view it is recommended that both the split 5L46 circuits be located adjacent to the existing 5L42 line to reduce loss of forest land on Mission Ridge, terrain disturbance in an area difficult to restore, and visual impacts.

Kelly Lake to Seton Portage Summary

The preferred corridor from Kelly Lake to Seton Portage from an environmental point of view is to follow the existing 500 kV right-of-way (5L42) from Kelly Lake to the east side of Mission Ridge, where construction would change to two 500 kV single circuits.

These single circuits should continue over Mission Ridge following the existing 500 kV right-of-way and then continue to Seton Portage.

The main factors considered in this recommendation were the terrain and visual problems at the new Fraser River crossing in segment CE, wildlife values in the Fraser and Antoine valleys, and scenic values in the Antoine and Bridge valleys, adverse impacts in the subalpine and alpine areas of the Camelsfoot Ranges.

If it is found that the cost differences between the recommended corridor and a northern corridor exceed the assessed

values of the environmental features protected by use of the recommended corridor, then it is recommended that the corridor ABCEIJKL be used, with segments IJ and JK consisting of twin 500 kV lines. Costs and Benefit/Cost comparisons were not part of this study.

CREEKSIDE TO CHEEKYE

From Creekside to Pemberton no alternate corridor options exist other than to follow the existing right-of-way. At Pemberton three corridor options are available.

Pemberton Options (MaN, MbN, McN)

Discussion: In order to avoid crossing directly through the Village of Pemberton, two options were studied in addition to that using the 2L1 right-of-way. These were 1) following adjacent to 5L42 and 2) a longer route that would swing north of Pemberton, traversing the steep hillside west of the village.

The latter option (MaN) was rejected because it would:

1) require two crossings over the existing 2L2 transmission line;

2) leave a highly visible scar on the hillside west of Pemberton;

3) would require the acquisition of an entirely new right-of-way through private farmland north of Pemberton;

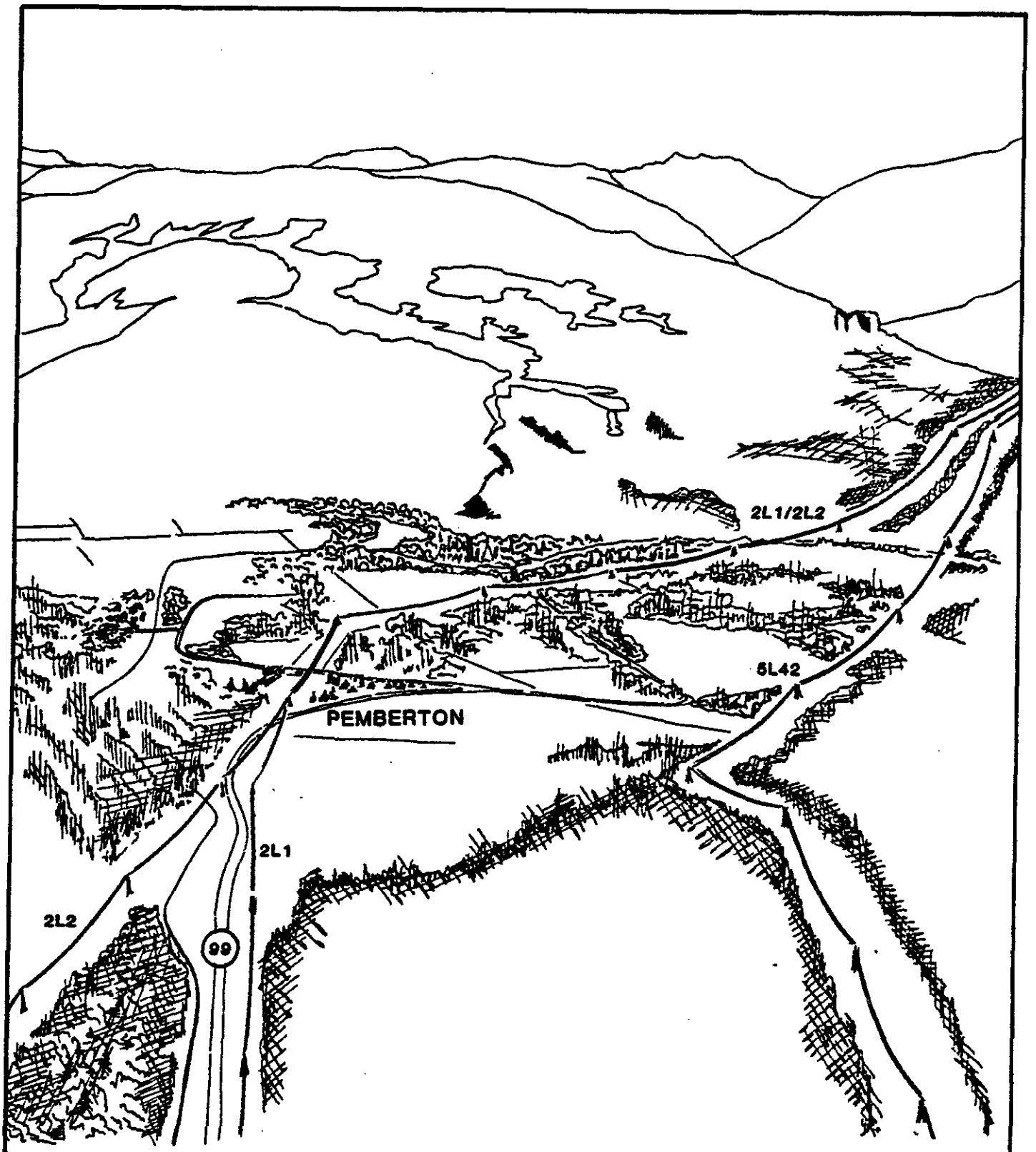
4) would result in a total of three widely-spaced transmission line corridors crossing the Lillooet Valley in close proximity to Pemberton; and

5) require a crossing of Pemberton Creek with potential adverse fishery impacts.

Use of the 2L1 right-of-way would minimize the need for new right-of-way through the developed area around Pemberton. However, use of this right-of-way would incur substantial visual and social impacts as both 2L1 and 2L2 cross the highway at the entrance to the valley and town; the larger towers of the proposed 5L46, if placed within the 2L1 right-of-way, would encroach heavily into the panoramic view of the Lillooet Valley at the approach to the town. Figure 9.1 and 9.2 show the existing situation, and that proposed. Both 2L1 and 2L2 cross through a parking lot adjacent to the Signal Hill Elementary School - use of 2L1 ROW would be less desirable than a location farther removed from the schoolyard.

The third option (McN), paralleling 5L42, is preferred from the point of view of visual impact as it is farther east of the Village and avoids crossing or paralleling Highway 99. Its ascent up Signal Hill would still be visible, but as it is quite a distance from the road, the visual impairment would be reduced. Locating 5L46 adjacent to 5L42, particularly if the existing 2L1 line was removed, would result in a net improvement to the visual quality in and around Pemberton. Figure 14.2 illustrates the existing situation in the Pemberton Valley.

A possible constraint to locating 5L46 adjacent to 5L42 is that it may encroach upon the approach path of the air-



Pemberton Valley Showing Locations Of Existing Transmission Lines; Preferred Location For 5L46 Is Adjacent To 5L42, With Removal Of 2L1

FIGURE 14.2

port. If the existing airstrip is expanded as indicated in the Willis, Cunliffe, Tait report (December, 1980), the required clearance at the point where 5L42 crosses the approach path is approximately 61 m. 5L46 towers will be roughly 56 m high, therefore it would appear that the required clearance can be achieved, alternately the circuits could be split for a short distance.

Impacts on agriculture would be minimized if the 2L1 right-of-way was utilized. The other options would both require new right-of-way across agricultural land in the Pemberton Valley. Terrain impacts would also be minimized with the 2L1 option, primarily as the Lillooet River crossing therein is on better drained, gravelly materials; the other options would cross on fluvial soils which are subject to compaction. Signal Hill (McN) consists mostly of stable materials; the northern option (MaN) would traverse steep, less stable slopes, particularly near Nairn Falls.

Decision: It was agreed that social and visual concerns were of primary importance in the vicinity of Pemberton, therefore it was recommended that 5L46 be located immediately west of the existing 5L42 line, subject to further investigation to determine whether such a location poses real limitations to the proposed airport expansion. The second choice would be that utilizing the 2L1 right-of-way.

Nairn Falls to Soo Valley

Between Nairn Falls and the Soo River, the line would follow the Green River, utilizing the 2L1 right-of-way as much as

possible. Environmental issues along this portion of the segment include the potential for rock slides near the mouth of the Soo River, and problems associated with crossing fluvial fans, such as at Rutherford Creek where recent flooding and erosion on the creek fan damaged two of the three existing lines. Fisheries values are quite high in the Green River system, however careful construction practices and scheduling would minimize impacts on fish due to stream siltation.

The 2L1 right-of-way crosses the highway about eight times between Nairn Falls and the Soo River, and lies immediately adjacent to the highway for most of the distance as the highway was constructed along the old Hydro access road. As such, visual impacts stand to be quite severe particularly as the towers are substantially taller, and number of conductors greater on the proposed double circuit line than the existing 230 kV line. It may be possible to moderate visual impacts in this section through careful routing; this should be addressed in detail during Stage 2.

Utilization of the existing 2L1 right-of-way will largely avoid any significant impacts on other resources, such as forestry and agriculture, or settlement, as new right-of-way requirements would be minimized.

At the junction of the Soo and Green Rivers corridor options again exist. There are two basic options, the Soo/Squamish (NOPRT) with sub-option OQR, and the Whistler/Cheakamus (NST), with the Rainbow Mountain sub-option (NOS). These are compared in the following sections and the comparison summarized in Table 14-3.

Sub-options Mt. Callaghan North (OPR) and South (OQR)

Terrain: Both segments traverse excessively steep topography, loose rock (talus) and recently glacial deposits. OPR passes close to extensive icefields and glaciers at the drainage divide between the Soo and Squamish Rivers. Potential for erosion is high, the passes are over 1800 m in elevation. Snow conditions are severe. Road construction would leave many scars.

Vegetation/Forestry: Both corridors are equally sensitive to disturbance due to the presence of fragile alpine vegetation in the higher elevations.

Wildlife: Both corridors are valuable for wildlife, particularly mountain goat and grizzly bear which do not have many similar undisturbed areas in the study area.

Fisheries: OQR passes by Callaghan Lake, and therefore creates a potential for impact on sport fishing. The upper Soo and Squamish Rivers have relatively low fisheries value.

Recreation/Visual: Both options encompass spectacular alpine scenery with high undeveloped potential for hiking, viewing, wildlife/nature photography etc. The OQR option would cross between Callaghan Lake and the smaller tarn lake immediately to the north. A transmission line through this spectacular setting would impose a severe visual impact. The presence of a transmission line in an otherwise unspoiled area represents a significant, permanent loss of wilderness recreation opportunities in close proximity to the Lower Mainland area and the Resort Municipality of Whistler. The wilderness values in this

area are very high and will certainly be accessed soon to extend the opportunities available to visitors to Whistler and to reduce the visitor pressure on the Garibaldi Lake area.

Discussion: Impacts in each corridor would be very high. OPR is marginally preferable to OQR as it keeps away from land in Callaghan Valley most likely to provide recreational opportunities in the future, and avoids possible siltation in the Callaghan System.

Sub-options, Rainbow Mountain (NOS) vs. Whistler Valley (NS)

The Rainbow Mountain loop offers the shortest bypassing of the Whistler Valley. The Whistler Valley corridor (N to S) is 4.0 km shorter than the Rainbow Mountain loop (NOS). The main issues are discussed below and impact ratings shown in Table 14-3.

Terrain: The main areas of adverse potential impact along the Whistler corridor between the Soo River and Brandywine are the valley floor between Alta Lake and Green Lake where organic deposits and high water tables occur, the soils are not resistant to compaction, and vegetation is slow to recover once disturbed; and areas of steep sidehill above the lakes where there is high potential for erosion. Areas with terrain hazards in the Whistler corridor include rock and earth slides, talus slopes, creek fans subject to torrent erosion as occurred at 19 Mile Creek in December 1980. Also, there are several areas subject to potential flash floods in creeks such as Fitzsimmons, Twenty-one Mile and Wedgemount Creeks, due to sudden release of water impounded by slumps in the actively eroding banks.

Most of these problem areas can be avoided, however, and in general, the 2L1 line is suitably located and has proven to be safe from such hazards over the years of its operation.

Use of the Soo/Callaghan option (NOS) would have much greater impact on terrain; difficult areas include the wet, organic deposits in the lower Soo Valley, and very unstable slopes (talus, rock slides) in the narrow pass west of Rainbow Mountain. The dramatic volcanic cones in the alpine areas are highly fractured and subject to crumbling (see Photos 11-16) below which are steep talus slopes where the corridor would lie.

The terrain hazards in this corridor consist of widespread avalanches and rock slides on the west side of Rainbow Mountain.

Vegetation/Forestry: The loss of forest land is marginal if the 2L1 right-of-way is utilized, as compared to loss of some 141 ha of forest land required for the right-of-way in the Soo and Callaghan drainages.

In the Whistler corridor wetlands are crossed between Alta and Green Lakes and care would be necessary to minimize disturbance here.

In the Soo Valley the extensive wetlands (8 km) are important to wildlife and waterfowl, they could be severely impacted if a route were chosen through them to avoid loss of forest land, or indirectly by erosion of soils from the right-of-way on the sidehill above them.

The subalpine vegetation in the pass west of Rainbow Mountain is also difficult to restore once disrupted.

TABLE 14.3

IMPACT COMPARISON - WHISTLER AND RAINBOW CORRIDORS

FACTOR	RAINBOW MOUNTAIN	WHISTLER
Terrain	4	1
Vegetation	3	1
Forestry	4	1
Agriculture	N/A	N/A
Recreation	4	2
Visual	4	3
Settlement	1	3
Wildlife	4	1
Fisheries	3	2
Heritage	1	1
Minerals	2	1

Note: Rating scale is 1 to 5, low to high.

Wildlife: Potential impacts on wildlife are much more severe if the Rainbow Mountain loop is utilized as it represents a significant disturbance to an otherwise undisturbed region, particularly for deer, goat and grizzly bear. Impacts on wildlife through Whistler would be marginal as most of the original wildlife has been displaced by residential and commercial development, and by existing transportation and transmission line corridors.

Fisheries: Potential impacts on fisheries are greater for the Rainbow Mountain loop than for the Whistler corridor. Little information exists on the fishery potential of the Soo River, but the Callaghan River and Cheakamus are highly rated, the chance of stream disturbance during construction is much greater due to more difficult terrain conditions, whereas use of the existing right-of-way through Whistler would entail less disruption to the surroundings. It must be recognized that all the lakes near Whistler (Alta, Nita, Alpha and Green) are stocked, and are an important component of local recreation deserving of careful attention to prevent erosion along the ROW during construction.

Recreation: The Callaghan drainage represents the only major opportunity for low elevation recreation in the Whistler area that is accessible by road and still in a natural state. It has significant recreation potential for cross-country skiing, snowmobiling, fishing and hiking. As well, the alpine areas in the upper Soo and Callaghan valleys offer some spectacular scenery and excellent ski touring and hiking opportunities. Access to these alpine areas is not well developed at present, though it is probable that this area will receive greater use as the Whistler resort is developed.

The potential value of the area for recreation has been recognized by the B.C. Government which has placed a reserve over much of the area. Proposals have been made to develop a downhill skiing complex near Mt. Callaghan and a ski touring complex near Callaghan Lake; the Parks Branch also has an interest in the area.

The Whistler Valley, although providing high quality recreation, primarily in the form of downhill skiing, has lost many of its natural amenities as a result of intensive residential development, logging, and use as a transportation corridor. Consequently, it was considered that location of the transmission line in the Whistler Valley, (provided attention was given to minimize visual impact) would be much less damaging than use of the Rainbow Mountain loop to the recreational resources in the region on which Whistler will largely depend as it progresses to an all season resort.

Visual: Use of the Rainbow Mountain loop would introduce a major visual intrusion into three areas of scenic value which are presently in a natural state. The Soo Valley is unusual in the region with its contrast between alpine peaks, uniform forested slopes and wide extensive wetlands on the valley floor. This pattern will probably be broken up by future logging. The valley walls are not steep and the straightness of the valley would make any cleared right-of-way visible for much of its distance from the mountain slopes in the attractive alpine area at the Soo/ Squamish divide.

The pass west of Rainbow Mountain is narrow and confined with steep slopes. The visual impact of the line would largely be confined to those using the pass as it would be

partially screened by the mountain slopes when viewed from above on Rainbow and Callaghan Mountains.

The impact in the pass would be severe due to the large towers in the confined area and the terrain alteration brought about by road construction.

The pass opens up into the wide Callaghan basin which is heavily forested. With care, the line could be routed so that it was not readily visible by users of the valley floor. It would be impossible to screen it when viewed from the peaks and slopes surrounding the valley. From such viewpoints the cleared right-of-way through the forested landscape of the basin would be very obvious.

By contrast, if the line were routed through Whistler the visual impact when viewed from the ski areas or other slopes above the valley would not change as little or no further clearing would be required.

When viewed from the valley floor the extra height of the towers and the greater number of conductors and insulators would make the line visible at a greater distance than the present 230 kV line (2L1) which it is to replace. This extra impact can be reduced to some degree by careful location of towers and by changing the alignment near Brandywine and Green Lake to follow the 500 kV line rather than the 2L1 line. This certainly reduces visual impacts seen by travellers on the north and south approaches to Whistler.

Given that use of the Rainbow Mountain loop would still leave one 500 kV line and one 230 kV line through Whistler, and that construction of the new line offers an opportunity to remove some of the worst eyesores created

by the present 230 kV alignment, and given that the Whistler Valley is a wide one with a broad valley floor on which there is much visual diversity of landform, development and vegetation to break up the linear pattern of any transmission line when viewed from the valley floor, it is concluded that use of the Whistler corridor would have less total visual impact than use of the Rainbow Mountain loop - a pristine area of future value to the community of Whistler and its visitors.

Heritage: Neither option has significant heritage resource potential.

Minerals: Callaghan Valley has high mineral potential, is extensively staked and has one operating mine. Mineral potential in portions of the Whistler Valley is high, but it is unlikely that mining development in proximity to a major tourist resort would proceed.

Settlement: Clearly, the Whistler Valley option has much greater potential for adverse effects on present settlement as compared to the Rainbow Mountain loop which today has no permanent settlement. In the long term, the use of the Rainbow Mountain loop could have an adverse impact on the inevitable development of the Callaghan Valley. Use of the existing right-of-way, with minor realignments to minimize visual impacts and to avoid existing residential areas will, however, reduce the impact on settlement through the Whistler corridor.

Decision: Wilderness recreation, undeveloped skiing potential, wildlife and terrain factors were considered to be of major importance along the Rainbow Mountain loop. It was agreed, therefore, that on balance the use of the

existing right-of-way through the Whistler Valley would incur much less impact than use of the Rainbow Mountain loop. It was recognized, however, that visual concerns will be a major issue for local residents and visitors to the Whistler area, thus careful consideration must be given to minimizing these effects at a later stage in the route planning process.

Soo/Squamish (NOPRT); and Whistler/Cheakamus Options (NST)

Selection of the Whistler Valley option over the Mt. Callaghan/Rainbow Mountain option allows comparison of the full corridor sections from the Soo River confluence (N) to Cheekye (T). These are as labelled above.

General: The Soo/Squamish option is about 103 km long with 57 km through an area not presently accessed or likely to be accessed by road. The Whistler/Cheakamus corridor is fully accessed by road and is 63 km long from N to T. The corridors are compared in the following sections and the impacts rated in Table 14-4.

Terrain: The Soo/Squamish option encounters difficult terrain in the Soo Valley, the Soo/Squamish Divide, and the upper Squamish Valley. In the Soo Valley, extensive wetlands with organic soils occur. Line and road construction on these soils would result in severe compaction.

The Soo/Squamish divide is a rugged alpine area that is still raw from recent glaciation. The impact of road construction would be very severe resulting in erosion in those areas that are still bare. The possibility of major slumping of unconsolidated deposits in road cuts is high.

TABLE 14.4

IMPACT COMPARISON - SOO/SQUAMISH AND
WHISTLER/CHEAKAMUS CORRIDORS

FACTOR	SOO/SQUAMISH	WHISTLER/CHEAKAMUS
Terrain	4	2
Vegetation	3	1
Forestry	5	1
Wildlife	3	1
Fisheries	4	2
Heritage	2	1
Recreation	3	2
Visual	4	3
Agriculture	2	1
Minerals	1	2
Settlement	3	2

The upper Squamish Valley is characterized by steep, unstable valley walls, with numerous rock slides, avalanche tracks and talus slopes. Construction on the lower slopes is at risk from slope failure and erosion, especially on creek fans. Deeply incised creeks flowing into the Squamish are subject to flash floods during peak runoff periods; recent (December 1980) floods are examples of the extent of damage created by heavy rainfall, particularly the widespread erosion and debris flows on the creek fans.

The valley floor of the lower Squamish Valley is all flood plain and subject to channel changes of the Squamish River as occurred during the December 1980 storm. Lateral creeks also present a problem in terms of gully erosion and direction changes on their fans.

The Whistler/Cheakamus corridor, in contrast, has fewer areas of difficult terrain where high impacts or hazards are anticipated. From the Soo Junction to Brandywine significant impacts are limited to the wetlands near Alta Lake, risk of flooding, and steep side hills above Alta and Alpha Lakes.

South of Garibaldi in the Cheakamus Valley the corridor is frequently crossing exposed rock or areas where rock is close to the surface. There is little hazard from rockfall, slides or avalanches except at three locations. It is recognized that several massive debris flows have come down the valley of Rubble Creek at infrequent intervals and spread across the floor of the Cheakamus Valley. The potential for such flows exists at Culliton Creek. The Cheekye fan has also experienced mud flows but the threat is common to both options, particularly in the vicinity of the Cheekye substation. The Whistler/Cheakamus corridor

is preferred as its use would incur less impact on terrain, and the like would be less exposed to natural hazards.

Forestry: Commercial forestry values in the Whistler and Cheakamus Valleys are insignificant in comparison to those in the Squamish Valley. The reasons for this are that much of the remaining forest in the Whistler Valley will eventually be logged for development purposes, and forest productivity on the rocky outcrops of the Cheakamus Valley is very low. By contrast the lower slopes along the Squamish Valley may have the highest forest capability in the region, and those of the Soo Valley have moderate productivity.

Use of the Soo/Squamish corridor would remove 420 ha (103 km ROW less 20 km over Soo/Squamish divide, 50.5 m width) of highly productive land from the commercial forest land base.

Use of the Whistler/Cheakamus corridor would probably result in the loss of up to 50 ha (10 km of new ROW at 50.5 m wide) of low productivity land from the forest land base, depending on the final alignment of the transmission line.

Vegetation: Use of the Soo/Squamish corridor has the potential for severe impact on 8 km of wetlands in the Soo Valley and on 17 km of subalpine and alpine vegetation in the Soo/Squamish divide, all of which are desirable to retain, and very slow to recover once disturbed. Road construction in the Soo Valley wetlands would require extensive fill, thus destroying some of the wetland.

The Whistler/Cheakamus corridor has some 2 km of wetlands near Alta Lake and many stands of trees along the existing right-of-way which are important for visual screening. As far as can be established the latter should not be affected except where some departures from the existing ROW are proposed to reduce visual impact. Some impact on the wetlands may result if the new tower bases are constructed in the wetlands.

Wildlife: The Soo Valley, the upper portion of the Squamish, and that area near the confluence of Ashlu Creek and the Squamish River are important areas for wildlife. In comparison, wildlife capability in the Whistler/Cheakamus corridor has been greatly reduced through the development of residential, transportation, recreational and other facilities.

Fisheries: The Squamish River has high fisheries values (particularly for salmon) up to its confluence with the Elaho River. The Cheakamus River is utilized by steelhead and salmon in its lower reaches. The lakes at Whistler are important recreational fisheries. As very little clearing is proposed through Whistler the impact on the lakes would be very small. The rocky terrain of the Cheakamus section will result in very little risk of erosion and siltation.

Heritage: Moderate heritage resource potential is indicated for that portion of the Squamish Valley below the mouth of the Elaho River. No recorded sites are noted for the Cheakamus Valley corridor, although aboriginal trading routes and early trails may have existed. Potential along this corridor is rated as low to medium.

Recreation/Visual: Highway 99 and B.C. Rail are both located in the Whistler/Cheakamus corridor and are important recreational travel routes. As such, location of a transmission line along this corridor has potential for impairment of views, particuarly in the narrower sections of the valley where space constraints would make it more difficult to locate the line so that it would be less visible from the highway. It has been established that the proposed line would be located such that the visual impacts along Green Lake, from Function Junction to Brandywine, and through the Cheakamus Canyon would be much reduced from that of the present 230 kV line (2L1).

A detailed assessment of visual impacts cannot be determined until a final route alignment is established during the Stage 2 studies. By contrast, the Squamish Valley has relatively little recreational traffic; the valley is broad and quite open and can more readily accommodate a large transmission line. The visually sensitive portions of the Soo/Squamish corridor are the Soo Valley and the Soo/Squamish divide as described earlier.

In comparing the two corridor options, it must be remembered that if the Soo/Squamish corridor were used, at most only one 230 kV line would be removed from the Whistler/Cheakamus corridor, leaving one 230 kV line and one 500 kV line. However, B.C. Hydro has not determined whether the 2L1 line would be removed from the Whistler/Cheakamus corridor in this case. The reduction in visual impact in Whistler from use of the Soo/Squamish corridor would be marginal.

For these reasons, the use of the Whistler/Cheakamus corridor is preferred from a visual perspective.

Agriculture: Use of the Soo/Squamish corridor would take the line over an extensive length of lands with undeveloped moderate agricultural capability in the Squamish Valley, most of which is included in the Agricultural Land Reserve.

Use of the Whistler/Cheakamus corridor would make use of an established ROW over a small area of land with agricultural capability below the Cheakamus canyon.

Mineral Resources: The Whistler/Cheakamus corridor passes over more areas of known mineralization than the Soo/Squamish corridor, but such mineralization is not seen as a restraint to route location.

Active quarrying of basalt in the upper Cheakamus Valley can be avoided.

Settlement: Use of the Whistler/Cheakamus corridor will require a very limited area of new acquisition of private lands along the right-of-way.

Use of the Soo/Squamish corridor would require acquisition of a new right-of-way over private and Crown lands in the Squamish valley.

Decision: Based on the previous comparisons, and taking into account the marked difference in length, the Whistler/Cheakamus corridor is strongly preferred over the Soo/Squamish corridor on environmental grounds.

Creekside to Cheekye Summary

The preferred route from Creekside substation, north of Pemberton, to the Cheekye substation, north of Squamish, is as follows: adjacent to 5L42 ROW from Creekside to Nairn Falls; the existing Whistler Valley and Cheakamus corridor from Nairn Falls to Cheekye, using both the existing 2L1 ROW and new ROW as required in visually sensitive, and settled areas.

CHAPTER 15

CONCLUSIONS

The study area divides neatly into three sub-regions: Kelly Lake to Seton Lake; Seton Lake to Creekside; and Creekside to Cheekye. Four possible corridors were identified between Kelly Lake and Seton Lake, two corridors from Seton Lake to Creekside, and three from Creekside to Cheekye. Some shorter sub-options exist within most of these broader corridors.

The steeply sloped terrain and unstable materials along the south shore of Seton Lake eliminated this corridor option from further consideration. The Cayoosh Creek corridor was also eliminated because of the potential hazard to a transmission line from avalanches and slides along much of this corridor, and because of the potentially high, adverse impacts on forestry wildlife, fisheries and visual resources.

Having once rejected the Seton Lake corridor, three corridor options between Kelly Lake and the Bridge River Terminal at the west end of Seton Lake remained for comparison. The environmental assessment of these three corridors established a preference for use of the corridor adjacent to the existing 5L42 circuit, provided that steps are taken to minimize disruption to agriculture and settlement along the east side of

the Fraser River. Mitigation measures were not examined in detail in this study; however it is suggested that the proposed line be accommodated within the existing 210 m right-of-way from Kelly Lake to the Fraser River crossing, as it is understood that sufficient space is available within this right-of-way for an additional 500 kV circuit. The second choice is the Antoine Creek corridor.

B.C. Hydro proposes to split the double circuit line into two, separated single circuits over Mission Ridge due to the severe icing and wind conditions that commonly occur in this area. The introduction of a 500 kV line into the Bridge River Canyon - one of the options proposed for the split circuit - would incur severe terrain and visual impacts. It is therefore preferred that the single circuit lines be located in a single corridor, adjacent to the existing 5L42 circuit.

From Bridge River Terminal to Creekside, use of the existing corridor along the north side of Anderson Lake is recommended. The major area of concern along this corridor is in the Gates/ Birkenhead River Valleys where three transmission lines, the B.C. Rail, a road and several settlements are all squeezed onto the narrow valley floor.

The replacement of one of the existing 230 kV circuits with the double circuit line will minimize the need for new right-of-way, but the larger towers could incur visual impact depending on the final route location.

From Creekside to Cheekye, three major corridors were studied, namely: the existing corridor through the Whistler/Cheakamus Valley; a lengthy corridor that would bypass Whistler via the Soo and Squamish Valleys; and a shorter corridor that would bypass Whistler via the lower Soo and Callaghan Valleys.

CONCLUSIONS

The Soo/Squamish corridor is the longest of the three options, involving a total distance of approximately 103 km, depending on the choice of location across the drainage divide at the headwaters of the Squamish River. This corridor was considered unattractive for a transmission line, due to the potential for severe rock slides in the upper elevations, and gully erosion in the lower Squamish. In addition, loss of productive forest land would be substantial in comparison to the other corridors, and there is also potential for fisheries impacts in the Squamish River, and degradation of visual resources in the alpine areas. As there might be no visual improvement at Whistler by removal of 2L1 if this corridor were used, it was discarded.

The corridors that remained for comparison presented a situation where a shorter bypass of Whistler, requiring new right-of-way through attractive alpine areas was compared to that utilizing an existing right-of-way through Whistler/Cheakamus Valleys. As the corridor bypassing Whistler via the Soo and Callaghan Valleys would involve a new line through an area of significant recreation appeal and productive forest land, and would still leave at least two major transmission lines through the Whistler area, it was concluded that use of the existing right-of-way through the Whistler area would have a lower, overall impact. Careful route alignment will be necessary to minimize visual impact in the vicinity of Whistler and between Whistler and Pemberton.

Three sub-options were examined in the vicinity of Pemberton; a route crossing the Lillooet Valley northwest of Pemberton, utilizing the existing 2L1 right-of-way, and a route adjacent to the 5L42 line, southeast of the town. The preferred option is that adjacent to the 5L42 line, as this was considered to have the least visual impact and disruption of existing settlement than the other options.

Specific issues requiring careful attention in the Creekside to Cheekye section during route selection are the potential visual impacts in Pemberton, and between Pemberton and Cheekye, potential interference with the preferred approach path to the proposed regional airport at Pemberton, and potential impacts on lakes and wetlands in the vicinity of Whistler.

APPENDIX I

TERMS OF REFERENCE

TECHNICAL TERMS OF REFERENCE FOR ENVIRONMENTAL CONSULTANTS ON ROUTE SELECTION FOR MAJOR TRANSMISSION LINE PROJECTS

STAGE I STUDIES

Subject to the constraints, assumptions and requirements described in these Terms of Reference and attachments (see list of attachments below), the environmental consultant will undertake studies and produce an environmental assessment report which will discuss and evaluate the significant ecological and socio-economic aspects of the construction, operation and maintenance of transmission lines on routes defined by B.C. Hydro.

1. Environmental impact assessment factors to be considered are to include but not ncessarily be limited to the following components:

- the natural resources: soils, soil capability for agriculture, vegetation, forest cover, water in all forms, water supply areas, minerals, wildlife, wildlife habitat, fish, fish habitat and recreational potential;

- geology: land forms, geophysical factors and natural features which may affect or be affected by transmission line location;

- land use capability: existing land use and projected land use, identification of Crown land, Native Indian lands, Agricultural Land Reserve, transportation and transmission facilities and other land use categories as far as recorded on official documents;

- human settlements: existing settlement and areas of potential settlement, generally as recorded in official documents;

- visual landscape: identification of specific scenic and landscape values in relation to land use, settlement, recreation areas and highways.

These components will be recorded on topographic maps of 1:125,000 scale (or other scales approved in advance by B.C. Hydro) and also described in narrative form. The interaction of these components with the proposed project is to be studied, evaluated and reported.

2. The consultant will take an inventory of existing and planned developments as well as taking into consideration those developments which may reasonably be expected in the geographical study area defined for the transmission project. The more definite developments (existing and planned) are to be clearly differentiated from the more speculative possibilities so there is no confusion between the two groups and the effects they may have on route selection. Interest will be focussed on those aspects of development which may affect or be affected by the transmission project and on the potential for decreasing or increasing impacts because of interaction between the transmission project and other developments.

Developments are understood to include but not be limited to other linear developments, resource exploitation activities, human settlements and such designated land uses, activities, and areas as Native Indian lands, parks watersheds, agricultural land reserves and wildlife habitat.

3. Environmental impact assessment factors for Stage I studies are to be derived from existing information and reconnaissance type field trips. B.C. Hydro expects the consultant to contact the staff of government resource agencies, Regional Districts, municipalities and others as appropriate in order to obtain the most up-to-date information on the topics mentioned in items 1 and 2 above. Discussions with the general public are not a part of the Stage I environmental studies. All spe-

cific outside contacts must be coordinated with and approved in advance by B.C. Hydro. The purpose of these contacts will be to gain access to information which will be relevant to the environmental evaluation of routes through the geographical study area. In areas where sufficient recorded information does not exist, the consultant and B.C. Hydro will review the project requirements and agree on a procedure to be followed to obtain the required information.

4. Based on the findings of the environmental studies, the consultant will prepare an environmental assessment report which will provide overview information on the ecological and socio-economic aspects of locating transmission facilities on the feasible transmission line routes in the geographical study area. As a part of the socio-economic studies the consultant will use quantitative data and information to describe the human settlements which might be affected by the project and to describe the general economic character of the areas involved. Maps and text will be used to describe the positive and negative environmental aspects associated with each route. Full consideration is to be given to an evaluation of those impacts which would be caused by other developments and which should not be completely attributed to the transmission line if it is developed first. The consultant will rank the feasible transmission routes in order of cumulative environmental impact.

5. In addition to the above, when the environmental studies are completed the consultant shall be prepared to attend public meetings, if so requested by B.C. Hydro, to defend and discuss the environmental study methodology and findings.

LEGEND

Impact on TERRAIN

High
Moderate
Low

High
Moderate
Low

Based on aerial reconnaissance only. No terrain maps or aerial photographs were available at the time of this study.

Hazards

Debris slides
Avalanche
Incised gully

Talus and rock fall
Creek channel erosion
Mission Pass West 5L42
Seton Portage
Rockslide and unstable surficial deposits
Bridge Canyon
Antoine Creek
Tectonic fault zone, unstable bedrock and surficial deposits
Deep surficial deposits; terrace scarp erosion
Tectonic fault zone; unstable bedrock and surficial deposits
Mission Pass East 5L42
Potential debris slide
Mission Ridge W.
Shalalth
Mission Ridge North
Mission Ridge South 5L42
Rock slide and unstable surficial deposits.
Extreme slopes
Applespring Creek
Gully erosion
Camelsfoot North
Rock slide
Extreme slopes; gully erosion
Camelsfoot South
Kelly Lake North
Kelly Lake South
Kelly Lake East 2L90 2L91 5L41 5L42
Kelly Lake Substation
Seton Lake 2L90 2L91
Potential massive slope failures
Potential rock and debris slide
Rock slides
Gully erosion and debris slide
Marble Range 2L90 2L91 5L41 5L42
Extreme slopes; loose surficial deposits; gully erosion and slope failure
Gully erosion
Pavilion - Mission Ridge 5L42
Pavilion
Creeping slide
Eroded creek channels
Deep surficial deposits; debris slides and gully erosion
Cayoosh Creek
Talus, rock fall and debris slides
Debris slides
Eroding terrace scarp
Fountain
Unstable bedrock and surficial deposits. Potential debris slides
Lillooet
Unstable bedrock and surficial deposits
Pavilion 2L90 2L91 5L42
Eroded creek channels
Unstable surficial deposits
Gully erosion

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - - -	- - - - - -	Using existing R/W
—·—	5L42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

TERRAIN

Kelly Lake — Seton Lake

Scale 1:125,000

Map 1a

Rock slide and avalanche

Creek channel erosion

Rock fall and creek channel erosion

Debris slide and rock fall

Avalanche and rock fall

Deep erodible surficial materials; incised gullies and flash flood on fans

M

Creekside Substation

Rock slide and avalanche

Potential massive slope failure; avalanche

Unstable surficial deposits and bedrock. Incised creek channels

Anderson Lake

5L42 2L1 2L2 3L2

D'Arcy

Potential massive slope failures

L

Seton Portage 2L1

5L42

2L90 2L91

Organic deposits

Debris slides, avalanche

Cayoosh Creek

2

LEGEND

Impact on TERRAIN

High
Moderate
Low

High
Moderate
Low

Based on aerial reconnaissance only. No terrain maps or aerial photographs were available at the time of this study.

Hazards

Debris slides
Avalanche
Incised gully

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
		Using new R/W
		Using existing R/W
	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

TERRAIN

Seton Lake — Creekside

Scale 1:125,000

Map 1b

LEGEND

Impact on TERRAIN

High
Moderate
Low

High
Moderate
Low

Based on aerial reconnaissance only. No terrain maps or aerial photographs were available at the time of this study.

Hazards

Debris slides
Avalanche
Incised gully

P
R
Q
O
N
S
M
a
b
c

Mt. Callaghan North
Mt. Callaghan South
Soo Valley
Callaghan Creek
Lamont
Rutherford
Pemberton
Creekside Substation
Mount Currie
Whistler Village
Brandywine Falls
Garibaldi Park

5L42 2L1 2L2 3L2

Rock fall and talus
Scarp erosion
Rock fall
Organic deposits
Rock slide
Rock slide and talus
Flood and avalanche Creek channel erosion
Avalanche and debris slide
Extreme slope, talus and rock fall
Rock slide, rock fall, talus and avalanche
Flash flood and debris flow
Unstable surficial deposits, rock fall, channel erosion and flood
Gully erosion
Flood and creek channel erosion
Talus
Talus and rock fall
Flash flood and potential mud flow
Channel erosion and flood
High vertical face, rock slide and talus

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
——·——	5L42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

TERRAIN

Creekside — Brandywine Falls

Scale 1:125,000

Map 1c

EAST

Rock fall, flash floods, talus and rock slides, avalanche and unstable surficial deposits

Flash flood

Flash flood

Rock fall and rock slides

Squamish Valley

R

Avalanche, creek channel erosion, flash flood, talus and rock fall

Rock fall and gully erosion

Talus

Avalanche, creek channel erosion, unstable surficial deposits and rock fall

Avalanche, rock fall, rock slides and talus

2L12

Talus and rock fall

Organic deposits

Unstable scarp

Rock fall

Rock fall, unstable surficial deposits and avalanche

Avalanche, talus, rock slides and rock fall

Organic deposits

Cheekye

Cheakamus Valley

2L7 2L2

Talus and rock fall

T

Garibaldi

5L42 2L7 2L2

Talus and rock fall

Talus

Brandywine Falls

Potential mud flow

Flood, talus and rock fall

S

Rock fall and talus, creek channel erosion and unstable surficial deposits

Potential rock falls

Rubble creek mud and rock flow

Unstable surficial deposits and talus

Talus, rock fall and gully erosion

Talus

Q

Z

Unstable surficial deposits; potential mud flows

LEGEND

Impact on TERRAIN

High
Moderate
Low

High
Moderate
Low

Based on aerial reconnaissance only. No terrain maps or aerial photographs were available at the time of this study.

Hazards

Debris slides
Avalanche
Incised gully

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
		Using new R/W
		Using existing R/W
	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

TERRAIN

Brandywine Falls — Cheekye

Scale 1:125,000

Map 1d

NOTE: Agriculture impacts are discussed in text, as impacts vary with farming practice and present use of land.

LEGEND

FOREST Impact
- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

AGRICULTURE
- A.L.R. boundary
- Agricultural Class 1-4
- Cultivated Land
- T.F.L./P.S.Y.U. boundary

Seton Portage
Shalalth
Lillooet
Pavilion
Kelly Lake Substation

L
K
J
I
H
G
F
E
D
C
B
A

Mission Pass West 5L42
Mission Pass East 5L42
Bridge Canyon
Mission Ridge W.
Mission Ridge South 5L42
Mission Ridge North
Antoine Creek
Applespring Creek
Camelsfoot North
Camelsfoot South
Kelly Lake North
Kelly Lake South
Kelly Lake East 2L90 2L91 5L41 5L42
Marble Range 2L90 2L91 5L41 5L42
Seton Lake 2L90 2L91
Pavilion - Mission Ridge 5L42
Cayoosh Creek
Pavil Dx - Fountain 2L90 2L91 5L41
BIG BAR P.S.Y.U.
BOTANIE P.S.Y.U.
YALAKOM P.S.Y.U.

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
——·——	5L42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

FORESTRY & AGRICULTURE

Kelly Lake — Seton Lake

Scale 1:125,000

Map 2a

M

Creekside Substation

Anderson Lake

5L42 2L1 2L2 3L2

D'Arcy

L

Seton Portage

5L42

2L1

2L90 2L91

YALAKOM P.S.Y.U.

SOO P.S.Y.U.

SOO P.S.Y.U.

YALAKOM P.S.Y.U.

Cayoosh Creek

2

LEGEND

FOREST Impact

- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

AGRICULTURE

- A.L.R. boundary
- Agricultural Class 1-4
- Cultivated Land
- T.F.L./P.S.Y.U. boundary

NOTE: Agriculture impacts are discussed in text, as impacts vary with farming practice and present use of land.

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
———	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye

500 kv Transmission Line Corridor Assessment

FORESTRY & AGRICULTURE

Seton Lake — Creekside

Scale 1:125,000

Map 2b

NOTE: Agriculture impacts are discussed in text, as impacts vary with farming practice and present use of land.

LEGEND

FOREST Impact
- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

AGRICULTURE
- A.L.R. boundary
- Agricultural Class 1-4
- Cultivated Land
- T.F.L. / P.S.Y.U. boundary

P
R
Q
O
N
S
M
Mt. Carlaghan North
Mt. Carlaghan South
Callaghan Creek
Soo Valley
T.F.L. No. 38
SOO P.S.Y.U.
Whistler
5L42 2L1 2L2
Whistler Village
Brandywine Falls
SOO P.S.Y.U.
GARIBALDI PARK
Garibaldi Park
Pemberton
a
b
c
5L42 2L1 2L2
Creekside Substation
Mount Currie
2

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
———	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

FORESTRY & AGRICULTURE

Creekside — Brandywine Falls

Scale 1:125,000

Map 2c

QUADRA P.S.Y.U.

SOO P.S.Y.U.

T.F.L. No. 38

SOO P.S.Y.U.

Squamish Valley

R

Q

Cheekye

T

2L1 2L2

Cheakamus Valley

Garibaldi

5L42 2L1 2L2

Brandywine Falls

S

2

SOO P.S.Y.U.

GARIBALDI PARK

LEGEND

FOREST Impact

- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

AGRICULTURE

- A.L.R. boundary
- Agricultural Class 1-4
- Cultivated Land
- T.F.L./P.S.Y.U. boundary

NOTE: Agriculture impacts are discussed in text, as impacts vary with farming practice and present use of land.

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
— · —	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye

500 kv Transmission Line Corridor Assessment

FORESTRY & AGRICULTURE

Brandywine Falls — Cheekye

Scale 1:125,000

Map 2d

LEGEND

Impact on FISH
- High
- Moderate
- Low
- Salmon present
- Salmon spawning
- Indian food fishery
- Sport fishing area
- Max. escapement in thousands (salmon only)
- Fish facility
- Migration barrier

Abbreviations
- Ch — Chinook Salmon
- Co — Coho Salmon
- Pk — Pink Salmon
- Sk — Sockeye Salmon
- Cm — Chum Salmon
- Ct — Cutthroat Trout
- St — Steelhead Trout
- Dv — Dolly Varden Char
- Rb — Rainbow Trout
- Mw — Mountain Whitefish
- Ko — Kokanee

WILDLIFE Impact
- High
- Moderate
- Low
- Moose
- Deer
- Mountain Goat
- Bighorn Sheep

Ko DV Rb

St DV MW Rb
Sk Ch Co Pk
0.4 0.45 0.25 2

Sk Ch Co Pk
1 0.5 1 40

St DV Rb MW

Antoine Creek

L — Mission Pass West 5L42 — K — Bridge Canyon — I — E — Camelsfoot North — C — Kelly Lake North — A

Seton Portage

Rb DV

Shalalth

Mission Pass East 5L42

Mission Ridge W.

J — Mission Ridge South 5L42

Mission Ridge North

H — Applespring Creek

Camelsfoot South

Kelly Lake South

Kelly Lake important recreational fishery.

Rb

Kelly Lake East 5L42

2L90 2L91 5L41 5L42

B

Kelly Lake Substation

Seton Lake — 2L90 2L91

High probability of debris and input into important sockeye rearing lake.

G

Possibility of erosion owing to presence of silts and fines. High aerial crossing or bed-rock protrusions should be utilized.

Marble Range

2L90 2L91 5L41 5L42

D

Pavilion - Mission Ridge 5L42

Pavilion

Cayoosh Creek

Pk Co Ch Sk
390 0.2 0.2

FF FF

F — 2L90 2L91

Lillooet

Pavilion - Fountain 2L90 2L91 5L41

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
———	5L42	Adjacent to existing R/W

0 5 10 kilometers

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

FISH & WILDLIFE

Kelly Lake — Seton Lake

Scale 1:125,000

Map 3a

Ch Co 1.5 15

Co 1.5

Sk 140

Important salmon areas. Leave bank vegetation. Do not cross streams with equipment.

DV Rb MW

Rb DV

Anderson Lake

5L42 2L1 2L2 3L2

M

L

5L42

Seton Portage 2L1

2L90 2L91

D'Arcy

Creekside Substation

FF

DV Rb St

d

g

Moderate erosion potential.

DV Rb MW

High erosion potential could affect salmon and steelhead values downstream.

Cayoosh Creek

Rb DV

LEGEND

Impact on FISH

- High
- Moderate
- Low
- Salmon present
- Salmon spawning
- Indian food fishery
- Sport fishing area
- Co 15 — Max. escapement in thousands (salmon only)
- FF — Fish facility
- I — Migration barrier

Abbreviations

- Ch — Chinook Salmon
- Co — Coho Salmon
- Pk — Pink Salmon
- Sk — Sockeye Salmon
- Cm — Chum Salmon
- Ct — Cutthroat Trout
- St — Steelhead Trout
- Dv — Dolly Varden Char
- Rb — Rainbow Trout
- Mw — Mountain Whitefish
- Ko — Kokanee

WILDLIFE Impact

- High
- Moderate
- Low
- m — Moose
- d — Deer
- g — Mountain Goat
- s — Bighorn Sheep

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
		Using new R/W
		Using existing R/W
	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye

500 kv Transmission Line Corridor Assessment

FISH & WILDLIFE

Seton Lake — Creekside

Scale 1:125,000

Map 3b

LEGEND

Impact on FISH

- High
- Moderate
- Low
- Salmon present
- Salmon spawning
- Indian food fishery
- Sport fishing area
- Co 15 — Max. escapement in thousands (salmon only)
- FF — Fish facility
- I — Migration barrier

Abbreviations

- Ch — Chinook Salmon
- Co — Coho Salmon
- Pk — Pink Salmon
- Sk — Sockeye Salmon
- Cm — Chum Salmon
- Ct — Cutthroat Trout
- St — Steelhead Trout
- Dv — Dolly Varden Char
- Rb — Rainbow Trout
- Mw — Mountain Whitefish
- Ko — Kokanee

WILDLIFE Impact

- High
- Moderate
- Low
- m — Moose
- d — Deer
- g — Mountain Goat
- e — Bighorn Sheep

P

R

Mt. Callaghan North

Mt. Callaghan South

Rb DV

Q

O

Soo Valley

Callaghan Creek

d

m

d

d

High erosion potential in Soo Valley. Leave bank vegetation.

DV Rb

N

Rb DV Ko

Rb Ko DV

Whistler

5L42 2L1 2L2

Whistler Village

S

Brandywine Falls

Ch Co 0.4 15

Important salmon river. Avoid introduction of fill and debris.

Co 0.4

DV Rb St

a

Sk Co 0.4 25

Pemberton

b

c

2L1 2L2

5L42

M

5L42 2L1 2L2 3L2

Creekside Substation

Mount Currie

Garibaldi Park

2

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
———	5L42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye

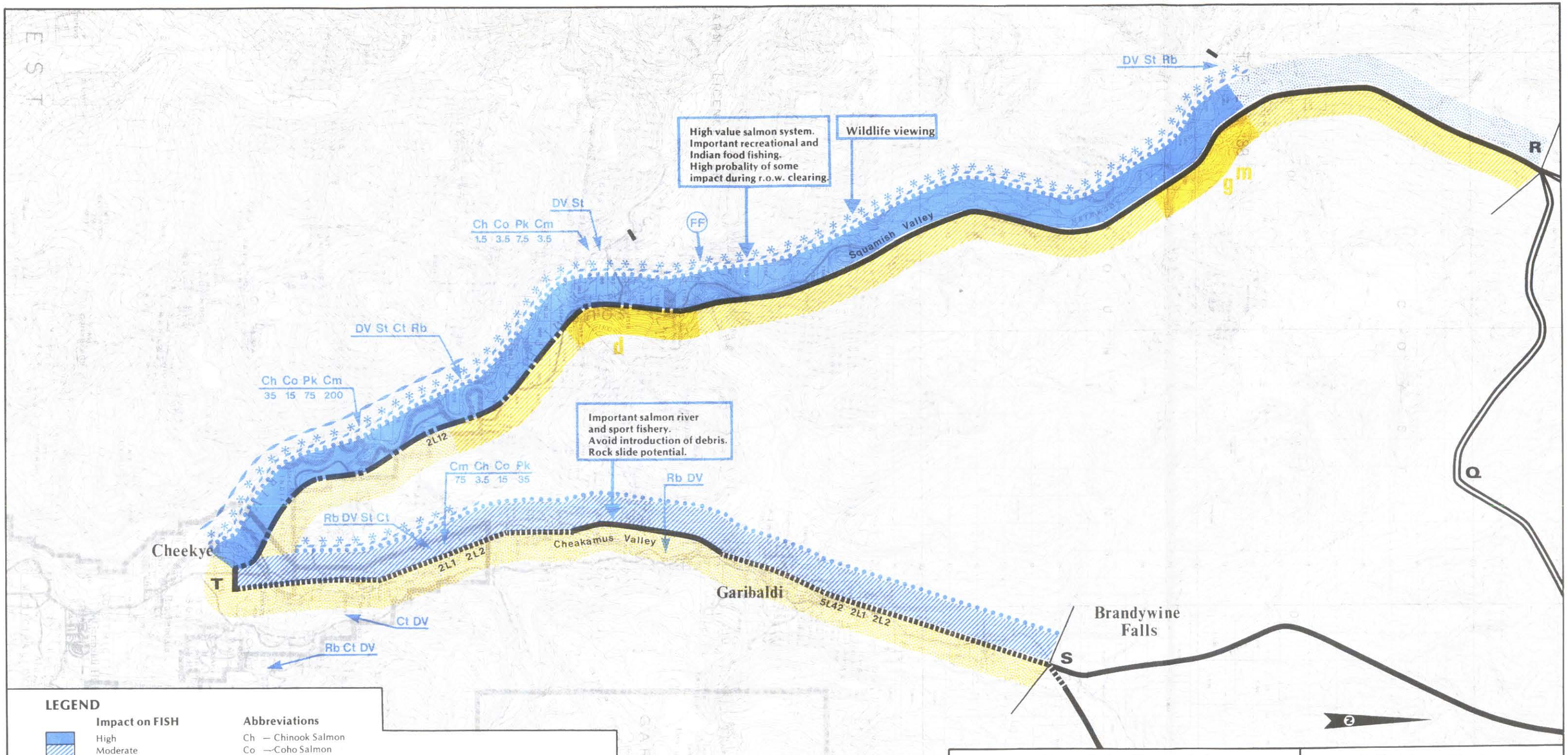
500 kv Transmission Line Corridor Assessment

FISH & WILDLIFE

Creekside — Brandywine Falls

Scale 1:125,000

Map 3c



LEGEND

Impact on FISH

- High
- Moderate
- Low
- Salmon Present
- Salmon spawning
- Indian food fishery
- Sport fishing area
- Co 15 — Max. escapement in thousands (salmon only)
- FF — Fish facility
- I — Migration barrier

Abbreviations

- Ch — Chinook Salmon
- Co — Coho Salmon
- Pk — Pink Salmon
- Sk — Sockeye Salmon
- Cm — Chum Salmon
- Ct — Cutthroat Trout
- St — Steelhead Trout
- Dv — Dolly Varden Char
- Rb — Rainbow Trout
- Mw — Mountain Whitefish
- Ko — Kokanee

WILDLIFE Impact

- High
- Moderate
- Low
- m — Moose
- d — Deer
- g — Mountain Goat
- s — Bighorn Sheep

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
—·—	5L 42	Adjacent to existing R/W

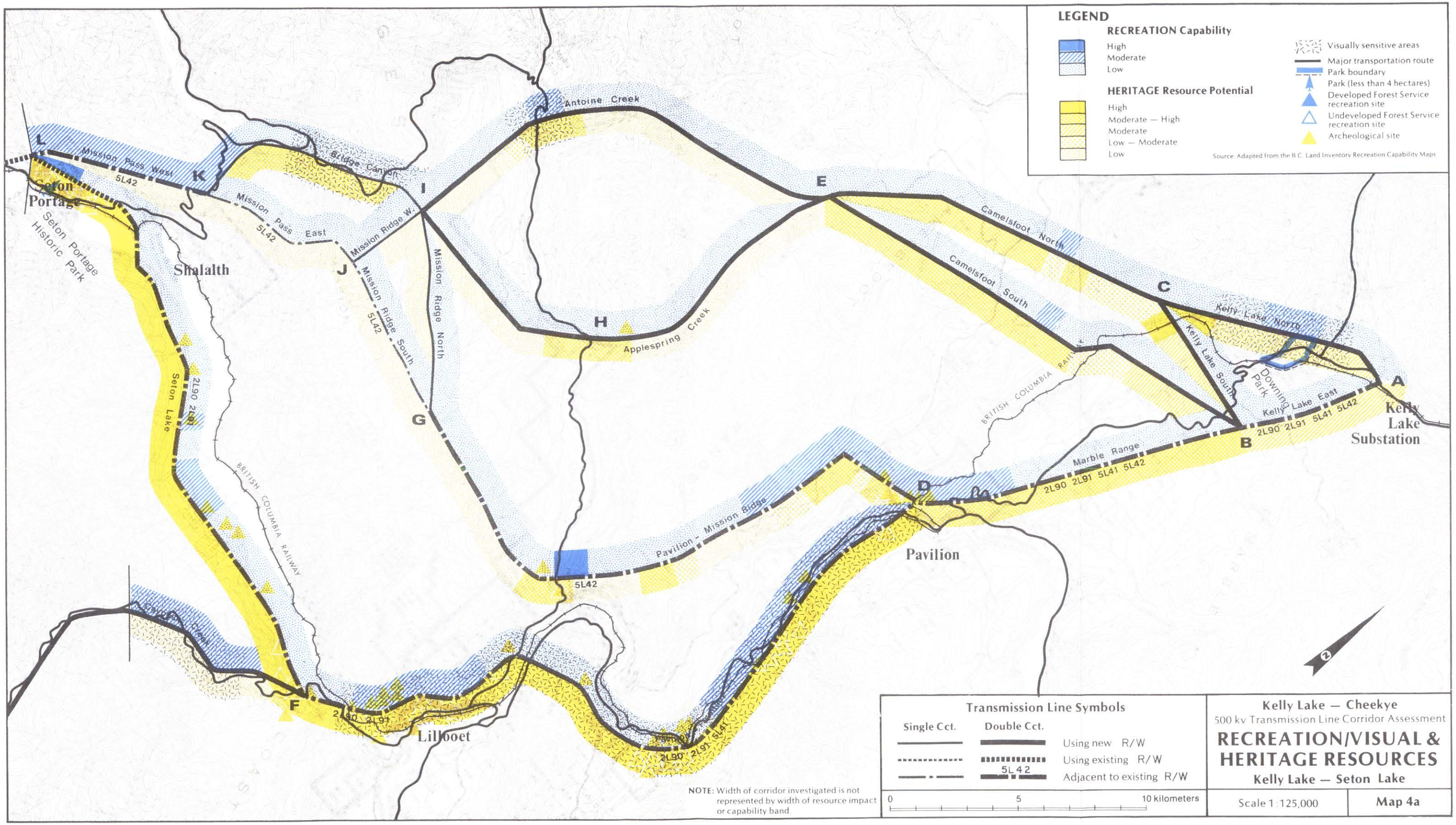
0 — 5 — 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

FISH & WILDLIFE

Brandywine Falls — Cheekye

Scale 1:125,000 | **Map 3d**


LEGEND
RECREATION Capability
High
Moderate
Low
HERITAGE Resource Potential
High
Moderate — High
Moderate
Low — Moderate
Low
Visually sensitive areas
Major transportation route
Park boundary
Park (less than 4 hectares)
Developed Forest Service recreation site
Undeveloped Forest Service recreation site
Archeological site
Source: Adapted from the B.C. Land Inventory Recreation Capability Maps
Antoine Creek
Mission Pass West 5L42
Bridge Canyon
Seton Portage
Seton Portage Historic Park
Shalalth
Mission Pass East 5L42
Mission Ridge W.
Mission Ridge South 5L42
Mission Ridge North
Applespring Creek
Camelsfoot North
Camelsfoot South
Kelly Lake North
Kelly Lake South
Downing Park
Kelly Lake East 2L90 2L91 5L41 5L42
Kelly Lake Substation
Marble Range 2L90 2L91 5L41 5L42
Pavilion - Mission Ridge 5L42
Pavilion
Seton Lake 2L90 2L91
BRITISH COLUMBIA RAILWAY
Canyon Creek
2L90 2L91
2L90 2L91 5L41
Lillooet
A
B
C
D
E
F
G
H
I
J
K
L
NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.
Transmission Line Symbols
Single Cct.
Double Cct.
Using new R/W
Using existing R/W
5L42
Adjacent to existing R/W
0
5
10 kilometers
Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment
RECREATION/VISUAL & HERITAGE RESOURCES
Kelly Lake — Seton Lake
Scale 1:125,000
Map 4a

M

Creekside Substation

D'Arcy

Anderson Lake

5L42 2L1 2L2 3L2

BRITISH COLUMBIA RAILWAY

L

Seton Portage

5L42

2L90 2L91

Cayoosh Creek

2

LEGEND

RECREATION Capability

- High
- Moderate
- Low

HERITAGE Resource Potential

- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

- Visually sensitive areas
- Major transportation route
- Park boundary
- Park (less than 4 hectares)
- Developed Forest Service recreation site
- Undeveloped Forest Service recreation site
- Archeological site

Source: Adapted from the B.C. Land Inventory Recreation Capability Maps

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
———	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye

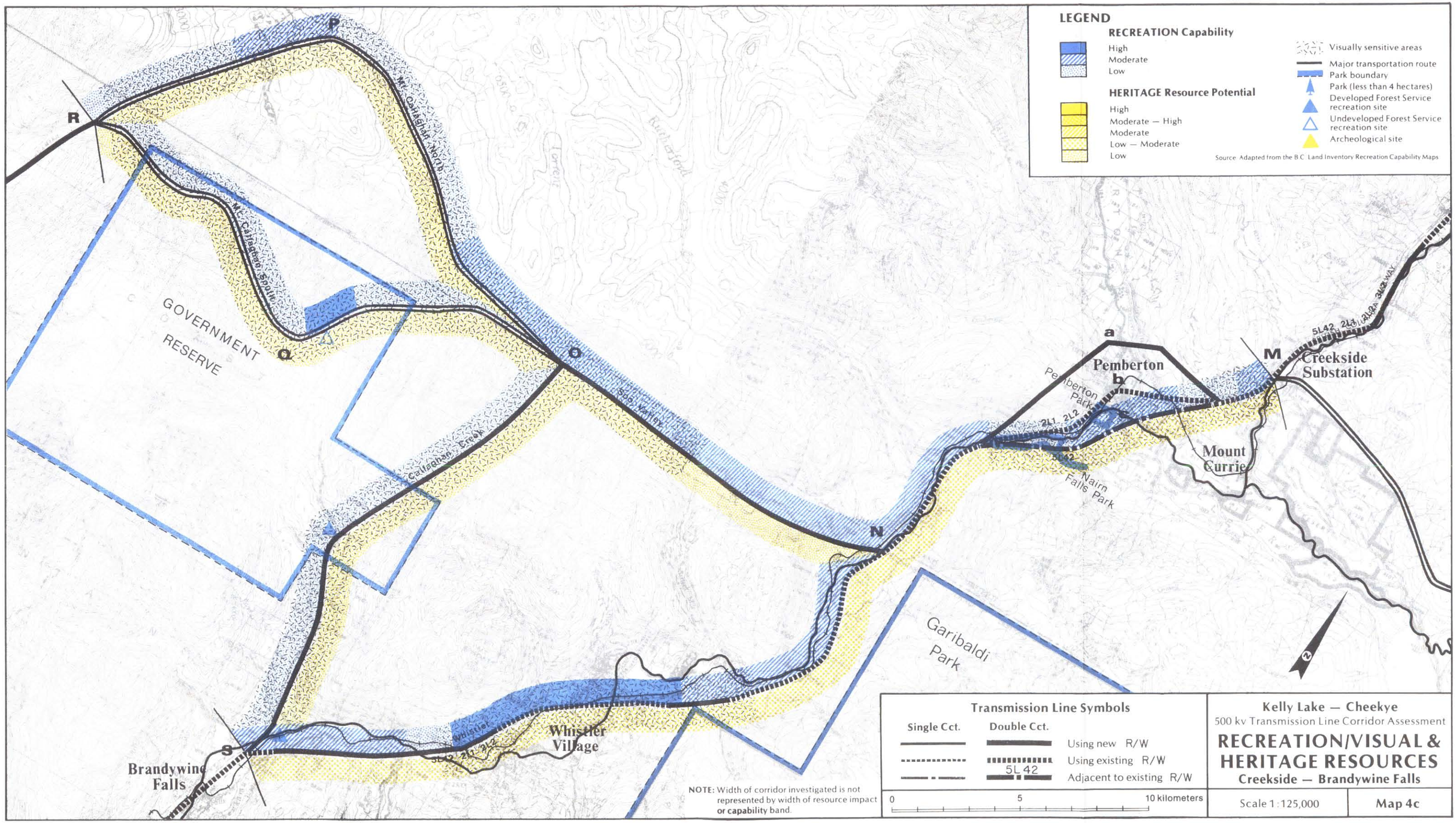
500 kv Transmission Line Corridor Assessment

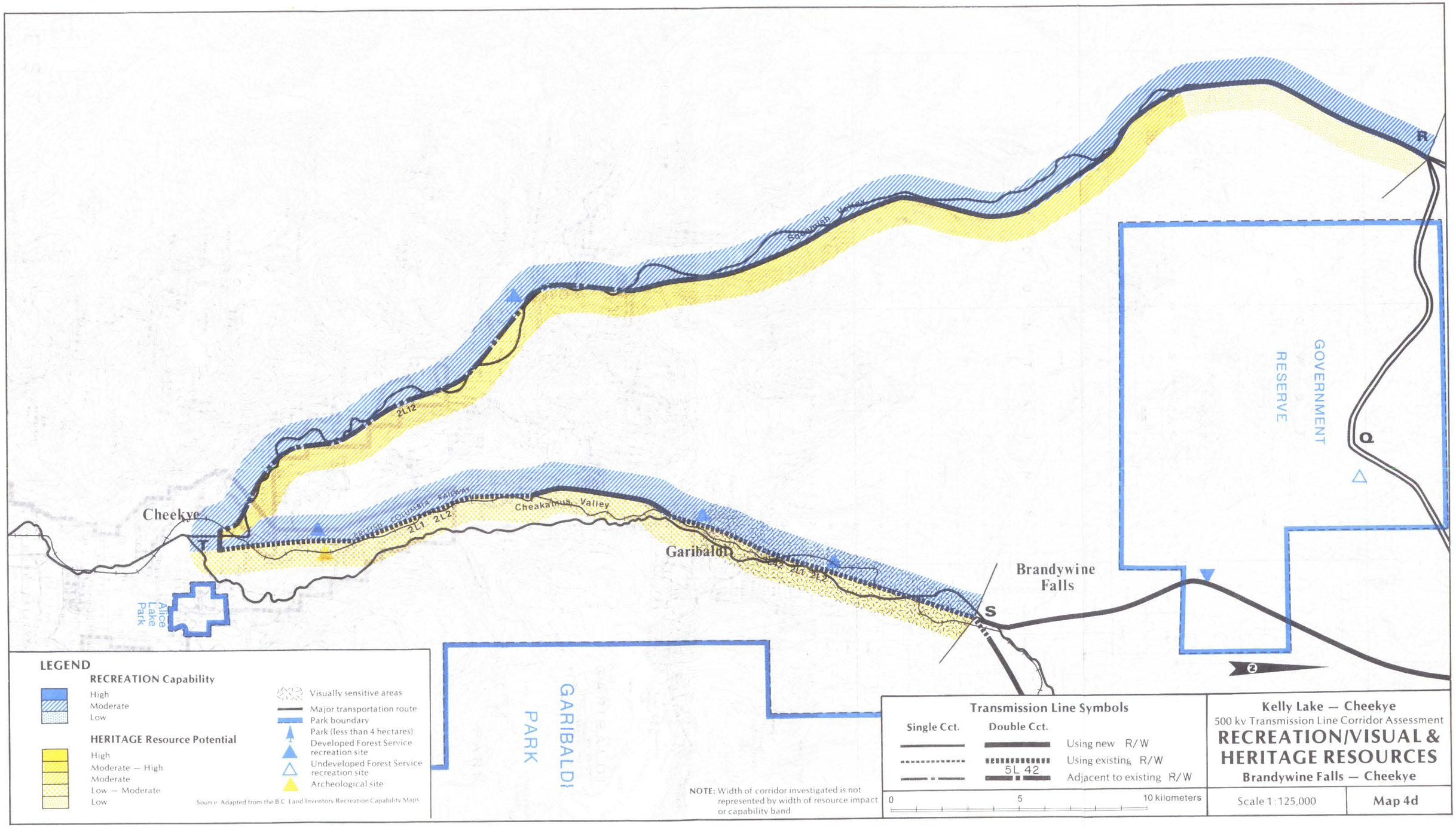
RECREATION/VISUAL & HERITAGE RESOURCES

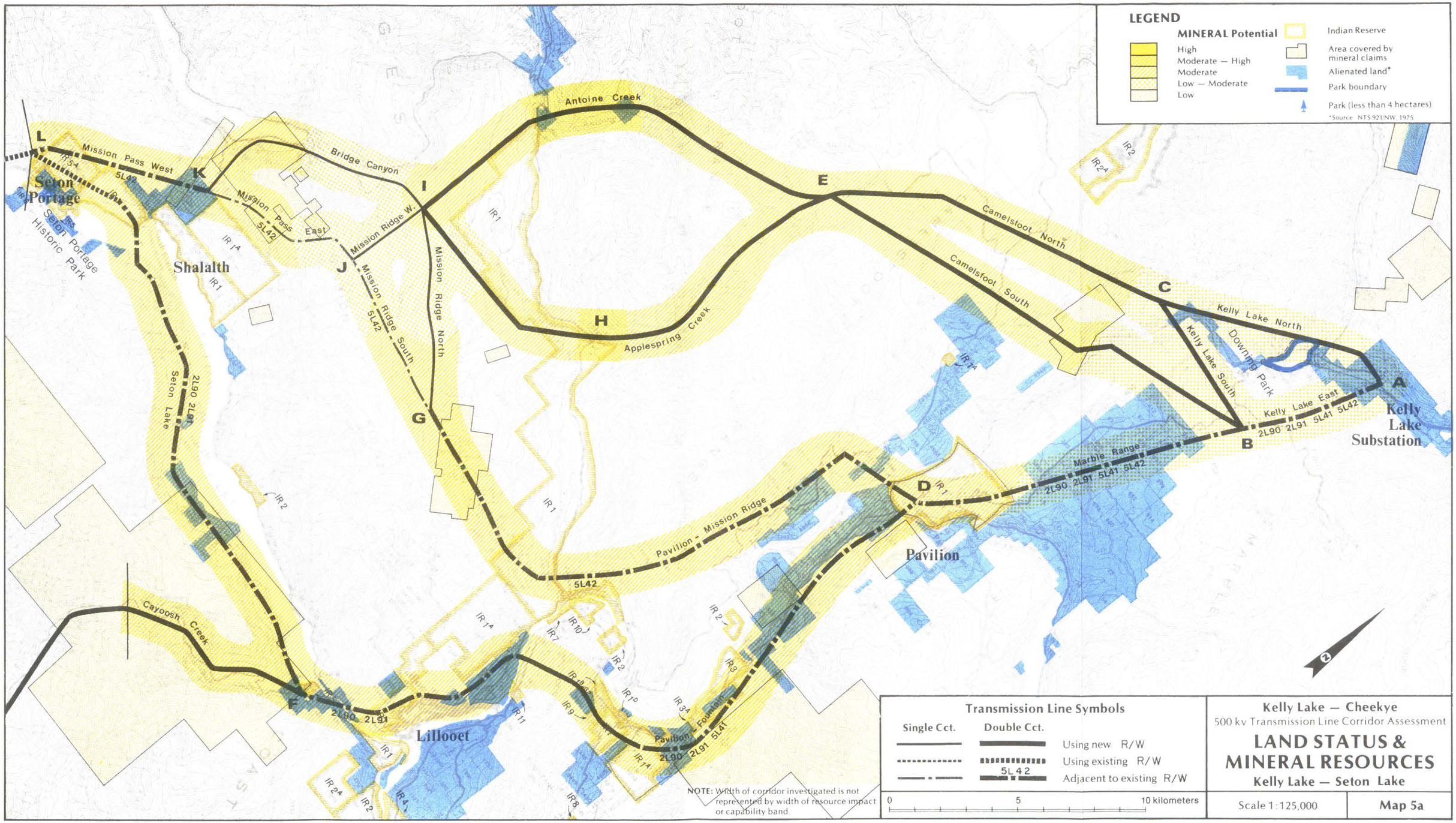
Seton Lake — Creekside

Scale 1:125,000

Map 4b


LEGEND
RECREATION Capability
High
Moderate
Low
HERITAGE Resource Potential
High
Moderate — High
Moderate
Low — Moderate
Low
Visually sensitive areas
Major transportation route
Park boundary
Park (less than 4 hectares)
Developed Forest Service recreation site
Undeveloped Forest Service recreation site
Archeological site
Source: Adapted from the B.C. Land Inventory Recreation Capability Maps
P
R
Q
O
N
S
M
a
b
GOVERNMENT RESERVE
Mt. Callaghan North
Mt. Callaghan South
Callaghan Creek
Soo Valley
Whistler
Whistler Village
Brandywine Falls
Pemberton
Pemberton Park
Creekside Substation
Mount Currie
Nairn Falls Park
Garibaldi Park
5L42
2L1
2L2
3L42
Transmission Line Symbols
Single Cct.
Double Cct.
Using new R/W
Using existing R/W
5L42
Adjacent to existing R/W
0
5
10 kilometers
NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.
Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment
RECREATION/VISUAL & HERITAGE RESOURCES
Creekside — Brandywine Falls
Scale 1:125,000
Map 4c


Squamish Valley
2L12
Cheekye
British Columbia Railway
2L1 2L2
Cheakamus Valley
Garibaldi
Brandywine Falls
Alice Lake Park
GARIBALDI PARK
GOVERNMENT RESERVE
LEGEND
RECREATION Capability
High
Moderate
Low
HERITAGE Resource Potential
High
Moderate — High
Moderate
Low — Moderate
Low
Visually sensitive areas
Major transportation route
Park boundary
Park (less than 4 hectares)
Developed Forest Service recreation site
Undeveloped Forest Service recreation site
Archeological site
Source: Adapted from the B.C. Land Inventory Recreation Capability Maps
NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.
Transmission Line Symbols
Single Cct.
Double Cct.
Using new R/W
Using existing R/W
Adjacent to existing R/W
5L 42
0
5
10 kilometers
Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment
RECREATION/VISUAL & HERITAGE RESOURCES
Brandywine Falls — Cheekye
Scale 1:125,000
Map 4d


LEGEND
MINERAL Potential
High
Moderate — High
Moderate
Low — Moderate
Low
Indian Reserve
Area covered by mineral claims
Alienated land*
Park boundary
Park (less than 4 hectares)
*Source: NTS 92I/NW; 1975
Antoine Creek
Bridge Canyon
Mission Pass West
5L42
Seton Portage
Seton Portage Historic Park
Shalalth
Mission Pass East
Mission Ridge W.
Mission Ridge North
Mission Ridge South
Applespring Creek
Camelsfoot North
Camelsfoot South
Kelly Lake North
Kelly Lake South
Downing Park
Kelly Lake East
Kelly Lake Substation
Marble Range
Pavilion - Mission Ridge
Pavilion
Pavilion - Fountain
Cayoosh Creek
Lillooet
Seton Lake
2L90 2L91
2L90 2L91 5L41 5L42
5L42
IR 1
IR 1A
IR 2
IR 2A
IR 3
IR 4
IR 7
IR 8
IR 9
IR 10
IR 11
IR 14
IR 18
A
B
C
D
E
F
G
H
I
J
K
L
NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.
Transmission Line Symbols
Single Cct.
Double Cct.
Using new R/W
Using existing R/W
5L42
Adjacent to existing R/W
0
5
10 kilometers
Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment
LAND STATUS & MINERAL RESOURCES
Kelly Lake — Seton Lake
Scale 1:125,000
Map 5a

Creekside Substation

IR 7

IR 6

IR 3

IR 4

IR 5

IR 2

IR 1

Anderson Lake

5L42 2L1 2L2 3L2

D'Arcy

IR 5A

Seton Portage

5L42

2L1

IR 6

IR 5

2L90 2L91

RANGE

Cayoosh Creek

LEGEND

MINERAL Potential

- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

*Source: NTS 92 I/NE, 1979
NTS 92 J/SE, 1972

- Indian Reserve
- Area covered by mineral claims
- Alienated land*
- Park boundary
- Park (less than 4 hectares)

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

Single Cct.	Double Cct.	
———	———	Using new R/W
- - - - -	- - - - -	Using existing R/W
———	5L 42	Adjacent to existing R/W

0 5 10 kilometers

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

LAND STATUS & MINERAL RESOURCES

Seton Lake — Creekside

Scale 1:125,000

Map 5b

LEGEND

MINERAL Potential
- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

*Source: NTS 92 I/SE 1972, NTS 92 I/SW 1972

- Indian Reserve
- Area covered by mineral claims
- Alienated land*
- Park boundary
- Park (less than 4 hectares)

P
R
Mt. Callaghan North
Mt. Callaghan South
GOVERNMENT RESERVE
Q
O
Soo Valley
Callaghan Creek
N
S
Brandywine Falls
Park (Provincial)
Whistler
5L42 2L1 2L2
Whistler Village
a
Pemberton
b
c
2L1 2L2
5L42
Nairn Falls Park
Pemberton Park
M
Creekside Substation
5L42 2L1 2L2 3L2
Mount Currie
IR 1
IR 2
IR 3
IR 6
IR 7
Garibaldi Park

Transmission Line Symbols

Single Cct.	Double Cct.	
———	═══	Using new R/W
- - - - -	═══	Using existing R/W
———	═══ 5L 42	Adjacent to existing R/W

0 5 10 kilometers

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band

Kelly Lake — Cheekye
500 kv Transmission Line Corridor Assessment

LAND STATUS & MINERAL RESOURCES

Creekside — Brandywine Falls

Scale 1:125,000 | Map 5c

Squamish Valley

Cheakamus Valley

Cheekye

Garibaldi

Brandywine Falls

Alice Lake Park

GARIBALDI PARK

Park (Provincial)

GOVERNMENT RESERVE

IR 7 IR 11 IR 13 IR 14 IR 15 IR 16 IR 17 IR 18 IR 19

2L12 2L1 2L2 5L42

R Q T S 2

LEGEND

MINERAL Potential

- High
- Moderate — High
- Moderate
- Low — Moderate
- Low

*Source: NTS 92J/SW, 1972 NTS 92G/NW, 1972

- Indian Reserve
- Area covered by mineral claims
- Alienated land*
- Park boundary
- Park (less than 4 hectares)

NOTE: Width of corridor investigated is not represented by width of resource impact or capability band.

Transmission Line Symbols

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LAND STATUS & MINERAL RESOURCES

Brandywine Falls — Cheekye

Scale 1:125,000

Map 5d