ENVIRONMENTAL SERVICES

EXAMINATION OF ROUTING ALTERNATIVES
FOR
THE ALASKA HIGHWAY GAS PIPELINE
IN THE
MARSH LAKE / SQUANGA LAKE REGION

SUBMISSION 3-3

AUGUST, 1981

Foothills Pipe Lines (South Yukon) Ltd.

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ADDENDUM
TO
THE ENVIRONMENTAL IMPACT STATEMENT
FOR
THE YUKON SECTION
OF
THE ALASKA HIGHWAY GAS PIPELINE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

Foothills Pipe Lines (South Yukon) Ltd.

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This document is one of a series of addenda prepared to meet information requirements placed on Foothills Pipe Lines (South Yukon) Ltd. by the Federal Environmental Assessment and Review Office. Addenda within the series are divided into seven sets of submissions dealing with separate subject areas:

1. Introduction to Addenda Submissions.

2. Project Description and Update for Addenda Submissions.

3. Alternative Routes.

4. Geotechnical, Hydrological, Design Mode and Revegetation Issues.

5. Fisheries, Wildlife and Scheduling Issues.

6. Issues Related to Pipeline Facilities.

7. Other Issues.

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EXECUTIVE SUMMARY

In selecting the route followed by the Alaska Highway Gas Pipeline in Yukon Territory, a multi-disciplinary approach was used, involving construction, engineering, environmental, socio-economic and operations evaluation. As a result, certain segments of the pipeline route were located in areas considered to be sensitive for environmental reasons, and criticisms of these routes have been voiced by individuals and groups with environmental interest. One such area is in the vicinity of Marsh and Squanga lakes. This report gives details of the selection process involved in identifying a route from three alternatives passing through this area, and describes potential impacts, mitigative measures and residual impacts along the preferred route.

In order to choose an acceptable route, an evaluation reflecting engineering and construction difficulties as well as environmental concerns, land-use issues and the matter of public safety related to potential third party damage to the pipeline was completed. Specific factors considered in the evaluation included:

engineering aspects of watercrossings, slope stability, wetlands, permafrost and third party right-of-way interactions;

construction difficulties associated with watercrossings, permafrost, slope stability, wetlands, near-surface rock, access, materials and third party rights-of-way;

socio-economic impacts associated with mineral leases, residential properties, agricultural land, commercial and recreational property, lands held or claimed by native persons and heritage sites;

environmental aspects of existing fish, raptor and big game populations; and

operational aspects of possible third party damage related to public safety.

Engineering and construction factors were evaluated by completing cost estimates for each alternative while other factors were evaluated using an ordinal rating scale.

Three alternatives were examined (see Map 3-3.1): one proceeding from the vicinity of Marsh Lake eastward, south of Mt. Michie, to a point northwest of Squanga Lake, then west of Squanga Lake to the Alaska Highway (Alternative #1); a second route following the first, but passing north and east of Squanga Lake (Alternative #2); and a third route which follows the Alaska Highway (Alternative #3). Alternative #3 was selected as the preferred route.

Specific descriptions of potential environmental impacts and mitigation measures for the chosen route are given. Potential impacts include disturbance of fish-bearing streams, nesting raptors, small numbers of caribou and land-use conflicts. Proposed mitigative approaches to meet potential environmental impacts include timing of stream crossings and activities to avoid sensitive life history stages of fish and reclamation of disturbed terrain. No residual environmental impacts are anticipated in light of the mitigation measures to be employed during construction of the pipeline in the Marsh Lake/Squanga Lake region.

PART 1

INTRODUCTION

In making application to the National Energy Board for a certificate of public convenience and necessity to construct the Alaska Highway Gas Pipeline in Yukon Territory, Foothills Pipe Lines (Yukon) Ltd. (the Project) identified a route which departed from the general vicinity of the Alaska Highway near Marsh Lake, and passed through the Mt. Michie range to a point immediately north of Squanga Lake, then south and east to intersect with the Alaska Highway west of the Squanga Lake Airfield. During public hearings concerning the Project's application, the routing north of Squanga Lake was criticized by a number of individuals and organizations. Among those particularly critical of the route were the Yukon Territorial Wildlife Branch and Dr. C. Lindsey of the University of Manitoba. Criticism that was brought forward resulted in Foothills being directed by the Environmental Assessment and Review (EAR) Panel to re-assess routing in the Marsh Lake/Squanga Lake region. Re-assessment was undertaken and a revised routing was chosen which followed the previously-preferred alignment north of the Alaska Highway and south of Mount Michie but which passed to the west and south of Squanga Lake.

In 1979, after reviewing the material submitted in the Project's Environmental Impact Assessment and information brought forward at further public hearings, the Panel requested, among other things, "a comprehensive description and comparison of the preferred route and potential alternatives...." in the Marsh Lake/Squanga Lake area. Subsequent to the 1979 hearings, Foothills revised the preferred routing to follow the Alaska Highway corridor from the Marsh Lake to Squanga Lake area. In 1980, after discussion between Panel members, the Project and representatives of the Northern Pipeline Agency (NPA), the Panel clarified it's information requirement as follows:

> "The proponent has announced its intention to move the route location next to the Alaska Highway in this

area. The Panel requires a description of the potential environmental impacts and mitigation measures for the new route."

As the Panel seeks further information on planning for the route in the Marsh Lake/Squanga Lake area, this report has been drawn together to review the advantages and disadvantages of reasonable alternative routings in the region, and to describe potential impacts and mitigative measures as requested by the Panel. The history of the alternative routings follows. In 1977, Alternative #2 was proposed, primarily on the basis of shortest distance and preliminary estimations indicating low cost. Concern was expressed by the Yukon Territorial Wildlife Branch in regards to woodland caribou and raptor populations in this region, and by Dr. C. Lindsey in regards to a unique population of lake whitefish which likely uses the inlet of Squanga Lake and Squanga Creek for spawning. In 1979, Alternative #1 was proposed, to avoid the lake whitefish spawning areas and to reduce geotechnical concerns, which moved to the route to the west side of Squanga Lake. In 1980, Alternative #3 was proposed as a result of more detailed cost estimates and as a response to the Yukon Territorial Wildlife Branch's concerns regarding potential impacts on woodland caribou and raptor populations.

During initial preparation of this document, the system of evaluation used in selecting the pipeline route in the Marsh Lake/Squanga lake area as well as the format for the resulting report were identical to those used for the Whitehorse/Ibex route selection report. The latter route review was the topic of a previous report in the series of submissions acting as addenda to the Environmental Impact Statement for the Alaska Highway Gas Pipeline Project in Yukon Territory. During public review of the Whitehorse/Ibex report, several criticisms of the method of evaluation were brought forward, which, in view of the on-going review process, deserve comment and clarification. This is particularly necessary in light of the Panel's recommendation that, in future submissions, an improved evaluation system be used. As well, the Panel's findings infer that matters of public safety, land-use and planning and to some extent costs were

not, at least in the case of the Whitehorse/Ibex routing, substantive routing issues.

Under the heading of "Evaluation of Alternative Routes: Methodology and Presentation of Information", the Panel reported that:

1. The Whitehorse/Ibex report was a justification for the choice of the preferred route.

2. The report was not an environmental impact statement.

3. The alternative routes were not addressed at the level of detail presented for the preferred route, and

4. That the panel was not informed of negative impacts that would occur were the preferred route to be accepted.

Difficulties with the method of evaluation put forward by the Panel involved:

1. The conclusion that the system masked an understanding of the range and levels of impacts (presumably environmental impacts).

2. The conclusion that evaluation of whole route alternatives as opposed to segments making up route alternatives tended to mask the location and areal extent of potential impacts, and

3. The conclusion that specific costs of recommended mitigative measures were masked by the evaluations.

A further difficulty, one not identified by the Panel in their report, was evident during the hearings. This difficulty involved the relative values expressed for each route alternative such as "high", "highest" or "lowest". Many reviewers felt that costs or risks expressed

as "highest" were not necessarily as high as the term indicated. In reaching this conclusion reviewers were attempting to put evaluations in the universal context rather than a local one. This result was not intended.

To assist both the Panel and reviewers in the examination and critical review of this and other submissions, a number of adjustments in approach and format have been introduced. These changes, however, have been limited by two factors. First, the method of evaluation outlined is in fact the one used in selecting the routes being discussed. While reviewers are largely correct in stating that the result is not an environmental impact statement, it must be pointed out that the exercise at hand is one of route selection, not environmental impact assessment. The method used involves approaches commonly recommended and used for route selection and as with any such method, potential impacts are implied. The suggestion made by some reviewers that all alternatives must be examined at a level of detail sufficient to support final construction planning and therefore detailed and accurate assessments of impact is rejected by the Project. Reasonable thresholds of knowledge upon which decisions can be made must be recognized.

The second factor limiting change in the present document is the nature of the Panel's request for further information as clarified in the Panel Chairman's letter addressed to the NPA dated December 18, 1980. This letter, based on thorough discussions between Panel members, the Project and representatives of the NPA, requires "detailed descriptions" of the "new route" rather than for all the possible alternatives.

With the limitations noted this submission documents the route selection process in a manner similar in most respects to that presented for the Ibex area, and presents a discussion of possible environmental impacts along the preferred route. This is followed by planned project responses to anticipated environmental impacts. A final section details "residual impacts" as most recently requested by the Panel. Use of terms "highest" and "lowest" as these appeared in the Whitehorse/Ibex report has been discontinued. The terms "high", meaning above the midpoint and "low",

meaning below the midpoint, are retained. In both cases these terms describe only the routes being evaluated and have no connotation outside the Marsh Lake/Squanga Lake area.

Owing to difficulties encountered in separating concerns regarding the physical and biological environments in the route evaluation process, consideration of the physical environment has been deleted as a separate route location category. In the Whitehorse/Ibex routing submission under the location factor category of terrain and hydrology, the physical environment was evaluated in relation to permafrost, slope stability and drainage concerns. In this and other submissions, the evaluation of concerns and necessary responses related to the physical environment is included in the engineering and construction categories, and in the cost evaluation of each alternative routing. Where concern for integrity of the physical environment has ramifications for the biological (fish, bird or mammal) environment, such as the potential loss of critical habitat, the concern is included in the evaluation of the appropriate biological category.

Finally, an appendix to the report (Appendix IV) briefly outlines the factors considered in arriving at specific evaluation scores in the route evaluations section. This, it is hoped, will clarify the reasons for choosing evaluation scores.

The end result of the modifications outlined is a report which explains the <u>important issues</u> raised by routings considered in the Marsh Lake/Squanga Lake region, existing conditions related to those issues, and how the issues were considered during route evaluation and route selection. In conclusion, this submission presents expected environmental impacts, planned mitigation and remaining unavoidable environmental impacts along the chosen route.

PART 2

ALTERNATIVE ROUTES IN THE MARSH LAKE/SQUANGA LAKE REGION

Three routing possibilities for the Alaska Highway Gas Pipeline have been considered within the Marsh Lake to Squanga Lake region. Two of these involve a route which departs from the Alaska Highway near Marsh Lake and travels east to the general vicinity of Squanga Lake; one passes to the west and south of Squanga Lake while the other passes the lake to the north and east (Map 3-3.1). A third alternative route closely follows the Alaska Highway from Marsh Lake to the area south of Squanga Lake (Map 3-3.1). For purposes of discussion these three alternatives are numbered one through three as follows:

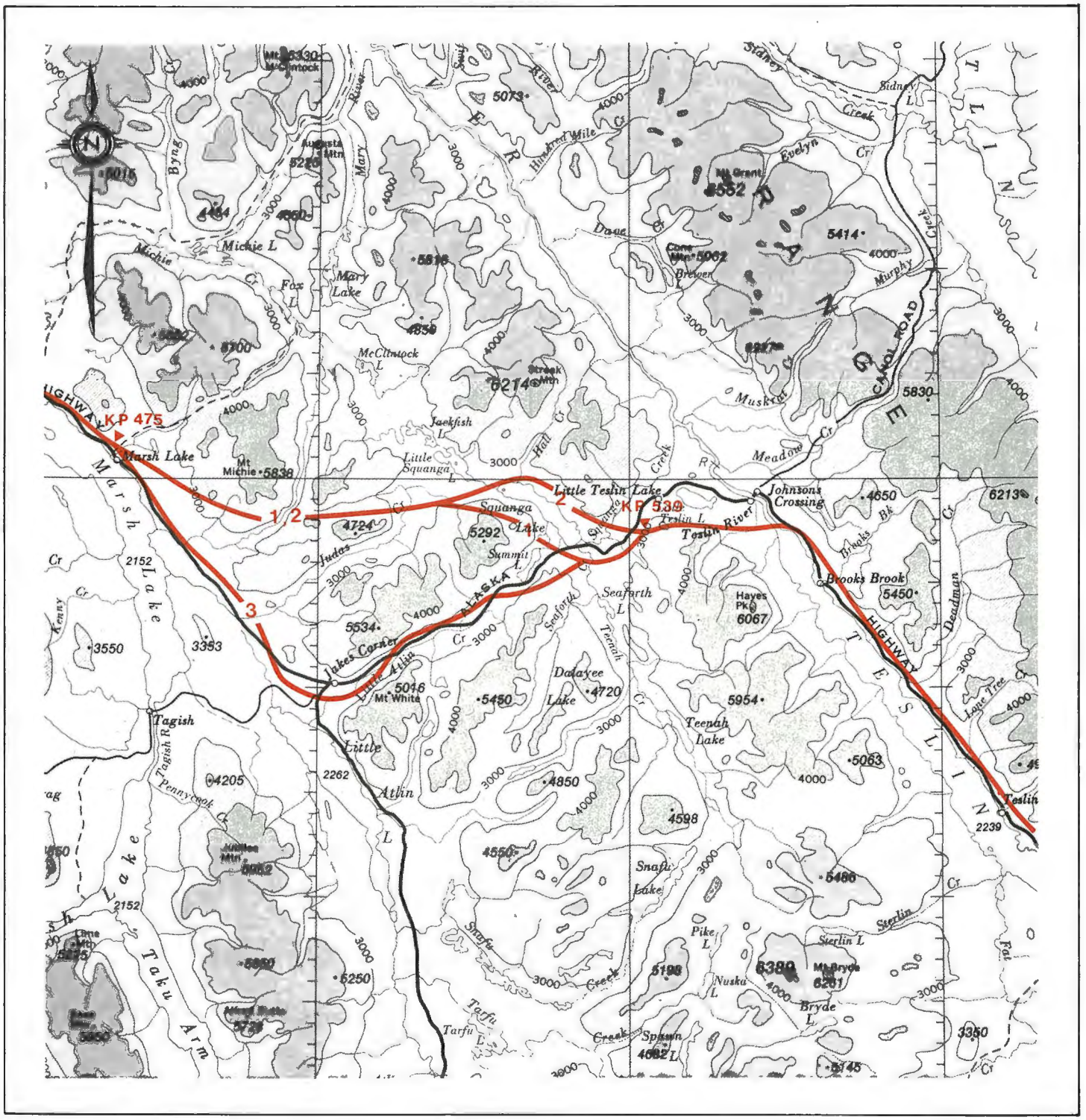
#1 Mt. Michie route passing west and south of Squanga Lake
#2 Mt. Michie route passing north and east of Squanga Lake
#3 Highway route

Comparative lengths of each alternative are respectively: 52.0 km, 52.7 km and 61.2 km (between mainline KP 475 and KP 539, Map 3-3.1). Construction schedules call for summer construction in all cases.

Concerns for the two routes departing from the highway (Alternatives #1 and #2) were entirely related to environmental matters. Specific concerns related to woodland caribou, nesting raptors and a unique form of whitefish. A more general concern, related to introducing human activity into what was viewed as a remote area, was also introduced.

MAP 3-3.1

DIAGRAMMATIC REPRESENTATION OF ALTERNATIVE ROUTES IN THE MARSH LAKE / SQUANGA LAKE AREA



PART 3

ROUTE LOCATION FACTORS

Pipeline routes have traditionally been determined by evaluating plausible, constructable alternatives and selecting the one that is the shortest and most economically feasible.

In order to choose the most advantageous alternative route in the Marsh Lake/Squanga Lake region, evaluation of specific location factors has continued for several years (see Introduction). In completing route evaluations, factors which fall into five broad categories were considered:

- engineering
- construction
- socio-economic matters
- environmental matters
- operational matters

Specific factors within each category and the manner in which they affect route selection are briefly outlined in Appendix I.

PART 4

EXISTING CONDITIONS ALONG ALTERNATIVE ROUTES

The alternative routes in the Marsh Lake/Squanga Lake region originate in the Yukon River and M'Clintock River valleys, of which Marsh Lake forms a part, and terminate in valleys occupied by Squanga Lake and Little Teslin Lake. These valleys are infilled with glaciofluvial and glaciolacustrine sediments which are incised in most areas by the existing streams. The Mt. Michie highlands through which two of the alternatives pass are rounded dome-like glaciated bedrock features. Most of the major tributary rivers and streams flowing from these highlands flow from glacial, U-shaped valleys.

For engineering, constructability and cost reasons, feasible pipeline route alternatives are limited to interconnecting valley systems. In the Marsh Lake/Squanga Lake area, this restricts the corridors for route alternatives to the Marsh Lake (Yukon River) valley, the Squanga Lake valley, and valleys draining the Mt. Michie highlands.

4.1 MAJOR ROUTING ISSUES

Conditions along routes in the Marsh Lake/Squanga Lake area have been the subject of study by the Project and others from a time prior to the initial application for a pipeline route. Information gathered in studies completed to date has been made available to interested parties and has been the subject of extended review. A list of reports dealing in whole or in part with conditions in the Marsh Lake/Squanga Lake area is included in Appendix II at the end of this report.

A number of "major" issues have arisen from studies conducted and from public hearings related to pipeline routing in the region. Major issues include: access to what is considered a remote and unspoiled area; woodland caribou populations; nesting sites of certain large raptors; and

fish populations, particularly a "unique" form of lake whitefish in the Squanga Lake drainage. These issues, together with those related to design, construction and operation have played a major role in route selection. The presence or absence of various factors and issues along each routing alternative is outlined in the following descriptions.

Alternative #1

Alternative #1 involves a route which departs from the vicinity of the Alaska Highway near mainline KP 475 and trends to the east passing south of Mt. Michie and eventually west and south of Squanga Lake. This routing rejoins the Alaska Highway at the south end of Squanga Lake. Environmental issues involve woodland caribou wintering areas along much of the route, and nesting raptors. Land-use issues are absent while design/construction factors involve excessive rock, areas of permafrost and wetlands. Issues relating to public safety and third party damage to the pipeline are minor owing to the remoteness of the route from most human activities.

Alternative #2

Alternative #2 follows an identical path as that followed by Alternative #1 (above) from the Alaska Highway near Marsh Lake to a point north of Squanga Lake where it continues east, passing to the north of Squanga Lake then south along Squanga Lake's eastern shore. Environmental issues involve caribou wintering areas, nesting raptors and potential spawning areas for "unique" lake whitefish. Land-use issues are absent and design/construction factors involve excessive rock, areas of permafrost and wetlands. Issues relating to public safety and third party damage to the pipeline are minor owing to the remoteness of the route from most human activities.

Alternative #3

Alternative #3 involves a routing which remains in the vicinity of the Alaska Highway between Marsh Lake and Squanga Lake. Major environmental issues are absent. Land-use issues are present and primarily involve privately held land. Issues relating to public safety and third party damage to the pipeline relate to the presence of the pipeline adjacent to the Alaska Highway. Design/construction factors involve excessive rock, areas of permafrost and wetlands.

4.2 DISCUSSION OF EXISTING CONDITIONS ALONG ALTERNATIVE ROUTES

It is clear from the previous section that no single routing alternative is free of concerns related to major location issues. The following section discusses the degree or extent of concerns along route alternatives in relation to engineering, construction, socio-economic, environmental and safety factors and where possible quantifies information available. In addition, the kind and extent of possible Project responses to concerns is outlined.

4.2.1 Engineering and Construction

Engineering and construction factors pertinent to route selection relate to line length, design difficulties, source and movement of materials, impediments to construction, and access. Each of these factors affects cost, and the route with the combination of factors resulting in the least cost is the most desirable. Estimates of direct costs for each routing alternative were completed based on the amount of timber, grade, rock and swamp for each alternative and the costs for special designs to overcome permafrost conditions. Direct costs were estimated in constant 1979 dollars. Indirect costs were added to direct cost estimates through the use of a multiplier which was in turn based on the most recent detailed estimate of costs for the construction spread involved. The applicable

multiplier to arrive at total cost from direct cost in the Marsh Lake/ Squanga Lake region is 2.1. Direct, indirect and total costs are presented in Table 3-3.1 for each alternative. Total costs represent the Project's response to engineering and construction concerns and difficulties.

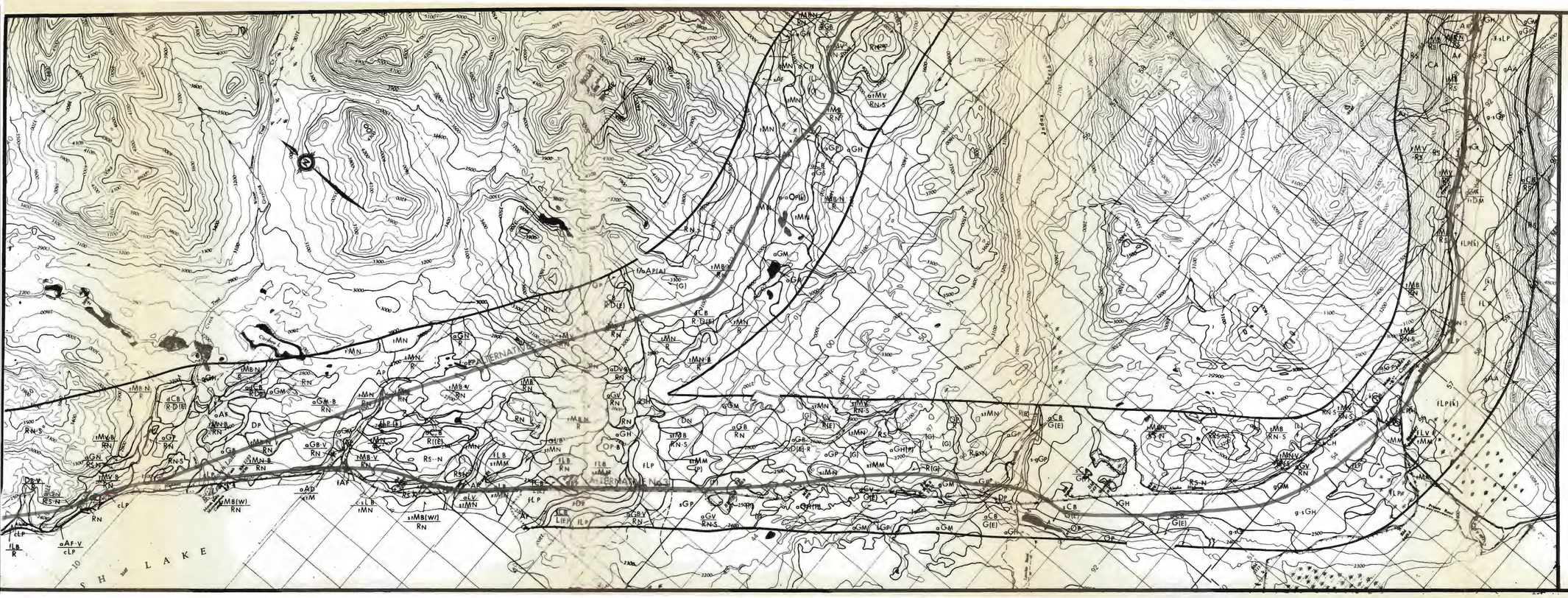
A brief description of the degree of difficulty for construction of the alternatives follows. Alternatives #1 and #2 have been combined for the purposes of this discussion, as these routes are virtually identical for construction considerations. The terrain types found along the three alternatives are presented in Map 3-3.2.

Alternatives #1 and #2 encounter wet areas which would require substantial quantities of fill material for trafficability. This fill would have to be transported over long distances as it is not immediately available along these alignments. Rock appears at the surface over considerable distances along these routes, and, in many areas where rock is not in evidence, large boulders are present. As a consequence, padding would be required during construction. The material requirements for pad construction do not appear to be available at suitable intervals along Alternatives #1 and #2. In areas where rock and boulders are absent, the routings follow side hills with areas of sloughing accompanied by water flow from springs. One section common to Alternatives #1 and #2 encounters a very steep slope, which would require building a "shoo-fly" for approximately 1.5 km. It is estimated that 25 percent of Alternatives #1 and #2 encounter permafrost, which would increase design, construction and operating difficulties. Access to these routings would have to be along the right-of-way, as there are no intermediate points of entry. Therefore, the right-of-way would have to be constructed to near-highway conditions and maintained continually for the construction period. In the Squanga Lake area, the routings encounter numerous steep cross-drainages, which would necessitate substantial grading and the placement of many culverts. The roughness of the terrain and the changes in elevation would require a large number of sections for the hydrostatic testing of the line. There do not appear to be suitable water sources for hydrostatic testing along Alternatives #1 and #2; this would necessitate using water from two sources and

TABLE 3-3.1

MARSH LAKE/SQUANGA LAKE AREA ALTERNATIVE ROUTES - COMPARISON OF LENGTHS/COSTS

		Length (km)	Direct Cost ($000,000)	Indirect Cost ($000,000)	Total Cost ($000,000)
#1	Mt. Michie - west and south of Squanga Lake	53.75	100.6	110.7	211.3
#2	Mt. Michie - north and east of Squanga Lake	54.5	102.4	112.6	215.0
#3	Highway Route	62.75	76.4	84.0	160.4



MARSH LAKE / SQUANGA LAKE ALTERNATIVES: TERRAIN TYPES

MAP 3-3.2

SHEET 1

TERRAIN TYPING LEGEND

GENETIC-COMPOSITIONAL CATEGORY
TEXTURAL MODIFIER(S)
→ PROCESS OR FORM MODIFIER(S)
→ MORPHOLOGIC MODIFIER(S)

m-gA = INDICATES CATEGORY CHARACTERIZED BY TWO TEXTURES, THE FIRST MODIFIER DOMINANT

MH-M = INDICATES CATEGORY CHARACTERIZED BY TWO MORPHOLOGIES, THE FIRST MODIFIER DOMINANT

tAP / aGM STRATIGRAPHIC RELATIONSHIP WHERE UPPER UNIT IS OFTEN LESS THAN 3 METRES THICK

← - INDICATES TERRAIN TYPE OR FEATURE BEING DESCRIBED

GENETIC COMPOSITION CATEGORIES

- **A** - ALLUVIAL DEPOSITS; SILT, SAND OR GRAVEL
- **C** - COLLUVIUM: UNSORTED MIXTURES OF FINE-GRAINED MATERIALS & RUBBLE
- **D** - DRIFT: UNDIFFERENTIATED GLACIOFLUVIAL, LACUSTRINE & MORAINAL DEPOSITS
- **E** - EOLIAN DEPOSITS; SILT, SAND & VOLCANIC ASH
- **G** - GLACIOFLUVIAL DEPOSITS; SAND OR GRAVEL, RARELY SILT
- **L** - LACUSTRINE & POND DEPOSITS; SILT & SAND, RARELY ORGANIC OR GRAVEL
- **M** - MORAINAL DEPOSITS; TILL, OCCASIONALLY GRAVEL, SAND & SILT
- **O** - ORGANIC DEPOSITS; PEAT, ORGANIC SILT, RARELY MARL
- **R** - BEDROCK

TEXTURAL MODIFIERS

- **a** - SAND OR GRAVEL, COARSE-GRAINED
- **b** - BOULDERS, BLOCKS, BOULDERY, BLOCKY
- **c** - CLAY, CLAYEY
- **d** - DIAMICTON, UNSORTED MATERIAL
- **f** - FINE-GRAINED; SILT, SAND, CLAY; FREQUENTLY ORGANIC
- **g** - GRAVEL, GRAVELLY
- **m** - SILT, SILTY
- **o** - ORGANIC
- **p** - PEAT, PEATY
- **r** - RUBBLE, RUBBLY
- **s** - SAND, SANDY
- **t** - TILL
- **v** - VOLCANIC ASH, TEPHRA
- **x** - COMPLEX

PROCESS or FORM MODIFIERS

- **(A)** - ACTIVE ALLUVIATION
- **(E)** - STREAM ERODED, STREAM ERODING
- **(G)** - CHANNELLED BY MELTWATER STREAMS
- **(L)** - MODIFIED DUE TO SLOPE FAILURE OR RAPID MASS MOVEMENT
- **(P)** - PITTED (KETTLE HOLE)
- **(S)** - SOLIFLUCTION LOBES & TERRACES
- **(K)** - THERMOKARST; MODIFIED BY THERMO-KARST
- **(V)** - GULLIED
- **(W)** - WAVE WASHED
- **(Z)** - PATTERNED GROUND

MORPHOLOGIC MODIFIERS

- **A** - APRON
- **B** - BLANKET
- **C** - CHANNEL (NO VEGETATION COVER)
- **D** - DELTA
- **F** - FAN
- **G** - GENTLY SLOPED (< 5°)
- **H** - HUMMOCKY
- **M** - ROLLING, UNDULATING
- **N** - MODERATELY SLOPED (5°–15°)
- **P** - PLAIN, POND
- **R** - RIDGE
- **S** - STEEPLY SLOPED (> 15°)
- **T** - TERRACE
- **V** - VENEER
- **X** - COMPLEX

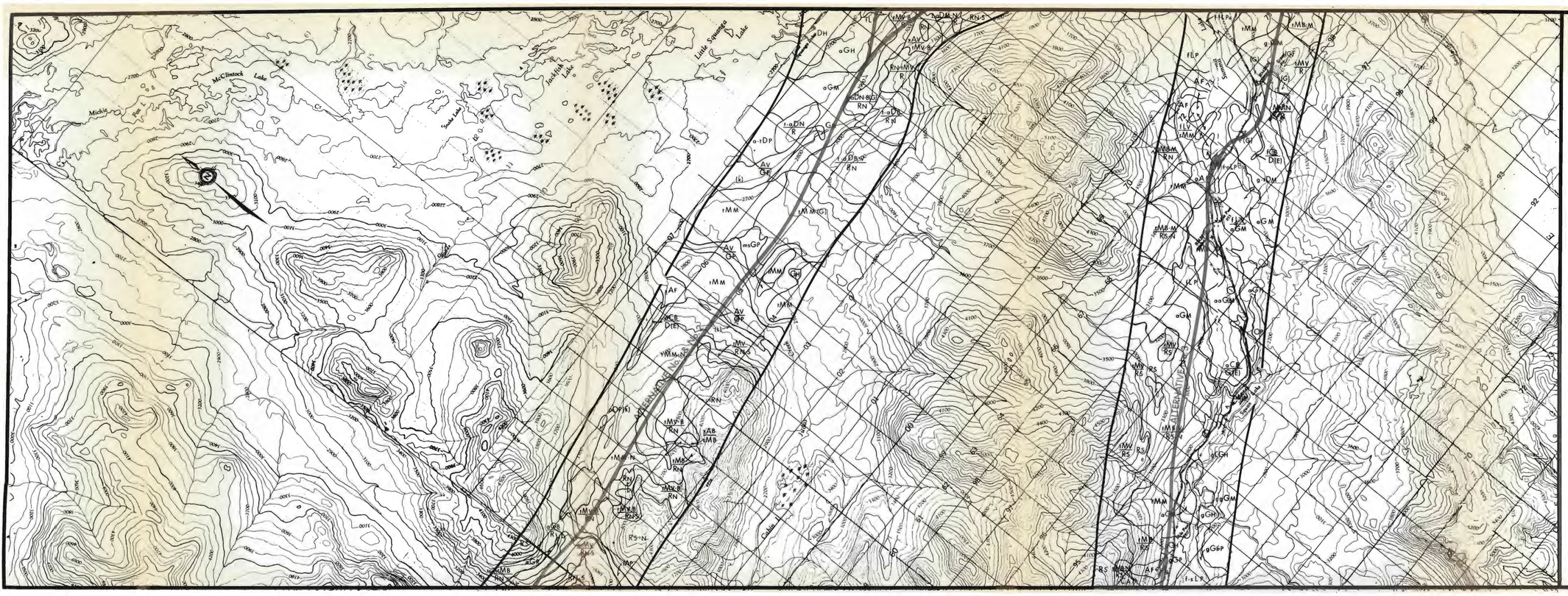
BLANKET - CONTINUOUS COVER GENERALLY 0.5-3 METRES THICK

VENEER - BROKEN THIN COVER AVERAGING 0.5 METRES IN THICKNESS

Scale 1: 50,000

0 0.5 1 miles 2

0 1 2 km 3



MARSH LAKE / SQUANGA LAKE ALTERNATIVES:
TERRAIN TYPES
MAP 3-3.2
SHEET 2

TERRAIN TYPING LEGEND

GENETIC–COMPOSITIONAL CATEGORY — PROCESS OR FORM MODIFIER(S)

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tAP / aGM – STRATIGRAPHIC RELATIONSHIP WHERE UPPER UNIT IS OFTEN LESS THAN 3 METRES THICK

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- **o** – ORGANIC
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GENETIC COMPOSITION CATEGORIES

A – ALLUVIAL DEPOSITS; SILT, SAND OR GRAVEL
C – COLLUVIUM: UNSORTED MIXTURES OF FINE-GRAINED MATERIALS & RUBBLE
D – DRIFT; UNDIFFERENTIATED GLACIOFLUVIAL, LACUSTRINE & MORAINAL DEPOSITS
E – EOLIAN DEPOSITS; SILT, SAND & VOLCANIC ASH
G – GLACIOFLUVIAL DEPOSITS; SAND OR GRAVEL, RARELY SILT
L – LACUSTRINE & POND DEPOSITS; SILT & SAND, RARELY ORGANIC OR GRAVEL
M – MORAINAL DEPOSITS; TILL, OCCASIONALLY GRAVEL, SAND & SILT
O – ORGANIC DEPOSITS; PEAT, ORGANIC SILT, RARELY MARL
R – BEDROCK

TEXTURAL MODIFIERS

a – SAND OR GRAVEL, COARSE-GRAINED
b – BOULDERS, BLOCKS, BOULDERY, BLOCKY
c – CLAY, CLAYEY
d – DIAMICTON, UNSORTED MATERIAL FREQUENTLY ORGANIC
f – FINE-GRAINED; SILT, SAND, CLAY; FREQUENTLY ORGANIC
g – GRAVEL, GRAVELLY
m – SILT, SILTY
o – ORGANIC
p – PEAT, PEATY
r – RUBBLE, RUBBLY
s – SAND, SANDY
t – TILL
v – VOLCANIC ASH, TEPHRA
x – COMPLEX

PROCESS or FORM MODIFIERS

(A) – ACTIVE ALLUVIATION
(E) – STREAM ERODED, STREAM ERODING
(G) – CHANNELLED BY MELTWATER STREAMS
(L) – MODIFIED DUE TO SLOPE FAILURE OR RAPID MASS MOVEMENT
(P) – PITTED (KETTLE HOLE)
(S) – SOLIFLUCTION LOBES & TERRACES
(x) – THERMOKARST; MODIFIED BY THERMOKARST
(V) – GULLIED
(W) – WAVE WASHED
(Z) – PATTERNED GROUND

MORPHOLOGIC MODIFIERS

A – APRON
B – BLANKET
C – CHANNEL (NO VEGETATION COVER)
D – DELTA
F – FAN
G – GENTLY SLOPED (< 5°)
H – HUMMOCKY
M – ROLLING, UNDULATING
N – MODERATELY SLOPED (5°–15°)
P – PLAIN, POND
R – RIDGE
S – STEEPLY SLOPED (>15°)
T – TERRACE
V – VENEER
X – COMPLEX

BLANKET – CONTINUOUS COVER GENERALLY 0.5–3 METRES THICK
VENEER – BROKEN THIN COVER AVERAGING 0.5 METRES IN THICKNESS

pumping over the total line length. Finally, the loss in crew time due to daily travel over the right-of-way would add significantly to the cost of this section of line.

Alternative #3 is characterized by relatively easy access to all parts of the line at regular intervals as the routing parallels the Alaska Highway. Rock in quantity is found mainly at the northerly end of this alignment. This alternative encounters permafrost in two short sections, thus enabling greater use of conventional construction practices. Where wet areas are encountered along Alternative #3, suitable fill material is available from areas adjacent to the right-of-way. Approximately 10 percent of this routing follows extreme side hills; however, the terrain involved appears to be composed of easily-gradable soils with little evidence of erodible material. Granular material useable for padding appears to be available along the entire length of this alternative. Right-of-way preparation would consist of only that which is required for actual construction, as material will be hauled along the highway. Access to the right-of-way is not limited along Alternative #3; therefore, equipment passage over any given point would be relatively short term. Elevation change along Alternative #3 is generally minimal over most of the route, and increases at a constant rate, a factor which reduce effort required for hydrostatic testing. Water would be supplied from only two sources, and pumping requirements would be minimized. Crew time-loss due to travel would be negligible along Alternative #3.

4.2.2 Environmental Conditions

As outlined previously, environmental factors which have become major routing issues in the Marsh Lake/Squanga Lake area involve woodland caribou populations, fish populations and the nesting sites of certain large raptors.

Fish

Studies of fish inhabiting streams crossed by alternative routes have been conducted and the results reported in a number of documents (see Appendix II). A brief summary of results for the alternative routes is presented in Table 3-3.2. A comprehensive summary of the results of fisheries investigations is presented in Appendix III. Alternative Routes #1 and #3 each cross 23 waterbodies, while Alternative #2 crosses 17. Of the waterbodies crossed, Alternative #1 crosses 10 waterbodies which support important fish species or which exhibit some potential for supporting desirable fishes. Alternative #2 crosses 12 such waterbodies, while Alternative #3 crosses 6.

A unique form of whitefish is found in Squanga Lake. Alternative #2 crosses two areas where this type of whitefish may spawn. Both Alternatives #1 and #3 avoid these potential spawning areas.

Project response to fisheries concerns can take a number of forms, including:

1. Relocation to avoid sensitive areas.

2. Scheduling constraints to ensure instream activities occur during a period when fish are absent or least sensitive to disturbance.

3. Use of special instream construction techniques to reduce or eliminate adverse effects upon fish during sensitive periods.

4. Utilizing post-construction techniques to rehabilitate habitat or enhance production.

5. No action and acceptance of the impacts.

TABLE 3-3.2

MARSH LAKE/SQUANGA LAKE ALTERNATIVE
ROUTES - COMPARISON OF FISHERY RESOURCES

Alternative	Total Number of Waterbody Crossings	Total Number of Crossings With No Fisheries Potential[1]	Total Number of Crossings Supporting Important Fish Species[2]	Number of Other Waterbody Crossings[3]
#1	23	13	6	4
#2	17	5	7	5
#3	23	17	5	1

[1]Waterbodies which do not exhibit habitat suitable for use by fish, usually because of one of the following characteristics: steep gradient; obstructions present such as log jams, waterfalls, impassable culverts; inadequate discharge; low water levels; or intermittent flow.

[2]Important fish species are: chinook salmon, chum salmon, Arctic grayling, lake trout, lake whitefish, Dolly Varden char, northern pike and burbot.

[3]Those waterbodies which have low or fair potential for supporting fish and/or support unimportant fish species.

In planning for Project activities fisheries studies have been completed or are presently underway at all stream crossing sites. Sensitive areas and periods have been identified for each stream with respect to important fish species. The approach taken in developing preliminary fisheries protection plans has been to schedule instream activities wherever possible to avoid sensitive periods. Where scheduling is not possible due to constraints of season (for example when overwintering fish occur in a winter construction zone in an area that cannot be constructed in summer due to streamside terrain conditions), special instream construction measures are being developed. Such special measures may include flumed installation, above-water crossings, stream diversions, or damming and pumping around a dry ditch. Other more usual practices that will be instituted during construction, depending upon site-specific conditions and concerns, have been outlined in the Project's Environmental Statement[1] on pages 9-6 and 9-7.

Birds

The nest sites of certain birds of prey have been a routing issue faced by Foothills from the outset of project planning. Concerns for nesting raptors centre on the fact that some are considered to be rare or endangered and upon the possibility of nesting activities being disturbed by pipeline construction in a sufficient number of cases to cause a population decline. In the Marsh Lake/Squanga Lake area, Golden Eagle and Bald Eagle nests have been located within 4 km of the alternative routes during surveys undertaken by the Project over three years. These species are not endangered in Canada.

Results of surveys completed since 1977 indicate that two Golden Eagle nests, neither of which are active, together with three Bald Eagle nests, one of which has been active in one of the last three years, are

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1. Foothills Pipe Lines (South Yukon) Ltd. 1979. Environmental Impact Statement for the Alaska Highway Gas Pipeline Project.

located within 2 km of the pipeline routes which diverge from the highway. Along the pipeline route which follows the highway, five Golden Eagle nests, one of which is active, and one active Bald Eagle nest, are located within 2 km of the right-of-way. One additional Bald Eagle nest was active in 1980 along Alternative #3 (Alaska Highway Alternative), but this nest was blown down and the nest site was not used in 1981. This nest is included in this analysis however, since it was active within the last three years. Nesting Ospreys have not been found within 4 km of any of the alternative routes. The closest Osprey nesting activity to the routes in question is at the edge of the Squanga Lake airfield. A summary of nest locations adjacent to alternative routes in the Marsh Lake/Squanga Lake area is presented in Table 3-3.3.

Project response to concerns related to raptor nests can take the following forms:

1. Location of the pipeline route to avoid close proximity to active raptor nest sites.

2. Scheduling of pipeline activity to non-nesting periods or periods when sensitivity at nest sites is low.

3. Use of special construction techniques to reduce or eliminate adverse effects upon raptors during sensitive periods.

4. Utilizing post-construction techniques to rehabilitate habitat or enhance production.

5. No action and acceptance of impacts.

Raptor nest sites occur throughout the portion of Yukon Territory traversed by the pipeline and avoidance through location of all raptor nests is not possible. In addition, the nesting period for the raptors present in Yukon Territory can extend from March through August with the result that both winter (January - April) and summer (June - November)

TABLE 3-3.3

SUMMARY OF RAPTOR NEST LOCATIONS ALONG
ALTERNATIVE ROUTES IN THE MARSH LAKE/SQUANGA LAKE AREA

(Number of nests active in at least one of last three years shown in brackets)

Alternative	Nests Within 4 km			Nests Within 2 km		
	Golden Eagle	Bald Eagle	Osprey	Golden Eagle	Bald Eagle	Osprey
#1	9 (2)	4 (1)	0	2 (0)	3 (1)	0
#2	9 (2)	4 (1)	0	2 (0)	3 (1)	0
#3	12 (3)	2 (2)	0	5 (1)	2 (2)	0

mainline construction periods will overlap nesting periods. This situation limits the extent to which the Project can react to raptor nesting concerns. Preliminary Project planning to date has utilized route location to avoid raptor nests by 2 km wherever a reasonable route alternative has been available. In addition, pre-construction activities (e.g., geotechnical drilling program) within 2 km of nests have been restricted to less sensitive periods, and a similar approach will be used wherever possible for pre-mainline (e.g., clearing, blasting) and post-mainline (e.g., hydrostatic testing, revegetation) activities. Scheduling of mainline construction activities will not be undertaken to avoid the nesting period. However, normal restrictions on such activities associated with ground conditions will likely reduce the severity of disturbance at the nests. Raptor sensitivity to disturbance for the species of concern in the Marsh Lake/ Squanga Lake area is thought to peak during egg-laying, incubation, and the hatching period (April 1 to May 31). Since mainline construction will be halted by spring break-up (April 1 - 15) in most areas, such activity will be minimal during the most sensitive nesting period. Other more usual practices that will be instituted during construction have been outlined in the Project's Environmental Statement[1] on pages 9-7 through 9-10.

Woodland Caribou

Woodland caribou inhabit much of Yukon Territory, including the area between Marsh and Squanga lakes. The Panel received testimony that the initially-proposed route would cross winter caribou range for which special concern was expressed, and that increased hunting due to access along the pipeline right-of-way would occur. Supported in part by Foothills, the Yukon Territorial Wildlife Branch (YTG) has conducted a three-year study of caribou in a region extending from Marsh Lake to Johnsons Crossing and south to Carcross. Animals have been collared with radio transmitters and tracked from the air. Results of these studies indicate

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1. Foothills Pipe Lines (South Yukon) Ltd. 1979. Environmental Impact Statement for the Alaska Highway Gas Pipeline Project.

that caribou use winter range along much of Alternatives #1 and #2; no animals have been observed along Alternative #3. In no case are large concentrations of animals involved, and winter range definition along Alternatives #1 and #2 is primarily based on relocations of the same few animals. Collared animals were found to range widely in all seasons, generally using valley bottoms in winter and higher elevations in summer. Conflict with identified ranges along Alternatives #1 and #2 could be partially avoided in that construction would pass through winter range during summer; thus, physical disturbance to caribou habitat would take place, although contact with the animals themselves would be unlikely. However, that is not the case with Alternative #3, in which summer construction passes through areas identified and mapped by YTG as summer range (see Map 3-3.3). It has, however, been suggested by YTG personnel that areas immediately adjacent to the highway (Alternative #3) are not important to the animals, and the lack of observations along Alternative #3 confirms this. Other winter ranges include two areas located south and west of Marsh Lake and a region well north of the pipeline route near Mt. Michie. During summer the animals have been more dispersed, with foci of activity south and west of Marsh Lake, near Mt. Michie, Mt. M'Clintock, Streak Mountain and southwest of Teslin Lake.

Given the wide-ranging habits of caribou in the Marsh Lake/ Squanga Lake area, there are few project actions that can be anticipated to affect caribou in either a positive or negative way. The extent of both winter and summer range is large in comparison to areas proposed for pipeline activity, and, consequently, little habitat would be altered or alienated. Any undesirable increase in hunting pressure due to hunter use of a pipeline right-of-way would of necessity have to be identified and controlled through regulations by the Territorial Wildlife Branch. Standard practices to mitigate adverse effects on ungulates that will be instituted during construction have been outlined in the Project's Environmental Statement[1] on pages 9-7 through 9-10.

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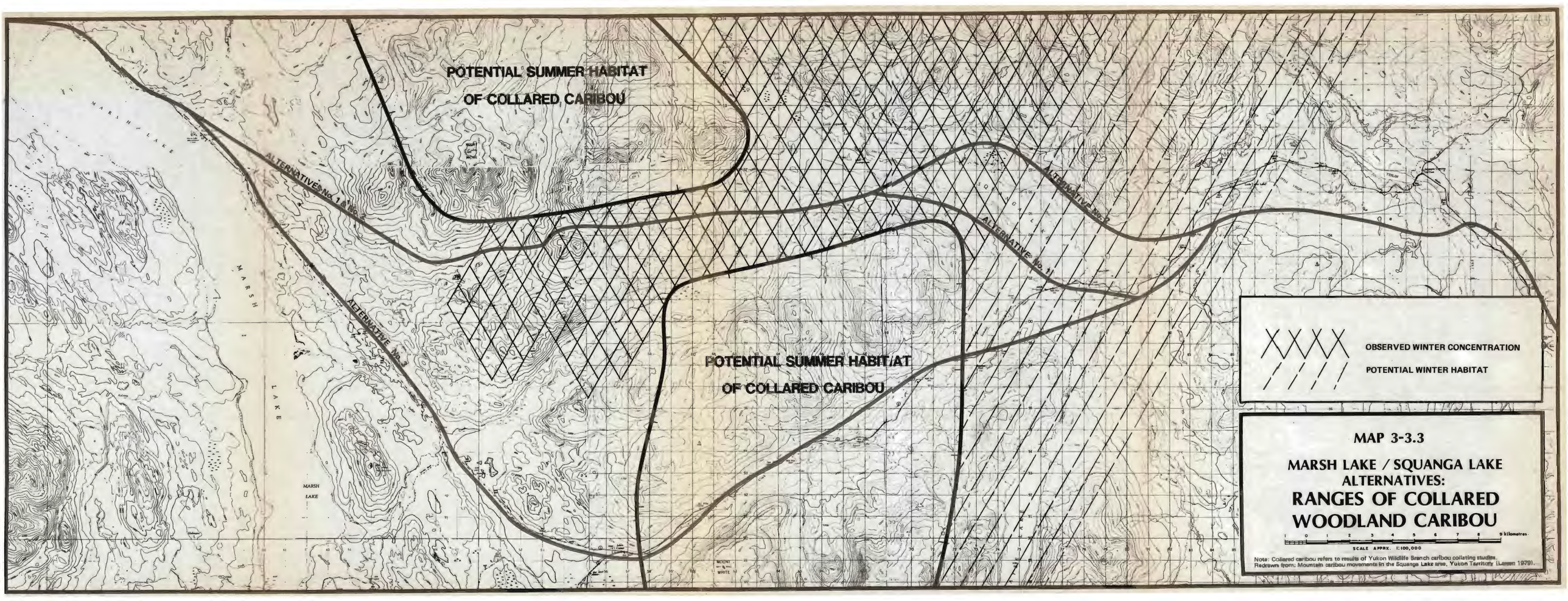
1. Foothills Pipe Lines (South Yukon) Ltd. 1979. Environmental Impact Statement for the Alaska Highway Gas Pipeline Project.


POTENTIAL SUMMER HABITAT
OF COLLARED CARIBOU
ALTERNATIVE No. 1 & No. 2
ALTERNATIVE No. 3
ALTERNATIVE No. 2
ALTERNATIVE No. 1
POTENTIAL SUMMER HABITAT
OF COLLARED CARIBOU
MARSH LAKE
MARSH LAKE
OBSERVED WINTER CONCENTRATION
POTENTIAL WINTER HABITAT
MAP 3-3.3
MARSH LAKE / SQUANGA LAKE
ALTERNATIVES:
RANGES OF COLLARED
WOODLAND CARIBOU
0 1 2 3 4 5 6 7 8 9 kilometres
SCALE APPRX. 1:100,000
Note: Collared caribou refers to results of Yukon Wildlife Branch caribou collating studies.
Redrawn from: Mountain caribou movements in the Squanga Lake area, Yukon Territory (Larsen 1979).

4.2.3 Socio-economic (Land-use) Conditions

Land use can be divided into the following categories: residential, commercial, recreational, agricultural, mineral extraction, lands held in reserve by government departments or agencies, lands used or claimed by native people, and lands with historic value.

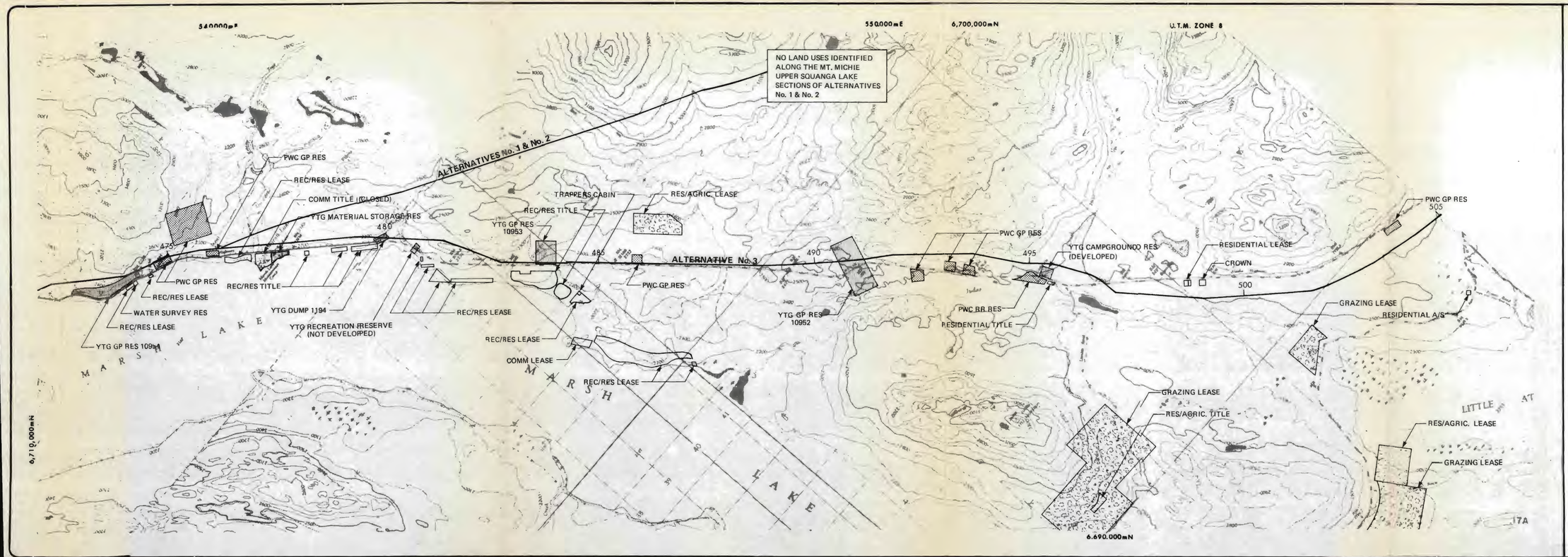
Concerns related to socio-economic or land-use issues can involve all of the categories noted, but in the Marsh Lake/Squanga Lake area, land uses are few and of minor concern along all alternative routes. For the most part, land-use issues in this area tend to be compatible with pipeline activity (see Map 3-3.4). A summary of approaches to addressing categories of land use follows.

Residential, Recreational, Agricultural and Commercial Land Use

Concerns for conflicts between residential and commercial land use and pipeline activity stem from: inconvenience to land users, the requirement for special design, construction and operational procedures and the possibility that future development may be limited.

Project response to the inconvenience to existing residents most often takes the form of special efforts and procedures to reduce inconvenience of construction to an acceptable level. Such response includes working during limited hours, replacing fences and other disturbed structures together with rehabilitating disturbed sites. Costs vary depending upon circumstances.

Alternative #1 does not cross any residential or commercial land. At the south end of Squanga Lake, it passes close to the Squanga Lake Yukon Territorial Government campground reserve (developed) and to a residential/recreational area, but inconvenience to users will be minimal given approaches described. Also, it crosses a gravel reserve near the south end of Squanga Lake.



MAP 3-3.4

MARSH LAKE / SQUANGA LAKE ALTERNATIVES:

LAND STATUS

SHEET 1 OF 2

LEGEND

YUKON TERRITORY

TERRITORIAL LANDS
GOVERNMENT OF CANADA ARMED FORCES
ENVIRONMENT CANADA
- KLUANE NATIONAL PARK
- WATER SURVEY RESERVE

DEPT. INDIAN AFFAIRS AND NORTHERN DEVELOPMENT (INDIAN AND INUIT AFFAIRS PROGRAM)
- INDIAN RESERVE
- MINERAL LEASE
- AGRICULTURAL GRAZING LEASE TITLE

MINISTRY OF TRANSPORTATION
PUBLIC WORKS CANADA
- BRIDGEHEAD RESERVE
- GRAVEL PIT RESERVE
- ROAD ALLOCATION RESERVE

REVENUE CANADA CUSTOMS RESERVE

COMMISSIONER'S LANDS
TERRITORIAL LANDS COMMISSIONER ADMINISTERED
- DEPT. OF HIGHWAYS AND PUBLIC WORKS
- DEPT. OF MUNICIPAL AFFAIRS
  - BLOCK LAND TRANSFER
- DEPT. OF RENEWABLE RESOURCES
  - CAMPGROUND RESERVE
  - RECREATIONAL RESERVE
  - REST AREA
  - BOAT LAUNCH RAMP
  - KLUANE GAME SANCTUARY

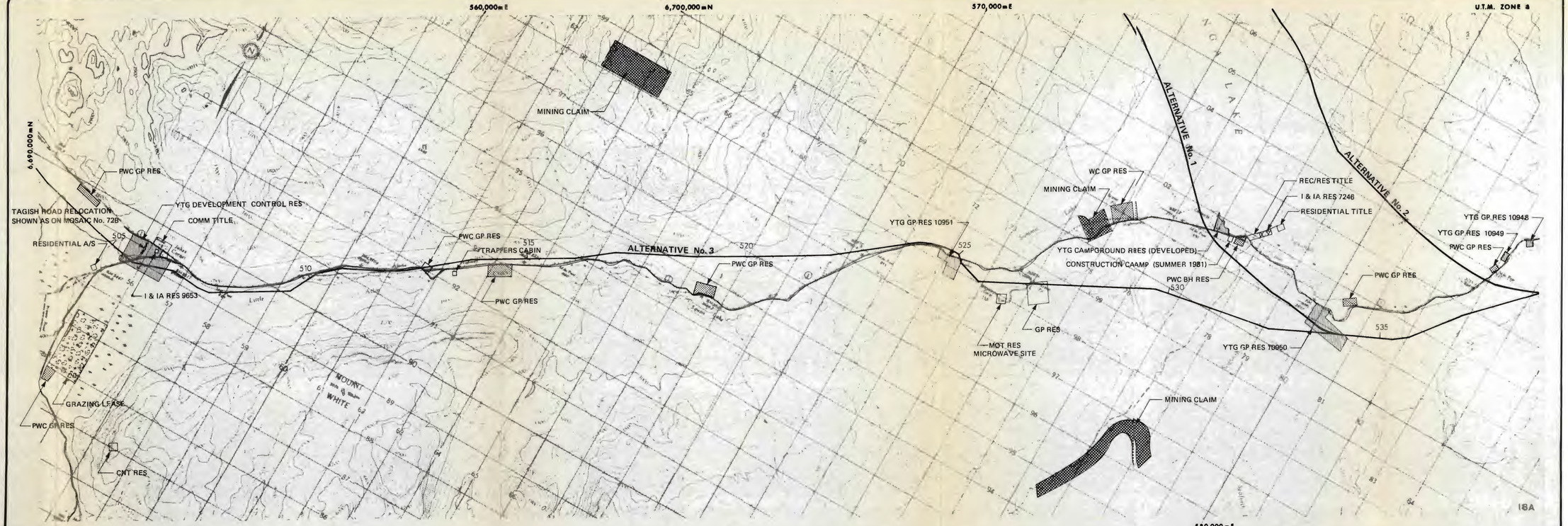
PRIVATE LANDS
- RESIDENTIAL, RECREATIONAL OR COMMERCIAL LEASE/TITLE

BRITISH COLUMBIA
MINISTRY OF LANDS, PARKS AND HOUSING
- B.C. RECREATION RESERVE

MISCELLANEOUS
- COMMUNITY WATER WELL OR INTAKE
- FLOAT PLANE DOCK

1000 500 0 1000 2000 3000 METRES

Scale 1:50 000



MAP 3-3.4

MARSH LAKE / SQUANGA LAKE ALTERNATIVES:

LAND STATUS

SHEET 2 OF 2

LEGEND

YUKON TERRITORY

TERRITORIAL LANDS
(GOVERNMENT OF CANADA ADMINISTERED)
- ENVIRONMENT CANADA
  - KLUANE NATIONAL PARK
  - WATER SURVEY RESERVE
- DEPT. INDIAN AFFAIRS AND NORTHERN DEVELOPMENT (NORTHERN PROGRAM)
  - INDIAN AND INUIT AFFAIRS — DIAND
  - MINING CLAIMS — I & IA RES
  - AGRICULTURAL/GRAZING LEASE/TITLE
- MINISTRY OF TRANSPORTATION — MOT RES
- PUBLIC WORKS CANADA :
  - BRIDGEHEAD RESERVE — PWC BH RES
  - GRAVEL PIT RESERVE — PWC GP RES
  - ROAD RELOCATION RESERVE — PWC RR RES
- REVENUE CANADA CUSTOMS RESERVE

COMMISSIONER'S LANDS
(TERRITORIAL LANDS COMMISSIONER ADMINISTERED)
- DEPT. OF HIGHWAYS AND PUBLIC WORKS — YTG GP RES
- DEPT. OF MUNICIPAL AFFAIRS:
  - BLOCK LAND TRANSFER
- DEPT. OF RENEWABLE RESOURCES:
  - CAMPGROUND RESERVE
  - RECREATIONAL RESERVE
  - REST AREA
  - BOAT LAUNCH RAMP — o
  - KLUANE GAME SANCTUARY

PRIVATE LANDS
- RESIDENTIAL, RECREATIONAL OR COMMERCIAL LEASE/TITLE

BRITISH COLUMBIA
- MINISTRY OF LANDS, PARKS AND HOUSING:
  - B.C. RECREATION RESERVE

MISCELLANEOUS
- COMMUNITY WATER WELL OR INTAKE — ⌀
- FLOAT PLAN DOCK — △

0 2 Miles

1000 500 0 1000 2000 3000 Metres

Scale 1: 50 000

Alternative #2 neither crosses nor passes close to any residential or commercial land; however, it comes close to one gravel reserve east of Squanga Lake.

Alternative #3 (the Alaska Highway Alternative) passes close to the following types of land use: recreational/residential, residential/agricultural, residential, commercial (service) facilities and a federal government reserve for a microwave site. Two campgrounds are located adjacent to the route at approximately KP 495 (Judas Creek) and KP 530 (Squanga Lake). It is anticipated that the Project responses noted above, however, will ensure that inconvenience to land holders along the route will be minimal. In addition, the right-of-way will cross four gravel reserves, one dump and one development control zone. It is not anticipated that this will create any problems for future use of these areas.

Lands Involving Native Interests

A number of areas in Yukon Territory have been set aside by the Department of Indian Affairs and Northern Development for Indian use. The reasons for such action vary from location to location but include protection of areas of cultural importance and protection of traditional resource-harvesting activities as well as native residential areas. These lands, which are under the control of the Federal Government, are protected by map reserves or departmental notation.

One Indian and Inuit Affairs Reserve, for native residential purposes exists along Alternative #3 at Jake's Corner (KP 505), and one similar area exists along Alternative #1 at the south end of Squanga Lake (KP 518). In neither case does the route cross these lands. No lands involving native interests are found along Alternative #2. The pipeline is unlikely to have any effect upon any of the native land areas in question.

4.2.4 Factors of Operational Safety

The largest single cause of pipeline failure over the years has been third party construction activities in the vicinity of the pipeline. Recognition of this cause of failure has led in part to the special design factors and codes in areas of residential or commercial land use. While such design factors are effective in reducing the risk to the pipeline and to persons and property, they do not eliminate the possibility of damage.

Public Safety

To meet the concerns for public safety, the engineering designer takes into account the current population density along the pipeline corridors being considered and also makes a population build-up projection into the future for the life of the pipeline in order to determine the safety factor to be assigned to each section of pipeline. The resulting safety factor governs the wall thickness and grade of pipe to be used. The population build-up prediction is checked each year during the Operations Phase with documented population density surveys along the corridor which contains the pipeline. If the prediction is accurate, no changes to the pipeline are necessary. On the other hand, if the prediction is not accurate because of reasons that are beyond the control of the pipeline operator, the following options are available from the standpoint of public safety and the codes and regulations that apply to high pressure gas pipelines:

1. Replace the pipe in the section that has been encroached by suburban or other development. The replacement pipe would have a thicker wall or be made of higher strength steel or both to increase the safety factor of the pipeline in the built-up area.

2. Lower the operating pressure.

3. Move the pipeline to another location.

Generally, items 1 or 3 are the only reasonable alternatives. Lowering the pressure places a restriction on system throughput which usually only delays the decision to replace or relocate. Of the other two options, relocation of the pipeline remote from the area of potential population build-up is by far the most suitable solution.

The public safety aspects of each of the three route Alternatives are different owing to the relative remoteness of Alternatives #1 and #2 from human activities compared to Alternative #3. Since human activities in the vicinity of Alternatives #1 and #2 are mostly limited to hunting, trapping and recreational fishing, public contact with these routes is transient at all points except at the south end of Squanga Lake near the Alaska Highway. Alternative #3, following the Alaska Highway, naturally has more contact with human activities than Alternative #1 and #2; however, very little permanent residential land exists along this section of the Alaska Highway with little or no build-up being projected. It should be noted that issues of public safety posed by Alternative #3 are no different in kind from those in all other areas where the proposed pipeline route follows the Alaska Highway. Similarly, concerns related to third party damage (see below) are lesser in remote areas and greater in areas of human activity. Assessment of the three alternatives is therefore the same for third party damage as it is for public safety.

Third Party Damage

Although pipeline design codes make provision for high pressure gas pipelines in suburban areas, the trend in the industry is to avoid these areas. The largest single cause of pipeline failure is by third-party damage, i.e., construction activities by others on or across the right-of-way of the operating pipeline which occasionally results in accidentally severing the high pressure gas pipeline, which in turn could result in an explosion and fire.

As suburban areas encroach and cross the right-of-way of an operating pipeline, the extension of underground and above-ground services required by the municipality increases the risk of third party damage. It is this activity which presents the greatest safety hazard to the general public who reside or work near an operating high pressure gas pipeline. The only way to avoid this type of conflict, and the hazards that may result, is to locate the pipeline in a corridor that is remote from areas of actual or potential population concentration. No such areas of population concentrations exist along any of the Marsh Lake/Squanga Lake alternatives.

4.3 OTHER ISSUES

4.3.1 Compression Requirements

Given the lengths of each alternative in the Marsh Lake/Squanga Lake area, system design requirements currently do not require location of compressor stations on any of the three Alternatives. Nearest compressor station locations for Alternatives #1 and #2 are those given in the EIS submitted in 1979. For Alternative #3, the nearest compressor stations are those given in the "Project Description" (Submission 2-1) of the addenda submissions.

4.3.2 Access To Remote Areas

As in other discussions regarding alternative routes, the question of access has been raised repeatedly for the Marsh Lake/Squanga Lake area. The issue in this case has primarily been the facilitated harvest of woodland caribou populations; however, it should be noted that much of the area, particularly around Squanga Lake, is already used by hunters and trappers on snowmobiles during the winter season, and access by boat is also possible during summer. The question of access is only relevant to Alternatives #1 and #2, with little difference between the issues raised by access for the two alternatives. For Alternative #3 - the Alaska Highway

route - new access is clearly not an issue, as access would consist of short connectors between the Highway and the pipeline route. No new areas will be opened to travel.

In responding to concerns put forward about the creation of additional access for pipeline construction, the Project has from the outset undertaken to limit or destroy new access after construction is complete. With regard to access along the right-of-way, measures to exclude vehicular traffic would involve natural barriers such as watercrossings and the placement of man-made barriers. In the case of off-right-of-way access, barriers consisting of large boulders could be used, or roadfills cut and barricaded. In both cases, however, the Project's response would be limited by the legal authority to control lands which are acquired by the Project. Project authority over right-of-way lands, while substantial in many ways, is limited to the transportation of natural gas and does not extend to the restriction of movement by third parties as long as that movement does not affect gas transportation. Authority to limit use of off-right-of-way lands is essentially non-existent. In short, authority to limit the use of access created by the Project rests with owners of the lands involved and not with the Project. If directed to do so by owners, however, the Project will take steps to limit access.

While some persons and groups see increased access to areas traversed by the pipeline as a negative development, this view is not shared by all Yukon residents. Many residents in fact, probably view increased access as a positive situation which will increase the degree to which resources can be reached. As an example, foresters generally view any access as being very useful to reach harvestable stands, as a firebreak and as a pathway to fires which may occur. Hunters and fishermen value new access because areas previously difficult to reach are made more accessible. Mining interests require access to find and develop mineral resources and even those land-users who generally prefer a wilderness situation, such as trappers and guides, use existing access when available.

In view of the varying positions on the advantages versus disadvantages of increased access, the Project did not arbitrarily introduce a predetermined bias into route selection procedures. Consideration of access for route selection purposes was limited to Project requirements such as the need to move men, equipment and materials to the right-of-way from stockpile areas. Foothills will however, honour undertakings to limit or alter new access created, provided that direction to do so is forthcoming from the owners of the affected land.

While access did not play a primary role in the route selection process described here, examination of access routes likely required for each alternative routing was completed during the cost-estimating process described earlier. Access for Alternatives #1 and #2 would be limited to the pipeline right-of-way; that is, access during construction and operations would be via the right-of-way with entry gained from the Alaska Highway near Marsh lake or Squanga Lake. As Alternative #3 closely parallels the Alaska Highway, access to the right-of-way is not a consideration.

PART 5

EVALUATION OF ALTERNATIVES AND SELECTION OF A ROUTE

Having determined the presence and magnitude of routing constraints and concerns, a comparison of alternative routes is possible.

Since every route involves some unavoidable concern, selection of a route cannot be made solely on the basis of avoidance through location but rather on the likelihood and/or difficulty of overcoming concerns through some action.

Ideally, in undertaking the approach suggested above, each response required for each alternative would be costed and a final comparison of costs made. While such costing is relatively easy for engineering and construction factors for which accepted estimation techniques exist, applying a similar approach to responses required to meet environmental, socio-economic and safety concerns is made difficult by a lack of established costing procedures. Consequently, in the following evaluations, engineering and construction responses have been based on total cost figures while environmental, land-use and safety responses are rated on an ordinal scale.

5.1 EVALUATION OF ALTERNATIVES

Cost evaluations for construction and design are based on estimates presented in Table 3-3.1.

Comparison of alternative routes for environmental, socio-economic and safety factors was facilitated through the use of a system of scoring using an ordinal scale. Scores were established for each factor along each Alternative for both the degree of concern for the routing factors involved and the extent of project response that would likely be required. Scores were listed under headings titled Importance of Concern

(I.C.) and Project Response (P.R.). For example, a road crossing may have a very limited degree of concern attached to it by persons outside the Project but involve a specific response with a measurable additional cost. In comparison, crossing of agricultural land involves a high degree of concern by the land holder but requires little in the way of project response beyond standard rehabilitation techniques.

5.1.1 Rating Scales

Where a location factor has been identified as being present on any Alternative under consideration, an assessment of the importance of the concern (I.C.), and the requirement for mitigation through project response (P.R.) was made. The assessments were rated using an ordinal scale.

For Importance of Concern (I.C.), the rating scale and ordinal values used were as follows:

Rating Scale	Rating Value
Factor absent	0
Factor present but with no concern	1
Factor present with low concern	2
Factor present with moderate concern	3
Factor present with high concern	4
Factor present with extreme concern	5

For Project Response (P.R.) the rating scale and values assigned were as follows:

Rating Scale	Rating Value
No response required	0
Response required is known to be effective and is part of standard plans or practice and involves no discernible extra cost	1
Response required is known to be effective and while not part of standard practice involves little if any additional cost	2
Response required is known to be effective, is not part of standard practice and involves a measurable additional cost	3
Response required is known to be effective, is not part of standard practice and involves substantial additional cost	4
Response required may not be effective based on previous experience and involves exceptional additional cost or the possibility of delay if necessary innovation is not effective	5

5.1.2 Evaluation

The three viable alternatives were evaluated using the rating scales described in Section 5.1.1. The results of the assessments are presented in Table 3-3.4 entitled "Evaluation of Marsh Lake/Squanga Lake Alternatives". This table lists the factors considered in the assessment down the left hand column and the alternatives considered across the top.

The Evaluation Table presents on a single page the degree of concern and the difficulty of resolving concern for the full range of routing factors. As a result, comparison of concerns and difficulty of resolution can be more easily made for individual alternatives. Totals for columns and rows have been included as they offer an indication of the degree of concern. Readers are cautioned against use of column and row totals for anything other than an indication of possible relationships. In order to assist reviewers in interpreting the information presented in Table 3-3.4, the rationalization used in arriving at values for the degree of concern and project response required for each concern is presented in Appendix IV of this submission.

The Evaluation Table clearly indicates that any route selected will not be ideal and that trade-offs will be required. Since every route involves some unavoidable concern, selection of a route must be made not on the basis of avoidance through location but rather on the likelihood and/or difficulty of overcoming concerns through some action. Examination of the table and the definitions for rating indicates that all concerns can be met by a project response (mitigative measure). Selection of a route in this situation must be made on the basis of the fewest, or alternatively the least expensive, series of mitigative measures.

5.2 COMPARISON AND ROUTE SELECTION

In order to compare the various alternatives in terms of the subjective environmental, socio-economic and safety evaluations and dollar

ALTERNATIVES / LOCATION FACTORS		ALTERNATIVE NO. 1		EVALUATION SCORE (a)	ALTERNATIVE NO. 2		EVALUATION SCORE(a)	ALTERNATIVE NO. 3		EVALUATION SCORE(a)
		I.C.	P.R.		I.C.	P.R.		I.C.	P.R.	
SOCIO-ECONOMIC										
LAND USE	MINERAL LEASES	0	0	0	0	0	0	0	0	0
	RESIDENTIAL	0	0	0	0	0	0	2	1	3
	AGRICULTURAL	0	0	0	0	0	0	0	0	0
	COMMERCIAL	0	0	0	0	0	0	0	0	0
	RECREATIONAL	0	0	0	0	0	0	2	1	3
	WATER SUPPLY	0	0	0	0	0	0	0	0	0
	HERITAGE	0	0	0	0	0	0	0	0	0
	NATIVE	0	0	0	0	0	0	0	0	0
	GRAVEL RESERVE	1	1	2	1	1	2	1	1	2
TOTAL		1	1	2	1	1	2	5	3	8
ENVIRONMENTAL										
FISH	HABITAT	2	2	4	3	2	5	2	2	4
BIRDS	RAPTORS	2	2	4	2	2	4	2	2	4
MAMMALS	CARIBOU	2	1	3	2	1	3	1	1	2
	OTHER	1	1	2	1	1	2	1	1	2
TOTAL		7	6	13	8	6	14	6	6	12
OPERATIONS										
PUBLIC SAFETY		2	1	3	2	1	3	3	1	4
THIRD PARTY DAMAGE		2	1	3	2	1	3	3	1	4
TOTAL		4	2	6	4	2	6	6	2	8

a. THE TERM "EVALUATION SCORE" IS SYNONYMOUS WITH THE TERM "RATING OF CONCERN" USED IN A COMPARABLE TABLE REGARDING POTENTIAL WHITEHORSE —IBEX ROUTE ALTERNATIVES.

I.C. = IMPORTANCE OF CONCERN. P.R. = PROJECT RESPONSE (FOR EXPLANATION, SEE TEXT)

Foothills Pipe Lines (Yukon) Ltd.

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

TABLE 3-3.4

EVALUATION OF MARSH LAKE / SQUANGA LAKE ALTERNATIVES

	DRAWN	CHECKED	APPROVED	APPROVED
BY	R. K.	A.G.		
DATE	81-05-06	81-05-06		

SCALE N.A. PREPARED BY D. FERNET

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costs, the evaluation scores for each alternative from Table 3-3.4 were categorized as low or high depending upon which side of the midpoint within the total range of scores they fell. Table 3-3.4 details the categorization process for environmental, land-use and safety factors. Factors related to engineering and construction are expressed in dollar figures based on detailed estimates (Table 3-3.1) as relationships between these factors and cost estimates are obvious. Table 3-3.5 combines the categories for the main routing disciplines together with estimated costs for construction.

It is apparent from Table 3-3.5 that the Alaska Highway Alternative (Alternative #3) offers a low cost and a low potential for environmental impact. Comparatively, this alignment has a high potential for socio-economic (land-use) conflicts but these conflicts are minor in nature. This Alternative also has a comparatively high risk to public safety and the possibility of third party damage. Alternatives #1 and #2 are desirable in terms of less potential for land-use conflicts and greater security from third party damage and risk to public safety. The disadvantages of these routes are the increased cost and the higher potential for environmental impact.

The project has chosen the Alaska Highway (Alternative #3) routing as concerns relating to land-use conflicts are not significant and concerns relating to public safety and third party damage are not excessive, but rather comparable to those for the majority of the routing along the Alaska Highway corridor. This alternative offers a low potential for environmental impact, as well as a low capital cost. The other alternative routings do not offer these advantages.

TABLE 3-3.5

COMPARISON OF COSTS AND EVALUATION SCORES FOR ENVIRONMENTAL AND SOCIO-ECONOMIC (LAND-USE) FACTORS, AND PUBLIC SAFETY FACTORS RELATED TO THIRD PARTY DAMAGE

Alternative	Total Capital Cost ($ Million)	Evaluation Score[1]		
		Environmental	Socio-Economic (Land-Use)	Public Safety
#1	211.3	13	2	6
#2	215.0	14	2	6
#3	160.4	12	8	8

[1]Evaluation scores from Table 3-3.4.

PART 6

ENVIRONMENTAL IMPACT ASSESSMENT OF ALTERNATIVE #3

The environmental implications of constructing the pipeline along the Alaska Highway between Marsh Lake and Squanga Lake (Alternative #3) are discussed in this section of the submission. Descriptions of existing environmental conditions along this routing are presented in Section 4.2.2; following is a discussion of unmitigated environmental impacts, proposed mitigation measures and predicted residual impacts. The schedule for the Marsh Lake/Squanga Lake region specifies summer construction, which will commence June 1. Pipe laying is scheduled for completion by September 30, and hydrostatic testing is scheduled for completion by October 31.

6.1 UNMITIGATED ENVIRONMENTAL IMPACTS

The construction of Alternative #3 with no mitigative action to protect fish and wildlife resources could result in a variety of impacts on these resources. These potential unmitigated impacts are outlined in the following.

Fish

In light of a summer construction schedule, in which instream construction activity could be conducted from June 1 through to September 30 (depending on the rate and sequence of construction), impacts on fisheries resources at three streams are possible. It must be noted here that fisheries investigations are continuing along the new preferred alignment, and these may reveal new information which refines the pattern of habitat utilization presented below. This submission assumes the habitat utilization indicated in Appendix III. In preparing Appendix III the highest possible use of habitat has been assumed based on stream conditions. As a result, refinements produced by new information, if any, will reduce the

degree of habitat utilization and therefore the possible impacts, or leave present assumed levels unchanged.

Conflicts between pipeline construction and critical life history stages of the important fish have been identified in Greyling Creek, Judas Creek and Seaforth Creek. All three watercourses are thought to support Arctic grayling spawning activity, and Seaforth Creek is also suspected of supporting a lake whitefish spawning migration. The concern at Greyling Creek is not related to instream trenching activity. This watercourse is situated in thaw-unstable terrain, and present Project planning has identified an above-grade pipe placement mode in this locale. The crossing of Greyling Creek is presently planned to be an aerial (free span) crossing; therefore, concern for the fishery resource is related to activities on the creek banks and such factors as the movement of vehicles through the watercourse. The concern at Judas and Seaforth creeks relates primarily to the consequences of instream construction activity.

Arctic Grayling

A summer construction schedule could impinge on Arctic grayling egg incubation during the month of June. This would occur if instream construction were to take place during the month of June in streams supporting these activities (dependent upon rate and sequence of construction). The number of Arctic grayling thought to utilize the areas within 1 km downstream of the pipeline crossings on Greyling Creek, Judas Creek and Seaforth Creek are small (less than 50). The loss of recruitment from any of these spawning areas would result in a partial or complete absence of fish in that age-class within the reach of stream affected. However, as Arctic grayling spawning activity occurs in other parts of the stream, and spawning activity is extensive in other tributaries to Marsh Lake and Squanga Lake, the loss of this age class would not be evident throughout the stream or in regional populations. In all likelihood, recruitment from other populations in each watercourse and/or watershed would assist in restoring this age class to the affected reach of stream within a period of one year.

Lake Whitefish

A summer construction schedule is in potential conflict with the timing of a lake whitefish spawning migration in Seaforth Creek. The numbers of fish involved in this migration are not known at the present time. The unmitigated consequences of instream construction activity during this spawning migration could have an affect on recruitment from the population. Conditions at Seaforth Creek indicate instream activity may take place for a maximum of four days. It is generally accepted that blockage of fish on a spawning migration may take place for up to 72 hours without any adverse impacts on spawners or spawning success. The consequence of a 96-hour blockage may be a limited amount of spawning in areas less desirable than the primary spawning bed, or physiological stressing of the spawners which may result in a decrease in spawning success. Either consequence would result in a reduction in recruitment for that year. However, in order to prevent such a spawning migration from taking place, a complete stream blockage or continuous (24 hour) instream activity would be required, during the time-period when the lake whitefish are migrating (August 15 to September 30). The consequences of a partial age-class loss due to impingement on a spawning migration would be a minor, short-term impact, which, in all likelihood, would not be detectable in the age-class structure of the population.

Physical Habitat

No loss of critical physical habitat, such as spawning or overwintering areas is anticipated at or below the pipeline crossings on Greyling, Judas or Seaforth creeks during the year subsequent to construction. For example, if sedimentation should inundate any Arctic grayling spawning areas in these watercourses, these spawning areas would be scoured during spring freshet, prior to use by this species. Sedimentation of lake whitefish spawning areas is not anticipated to be a problem, as this species has been reported to spawn in backwater areas of watercourses such as Seaforth

Creek where normal sediment deposition takes place. Therefore, lake whitefish spawning areas would assume a condition very similar to that present prior to construction, once introduced sediments had settled out of the water column.

Summary

Anticipated impacts upon fish populations in the absence of mitigative efforts are:

1. Short-term, local reductions in Arctic grayling numbers within Greyling, Judas and Seaforth creeks; and,

2. Short-term, local reductions in lake whitefish numbers within Seaforth Creek.

Birds

There is the possibility that the Golden Eagle nest at KP 514, located 1.4 km from the right-of-way, may be affected during construction activities. In addition, if the Bald Eagle nest is re-established near KP 517, this nest may also be affected. This nesting location is 1.5 km away from the right-of-way.

If unmitigated, pipeline construction could, in worst case result in permanent abandonment of both nests and a loss in production from these breeding pair(s) during the year of construction and in subsequent years. An alternative scenario would be the loss of production for the year of impact only. Given the continued productivity of these nests in spite of the existing use and current upgrading of the highway in this locale, it is quite conceivable that pipeline-related disturbance will not cause any impact.

Mammals

Caribou are known to utilize the area traversed by the pipeline during summer in small groups or as individual animals. These animals will therefore come in contact with construction activity. It is expected that they will avoid areas where construction activity is intense and will cross the right-of-way during periods of inactivity, most likely at night. In crossing the right-of-way, animals could encounter ditch or strung pipe which would prevent or delay crossings at construction sites for periods of up to one month. Animals would either abandon crossing attempts or cross at other locations. Such delays are expected to be inconsequential to the animals because suitable summer habitat is common to both sides of the pipeline route, and is not a limiting factor in summer range use. In addition, the type of delays which may be experienced by the animals would be similar to that which they would normally experience in attempting to cross the Alaska Highway during the summer season.

6.2 PROJECT RESPONSE TO ENVIRONMENTAL ISSUES

Given selection of Alternative #3 as the pipeline route, with a summer construction schedule, the following project response are called for.

Fish

The potential project responses to fisheries concerns were identified in Section 4.2.2 of this document. The project response to fisheries concerns along Alternative #3 have been identified, and are presented in Table 3-3.6. Fisheries studies of streams crossed by the pipeline have identified sensitive time-periods for important fishes utilizing these watercourses, and the project proposes to avoid these time-periods through scheduling of instream construction activity as indicated in Table 3-3.6.

TABLE 3-3.6

WATERCROSSINGS, FISHERIES DATA, SCHEDULED INSTREAM CONSTRUCTION PERIOD AND RESOLUTION OF FISHERIES/CONSTRUCTION CONFLICTS FOR ALTERNATIVE #3

Crossing Number	Approx. KP	Water-Crossing Name	Important Fish Present*	Use of Habitat By Fish**	Critical Habitat Use	Critical Period	Cumulative Critical Period	Construction Season For Section	Scheduled Mainline Construction Period	Conflict	Action (Schedule Change)	Remaining Conflict
164***	476.0	Greyling Creek	Ci.S.	c,f	f	Nov 15-Apr 15	Nov 15-June 30	summer	June 1-Sep 30	yes	July 1-Sep 30	no
			A.G.	a,b,c, d,e,f	a,b,f	Nov 15-June 30						
			L.W.F.	e,f	f	Nov 15-Apr 15						
165	477.3	Elbow Creek	Ci.S.	c	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
			A.G.	d	none	n/a						
			L.T.	e	none	n/a						
			L.W.F.	d,e	none	n/a						
166	480.1	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
167	484.1	Unnamed	A.G.	c,d,e	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
168	491.5	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
169	496.5	Judas Creek	A.G.	b,c,d, e	b	May 1-June 30	May 1-June 30	summer	June 1-Sep 30	yes	July 1-Sep 30	no
170	501.7	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
171	507.7	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
172	508.8	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no

TABLE 3-3.6 Continued

Crossing Number	Approx. KP	Water-Crossing Name	Important Fish Present*	Use of Habitat By Fish**	Critical Habitat Use	Critical Period	Cumulative Critical Period	Construction Season For Section	Scheduled Mainline Construction Period	Conflict	Action (Schedule Change)	Remaining Conflict
173	512.7	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
174	513.0	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
175	518.0	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
176	520.5	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
177	521.4	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
178	521.5	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
179	523.8	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
180	525.1	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
181	529.1	Seaforth Creek	A.G.	a,b,c, d,e,f	a,b,f	Nov 15-June 30	Aug 15-June 30	summer	June 1-Sep 30	yes	July 1-Aug 15	no
			L.W.F.	a,b,d, e,f	a,b,f	Aug 15-Apr 15						
182	532.3	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
183	532.6	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
184	532.9	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
185	533.2	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
186	534.0	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no

* Fish species abbreviations: Ci.S. = Chinook Salmon; A.G. = Arctic Grayling; L.W.F. = Lake Whitefish; L.T. = Lake Trout.
** a) spawning migration; b) spawning area; c) nursery area; d) rearing area; e) summer habitat; f) overwintering area of important fish species.
*** Present Project planning identifies a free-span crossing of Greyling Creek.

Birds

One active Golden Eagle nest is located within 2 km of Alternative #3. A previously-active Bald Eagle nest adjacent to Squan Lake is also located within 2 km of this route. This nest was destroyed in the winter or spring of 1981; however, given the history of continuous occupancy and productivity of this nest, as demonstrated by the Project's field studies, the potential for a nest to be re-established in this locale before pipeline construction commences is good. Consequently, this site will be monitored up to and including the year of construction. If the nest site is re-established, appropriate protection planning measures will be implemented.

Given the apparent habituation by nesting raptors to the existing use of and current upgrading program for the Alaska Highway in this area, and the fact that mainline activities will commence after the most sensitive portion of the nesting period (i.e., June 1), concerns for the productivity of these nests are not sufficient to warrant relocation of the route or rescheduling of mainline activities to avoid the remainder of the nesting period (June and July). However, any activities which may not be included in the category of mainline construction (e.g., clearing, blasting) will be confined, where possible, to the mainline construction season of June 1 to November 30. If such activities cannot be rescheduled to fall within the mainline season, these activities will be conducted at a time which avoids the nesting period (March 20 to July 31) in the regions of the alignment which are within 2 km of an active raptor nest. This project response will limit disturbance of these birds to one nesting season. In addition, Project-controlled aircraft overflights will be prohibited within 1 km of an active nest from March 20 to July 31, unless involved in emergency or reconnaissance operations.

Mammals

The selection of Alternative #3 removes concerns for woodland caribou related to disturbance during winter, alteration of habitat, and

facilitated harvest discussed in the route selection portion of this document. Concerns for mammals are reduced to the possibility of occasional encounters with a few woodland caribou moving across summer range. The likelihood of encounters, the numbers of caribou involved, and the potential impacts to those animals that may encounter pipeline construction activity do not justify a major project response in terms of route relocation or timing of activities. However, standard practices such as leaving gaps in the pipe string and spoil piles, and the installation of ditch plugs, all to facilitate caribou passage, will be implemented. These mitigative techniques will assist passage of any animals which may encounter construction activities, thereby minimizing the possibility of blocking movements. These procedures will restrict concerns to the potential effects of any inconvenience to the animals in locating passage facilities, or the effects of using available, alternative summer range.

6.3 RESIDUAL ENVIRONMENTAL IMPACTS

This section of the submission is devoted to identifying impacts which may persist in light of the Project's proposed mitigation measures.

Fish

Through the use of the proposed time windows, no loss of recruitment from any important fish populations is anticipated, nor is the loss of any critical or sensitive habitat. Although the consequences of instream activity may inconvenience fish resident in the affected watercourses, no detectable effects on fish production are anticipated.

Birds

As discussed in Section 6.1, the response of breeding raptors to current land-use activities suggests that in all likelihood pipeline construction activities will have little or no effect on the productivity of

the Golden Eagle nest at KP 514, or the potential productivity of the Bald Eagle nest at KP 517 if this nest is re-established. In the worst case, however, the residual impact would involve one of the three following possibilities:

1. Permanent abandonment of the nest(s);
2. Abandonment of the nest(s) for one or more years; or
3. Loss of production for one year.

Mammals

If woodland caribou approach the pipeline right-of-way during the mainline construction phase with the intent to cross, the crossing may be inconvenienced by the necessity of finding gaps in the pipe string or spoil pile, or locating ditch plugs. Alternatively, the caribou may be dissuaded from crossing by the presence of obstacles on the right-of-way. However, experience from other pipelines has shown that ungulates will use ditch plugs as crossing sites. Therefore, residual impacts could vary in extent from a minor expenditure of energy in locating a crossing site through to deflection of movements and the potential alienation of traditional habitats. Any such impacts would be very minor in nature. These potential impacts should be viewed from the perspective of the unlikelihood of encounters between construction activity and caribou, given the small number of caribou involved, and the dispersion of available, suitable habitats to the north and south of the pipeline route.

APPENDIX I

ROUTE LOCATION FACTORS

FACTORS RELATED TO ENGINEERING

Engineering factors which affect route selection involve the requirement for utilization of either "typical" design solutions or the development of "unique" ones. As a general rule, an engineering preference is given either to the route which has a requirement for the fewest "unique" or specialized designs, or makes greatest use of "typical" designs.

Watercrossings

Major

The presence of a "major watercrossing" on a route requires an intense design effort to produce a unique river crossing design. A preference is given to major watercrossing locations that have the fewest design difficulties. No major crossings are involved in the Marsh Lake/Squanga Lake area.

Other

For other watercrossings, the total number of crossings, requirement for non-typical design and general design difficulty are considered.

Geotechnical

Permafrost

The presence of permafrost is considered in view of the requirement for special designs to accommodate potential terrain instability problems, and/or pipeline integrity.

Slope Stability

Potentially unstable slopes are noted and considered for the probable requirement of slope stabilization designs particularly in the vicinity of river banks.

Wetlands

The presence of wetland terrain along a route may require the utilization of weighting, and/or heavy-wall pipe.

Right-of-Way Crossings

Roads

The crossing of a public road or highway requires the utilization of a road crossing design and the requirement for heavy-wall pipe and casing pipe.

Other

Other right-of-way crossings could include power lines, telephone lines, and other pipelines. Any such crossings may require the utilization of a special design.

FACTORS RELATED TO CONSTRUCTION

In general, construction factors which affect route assessment involve the ease or difficulty of construction required which relates directly to cost. As a rule, preference is given to the route which exhibits the fewest instances where difficult or specialized construction procedures are required.

Watercrossings

Major

Difficulty of construction is an important consideration in route assessment when major river crossings are involved. No major watercrossings are involved in the Marsh Lake/Squanga Lake section.

Other

For other watercrossings on the alternatives, the total number of crossings and degree of construction difficulty are considered.

Geotechnical

Permafrost

The presence of permafrost and/or thermokarst is considered for the possibility of construction difficulty as well as the probable requirement for special or unique design calling for special or unique construction procedures.

Slope Stability

The presence of naturally-unstable slopes requires the utilization of special slope stabilization techniques.

Wetlands

The presence of wetlands, particularly along the pipeline right-of-way, is considered in view of the effect on machinery and material movement, as well as the requirement for pipe weighting and/or rip-rapping. In addition, where the presence of wetland is extensive, consideration would have to be given to winter construction.

Rock

The presence of rock along the right-of-way indicates a requirement for blasting with attendant increases in cost, time and pipe padding material supply. This requirement includes an assessment for both rock grade and rock ditch work. In addition, where rock grade and rock ditch work is required close to public roads or areas, additional scheduling requirements are likely.

Right-of-Way Crossings

Roads

The crossing of a public road may involve the use of special construction techniques as well as the installation of heavy-wall pipe and possibly casing pipe.

Other

Other right-of-way crossings may involve the use of special construction techniques such as the exposure of telephone cables or other pipelines by hand digging.

Constructability

Access

The route alternatives are assessed for ease of access for construction purposes including an examination of the status of existing access and the possible requirement for expanded access.

Materials

The availability of construction materials, such as gravel, is assessed.

Grading

The requirement for right-of-way grading for construction purposes is assessed.

SOCIO-ECONOMIC FACTORS

Socio-economic factors which affect route selection all involve land-use issues. Consideration is given to existing, proposed and historic land uses, with a general preference given to the routing with fewest land-use conflicts.

Land Use

Mineral Leases

Mineral leases indicate a mining interest in an area and must be noted as such for routing assessment.

Residential

Where a route is proximal to or crosses residential development land, consideration must be given to the requirement for control of project activities and special design.

Agricultural

Where land is used for agricultural purposes, topsoil conservation and compensation for use of the right-of-way are likely requirements.

Commercial

Where a route is proximal to or crosses land used for commercial activity, compensation for right-of-way, and the use of heavy-wall pipe may be required. In addition, consideration for control of construction activities may be required.

Recreational

Where a route is proximal to or crosses land designated for recreational use, consideration must be given to the recreational values to be encountered, and the effect of project activities on recreational land use.

Water Supply

Where a route crosses land designated as a watershed area supplying drinking water or is proximal to control dams or weirs, consideration must be given to the effect of project activities on such locations.

Heritage

Where a route crosses or lies proximal to an area designated by legislation, or known to have heritage values, consideration must be given to the maintenance or salvage of the heritage resources encountered.

Native Lands

Where a route crosses or lies proximal to an area designated by appropriate government authority for use by native persons, consideration must be given to the importance and planned uses of that area.

Gravel Reserves

Where a route crosses a gravel reserve, consideration must be given to the status of that reserve, to any restrictions that the pipeline may place on future use of the reserve, and to any pipeline design requirements that will result from proposed future use of the reserve.

ENVIRONMENTAL FACTORS

Environmental factors which affect route selection involve consideration of both the physical and biological environment.

Fish, Birds and Mammals

The presence of habitat used by important species of fish, birds and mammals is considered in route assessment. Of prime concern for fish are spawning, overwintering and migrating activities; for birds, nesting, moulting and staging (migration) areas are of concern; for mammals, winter range, migration corridors, birthing areas, den sites, rutting areas and mineral licks are of concern.

OPERATIONAL FACTORS

Costs of system operation are generally not considered separately during the route refinement process as design and construction considerations outlined earlier produce a system which can be operated efficiently. Two operations factors which are, however, considered during route selection are public safety and the possibility of third party damage. The two factors are interrelated. Routes are selected to maximize public safety and to reduce the possibility of third party damage.

APPENDIX II

REPORTS CONTAINING INFORMATION ON THE MARSH LAKE/SQUANGA LAKE REGION

Beak Consultants Limited. 1976.
Fall (1976) waterfowl migration: implications for the proposed Alaska Highway pipeline, southern Yukon Territory. Prepared for Foothills Pipe Lines (Yukon) Ltd. 21 pp. + app.

Beak Consultants Limited. 1977.
Spring waterfowl migration: Alaska Highway gas pipeline route, southern Yukon Territory. Prepared for Foothills Pipe Lines (Yukon) Ltd. 30 pp. + app.

Beak Consultants Limited. 1977.
Fall (1977) waterfowl concentrations, alternate routes for the proposed Alaska Highway gas pipeline, southern Yukon Territory. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Beak Consultants Limited. 1977.
Fall (1977) waterfowl concentrations: proposed Alaska Highway gas pipeline route, southern Yukon Territory. Prepared for Foothills Pipe Lines (Yukon) Ltd. 25 pp. + app.

Beak Consultants Limited. 1977.
A spring inventory of fishery resources along the proposed Alaska Highway gas pipeline in Yukon Territory, 1977. Prepared for Foothills Pipe Lines (Yukon) Ltd. 54 pp. + app.

Beak Consultants Limited. 1977.
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APPENDIX III

HABITAT UTILIZATION BY IMPORTANT FISH SPECIES
IN WATERBODIES CROSSED BY ALTERNATIVE #1

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
476.0***	Greyling Creek	N, R, OW		M, Sp, N, R, S, OW		S, OW			R,S	3
478.1	Elbow Creek	N, R		R	S	R, S, OW			R	3
480.1	Unnamed	N, R		R						3
482.1	Unnamed	Beaver ponds, swamp, very low potential.								3
486.1	Unnamed			N, R, S						3
489.4	Unnamed	Inadequate discharge.								3
491.6	Unnamed	Inadequate discharge.								3
492.1	Unnamed	Inadequate discharge.								3
496.6	Unnamed	Inadequate discharge.								3
497.7	Unnamed	Inadequate discharge.								3
499.1	Unnamed	Minimal discharge, detrital substrate, narrow and occasionally very shallow.								3
503.6	Judas Creek			R						3
507.7	Judas Creek	Shallow, gravel substrate, cover limited.								3

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
511.1	Unnamed	Intermittent.								3
512.8	Unnamed	Intermittent.								3
518.9	Little Summit Creek	Intermittent.								3
520.0	Unnamed	Creek may provide limited rearing habitat.								3
520.8***	Seaforth Creek			M, Sp, N, R, S, OW		M, Sp, R, S, OW		S		3
524.0	Unnamed	Intermittent.								2
524.3	Unnamed	Intermittent.								2
524.6	Unnamed	Intermittent.								2
524.9	Unnamed	Intermittent.								2
525.7	Unnamed	Intermittent.								2

* M = Migration route; N = Nursery area; R = Rearing area; Sp = Spawning area; S = Summer habitat; OW = Overwintering area.

** See end of Appendix III.

*** Investigations currently underway on this watercourse.

HABITAT UTILIZATION BY IMPORTANT FISH SPECIES IN WATERBODIES CROSSED BY ALTERNATIVE #2

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
476.0***	Greyling Creek	N, R, OW		M, Sp, N, R, S, OW		S, OW			R,S	3
478.1	Elbow Creek	N, R		R	S	R, S, OW			R	3
480.1	Unnamed	N, R		R						3
482.1	Unnamed	Beaver ponds, swamp, very low potential.								3
486.1	Unnamed			N, R, S						3
489.4	Unnamed	Inadequate discharge.								3
491.6	Unnamed	Inadequate discharge.								3
492.1	Unnamed	Inadequate discharge.								3
496.6	Unnamed	Inadequate discharge.								3
497.7	Unnamed	Inadequate discharge.								3
499.1	Unnamed	Minimal discharge, detrital substrate, narrow and occasionally very shallow.								3
503.6	Judas Creek			R						3
507.7	Judas Creek	Shallow, gravel substrate, cover limited.								3
511.6	Squanga Lake Inlet			M, N, R, S		Sp, S		S		1

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
514.2	Hall Creek									
518.6	Unnamed									
523.5	Squanga Creek			Sp, R, S		Sp, S		S		1

* M = Migration route; N = Nursery area; R = Rearing area; Sp = Spawning area; S = Summer habitat; OW = Overwintering area.

** See end of Appendix III.

*** Investigations currently underway on this watercourse.

HABITAT UTILIZATION BY IMPORTANT FISH SPECIES IN WATERBODIES CROSSED BY ALTERNATIVE #3

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
476.0***	Greyling Creek	N, R, OW		M, Sp, N, R, S, OW		S, OW			R,S	3
477.3	Elbow Creek	N, R		R	S	R, S, OW			R	3
480.1	Unnamed	Beaver ponds, swamp, very low potential.								3
484.1	Unnamed			N, R, S						3
491.5	Unnamed	Intermittent.								2
496.5***	Judas Creek			Sp, N, R, S						3
501.7	Unnamed	Intermittent.								2
507.7	Unnamed	Intermittent.								2
508.8	Unnamed	Intermittent.								2
512.7	Unnamed	Shallow, narrow, no access for fish.								2
513.0	Unnamed	Intermittent.								2
518.0	Unnamed	Small stream, no access for fish.								2
520.5	Unnamed	Limited discharge.								2
521.4	Unnamed	Undefined drainage.								2
521.5	Unnamed	Limited discharge, undefined drainage.								2
523.8	Unnamed	Intermittent.								2
525.1	Unnamed	Intermittent.								2

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
529.1***	Seaforth Creek			M, Sp, N, R, S, OW		M, Sp, R, S, OW		S		3
532.3	Unnamed	Intermittent.								2
532.6	Unnamed	Intermittent.								2
532.9	Unnamed	Intermittent.								2
533.2	Unnamed	Intermittent.								2
534.0	Unnamed	Intermittent.								2

* M = Migration route; N = Nursery area; R = Rearing area; Sp = Spawning area; S = Summer habitat; OW = Overwintering area.
** See end of Appendix III.
*** Investigations currently underway on this watercourse.

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APPENDIX IV

BASIS FOR SCORES ASSIGNED TO
IMPORTANCE OF CONCERN AND PROJECT RESPONSE

ALTERNATIVE #1

LOCATION FACTORS

Socio-Economic (Land-Use)

Mineral Leases	No Project Concerns or Responses Identified
Residential	No Project Concerns or Responses Identified
Agricultural	No Project Concerns or Responses Identified
Commercial	No Project Concerns or Responses Identified
Recreational	No Project Concerns or Responses Identified
Water Supply	No Project Concerns or Responses Identified
Heritage	No Project Concerns or Responses Identified
Native	No Project Concerns or Responses Identified

Gravel Reserve

Importance of Concern - 1: One reserve crossed

Project Response - 1: Provide for access to reserve; appropriate identification of buried pipeline and restrictions because of right-of-way.

Environmental

Fish

Habitat

Importance of Concern - 2: Sensitive habitat of important fish present in Greyling and Seaforth creeks; pipeline in proximity to Squanga Lake.

Project Response - 2: Scheduling of instream construction activities on sensitive streams; stabilization measures along south side of Squanga Lake.

Birds

Raptors

Importance of Concern - 2: One active Bald Eagle nest, one active Golden Eagle nest within 2 km.

Project Response - 2: Scheduling of pre- and post-mainline construction activities to avoid nesting period. Restrictions on Project-controlled aircraft overflights during nesting period.

Mammals

Caribou

Importance of Concern - 2: Caribou occupying summer range in small numbers.

Project Response - 1: Leave breaks in pipe string, spoil piles; ditch plugs put in place to allow for movement.

Other

Important of Concern - 1: Aquatic furbearer habitat, Judas Creek headwaters.

Project Responses - 1: Maintain existing drainage patterns.

Operations

Public Safety

Importance of Concern - 2: Public contact with route near east end of Squanga Lake.

Project Responses - 1: Meet standard codes and regulations.

Third Party Damage

Importance of Concern - 2: Public contact with route near east end of Squanga Lake.

Project Response - 1: Meet standard codes and regulations.

ALTERNATIVE #2

LOCATION FACTORS

Socio-Economic (Land-Use)

Mineral Leases	No Project Concerns or Responses Identified
Residential	No Project Concerns or Responses Identified
Agricultural	No Project Concerns or Responses Identified
Commercial	No Project Concerns or Responses Identified
Recreational	No Project Concerns or Responses Identified
Water Supply	No Project Concerns or Responses Identified
Heritage	No Project Concerns or Responses Identified
Native	No Project Concerns or Responses Identified

Gravel Reserve

Importance of Concern - 1: Route passes close to one reserve.
Project Response - 1: Maintain access to reserve.

Environmental

Fish

Habitat

Importance of Concern - 3: Sensitive habitat of important fish present in Greyling Creek; spawning utilization of Squanga Lake Inlet and Squanga Creek by a unique lake whitefish population; pipeline in close proximity to Squanga Lake.
Project Response - 2: Scheduling of instream construction activities on sensitive streams; stabilization measures along north side of Squanga Lake.

Birds

Raptors

Importance of Concern - 2: One active Bald Eagle nest within 2 km.
Project Response - 2: Scheduling of pre- and post-mainline construction activities to avoid nesting period. Restrictions on Project-controlled aircraft overflights during nesting period.

Mammals

Caribou

Importance of Concern - 2: Caribou occupying summer range in small numbers.
Project Response - 1: Leave breaks in pipe string, spoil piles; ditch plugs put in place to allow for movement.

Other

Importance of Concern - 1: Aquatic furbearer habitat, Judas Creek headwaters.
Project Response - 1: Maintain existing drainage patterns.

Operations

Public Safety

Importance of Concern - 2: Public contact with route near east end of Squanga Lake.
Project Response - 1: Meet standard codes and regulations.

Third Party Damage

Importance of Concern - 2: Public contact with route near east end of Squanga Lake.

Project Response - 1: Meet standard codes and regulations.

ALTERNATIVE #3

LOCATION FACTOR

Socio-Economic (Land-Use)

Mineral Leases No Project Concerns or Responses Identified

Residential

Importance of Concern - 2: Route in close proximity to property adjacent Marsh Lake and near Jakes Corner.

Project Response - 1: Normal construction practices; possibly restrict hours of work.

Agricultural No Project Concerns or Responses Identified

Commercial No Project Concerns or Responses Identified

Recreational

Importance of Concern - 2: Route in close proximity to land designated for recreational use at Marsh Lake, and campground at Judas Creek.

Project Response - 1: Normal construction practices; possibly restrict hours of work.

Water Supply No Project Concerns or Responses Identified

Heritage No Project Concerns or Responses Identified

Native No Project Concerns or Responses Identified

Gravel Reserve

Importance of Concern - 1: Route crosses 4 reserves.

Project Response - 1: Provide for access to reserves: appropriate identification of buried pipeline and restrictions because of right-of-way.

Environmental

Fish

Habitat

Importance of Concern - 2: Sensitive habitat of important fish present in Greyling, Judas and Seaforth creeks.

Project Response - 2: Scheduling of instream construction activities on sensitive streams.

Birds

Raptors

Importance of Concern - 2: One active Golden Eagle nest and one recently active Bald Eagle nest site within 2 km of route.

Project Response - 2: Scheduling of pre- and post-mainline construction activities to avoid nesting period. Restrictions on Project-controlled aircraft during nesting period.

Mammals

Caribou

Importance of Concern - 1: Occasional caribou passing through summer range.

Project Response - 1: Breaks will be left in pipe string, spoil piles; ditch plugs put in place to allow for movement.

Other

Important of Concern - 1: Aquatic furbearer habitat, Judas Creek.
Project Responses - 1: Maintain existing drainage patterns.

Operations

Public Safety

Importance of Concern - 3: Pipeline paralleling highway and associated developments.
Project Response - 1: Meet standard codes and regulations.

Third Party Damage

Importance of Concern - 3: Pipeline paralleling highway and associated developments.
Project Response - 1: Meet standard codes and regulations.