ENVIRONMENTAL SERVICES

EXAMINATION OF ROUTING ALTERNATIVES
FOR
THE ALASKA HIGHWAY GAS PIPELINE
IN THE
SWIFT RIVER / RANCHERIA VALLEY REGION

SUBMISSION 3-4

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Foothills Pipe Lines (South Yukon) Ltd.

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 the Swift River and Rancheria Valley. This report gives details of the process involved in selecting a route from two 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 involving mineral leases, residential properties, agricultural land, commercial and recreational property, lands held or claimed by native persons and heritage sites;

environmental aspects of terrain and water movement, as well as existing fish, bird and mammal 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.

Two alternatives were examined (see Map 3-4.1): one which generally parallels the north side of the Alaska Highway from Swan Lake to the British Columbia border near Watson Lake (Alternative #1); and, a second which passes to the south side of the Swift River near the inlet of Swan Lake and remains on the south side of the Swift River, Rancheria River and the Alaska Highway to the British Columbia border near Watson Lake (Alternative #2). Alternative #2 was selected as the preferred route.

Specific descriptions of potential environmental impacts and mitigation measures for the chosen route are presented in this report. Potential impacts include disturbance of fish-bearing streams, wintering moose and caribou, and a small number of raptor nests. Proposed mitigative techniques to meet potential environmental impacts include timing of stream crossings to avoid sensitive life history stages of fish, timing of activities where possible to avoid the wintering period of ungulates and nesting periods of raptors, construction techniques which will allow ungulate movement across open ditch or strung pipe, and measures to reclaim disturbed terrain. No residual impacts are anticipated.

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 in 1976, Foothills Pipe Lines (Yukon) Ltd. (the Project) identified a route which lay north of and generally paralleled the Alaska Highway in the Swan Lake area (where the route briefly enters northern British Columbia and re-enters Yukon Territory) to a point southwest of Watson Lake where the route leaves the Yukon Territory permanently. This routing was located south of the Alaska Highway in only two regions along this section of the line; at the community of Swift River; and, for a 25-km section from the Swift River/Alaska Highway crossing to a point near the settlement of Rancheria.

Prior to the 1979 Environmental Assessment and Review (EAR) Panel hearings in Whitehorse, the alignment described above was rerouted in two areas. The line was moved to the north side of the highway at the community of Swift River, and was relocated to remain on the south side of the Rancheria River and Alaska Highway to the point where the line enters northern British Columbia near Watson Lake.

As a consequence of the 1979 relocation (which placed the pipeline route on the south side of the Rancheria River Valley through to the British Columbia border), the EAR Panel requested the rationale for this relocation, and a description of problem areas relevant to the two alternative alignments. This description was to be presented in a general discussion of terrain conditions on the respective sides of the river valley. The present routing document presents the rationale for the initial route relocation, and identifies areas of environmental concern along the north and south sides of the Rancheria River Valley.

In addition to the route relocation presented to the EAR Panel in 1979, a further route refinement was identified during 1980 in the Swift River region. This relocation involves a route which crosses the Alaska Highway and the Swift River approximately 2 km east of Swan Lake. This alignment then remains on the south side of the Swift River Valley, and joins the originally-proposed (1976) alignment where that line crossed to the south side of the Rancheria River. In an effort to provide the Panel with the most up-to-date Project information available, this document presents a comparison of the preferred route in 1977 with the present routing identified in the Swift River/Rancheria Valley region (see Map 3-4.1).

The route evaluation procedure presented in this submission is complemented by an environmental assessment of the now-preferred routing. This assessment consists of a discussion of potential environmental impacts along the preferred route, followed by the planned Project responses which are designed to ameliorate possible adverse impacts. A final section of the report delineates residual impacts which will result from construction of the preferred route in the Swift River/Rancheria Valley region. The environmental assessment component of this routing submission has been incorporated to assist the EAR Panel and their advisors in reviewing the document which in its original form dealt solely with route selection. To further facilitate this review, the reasons for arriving at specific evaluation scores for the various components under review along each alternative are appended to this submission (Appendix IV).

PART 2

ALTERNATIVE ROUTES IN THE SWIFT RIVER/RANCHERIA VALLEY REGION

Two possible routings for the Alaska Highway Gas Pipeline in the Swift River/Rancheria Valley region are discussed in this submission. One route, referred to here as Alternative #1, generally parallels (to the north) the Alaska Highway (Map 3-4.1). This alternative route crosses the Alaska Highway briefly to pass south of the community of Swift River, and runs on the south side of the Rancheria Valley for approximately 25 km in the upper Rancheria River region.

Alternative #2 crosses the Alaska Highway near Screw Creek, approximately 2 km east of Swan Lake (Map 3-4.1). This route then crosses the Swift River, and remains on the south side of the Swift and Rancheria rivers and the Alaska Highway through to the British Columbia border southwest of Watson Lake.

The line lengths are essentially comparable, with Alternative #2 being 0.6 km longer (144.6 km vs 144.0 km) than Alternative #1. The pipeline Construction Sections involved are 11, 12a, 12b, 13a and 13b (KP 661-829), of which KP 686-829 are considered in this submission. Both winter and summer construction schedules are planned along this reach of the pipeline.

The concern expressed by the EAR Panel was related to the rationale for relocating the pipeline route from the north side of the Rancheria River Valley, which is occupied by the Alaska Highway, to the south side of the valley. The concern related to terrain conditions on the respective sides of the valley, and a comparison of the consequences of construction on each side was requested. In addition, questions were raised regarding the necessity for creating access and specifically bridge crossings on the Rancheria River, and the overall environmental impact of pipeline construction on the north side as compared to the south side of the river valley. The concerns have been considered in the following evaluation.

MAP 3 - 4.1

DIAGRAMMATIC REPRESENTATION OF ALTERNATIVE ROUTES IN THE SWIFT RIVER/RANCHERIA VALLEY REGION

ALTERNATIVE 1

ALTERNATIVE 2

ALASKA HIGHWAY

10 0 20 40 60 Kilometres

SCALE: 1: 500,000

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 Swift River/Rancheria Valley region, evaluation of specific location factors has continued for several years. 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

Both alternative routes follow the Swift and Rancheria River valleys through the Cassiar Mountains. The Cassiar Range is composed mainly of intrusive igneous rock and to a lesser extent metamorphic rock. The valley bottoms are mantled with glaciofluvial, morainal and recent lacustrine sediments. Deep morainal and colluvial materials cover much of the middle and lower slopes. The eastern portions of the route alignments cross the Liard Plain and a small part of the Dease Plateau. Most of this region is underlain by sedimentary and to a lesser extent metamorphic rocks. The surficial geology consists of a deep mantle of morainal, glaciofluvial and lacustrine deposits.

For engineering, constructability and cost reasons, feasible pipeline route alternatives are limited to interconnecting valley systems. In the Swift River/Rancheria Valley region, this restricts the corridors for route alternatives to the Swift and Rancheria River valleys.

4.1 MAJOR ROUTING ISSUES

Conditions along routes in the Swift River/Rancheria Valley region have been the subject of study by the Project and others from a time prior to the initial application for a pipeline route in 1976. Information gathered in studies completed to date has been made available to interested parties. A listing of reports dealing in whole or in part with conditions in the Swift River/Rancheria Valley region is included in Appendix II of this report.

The major routing issue raised by the EAR Panel with regard to the Swift River/Rancheria Valley region is the rationale used by the Project for relocating the pipeline route from the north to the south side of the river valleys. In this regard, a general description of the terrain

conditions on the respective sides of the river valleys was requested, as was a description of potential problem areas in relation to fisheries, wildlife and aesthetics, and mitigation measures. The presence or absence of the various factors and issues along each of the two routing alternatives is outlined in the following descriptions.

Alternative #1

Alternative #1 involves a routing which generally follows the north side of the Alaska Highway, with a 25 km diversion to the south side of the Rancheria River. Environmental issues include the disturbance of fish populations particularly in the Swift and Rancheria rivers, moose wintering areas encountered by the pipeline in the Swift and Rancheria River valleys, a caribou wintering area traversed by the pipeline east of the Cassiar Mountains, and two Golden Eagle nests located within 2 km of the pipeline right-of-way. Land-use issues are present and involve a commercial lease, a commercial title, a recreational (summer camp) lease, a YTG campground reserve (developed) and a YTG Highway Rest Area, and land set aside for Indian use at the lower Alaska Highway crossing of the Rancheria River. In addition, there are the issues of crossing a number of gravel pit reserves, a Department of Indian Affairs and Northern Development/Yukon Forest Service Reserve, a microwave station site and one mining claim. Construction and design factors involve the necessity of benching side slopes to provide a flat working surface, excessive rock requiring blasting, the presence of small zones of permafrost along this alignment, and a number of highway and major river crossings. The presence of the pipeline adjacent to the Alaska Highway introduces the issue of possible third party damage as it relates to public safety.

Alternative #2

Alternative #2 involves a routing which crosses the Swift River near the inlet of Swan Lake, follows the south side of the Swift and

Rancheria River valleys, and remains to the south of the Alaska Highway until the route enters British Columbia southwest of Watson Lake. Environmental issues include the disturbance of fish populations, the presence of moose wintering areas encountered along the Swift and Rancheria River valleys, caribou wintering areas encountered in the McNaughton Creek/Swan Lake area and east of the Cassiar Mountains, and two Golden Eagle nests within 2 km of the right-of-way. Land-use issues involve a commercial title, a gravel pit reserve, a mining claim through which the route passes and a road reserve for access to a Ministry of Transport microwave station site. Construction and design factors involve the presence of small zones of permafrost, the necessity of benching side slopes to create a working surface, and excessive rock which would require blasting. Issues relating to public safety and third party damage are virtually absent.

4.2 DISCUSSION OF EXISTING CONDITIONS ALONG ALTERNATIVE ROUTES

Neither of the two routings under consideration is free of concerns related to major location issues. The following section discusses the degree or extent of concerns along the route alternatives in relation to engineering, construction, environmental, socio-economic and safety factors. Where possible, quantitative information is provided regarding these concerns.

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 spreads involved. The applicable multiplier to arrive at total cost from direct cost in the Swift River/ Rancheria Valley region is 2.1. Direct, indirect and total costs are presented in Table 3-4.1 for each alternative. Total costs represent the Project's response to engineering and construction concerns and difficulties.

A brief discussion of the degree of difficulty for construction of the two alternatives follows. This discussion provides a general description of such factors as prevalence of permafrost, the extent of intervals of side slope requiring benching for construction, the extent of intervals with near-surface bedrock requiring blasting for benching and/or ditching, and the susceptibility of the terrain to erosion. In addition to this description, Map 3-4.2 (presented in Appendix V) illustrates the terrain types encountered along these two alternatives.

The degree of construction difficulty is generally assessed by evaluating the nature of terrain traversed and the number of times special construction techniques are required. For example, terrain conditions may require special procedures to achieve stability in permafrost areas. Similarly, benching of side slopes and blasting of near-surface bedrock may be required to accommodate construction of a flat working surface and trench for the pipe. Comparing the two alternative routes, areas of permafrost have been noted infrequently (approximately 3 percent of each alternative) along both routes. The nature of the permafrost (near-surface ice) does not necessitate the use of unconventional pipe placement designs. Alternative #1 requires benching of side slopes over 61 km of its total length, 47 km of which are considered extreme. In contrast, Alternative #2 requires benching over 55 km, 18 km of which are considered extreme. For the most part, side slope areas along both alternatives occur in the area between Swan Lake and KP 755; however, greater amounts of extreme side slope give rise to greater concern for erosion potential along Alternative #1. Rock

TABLE 3-4.1

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVE
ROUTES - COMPARISON OF LENGTHS/COSTS

	Length (km)	Direct Cost ($000,000)	Indirect Cost ($000,000)	Total Cost ($000,000)
Alternative #1 North of Alaska Highway	144.6	253.0	278.3	531.3
Alternative #2 South of Alaska Highway	144.0	190.0	255.0	399.0

requiring blasting is located at or near the surface in the same section of the two alternatives. Rock requiring blasting occurs along 49 km of Alternative #1, and blasting would be necessary to provide a ditch over 56 km of this alternative. The corresponding lengths for Alternative #2 are 25 km and 32 km respectively. However, Alaska Highway closures during rock blasting would only be necessary for construction of Alternative #1. Special construction techniques are necessary for highway and major river crossings. Alternative #1 involves four crossings of the Alaska Highway and five major river crossings (three of the Swift River, two of the Rancheria River). Alternative #2 involves one crossing of the Alaska Highway, and one major river crossing (the Swift River).

4.2.2 Environmental Conditions

As previously outlined, environmental factors which are major routing issues in the Swift River/Rancheria Valley region are fish, moose and caribou populations, and the nesting sites of certain large raptors. These issues are discussed in the following section of this submission. In addition to identifying the existing environmental conditions along the alternatives, potential project responses to identified concerns are also presented.

Fish

Studies of fish inhabiting streams crossed by alternative routes have been conducted and the results reported in a number of documents (see Appendix I). A brief summary of results for the alternative routes is presented in Table 3-4.2. A comprehensive summary of the results of fisheries investigations is presented in Appendix III. Alternative #1 involves 42 waterbody crossings, while Alternative #2 crosses 45. Of the waterbodies crossed, Alternative #1 crosses 23 which support important fish species or exhibit some potential for supporting desirable fish. Alternative #2 crosses 20 such waterbodies.

TABLE 3-4.2

SWIFT RIVER/RANCHERIA VALLEY 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	42	19	10	13
#2	45	25	10	10

[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.

The total number of waterbodies crossed on the two sides of the Swift and Rancheria River valleys is comparable, as is the number of waterbodies which either support important fish or exhibit some potential for use by these species. The numbers of tributaries entering the Swift and Rancheria rivers directly which would be crossed by Alternative #1 and Alternative #2 are 31 and 37, respectively. In both cases, 17 of these watercourses either support important fish or exhibit some potential for use by these species. This latter information is provided to assist in evaluating the potential for sediment deposition in the mainstem rivers along the respective alternative routes.

The major disadvantage of Alternative #1 in a fisheries comparison is that it crosses the Swift River in three locations, and the Rancheria River in two locations. This disadvantage was alleviated to some extent by the routing proposed in 1979 which eliminated two crossings of the Swift River near the community of Swift River. However, Alternative #2 crosses the Swift River only once, and completely avoids crossing the Rancheria River.

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.

In planning for Project activities, fisheries studies have been undertaken 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

Surveys for important species of birds have been undertaken by the Project in the Swift River/Rancheria Valley region, in areas within 8 km of the originally-proposed route (Alternative #1). Habitat for raptors and waterfowl is limited along both alternatives relative to other sections of the Alaska Highway Gas Pipeline Route. The bottom and sides of the Swift River and Rancheria River valleys contain little habitat for breeding, moulting and staging waterfowl (i.e., lakes and ponds), and only minor habitat exists along more eastern parts of the alternative routes. For raptors, recent surveys located few active nests (see Table 3-4.3) along the alternative routes. In the Rancheria Valley, two Golden Eagle nests occur within 2 km of both routes. East of the Cassiar Mountains, lake habitats support few nesting Bald Eagles, none of which are within 2 km of either route, and no Ospreys.

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

TABLE 3-4.3

SUMMARY OF RAPTOR NEST LOCATIONS ALONG ALTERNATIVE ROUTES IN THE SWIFT RIVER/RANCHERIA VALLEY REGION*

(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	Golden Eagle	Bald Eagle
#1	5 (2)	2 (1)	2 (2)	0
#2	5 (2)	2 (1)	2 (2)	0

*Only nests in good repair included.

Project response to raptor concerns 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) 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 has 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 is thought to peak during the egg laying, incubation, and 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 throughout most of the 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.

Mammals

Several studies of the distribution and abundance of important mammal species in the Swift and Rancheria River valleys have been undertaken by the Project in order to assist pipeline planning. Woodland caribou are found in small groups throughout much of the area under review, and as a species are known to range widely in their movements. Indications of regular occurrence in winter have been noted in the vicinity of McNaughton Creek (with no confirmed sightings north of the Alaska Highway along this part of the pipeline route), and east of the Cassiar Mountains from the headwaters of Big Creek to the British Columbia border. The majority of sightings have involved caribou in mature pine-spruce stands or on frozen waterbodies surrounded by forest. Habitat for caribou in these areas does not vary greatly, consisting almost entirely of mature forest stands. The areas occupied by woodland caribou during the winter are shown on Map 3-4.3 (Appendix V).

Moose occur throughout the region in moderate densities (0.4-0.6/km^2) in winter ranges which are encountered by both alternatives. Preferred areas (shown on Map 3-4.3) include climax riparian stands, regenerating burn areas with a significant willow-lodgepole pine component, or localized south-facing slopes. Wintering concentrations appear to peak from December to February in these areas, and have usually dispersed by mid-March.

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

Stone's sheep have not been found within 5 km of either alternative. Beaver, muskrat and various terrestrial furbearers are widespread along both alternatives, but do not occur in significant concentrations in the low-lying areas bordering the Swift and Rancheria rivers. There is no information to suggest that areas adjacent to either route are important grizzly bear ranges. Sightings are infrequent, and only three "nuisance" animals have been reported in this region in the last seven years.

Project response to mammals concerns can take the following forms:

1. Location of the pipeline route to avoid close proximity to migration routes, winter ranges, lambing or calving areas, or mineral licks.

2. Scheduling of pipeline activity to periods of time when the species of concern are least sensitive to disturbance.

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

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

5. No action and acceptance of impacts.

Given the widespread distribution of moose and of caribou along both alternatives and the limited options for other pipeline routes, scheduling rather than route relocation will be the mitigative measure utilized to minimize disturbance to wintering ungulates. Construction procedural constraints will also be implemented to ensure that cross right-of-way movement of animals is maintained throughout the construction period.

Any undesirable increase in hunting pressure due to a pipeline right-of-way would of necessity have to be identified and controlled

through regulations by the Territorial Wildlife Branch. If required to do so, the Project can provide means of limiting or preventing access if the concern for increased hunting mortality of moose or caribou overrides other environmental or land-use concerns. 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.

4.2.3 Socio-economic (Land-use) Conditions

Land use along the alternatives may be divided into the following categories: residential, commercial, recreational, agricultural, mineral extraction, lands held in reserve by territorial or federal government departments and 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 Swift River/Rancheria Valley region land uses are few and generally of minor concern. For the most part, land-use issues in this area tend to be compatible with pipeline activity (see Map 3-4.4 in Appendix V). A summary of approaches to addressing categories of land use follows.

Residential 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 operation procedures; and, the possibility that future development may be limited.

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

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 passes in proximity to a commercial lease near KP 713, and crosses a commercial title (abandoned) at KP 768. In addition, the route crosses a recreational (summer camp) lease at KP 769.5. At KP 788.5, Alternative #1 traverses at YTG campground reserve (developed) and passes close to a YTG Highway Rest Area at KP 794.8.

Alternative #2 passes in proximity to a commerical title near KP 732.5; however, there is a river intervening between the facility and the pipeline right-of-way.

Lands Involving Native Interests

One land area involving native interests exists immediately adjacent to Alternative #1 at the lower Alaska Highway crossing of Rancheria River (KP 768). No lands involving native interests are found along Alternative #2.

Other Land Uses

Other land uses which were taken into consideration during this analysis were mineral extraction areas, gravel pit reserves and lands held in reserve by territorial or federal government departments and agencies. Alternative #1 crosses ten gravel pit reserves, one Department of Indian Affairs and Northern Development/Yukon Forest Service reserve, one Ministry of Transport microwave station site and one mining claim.

Alternative #2 crosses two gravel pit reserves, one access road to a Ministry of Transport microwave station site and one mining claim.

4.2.4 Factors of Operational Safety

The largest single cause of pipeline failure over the years of operation 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.

The public safety aspects of the two route alternatives are different owing to the relative remoteness of Alternative #2 from human activities in contrast with Alternative #1 which generally closely parallels the Alaska Highway. Thus, Alternative #1 has more contact with human activities. Very little permanent residential land exists along Alternative #1, however, which diminishes the concern for public safety; and, concerns posed for public safety along Alternative #1 are identical in kind to those in all other areas where the proposed pipeline route follows the Alaska Highway. Such concerns are, however, eliminated along Alternative #2.

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 accidental severance of 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 areas of population concentration exist along any of the Swift River/Rancheria Valley region alternatives.

4.3 OTHER ISSUES

4.3.1 Compression Requirements

The lengths of the two alternative alignments under consideration are comparable (144.6 km vs 144.0 km). The construction of either alternative alignment would not alter the location of upstream compressor stations, which may be found in the "Project Description" (Submission 2-1) of the addenda submissions. One compressor station would be required along either of the two alternatives under consideration. Alternative #1 requires a compressor station in the vicinity of KP 740. The location of the compressor station along Alternative #2 would be at KP 739.2 (see Map 3-4.3, Sheet 3).

4.3.2 Access

The question of access has been raised in relation to alternative routings which diverge from the immediate vicinity of the Alaska Highway in the Swift River/Rancheria Valley region. The issue of access as a major routing consideration relates to the necessity of installing bridge crossings on rivers during the construction phase of the project, and the type of crossing structures to be employed. In addition to this major issue, the question of creating access to areas which are presently difficult to

reach by conventional transportation methods (two- and four-wheel-drive vehicles, boat, snowmobile) is discussed in the following section of this report.

While access did not play a primary role in the route selection process described here, examination of access routes likely required for both alternative routings was completed during the cost-estimating process described earlier. The locations of both temporary and permanent access roads which would be required for the construction of either of the two alternative routings under consideration are illustrated on Map 3-4.3 in Appendix V. With regard to river crossings, two temporary bridge crossings, both on the Rancheria River, would be required for the construction of Alternative #1. Access for Alternative #2 will be provided by the pipeline right-of-way where it leaves the Alaska Highway at KP 686; the Swift River will be crossed at this locale and no access road will be created. Three temporary and one permanent access road crossings of the Rancheria River will be necessary. Two of the Rancheria River crossings are identical to river crossings required for construction of Alternative #1. A summary of access road requirements is presented in Table 3-4.4 for construction of the two alternatives under consideration.

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, often use existing access when available.

In view of the varying positions on the values versus disadvantages of increased access, the Project did not arbitrarily introduce a

TABLE 3-4.4

ACCESS ROAD REQUIREMENTS FOR ALTERNATIVES #1
AND #2 IN THE SWIFT RIVER/RANCHERIA VALLEY REGION

	Alternative #1	Alternative #2
Number of Access Roads	20	12
Number of Highway/ Pipeline Junctions	5	2
Length of Existing Access (trails/roads) Required (km)	10.35	10.05
Length of New Access (km)	0.6	0.8
Number of Temporary Bridges	2	3
Number of Permanent Bridges	0	1

pre-determined 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. The Project 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.

4.3.3 Aesthetics

The EAR Panel requested a description of potential aesthetic impacts with regard to the two alternative routes in the Swift River/ Rancheria Valley region. Assessment of this issue has led the Project to the conclusion that there is very little difference between the two alternatives.

In order to assess this issue it was assumed that aesthetic impact should be evaluated from the point of view of the highway traveller. As such, the pipeline route will only be visible at a road crossing or an overview of the right-of-way. Alternative #1 provides the greatest number of road crossings and therefore will have the greatest aesthetic impact from that source. On the other hand, overviews of the right-of-way will occur along both alternatives, as these routes both follow the bottom of the river valley from KP 715 to 735. Alternative #2 may present an overview from KP 687 to KP 690 and KP 735 to KP 745. Alternative #1 will present an overview from KP 693 to KP 695 and in the vicinity of KP 700. Both routes therefore appear to have approximately the same potential for aesthetic impact.

The right-of-way will be revegetated in areas where overviews are available and at road crossings in order to reduce aesthetic impact. In addition, a major portion of the Swift River/Rancheria Valley area has in the past been the site of an extensive forest fire and is not considered to be an area of high aesthetic value.

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 3-4.1.

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 entitled 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 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 two viable alternatives were evaluated using the rating scales described in section 5.1.1. The results of the assessments are presented in Table 3-4.5 entitled "Evaluation of Swift River/Rancheria Valley Region 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.

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. Selection of a route in this situation must be made on the basis of the fewest, or alternatively the least expensive, series of project responses.

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 costs, the evaluation scores for each alternative from Table 3-4.5 were categorized as lower or higher, as such a comparison is appropriate when only two alternatives are being compared. Table 3-4.5 details the categorization process for environmental, land-use and safety factors. Factors

LOCATION FACTORS		ALTERNATIVE NO. 1		RATING OF CONCERN	ALTERNATIVE NO. 2		RATING OF CONCERN
		I.C.	P.R.		I.C.	P.R.	
SOCIO-ECONOMIC							
LAND USE	MINERAL LEASES	2	1	3	2	1	3
	RESIDENTIAL	0	0	0	0	0	0
	AGRICULTURAL	0	0	0	0	0	0
	COMMERCIAL	1	1	2	0	0	0
	RECREATIONAL	2	1	3	0	0	0
	WATER SUPPLY	0	0	0	0	0	0
	HERITAGE	0	0	0	0	0	0
	NATIVE	1	0	1	0	0	0
	GRAVEL RESERVE	2	1	3	2	1	3
TOTAL		8	4	12	4	2	6
ENVIRONMENTAL							
FISH	HABITAT	4	3	7	3	2	5
BIRDS	RAPTORS	3	2	5	2	2	4
	WATERFOWL	1	0	1	1	0	1
MAMMALS	UNGULATES	2	2	4	3	2	5
	FURBEARERS	1	0	1	1	0	1
TOTAL		11	7	18	10	6	16
OPERATIONS							
PUBLIC SAFETY		2	1	3	1	1	2
THIRD PARTY DAMAGE		3	1	4	1	1	2
TOTAL		5	2	7	2	2	4

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).

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TITLE

TABLE 3 - 4.5

EVALUATION OF SWIFT RIVER/RANCHERIA VALLEY ROUTE ALTERNATIVES

	DRAWN	CHECKED	APPROVED	APPROVED	SCALE	PREPARED BY
BY	R.K.					

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related to engineering and construction are expressed in dollar figures based on detailed estimates (Table 3-4.1) as relationships between these factors and cost estimates are obvious.

It is apparent from Tables 3-4.1 and 3-4.5 that Alternative #2 offers a lower cost, lower potential for environmental impact, lower potential for socio-economic (land-use) conflicts and risk to public safety and possibility of third party damage. Conversely, Alternative #1 offers a higher cost, higher potential for socio-economic (land-use) conflicts, higher potential for environmental impact and higher potential for risk to public safety and possibility of third party damage.

Consequently, the Project has chosen Alternative #2 as the preferred route.

PART 6

ENVIRONMENTAL IMPACT ASSESSMENT OF ALTERNATIVE #2

The environmental implications of constructing the pipeline along Alternative #2 in the Swift River/Rancheria Valley region 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 environmental impacts that would occur if no action were taken by the Project to mitigate them, proposed mitigation measures and predicted residual impacts. Alternative #2 in the Swift River/Rancheria Valley region is comprised of portions or all of Construction Sections 11, 12a, 12b, 13a and 13b, from KP 686 to KP 829. Winter construction is scheduled for Construction Sections 11, 13a and 13b, with pipelaying taking place in the period February 1 - April 15. Summer construction is scheduled for Construction Sections 12a and 12b, with pipelaying taking place in the period June 1 - September 30 (see Project Description, Submission 2-1, and map sheets which accompany that submission for clarification of Construction Sections and schedules).

6.1 UNMITIGATED ENVIRONMENTAL IMPACTS

The construction of Alternative #2 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 sections.

Fish

Potential impacts on fish populations are highly variable, and largely dependent on the season of construction. Unmitigated impacts on fish populations are addressed in the following discussion according to the season of construction scheduled for each watercourse. Concerns have been

identified in four watercourses where winter construction activity has been scheduled; no concerns have been identified in watercourses scheduled for summer construction activities.

Winter Construction Sections

Concerns regarding winter instream activities in relation to the fishery resource fall into two major categories: the presence of fish in the watercourse at this time; and, the presence of incubating eggs of fall spawners at the location of or downstream of instream construction activities. The presence of fish in an overwintering area can be further broken down in terms of degree of concern: those which are not restricted to isolated regions of the watercourse and are capable of movement up- or downstream of instream construction activities; and fish which are overwintering in restricted habitat, such as isolated pools, where surficial discharge is inadequate to allow for movement to other areas of the watercourse. The primary fisheries concerns in relation to winter instream activity are the presence of incubating eggs or overwintering fish in restricted habitat downstream of pipeline crossing locations.

Concern for overwintering fish exists at the proposed crossings of the Swift River, and McNaughton, Plate and Albert creeks. In all watercourses, sufficient surficial discharge exists during the winter months to allow fishes to avoid the location of instream construction activity, or sediment loads in downstream areas. The consequences of displacement from preferred overwintering areas is not likely to cause direct mortality, with the possible exception of smaller fish which may not be able to locate appropriate hiding places, and may be subject to predation. Larger fish may be forced to spend that part of the winter when instream activity is underway in less-optimal winter habitat, and may suffer due to such factors as a decrease in food availability. This is particularly true of species which rely on invertebrates as a food source; this group of animals will also move downstream in response to silt loads, and recolonization would not normally occur until the following openwater season. Such an impact on

fish populations in a stream would be short-term in nature, as fish do not feed heavily during the winter months. Any reduction in the condition of fish would be overcome in the spring when food is generally abundant in these watercourses.

Concern for incubating eggs exists at one watercrossing which is scheduled for winter construction, the Swift River. Lake whitefish are known to spawn in the immediate vicinity of this pipeline crossing. The actual location of the spawning area is not presently known. Further field investigations are planned to determine whether spawning occurs upstream or downstream of the actual crossing, although preliminary indications are that the spawning area is located upstream of the pipeline crossing. If the spawning area is located at or downstream of the crossing, instream construction activity during the period February 1 to April 15 would result in a complete loss of eggs (recruitment) from this spawning bed for the year of construction. This would result in an absence of fish in that age-class from the spawning area, within this reach of the river. Although recruitment from other spawning areas would assist in restoring this age-class to the population, there appear to be very few lake whitefish spawning areas in the reach of the Swift River above Swan Lake. The end result would likely be a short-term (less than 10 years) decrease in the standing crop of lake whitefish in the region of the Swift River above Swan Lake while the missing age-class from this spawning bed passes through the population.

Summer Construction Sections

No conflicts have been identified between sensitive life history stages of the important fishes and those watercourses scheduled for instream construction during the summer season. Therefore, no unmitigated impacts are predicted for these watercourses.

Physical Habitat

The only potential loss of critical physical habitat (i.e., spawning areas, overwintering areas, migration routes) which could result from instream construction activities along Alternative #2 would be in relation to the lake whitefish spawning area at the Swift River crossing. As previously discussed, the actual location of this spawning area has not been identified. At worst case, if the spawning area was located at the exact location of the pipeline crossing, and the trench was backfilled with a substrate which would not be used by lake whitefish for spawning, such as large boulders, such a scenario could result in long-term impacts on this spawning population and the standing crop of lake whitefish in this region of the Swift River. Under these conditions, this fish population would be forced to locate alternative spawning sites, which may result in a decrease in spawning success. As the preferred spawning habitat would be lost permanently, it is not unreasonable to assume that this could result in long-term reduction in the numbers of lake whitefish in this region of the river. If the spawning area is located downstream of the crossing as opposed to the actual crossing location itself, in all likelihood there would not be any effects on the spawning habitat (with the exception of the actual winter of construction). Given this scenario, normal stream scour would restore the downstream reaches of the river during the openwater season, and by the following October, the spawning area would be suitable for spawning use by lake whitefish.

Road Watercrossings

The type of structure used in crossing waterbodies to provide passage for men and equipment during the construction phase is a major concern in relation to the fisheries resources. The potential impacts of road crossings are wide in scope, and contingent upon many factors including the aspects of habitat utilization by fish at the crossing facility, the type of structure installed (e.g., culvert, bridge) and the configuration of the water passage structure subsequent to installation. Four major access road

crossings are planned along Alternative #2, all of which traverse the Rancheria River. One of these crossings is planned to be a permanent structure (KP 739), while three are temporary (KP 719, KP 732 and KP 746).

At worst case, such as a scenario where a structure is installed which precludes upstream or downstream fish movement, the impact could be the loss of fish productivity in the upper reaches of the Rancheria River. This prediction is based on the assumption that the upper reaches of the river do not provide year-round habitat for fish, and that use of the upstream areas is facilitated by seasonal upstream movement of fish, rather than downstream movement from headwater lakes. In the case of the three temporary road crossings, any effect would also be temporary, as fish would be capable of attaining the upper reaches of the river once the structures were removed. In addition to a temporary loss of productivity, there is also a possibility of fish mortality if the watercrossing structure prevents downstream movements to overwintering areas, resulting in winterkill.

A further potential impact could be a temporary loss of sensitive habitat (e.g., spawning area, overwintering area), if a watercrossing structure such as a culvert is placed on or near such habitats. The implications of such an impact are not as severe as the potential loss of productivity just described, but would result in the requirement for the species of fish involved to find alternative habitat. If the alternative habitat is less desirable than that which is lost, the consequence may be a reduction in the numbers of the species in this region of the Rancheria River. This habitat loss may be temporary, if the habitat is useable following removal of the temporary road crossing.

In the case of a permanent road crossing, the previously-described scenarios may also be realized; however, in the case of a permanent structure, the predicted impacts would also be permanent in nature.

The examples presented in this discussion have been worst case. The actual impact realized from the installation of road crossings on the

Rancheria River could range from these worst-case examples through to no impact at all, depending on the location and type of facility actually installed.

Summary

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

1. A short-term negative effect on the physical condition of fish due to reduced food availability in the Swift River, and McNaughton, Plate and Albert creeks;

2. A reduction in the numbers of lake whitefish in the Swift River which may be short or long term; and

3. A wide range in potential impacts due to access road crossings of the Rancheria River, which, at worst case, could result in a permanent loss of fish productivity from the region of the Rancheria River upstream of access road crossings.

Birds

Two Golden Eagle nests have been active during the last three years within 2 km of Alternative #2. This represents the extent of concerns for birds. The Alaska Highway lies between both nests and the pipeline route, and the birds have already been exposed to (and therefore are habituated to, at least in part) traffic and other human activities along the highway. If unmitigated, the most severe pipeline-related impact on these nests would be permanent abandonment, and a loss in production from these breeding pairs for the year of impact and subsequent years. An alternative scenario would be the loss of production for the year of impact

only. Given the location of the nests adjacent to the Alaska Highway, the distance from the pipeline route (1.0 km and 1.9 km), and the variability in responses of nesting eagles to disturbance, it is quite possible that pipeline-related activities will cause no impact.

Mammals

Winter Construction Sections

In the extensive moose winter range of the Swift River Valley, and the caribou winter ranges of the McNaughton Creek/Swan Lake region and the area east of the Cassiar Mountains, the direct impact of winter construction will likely involve temporary withdrawal from the area of the pipeline and highway, and a potential blockage of normal intra-range movements during the construction period. However, the severity of this impact will likely be minimal because of the availability of alternative winter range away from the zone of disturbance associated with pipeline construction. The McNaughton Creek caribou range and Swift River moose range fall almost entirely south and north, respectively, of the route, while the caribou range east of the Cassiar Mountains extends for at least 10 km on either side of the pipeline route. Consequently, these ranges can accommodate some temporary displacement of animals without forcing the animals into sub-optimal habitat. At worst, pipeline activities could prevent access to a part of the winter range on which the moose and caribou depend for survival; however, this is not considered likely, and the predicted unmitigated impact is one of minor habitat alteration, and reduced availability of winter range. No major pipeline-related impacts on these animals are anticipated following the construction phase of the Project. Given the remoteness of the route from the highway east of McNaughton Creek, the pipeline right-of-way through this part of the caribou winter range could facilitate access by hunters, thus increasing hunter kills. However, as the direction of the pipeline route is west-east, access created would not take a hunter into the main part of the winter range which is located to the south of the pipeline route. An old mining trail

parallel to McNaughton Creek already exists in this area, and could be used by hunters at present. Unrestricted access is therefore likely to create minor if any increases in hunter effort in excess of the existing effort.

Some disturbance to moose and caribou with potentially significant effects could result from unrestricted overflights of Project aircraft in mid-winter.

Summer Construction Sections

Construction through the spatially-constrained moose winter range in the Rancheria Valley will occur during the summer and fall months. Consequently, no conflicts will occur with range use during the sensitive period. However, a compressor station will be constructed at Freer Creek (KP 739.2), near the western edge of this winter range. Construction of the compressor station will alienate a small portion of this range from the animals. The animals may also avoid the area until they habituate to normal operational activities and sounds, which are generally not alarming to ungulates. These impacts are not considered to be significant, given the east-west extent of available range away from the compressor site.

Physical Habitat

Winter ranges of both moose and caribou will be physically altered by pipeline construction. However, permanent habitat alteration will be limited to the operational right-of-way (which involves approximately 10 of the total 40 m width), a 15 ha area at Compressor Station 324, and, access roads to the block valve at KP 686 and Compressor Station 324. Both of these access roads currently exist, and will merely be upgraded. Other areas cleared during construction will be revegetated, either actively or passively, by native shrubs and grasses. While these areas are supporting successional vegetation, they will likely offer many preferred forage species to moose. Given the expansiveness of the winter range encountered in

this region of the pipeline route, permanent habitat alteration will cause negligible impacts.

6.2 PROJECT RESPONSE TO ENVIRONMENTAL ISSUES

Given selection of Alternative #2 as the pipeline route, with both summer and winter construction schedules, 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 responses to fisheries concerns along Alternative #2 have been identified, and are presented in Table 3-4.6. Fisheries studies of streams crossed by the pipeline have identified sensitive time-periods for important fish utilizing these watercourses, and the Project proposes to avoid these time-periods by scheduling instream construction activity as indicated in Table 3-4.6. In relation to the potential for loss of critical habitat, the normal procedure for backfilling in watercourses is to use the spoil from trenching activities. This procedure will alleviate concerns for loss of spawning habitat at the Swift River crossing.

The project response to fisheries concerns at access road crossings on the Rancheria River is to use bridge structures to facilitate movement of men, materials and equipment across this watercourse. The specifications for temporary bridges or span structures to be used for major river crossings such as those on the Rancheria River are:

1. Commercially-available bridge structures will be used;

2. Bridging structures will be single span;

Mammals

Because the pipeline routing through this portion of the Yukon is restricted to the Swift and Rancheria River valleys, major route relocation is not a feasible mitigation option to minimize disturbance to moose and caribou on winter ranges. Consequently, timing and procedural constraints must be heavily relied on as mitigative measures.

The degree to which timing constraints will be placed on the pipeline where it encounters winter range will largely be a function of habitat availability outside of the zone of potential pipeline disturbance (i.e., >2 km from right-of-way). In the Swift River Valley, most of the burn and riparian-dominated communities utilized as winter habitat occur outside of the pipeline's zone of disturbance. In such areas, animals displaced by pipeline activity will have alternative suitable wintering habitats available. As a result, mainline construction will not be scheduled to avoid the wintering period, although pre- and post-mainline activities will be restricted to less sensitive periods to limit disturbance in these areas to a single winter season. In the more restricted moose winter range of the Rancheria Valley, mainline construction is scheduled for summer, and pre- and post-mainline activities will also be restricted to a non-winter period, thus eliminating any major animal/pipeline conflicts.

Both caribou ranges encountered by the pipeline route are extensive and fall largely outside of the zone of potential influence. Consequently, mainline construction will not be scheduled to avoid the wintering period, although disturbance to these areas will be limited to one winter season by restricting pre- and post-mainline activities to a non-winter period. Certain procedural constraints will be placed on the pipeline during construction within moose and caribou winter ranges. To facilitate movement of animals across the right-of-way, crossing sites along open ditch, strung pipe, spoil piles and snow banks will be provided at 250-m intervals. With the exception of flights for emergency or monitoring requirements, disturbance from air traffic will be minimized by subjecting

TABLE 3-4.6

WATERCROSSINGS, FISHERIES DATA, SCHEDULED INSTREAM CONSTRUCTION PERIOD AND RESOLUTION OF FISHERIES/CONSTRUCTION CONFLICTS FOR ALTERNATIVE #2

Crossing Number	Approx. KP	Water-Crossing Name	Important Fish Present*	Use of Habitat By Fish**	Sensitive Habitat Use	Sensitive Period	Cumulative Sensitive Period	Construction Season For Section	Scheduled Mainline Construction Period	Conflict	Action (Schedule Change)	Remaining Conflict
243	686.4	Screw Creek	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
244	687.7	Swift River	Ci.S.	a,c,f	a,f	July 21-Aug 31 Nov 15-Apr 15	July 21-Aug 31 Oct 1-June 30	winter	Feb 1-Apr 15	yes	Sep 1-Sep 30	no
			A.G.	b,c,d,e,f	b,f	Nov 15-June 30						
			L.W.F.	b,e,f	b,f	Oct 1-May 31						
			D.V.	d,e,f	f	Nov 15-Apr 15						
245	689.3	McNaughton Creek	Ci.S.	a,d,f	a,f	July 21-Aug 31 Nov 15-Apr 15	July 21-Aug 31 Nov 15-Apr 15	winter	Feb 1-Apr 15	yes	Apr 15-July 21 or Sep 1-Nov 14	no
			A.G.	c,d,f	f	Nov 15-Apr 15						
			D.V.	d,f	f	Nov 15-Apr 15						
			Burbot	d,f	f	Nov 15-Apr 15						
246	691.7	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
247	693.9	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
248	696.3	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
249	699.2	Unnamed	Burbot	d	n/a	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
250	703.3	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
251	707.3	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no

TABLE 3-4.6 Continued

Crossing Number	Approx. KP	Water-Crossing Name	Important Fish Present*	Use of Habitat By Fish**	Sensitive Habitat Use	Sensitive Period	Cumulative Sensitive Period	Construction Season For Section	Scheduled Mainline Construction Period	Conflict	Action (Schedule Change)	Remaining Conflict
252	708.6	Plate Creek	A.G. D.V.	c,d,f e,f	f f	Nov 15-Apr 15 Nov 15-Apr 15	Nov 15-Apr 15	winter	Feb 1-Apr 15	yes	Apr 15-Nov 15	no
253	710.8	Unnamed	none	none	n/a	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
254	714.5	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
255	718.7	Carlick Creek	A.G.	c	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
256	723.9	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
257	724.9	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
258	725.8	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
259	726.4	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
260	729.7	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
261	734.9	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
262	735.3	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
263	737.4	Alan Creek	D.V.	c,d,f	f	Nov 15-Apr 15	Nov 15-Apr 15	summer	June 1-Sep 30	no	none	no
264	738.7	Freer Creek	A.G. D.V.	e d	none none	n/a n/a	n/a	summer	June 1-Sep 30	no	none	no
265	740.4	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no

TABLE 3-4.6 Continued

Crossing Number	Approx. KP	Water-Crossing Name	Important Fish Present*	Use of Habitat By Fish**	Sensitive Habitat Use	Sensitive Period	Cumulative Sensitive Period	Construction Season For Section	Scheduled Mainline Construction Period	Conflict	Action (Schedule Change)	Remaining Conflict
266	741.0	Unnamed	A.G.	d	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
267	742.1	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
268	743.3	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
269	746.4	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
270	749.1	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
271	751.3	Tootsee River	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
272	757.1	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
273	758.6	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
274	759.5	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no
275	762.1	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
276	764.0	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
277	764.9	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
278	765.8	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
279	766.1	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
280	777.0	Unnamed	none	none	none	n/a	n/a	winter	Feb 1-Apr 15	no	none	no
281	780.7	Unnamed	none	none	none	n/a	n/a	summer	June 1-Sep 30	no	none	no

TABLE 3-4.6 Continued

Crossing Number	Approx. KP	Water-Crossing Name	Important Fish Present*	Use of Habitat By Fish**	Sensitive Habitat Use	Sensitive Period	Cumulative Sensitive Period	Construction Season For Section	Scheduled Mainline Construction Period	Conflict	Action (Schedule Change)	Remaining Conflict
282	787.8	Big Creek	A.G. D.V.	c,d,e,f d,e,f	f f	Nov 15-Apr 15 Nov 15-Apr 15	Nov 15-Apr 15	summer	June 1-Sep 30	no	none	no
283	792.1	Little Rancheria River	A.G. D.V.	c,d,e,f d,e,f	f f	Nov 15-Apr 15 Nov 15-Apr 15	Nov 15-Apr 15	summer	June 1-Sep 30	no	none	no
284	803.1	Unnamed	none	none		n/a	n/a	winter	Feb 1-Apr 15	no	none	no
285	812.7	Unnamed	N.P.	d		n/a	n/a	winter	Feb 1-Apr 15	no	none	no
286	824.8	Albert Creek	A.G. L.W.F.	b,c,d,e,f e,f	b,f f	Nov 15-June 30 Nov 15-Apr 15	Nov 15-June 30	winter	Feb 1-Apr 15	yes	July 1-Nov 15	no
287	828.1	Unnamed	none	none		n/a	n/a	winter	Feb 1-Apr 15	no	none	no

*Fish species abbreviations: Ci.S. = Chinook Salmon; A.G. = Arctic Grayling; L.W.F. = Lake Whitefish; D.V. = Dolly Varden; N.P. = Northern Pike.

**a) spawning migration; b) spawning (includes incubation through to emergence); c) nursery; d) rearing; e) summer; f) overwintering area of important fish species.

3. Bridge weight capacities will be in excess of 100,000 tonnes;

4. Bridges will be single lane structures; and

5. Bridge abutments will be constructed as required by site-specific conditions.

Bridges will be installed and removed during the least sensitive period of time for the fish present in the watercourse. These project responses remove concerns for obstruction of fish passage and alteration of sensitive habitats at these crossing locations. The permanent bridge to be installed at KP 739 will simply involve upgrading an existing structure at this location. This activity is not anticipated to result in an impact on the fish populations in the Rancheria River.

Birds

Two active raptor nests (Golden Eagle) lie within 2 km of the preferred alternative, both within a summer construction spread (June 1 to November 30). Given that the critical early nesting and incubation period of the birds (April and May) will occur prior to mainline construction and that the Alaska Highway lies between the nests and the pipeline right-of-way, there is not sufficient cause to reschedule mainline construction to avoid the remainder (June and July) of the nesting period. However, activities prior to or following mainline construction will be scheduled outside of the nesting period. In addition, Project-controlled aircraft will be restricted to specific flight corridors more than 1 km removed from the nest site from March 20 to July 31, unless involved in low elevation right-of-way monitoring or inspection.

all traffic under Project control to a minimum above-ground altitude of 600 m from January 1 to March 31 in the designated wintering areas.

Post-construction procedures will also be implemented to reduce any long-term impacts from the pipeline. All but approximately 10 m of the 40 m-wide right-of-way will be allowed to revegetate, either passively or actively, with native grasses and shrubs. In addition, increased hunting pressure facilitated by vehicle access along the right-of-way will be limited by removing temporary bridges or culverts, or, if required, by blocking the highway/right-of-way junction by means of barricades.

Originally, a block valve was planned along Alternative #2 at KP 695. This would have required a permanent access road from the Alaska Highway, thus impinging on the winter range of the woodland caribou. As a result of the concern for caribou and access provided to their range, the planned location of this block valve has been moved to KP 686, adjacent to the Alaska Highway, thus restricting the requirement for access to the block valve to the immediate vicinity of the Alaska Highway.

6.3 RESIDUAL ENVIRONMENTAL IMPACTS

This section of the submission is devoted to identifying impacts which may persist despite 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. Likewise, no loss of any critical or sensitive habitat will occur in light of the proposed construction practices and the use of bridges for road crossings of the Rancheria River. Although the consequences of instream activity may inconvenience fish resident in the affected watercourses, no detectable effects on fish production are anticipated.

Birds

Given the nature of the concerns and prediction of impacts described above, no residual environmental impacts are likely for birds.

Mammals

Winter construction through caribou and moose winter range will undoubtedly result in a temporary displacement of animals away from the immediate centres of activity. However, considering that under average pipelining conditions, mainline activities progress at approximately 1 km/day, any given point along the line will experience peak activity for only several weeks. Consequently, alienation of habitat from construction activity is a temporary and relatively localized phenomenon and will not constitute a significant impact on the extensive wintering areas encountered along the preferred route. Other aspects of pipeline construction such as open ditch, strung pipe, and spoil piles may present a physical barrier to animal movement within winter range, resulting in habitat alienation over a more extensive area (>10 km) than that resulting from construction activity. Although experience with other pipelines has shown that ungulates will use facilities provided for crossing over or through such obstacles, the degree of use by animals is largely dependent on several factors, including their level of motivation to cross and their level of habituation to linear developments. Consequently, some blockage of movements within winter range may occur. However, given the temporary nature of such a disturbance and the availability of range well-removed from the right-of-way, it is doubtful that wintering animals would be affected to a significant degree. Since pipeline-related obstacles will not be present within the Swift/Rancheria winter ranges for a significant portion of the spring movement period, movement from these areas will be affected minimally by pipeline construction. Following reclamation of the right-of-way, no impediments to moose or caribou movement would exist along the pipeline route.

APPENDIX I

ROUTE LOCATION FACTORS

FACTORS RELATED TO ENGINEERING

Engineering factors which affect route selection involve the requirement for the development and utilization of either "typical" or "unique" design solutions. 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. Major watercrossings along Alternative #1 involve multiple crossings of the Swift and Rancheria rivers. Major watercrossings along Alternative #2 consist of a single crossing of the Swift River.

Other

For other watercrossings on the alternatives, 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 mainline integrity.

Slope Stability

Potentially unstable slopes are noted and considered for the probable requirement of slope stabilization designs.

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. 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. Major

watercrossings involved in Alternative #1 are the multiple crossings of the Swift and Rancheria rivers. Major watercrossings in Alternative #2 involve the Swift River only.

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 may 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 bedding material requirements. This requirement includes an assessment for both rock grade and rock ditch work. In addition, where rock grade and rock ditch work are 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.

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 historical 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 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 since design and construction considerations outlined in the foregoing produce a system which can be operated efficiently. However, two operations factors which are 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
SWIFT RIVER/RANCHERIA VALLEY 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.
A summer inventory of the fishery resource along the proposed Alaska Highway pipeline in Yukon Territory, 1977. Prepared for Foothills Pipe Lines (Yukon) Ltd. 45 pp. + app.

Beak Consultants Limited. 1977.
A survey of fall spawning fish species in waterbodies within the influence of the proposed Alaska Highway pipeline in Yukon Territory, 1977. Prepared for Foothills Pipe Lines (Yukon) Ltd. 40 pp. + data sheets.

Beak Consultants Limited. 1977.
Winter ungulate surveys along the proposed Foothills Pipeline route (Yukon Territory). Prepared for Foothills Pipe Lines (Yukon) Ltd. 23 pp.

Beak Consultants Limited. 1978
Inventory studies of birds along the proposed Alaska Highway gas pipeline route, southern Yukon Territory, summer, 1977. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Beak Consultants Limited. 1978.
Raptor nest sites - summer 1977 - Alaska Highway gas pipeline route. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Beak Consultants Limited. 1978.
Spring (1978) waterfowl migration: proposed Alaska Highway gas pipeline route, southern Yukon Territory. Prepared for Foothills Pipe Lines (South Yukon) Ltd. 40 pp.

Beak Consultants Limited. 1978.
A summary of fishery investigations in waterbodies within the influence of the proposed Alaska Highway pipeline in Yukon Territory, 1976-1977. Prepared for Foothills Pipe Lines (South Yukon) Ltd. 2 vols.

Beak Consultants Limited. 1978.
Summer-fall mammal studies, 1977, Alaska Highway pipeline route. Prepared for Foothills Pipe Lines (Yukon) Ltd. 30 pp. + app.

Beak Consultants Limited. 1978.
Winter ungulate surveys (1978): Alaska Highway pipeline route. Prepared for Foothills Pipe Lines (Yukon) Ltd. 30 pp.

Beak Consultants Limited. 1978
An overview of environmental concerns related to the shipment of crude oil by tanker and barge from Valdez to Skagway. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Beak Consultants Limited. 1979.
A catalogue of nest sites of golden eagles, bald eagles, ospreys and gyrfalcon along the Alaska Highway gas pipeline route, southern Yukon Territory. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Beak Consultants Limited. 1979.
Surveillance of selected watercourse crossings. Alaska Highway gas pipeline, Aquatics Program, 1978. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Beak Consultants Limited. 1979.
A summary of fisheries resource investigations in waterbodies within the influence of the Alaska Highway gas pipeline in Yukon Territory, 1978. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Beak Consultants Limited. 1979.
Winter ungulate surveys (1979): Alaska Highway pipeline route. Prepared for Foothills Pipe Lines (South Yukon) Ltd. 17 pp. + maps.

Beak Consultants Limited. 1980.
Summary of fisheries investigations of new crossing locations, Alaska Highway gas pipeline, Yukon Territory, 1979. Report prepared for Foothills Pipe Lines (Yukon) Ltd.

Blood, Donald A. & Associates. 1979.
1979 inventory of raptor nests within 3.5 km of Foothills gas pipeline preferred alignment in southern Yukon Territory by G.G. Anweiler, M.J. Chutter and D.A. Blood. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Environmental Management Associates. 1980.
Winter studies of aquatic systems along the Alaska Highway gas pipline in southern Yukon Territory - Nisutlin Bay area (Kp 586 to KP 649). Prepared for Foothills Pipe Line (South Yukon) Ltd., Calgary. 35 pp. + app.

Environmental Management Associates. 1980.
Enumeration of spawning salmon in aquatic systems along the Alaska Highway gas pipeline in southern Yukon Territory, 1980. Prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary. 47 pp. + app.

Environmental Management Associates. 1981.
Fisheries resources of selected watercourses within the Alaska Highway gas pipeline in southern Yukon Territory - Update to January 1, 1981. Prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary. 18 pp.

Environmental Management Associates. 1981.
Fishery resource investigations along the Alaska Highway gas pipeline in southern Yukon Territory, 1980. Prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary. 46 pp. + app.

Environmental Management Associates. 1981.
Winter studies of selected watercourses along the Alaska Highway gas pipeline in southern Yukon Territory, 1981. Prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary. 28 pp. + app.

Foothills Pipe Lines (South Yukon) Ltd. 1978.
Golden eagles, bald eagles, osprey and gyrfalcon active nest sites, identified within 3.2 km of the Alaska Highway pipeline Project in Yukon Territory. 8 maps.

Foothills Pipe Lines (South Yukon) Ltd. 1979.
Environmental impact assessment for the Alaska Highway gas pipeline project. Report includes: Overview Summary and 29 annexes.

Foothills Pipe Lines (South Yukon) Ltd. 1979
Overview summary of the environmental impact statement for the Alaska Highway gas pipeline project.

Foothills Pipe Lines (South Yukon) Ltd. 1981
The Alaska Highway Gas Pipeline Project, Geotechnical Atlas.

Interdisciplinary Systems Ltd. 1977.
Initial environmental evaluation of the proposed Alaska Highway gas pipeline, Yukon Territory. Prepared for the Alaska Highway Pipeline Panel as sponsored by Foothills Pipe Lines (Yukon) Ltd. 667 pp.

Lifeways of Canada Ltd. 1978
Historical site reconnaissance (1977), Alaska Highway gas pipeline route, Yukon Territory. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Lifeways of Canada Ltd. 1978
Historical site inventory forms, Alaska Highway pipeline route, Yukon Territory. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Lifeways of Canada Ltd. 1978.
Historical site reconnaissance (1978), Alaska Highway gas pipeline route, Yukon Territory, Canada. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Lifeways of Canada Ltd.
Historical site inventory forms - 1978, Alaska Highway gas pipeline route, Yukon Territory. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Lifeways of Canada Ltd. 1979
Archaeological studies. Alaska Highway gas pipeline project, Yukon Territory. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Lifeways of Canada Ltd. 1979.
Archaeological catalogue, Alaska Highway gas pipeline project, Yukon Territory. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Northwest Hydraulic Consultants Ltd. 1978.
Multi-discipline stream characteristics along the Foothills (South Yukon) pipeline route. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Northwest Hydraulic Consultants Ltd. 1978
1978 Spring break-up observations along the proposed South Yukon pipeline route. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Vaartnou & Sons Enterprises Ltd. 1978.
Grasses, legumes and shrubs adjacent to the Alaska Highway of Yukon Territory. Prepared for Foothills Pipe Lines (South Yukon) Ltd. 47 pp.

Vaartnou & Sons Enterprises Ltd. 1979.
Pipeline revegetation research: Northern British Columbia test sites. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Vaartnou & Sons Enterprises Ltd. 1979.
Pipeline revegetation research: Alaska Highway test sites, progress report, 1978. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Windsor, J. 1978.
Survey of raptor nests in the south Yukon Territory (data sheets). Prepared for Yukon Territorial Government, Wildlife Branch. Funded by Foothills Pipe Lines (South Yukon) Ltd.

Windsor, J. 1979.
Survey of raptor nests in the southern Yukon Territory. Data sheets and maps 1:250,000. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

Windsor, J. 1979.
Birds of prey in the southern Yukon Territory in relation to the Alaska Highway and proposed gas pipeline. Prepared for Foothills Pipe Lines (South Yukon) Ltd. February 1979. + maps.

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	
686.4	Screw Creek	Low potential - sampled, no important species collected.								1
688.4	Unnamed	Steep gradient, limited discharge.								5
692.6	Unnamed	Obstructions, limited discharge.								5
694.7	Unnamed	Low potential - sampled, no important species collected.								5
695.2	Partridge Creek	Low potential - sampled, no important species collected.								1,4
696.5	Unnamed	Obstructions, steep gradient.								5
697.7	Swift River			N,R,S,OW						1,4
698.0	Unnamed									
703.9	Swift River			N,R,S,OW			S,OW			1,4
705.1	Unnamed	Obstructions, steep gradient.								5
709.2	Unnamed	Obstructions, steep gradient.								5
709.8	Unnamed	Obstructions, limited discharge.								5
710.0	Unnamed	Obstructions, limited discharge.								5
712.5	Swift River			N,R,Sp,S,OW						1,4
714.8	Unnamed	Intermittent.								5
716.7	Unnamed	Intermittent.								5

Alternative #1 Continued

Approximate KP	Waterbody	Habitat Utilization*								Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	
720.2	Carlick Creek			N						5
725.2	Unnamed	Intermittent.								5
726.5	Unnamed	Intermittent.								5
727.2	Unnamed	Intermittent.								5
730.6	Unnamed	Intermittent.								5
735.8	Rancheria River			M,N,R,S,OW					R	1,3
737.1	Unnamed									
741.2	Unnamed									
743.8	Unnamed									
745.6	Unnamed									
746.8	Boulder Creek						R			1,4
756.9	Spencer Creek	Low potential - sampled, no important species collected.								1,4
762.1	Unnamed									
764.8	Unnamed	Obstructions, steep gradient.								2
768.2	Rancheria River			N,R,S,OW			R,S,OW	S,OW	R,OW	1,4
777.9	Unnamed	Bog-like.								2
778.0	Unnamed	Bog-like.								2
788.8	Unnamed	Low potential - obstructions, limited discharge.								2

Alternative #1 Continued

Approximate KP	Waterbody	Habitat Utilization*								
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	Reference**
789.3	Big Creek			N,R,S,OW			R,S,OW		S,OW	1,4,5
795.4	Little Rancheria River			N,R,S,OW			R,S,OW			1,4,5
804.6	Unnamed	Bog-like.								5
812.6	Unnamed									
814.6	Unnamed	Low potential - sampled, no important species collected.								2
822.7	Unnamed	Obstructions, limited discharge.								2
827.1	Albert Creek			N,R,Sp,S,OW		S,OW		N,R,S,OW	R,OW	1,4,5
830.1	Unnamed	Bog-like.								5

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

Note: Kilometre posting based on the route revision dated March 1, 1981, which follows the route field under Foothill's 1976 submission.

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

Approximate KP	Waterbody	Habitat Utilization*								
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	Reference**
686.4	Screw Creek	Low potential - sampled, no important species collected.								1
687.7	Swift River	M,N,OW		N,R,Sp,S,OW		Sp,S,OW	R,S,OW		R,OW	6
689.3	McNaughton Creek	M,R,OW		N,R,OW			R,OW		R,OW	6
691.7	Unnamed	No channel evident.								6
693.9	Unnamed	Dry, overgrown.								6
696.3	Unnamed	Dry, overgrown.								6
699.2	Unnamed	Low potential - steep gradient, lack of cover.								6
703.3	Unnamed	Steep gradient, lack of cover.								6
707.3	Unnamed	Low potential - sampled, no important species collected.								6
708.6	Plate Creek			N,R,OW			S,OW			6
710.8	Unnamed	Steep gradient, narrow, shallow.								6
714.5	Unnamed	Intermittent.								5
718.7	Carlick Creek			N						5
723.9	Unnamed	Intermittent.								5
724.9	Unnamed	Intermittent.								5
725.8	Unnamed	Intermittent.								5
726.4	Unnamed	Intermittent.								5

Alternative #2 Continued

Approximate KP	Waterbody	Habitat Utilization*						Northern Pike	Burbot	Reference**
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden			
729.7	Unnamed	Intermittent.								5
734.9	Unnamed	Dry, undefined channel.								5
735.3	Unnamed	Dry, undefined channel.								5
737.4	Alan Creek						N,R,OW		R,OW	5
738.7	Freer Creek			S			R			5
740.4	Unnamed	Muskeg seepage.								5
741.0	Unnamed			R						5
742.1	Unnamed	No channel evident.								5
743.3	Unnamed	Low potential - obstructions, shallow, narrow.								5
746.4	Unnamed	Low potential - shallow, narrow.								5
749.1	Unnamed	Intermittent.								5
751.3	Tootsee River	Fair potential - sampled, no important species collected.								5
757.1	Unnamed	Low potential - lack of cover.								5
758.6	Unnamed	No channel evident.								5
759.5	Unnamed	No channel evident.								5
762.1	Unnamed	No channel evident.								5
764.0	Unnamed	No channel evident.								5
764.9	Unnamed	Low potential - obstructions, limited discharge.								5
765.8	Unnamed	Low potential - obstructions, limited discharge.								5
766.1	Unnamed	Low potential - obstructions, limited discharge.								5

Alternative #2 Continued

Approximate KP	Waterbody	Habitat Utilization*								
		Chinook Salmon	Chum Salmon	Arctic Grayling	Lake Trout	Lake Whitefish	Dolly Varden	Northern Pike	Burbot	Reference**
777.0	Unnamed	Bog-like.								2
780.7	Unnamed	Limited discharge.								5
787.8	Big Creek			N,R,S,OW			R,S,OW		S,OW	1,4,5
792.1	Little Rancheria River			N,R,S,OW			R,S,OW			1,4,5
803.1	Unnamed	Bog-like, limited discharge.								5
812.7	Unnamed	Limited discharge.								5
824.8	Albert Creek			N,R,Sp,S,OW		S,OW		N,R,S,OW	R,OW	1,4,5
828.1	Unnamed	Bog-like.								5

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

Note: Kilometre posting based on route revision dated March 1, 1981.

REFERENCES FOR APPENDIX III

1. Beak Consultants Limited. 1978
   A summary of fishery investigations in waterbodies within the influence of the proposed Alaska Highway pipeline in Yukon Territory, 1976-1977. Prepared for Foothills Pipe Lines (South Yukon) Ltd. 2 vols.

2. Northern Natural Resource Services Ltd. 1978.
   A compilation of fisheries data from waterbodies adjacent to the Alaska Highway from kilometer 1008 to kilometer 1635. Prepared for Dept. of Fisheries and the Environment, Vancouver.

3. Beak Consultants Limited. 1979
   Surveillance of selected watercourse crossings along the Alaska Highway gas pipeline route in Yukon Territory, Year 1 (1979). Prepared for Foothills Pipe Lines (South Yukon) Ltd.

4. Beak Consultants Limited. 1979.
   A summary of fisheries resource investigations in waterbodies within the influence of the Alaska Highway gas pipeline in Yukon Territory, 1978. Prepared for Foothills Pipe Lines (South Yukon) Ltd.

5. Beak Consultants Limited. 1980.
   Summary of fisheries investigations of new crossing locations, Alaska Highway gas pipeline, Yukon Territory, 1979. Prepared for Foothills Pipe Lines (Yukon) Ltd.

6. Environmental Management Associates. 1981.
   Fishery resource investigations along the Alaska Highway gas pipeline in southern Yukon Territory, 1980. Prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary.

APPENDIX IV

BASIS FOR SCORES ASSIGNED TO
IMPORTANCE OF CONCERN AND PROJECT RESPONSE

ALTERNATIVE #1

LOCATION FACTORS

Socio-economic (Land-use)

Mineral Leases
Importance of Concern - 2: One mineral lease traversed.
Project Response - 1: Compensation for access.

Residential — No Project Concerns or Responses Identified

Agricultural — No Project Concerns or Responses Identified

Commercial
Importance of Concern - 1: Route passes in close proximity to one commercial lease and one commercial title.
Project Response - 1: Ensure avoidance of areas, and minimize disturbance from men and equipment.

Recreational
Importance of Concern - 2: Route proximal to an existing campground.
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
Importance of Concern - 1: One land area crossed.
Project Response - 0: Standard restoration procedures.

Gravel Reserve
Importance of Concern - 2: Route encroaches on ten gravel pit reserves.
Project Response - 1: Provide for access to reserves; appropriate identification of pipeline and restrictions because of right-of-way.

Environmental

Fish
Habitat
Importance of Concern - 4: Potential conflicts with sensitive habitats present in eight watercourses; five major river crossings.
Project Response - 3: Scheduling of instream construction activities in sensitive watercourses; difficulties in scheduling five river crossings which require special crossing crews, for the summer season.

Birds

Raptors

Importance of Concern - 3: Presence of active Golden Eagle nests 300 m and 250 m from the right-of-way.

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

Waterfowl

Importance of Concern - 1: Limited breeding habitat within 1 km of pipeline route.

Project Response - 0: Project response unjustified. Insufficient numbers and minimal potential for impact.

Mammals

Ungulates

Importance of Concern - 2: Moose and caribou distributed on winter range along the route.

Project Response - 2: Minimum altitude of 600 m for Project-controlled aircraft between January 1 and March 31. Scheduling of pre- and post-mainline activities outside of the winter period. Crossing facilities every 250 m along open ditch, strung pipe and spoil piles.

Furbearers

Importance of Concern - 1: Some furbearer habitat in vicinity of pipeline route.

Project Response - 0: Project response unjustified. Insufficient numbers of furbearers within the influence of the pipeline.

Operations

Public Safety

Importance of Concern - 2: Public contact with the route at various locations.

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.

ALTERNATIVE #2

LOCATION FACTORS

Socio-economic (Land-use)

Mineral Leases
Importance of Concern - 2: One mineral lease traversed.
Project Response - 1: Compensation for access.

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 - 2: Route passes through two gravel pit reserves.
Project Response - 1: Provide for access to reserves; appropriate identification of pipeline and restrictions because of right-of-way.

Environmental

Fish
Habitat
Importance of Concern - 3: Potential conflicts with sensitive habitats present in seven watercourses crossed.
Project Response - 2: Scheduling of instream construction activities in sensitive watercourses.

Birds
Raptors
Importance of Concern - 2: Two active Golden Eagle nests, one at 1.0 km and one at 1.9 km from right-of-way. Highway between nests and right-of-way.
Project Response - 2: Scheduling of pre- and post-mainline activities to avoid nesting period. Restriction on Project-controlled aircraft overflights during nesting period.
Waterfowl
Importance of Concern - 1: Breeding waterfowl present on minimal habitat.
Project Response - 0: No response justified. Insufficient numbers, no threat of significant impact.

Mammals
Ungulates
Importance of Concern - 3: Woodland caribou and some moose present on winter range.

Project Response - 2: Crossing facilities every 250 m along strung pipe, ditch, and spoil piles; access blockage. Project aircraft minimum above-ground altitude of 600 m between January 1 and March 31. Scheduling of pre- and post-mainline activities outside of the winter period.

Furbearers

Importance of Concern - 1: Aquatic furbearers present in small numbers.

Project Response - 0: No response justified. Insufficient numbers, no threat of significant impact.

Operations

Public Safety

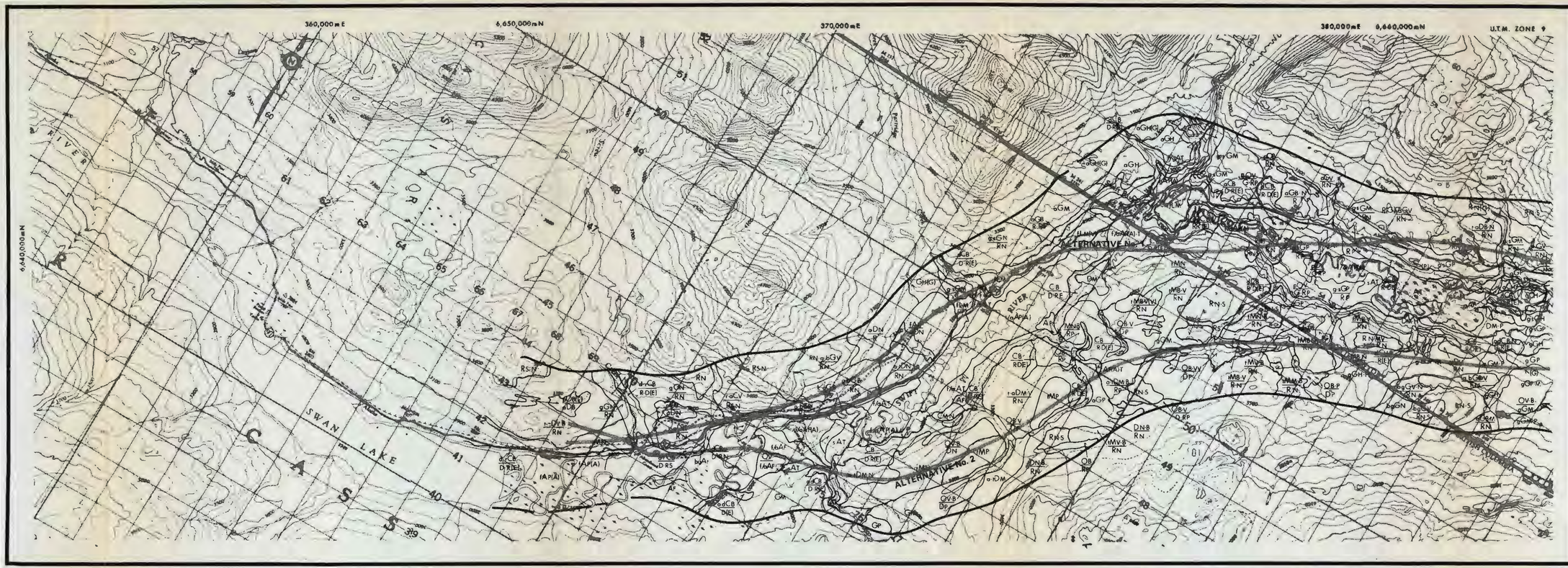
Importance of Concern - 1: Minimal public contact with the route.

Project Response - 1: Meet standard codes and regulations.

Third Party Damage

Importance of Concern - 1: Minimal public contact with the route.

Project Response - 1: Meet standard codes and regulations.



SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:
TERRAIN TYPES
MAP 3-4.2
SHEET 1 OF 5

TERRAIN TYPING LEGEND

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

TEXTURAL MODIFIERS — MORPHOLOGIC MODIFIER(S)

mgA - INDICATES CATEGORY CHARACTERIZED BY TWO TEXTURES. THE FIRST MODIFIER DOMINANT

MH M INDICATES CATEGORY CHARACTERIZED BY TWO MORPHOLOGIES. THE FIRST MODIFIER DOMINANT

tAp - STRATIGRAPHIC RELATIONSHIP WHERE aGM - 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

PROCESS or FORM MODIFIERS:

- (A) ACTIVE ALLUVIATION
- (E) STREAM ERODED: STREAM ERODING
- (C) CHANNELLED BY MELTWATER STREAMS
- (L) MODIFIED DUE TO SLOPE FAILURE OR RAPID MASS MOVEMENT
- (R) PITTED (KETTLE HOLES)
- (S) SOLIFLUCTION LOBES & TERRACES
- (K) 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 (1 - 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 0.3-3 METRES THICK

VENEER - BROKEN THIN COVER AVERAGING 0.5 METRES IN THICKNESS

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
- g FREQUENTLY ORGANIC
- k GRAVEL, GRAVELLY
- m SILTY
- o ORGANIC
- p PEAT, PEATY
- r RUBBLE, RUBBLY
- s SAND, SANDY
- t TILL
- v VOLCANIC ASH, TEPHRA
- x COMPLEX

Scale 1:50,000

1000 500 0 1000 2000 3000 Metres

2 Miles

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:
TERRAIN TYPES
MAP 3-4.2
SHEET 2 OF 5

TERRAIN TYPING LEGEND

GENETIC-COMPOSITIONAL CATEGORY — PROCESS OR FORM MODIFIERS (Le)
TEXTURAL MODIFIERS — MORPHOLOGIC MODIFIERS

mA - INDICATES CATEGORY CHARACTERIZED BY TWO TEXTURES THE FIRST MODIFIER DOMINANT

Mm M - INDICATES CATEGORY CHARACTERIZED BY TWO MORPHOLOGIES THE FIRST MODIFIER DOMINANT

tAP - STRATIGRAPHIC RELATIONSHIP WHERE tAP 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 OR 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 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 THERMO KARST
(V) GULLIED
(W) WAVE WASHED
(Z) PATTERNED GROUND

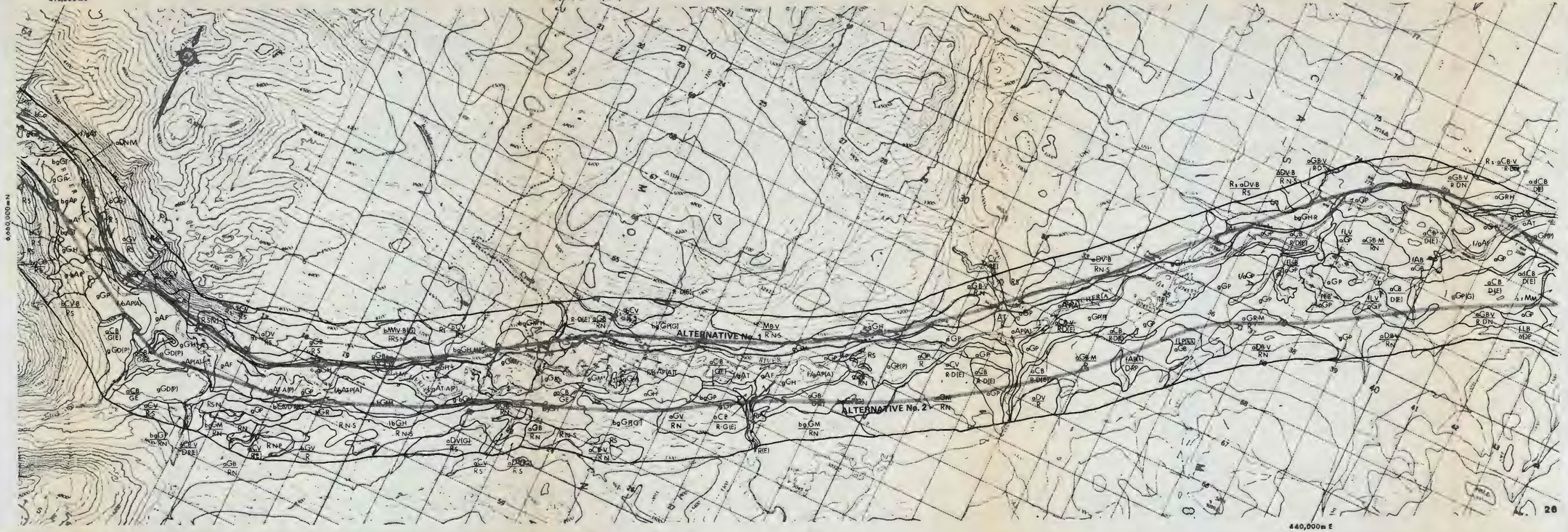
MORPHOLOGIC MODIFIERS

A APRON
B BLANKET
C CHANNEL (NO VEGETATION COVER)
D DELTA
F FAN
G GENTLY SLOPED (1 - 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 TO 3 METRES THICK
VENEER BROKEN THIN COVER AVERAGING 0.5 METRES IN THICKNESS

Scale 1:50,000

1000 500 0 1000 2000 3000 Metres
0 1 2 Miles



SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:
TERRAIN TYPES
MAP 3-4.2
SHEET 3 OF 5

TERRAIN TYPING LEGEND

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

TEXTURAL MODIFIER(S) → MORPHOLOGIC MODIFIER(S)

mgA INDICATES CATEGORY CHARACTERIZED BY TWO TEXTURES THE FIRST MODIFIER DOMINANT

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

tAP , STRATIGRAPHIC RELATIONSHIP WHERE aGM UPPER UNIT IS OFTEN LESS THAN 2 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 MAR.
- 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

- iA ACTIVE ALLUVIATION
- iE STREAM ERODED STREAM ENCROING
- iG CHANNELLED BY MELTWATER STREAMS
- iL MODIFIED DUE TO SLOPE FAILURE OR RAPID MASS MOVEMENT
- iP PITTED (KETTLE HOLE)
- iS SOLIFLUCTION LOBES & TERRACES
- iT THERMOKARST MODIFIED BY THERMO KARST
- iW GULLIED
- iW WAVE WASHED
- iZ 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

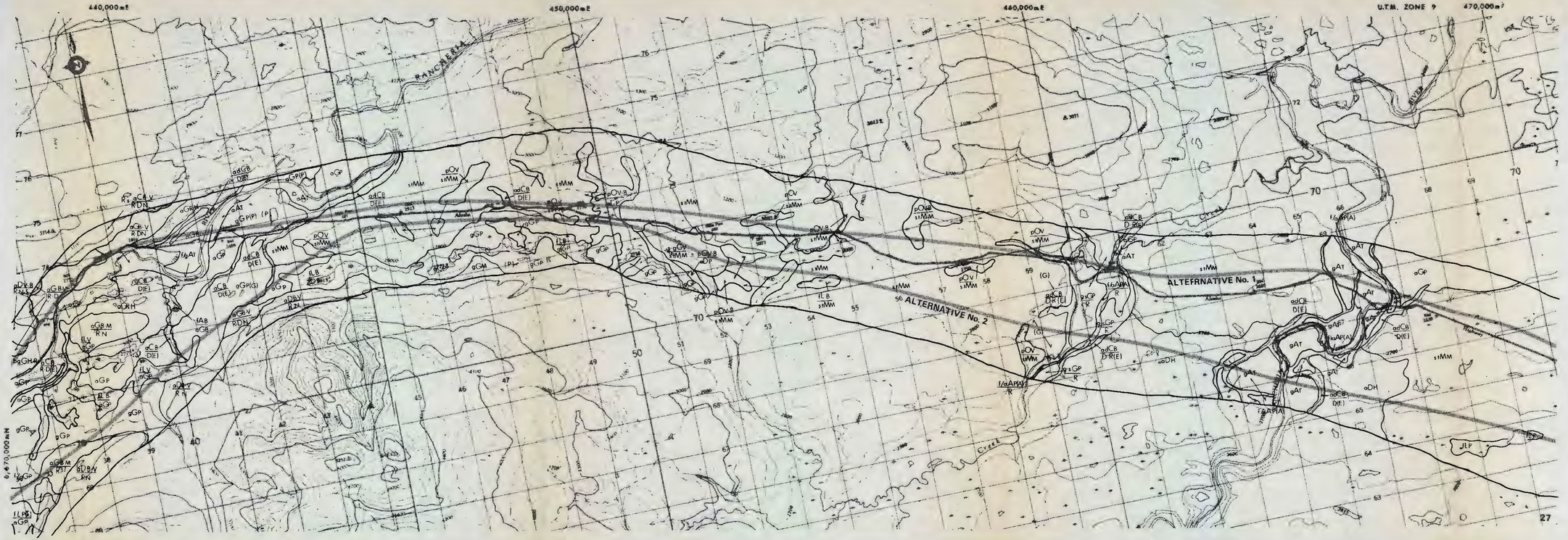
BLANKET CONTINUOUS COVER GENERALLY 0.5 3 METRES THICK

VENEER DISCONTINUOUS THIN COVER AVERAGING 0.5 METRES IN THICKNESS

Scale 1:50,000

0 1 2 Miles

1000 500 0 1000 2000 3000 Metres



SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

TERRAIN TYPES

MAP 3-4.2

SHEET 4 OF 5

TERRAIN TYPING LEGEND

GENETIC COMPOSITIONAL CATEGORY — PROCESS OR FORM MODIFIERS
TEXTURAL MODIFIERS — MORPHOLOGIC MODIFIERS

mgA - INDICATES CATEGORY CHARACTERIZED BY TWO TEXTURES: THE FIRST MODIFIER DOMINANT

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

tAP - STRATIGRAPHIC RELATIONSHIP WHERE gGM - UPPER UNIT IS OFTEN LESS THAN 2 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 INCISING
(G) - CHANNELLED BY MELTWATER STREAMS
(L) - MODIFIED DUE TO SLOPE FAILURE OR RAPID MASS MOVEMENT
(P) - PITTED (KETTLE HOLE)
(S) - SOLIFLUCTION LOBES & TERRACES
(T) - THERMOKARST: MODIFIED BY THERMOKARST
(V) - GULLIED
(W) - WAVE WASHED
(Z) - PATTERNED GROUND

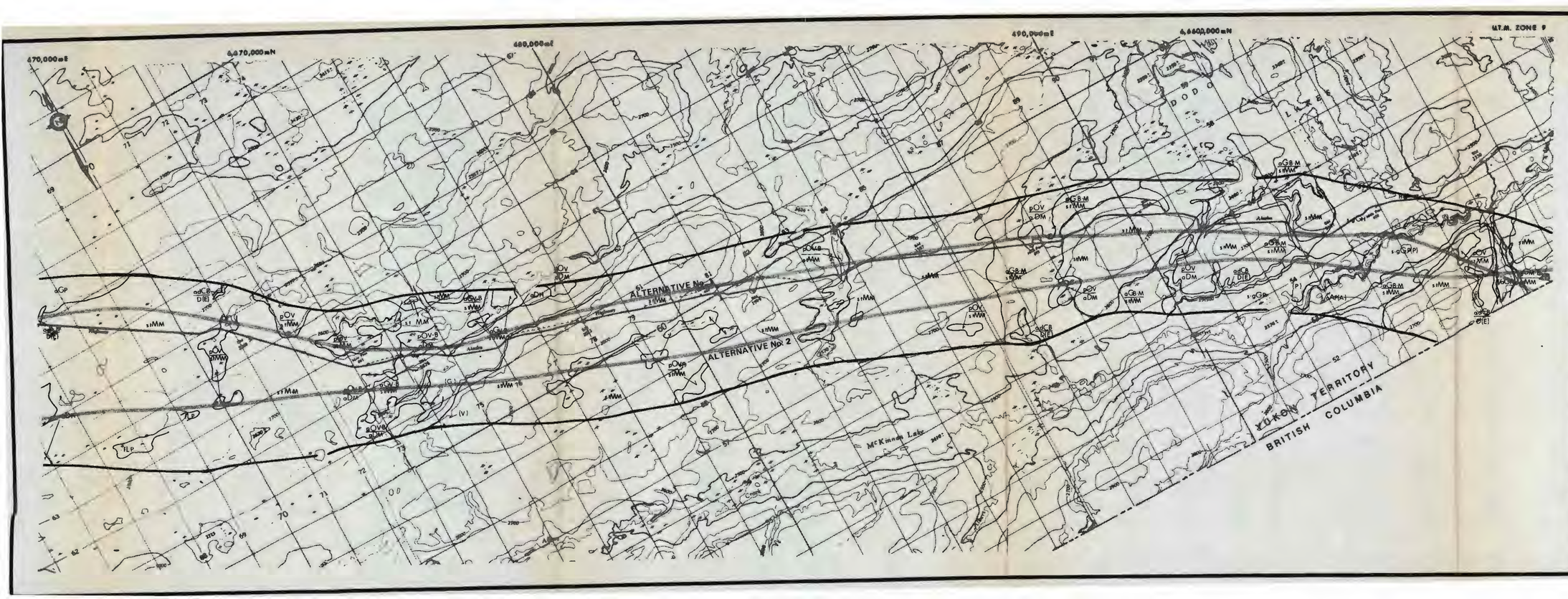
MORPHOLOGIC MODIFIERS

A - APRON
B - BLANKET
C - CHANNELLED VEGETATION COVER
D - DELTA
F - FAN
G - GENTLY SLOPED (1-5°)
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

1000 500 0 1000 2000 3000 Metres
Miles



SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:
TERRAIN TYPES
MAP 3-4.2
SHEET 5 OF 5

TERRAIN TYPING LEGEND

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

mcA INDICATES CATEGORY CHARACTERIZED BY TWO TEXTURES THE FIRST MODIFIER DOMINANT

M=A INDICATES CATEGORY CHARACTERIZED BY TWO MORPHOLOGIES THE FIRST MODIFIER DOMINANT

/AP STRATIGRAPHIC RELATIONSHIP WHERE aDM 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
(T) THERMOKARST MODIFIED BY THERMOKARST
(V) GULLIED
(W) WAVE WASHED
(Z) PERMAFROST GROUND

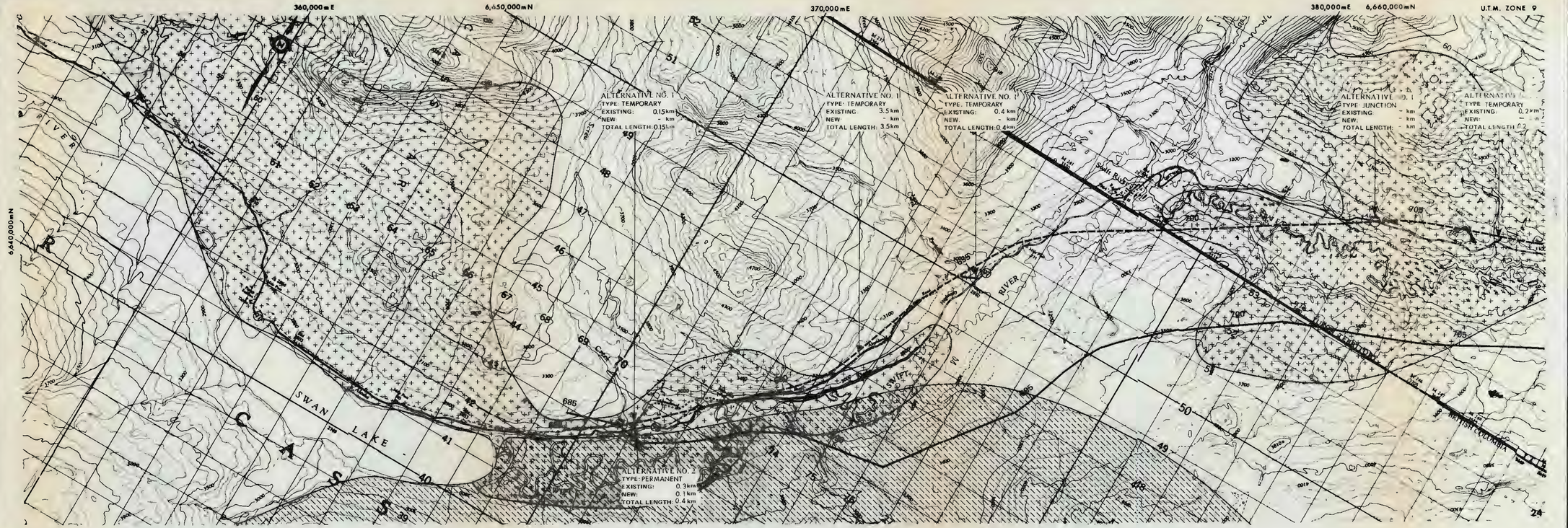
MORPHOLOGIC MODIFIERS

A APRON
B BLANKET
C CHANNEL (NO VEGETATION COVER)
D DELTA
F FAN
G GENTLY SLOPED (1-5°)
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 1 METRES IN THICKNESS

Scale 1:50,000

1 0 1 2 3 Miles
1000 500 0 1000 2000 3000 Metres



MAP 3-4.3

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

WOODLAND CARIBOU AND MOOSE WINTER RANGES; PIPELINE ACCESS REQUIREMENTS

SHEET 1 OF 5

ALTENATIVE No.
TYPE:
EXISTING:
NEW:
TOTAL LENGTH:

ACCESS ROAD INFORMATION

MOOSE WINTER RANGE

WOODLAND CARIBOU WINTER RANGE

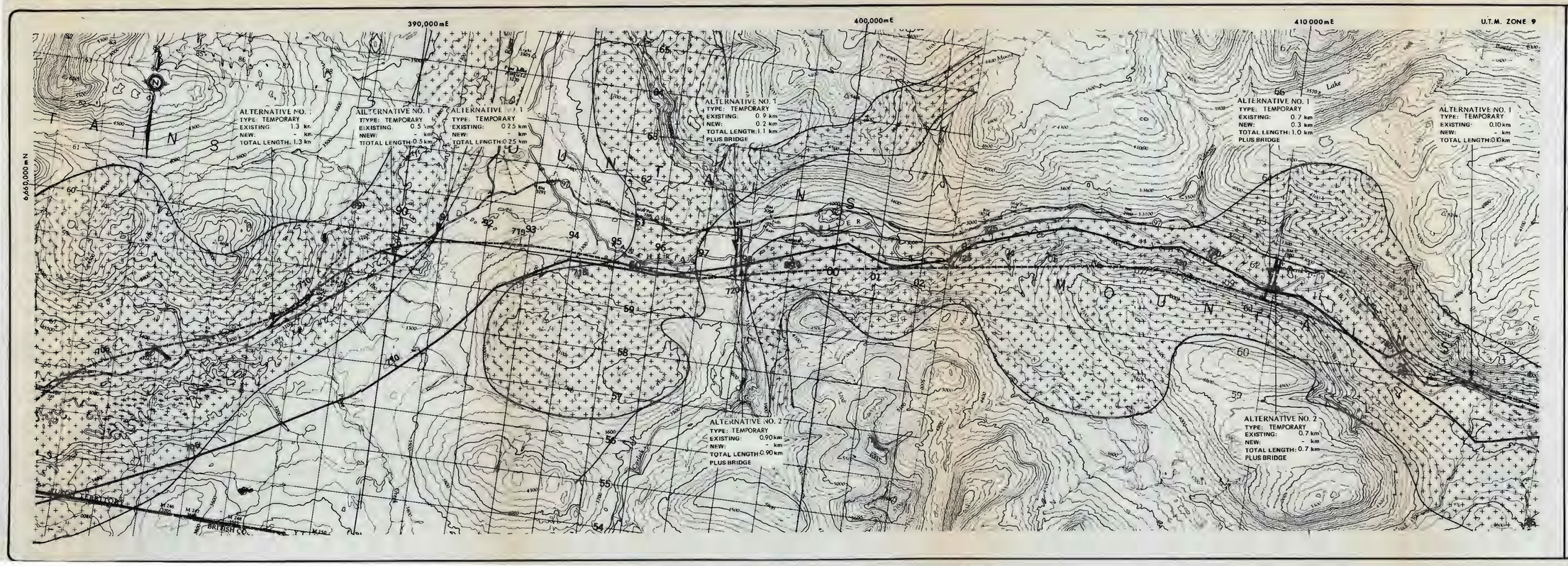
ALTERNATIVE No. 1

ALTERNATIVE No. 2

Scale 1:50,000

Miles

Metres



MAP 3-4.3

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

WOODLAND CARIBOU AND MOOSE WINTER RANGES; PIPELINE ACCESS REQUIREMENTS

SHEET 2 OF 5

ALTENATIVE No.
TYPE:
EXISTING:
NEW:
TOTAL LENGTH:

ACCESS ROAD INFORMATION

MOOSE WINTER RANGE

WOODLAND CARIBOU WINTER RANGE

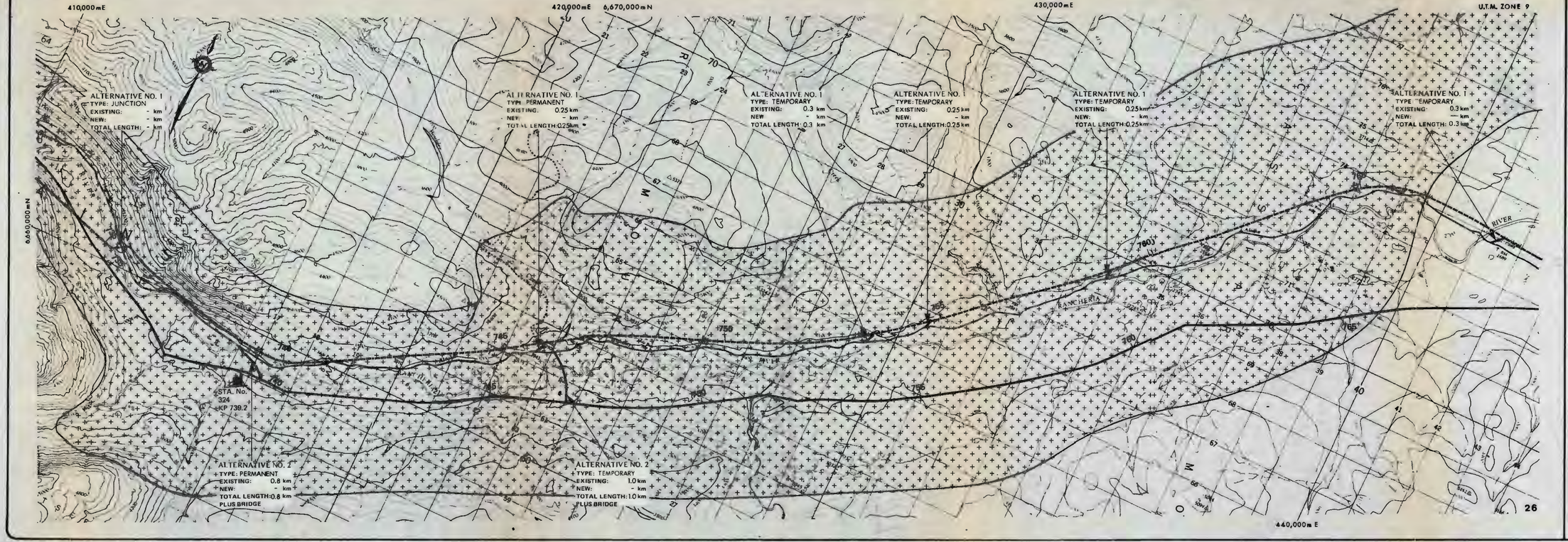
ALTERNATIVE No. 1

ALTERNATIVE No. 2

Scale 1:50,000

Miles

1000 500 0 1000 2000 3000 Metres



MAP 3-4.3

SWIFT RIVER / RANCHERIA VALLEY ALTERNATIVES:

WOODLAND CARIBOU AND MOOSE WINTER RANGES; PIPELINE ACCESS REQUIREMENTS

SHEET 3 OF 5

ALTENATIVE No.
TYPE:
EXISTING:
NEW:
TOTAL LENGTH:

ACCESS ROAD INFORMATION

MOOSE WINTER RANGE

WOODLAND CARIBOU WINTER RANGE

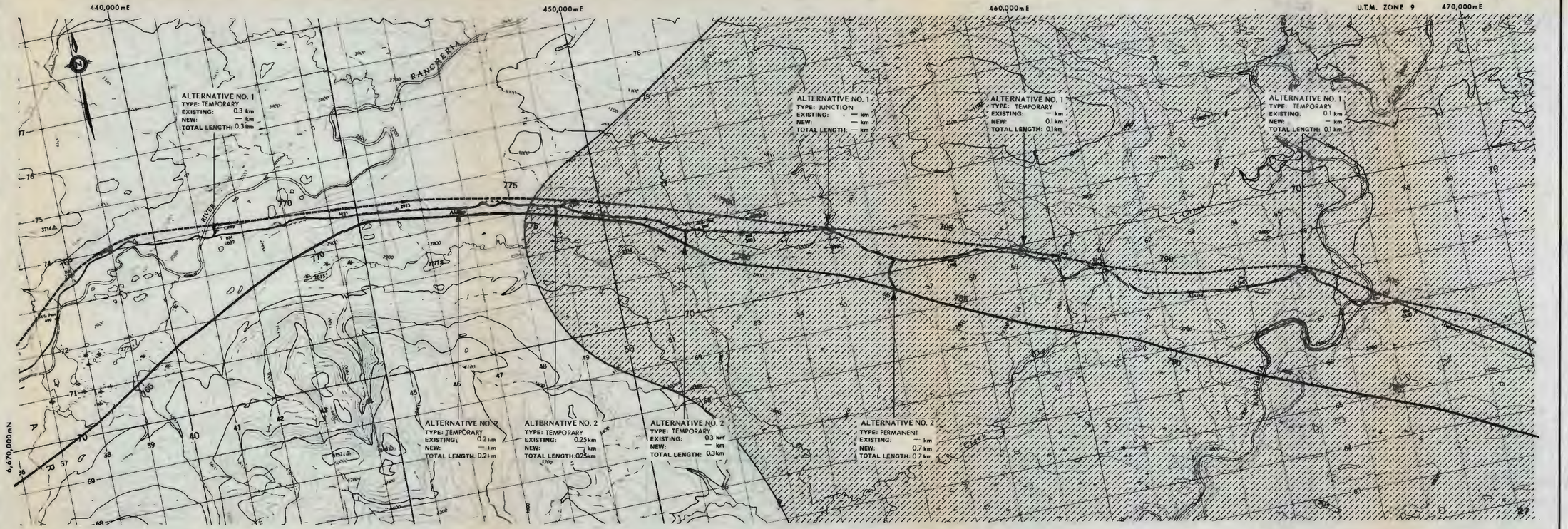
ALTERNATIVE No. 1

ALTERNATIVE No. 2

Scale 1:50,000

Miles

Metres



MAP 3-4.3

SWIFT RIVER / RANCHERIA VALLEY ALTERNATIVES:

WOODLAND CARIBOU AND MOOSE WINTER RANGES; PIPELINE ACCESS REQUIREMENTS

SHEET 4 OF 5

ALTERNATIVE No.
TYPE:
EXISTING:
NEW:
TOTAL LENGTH:

ACCESS ROAD INFORMATION

MOOSE WINTER RANGE

WOODLAND CARIBOU WINTER RANGE

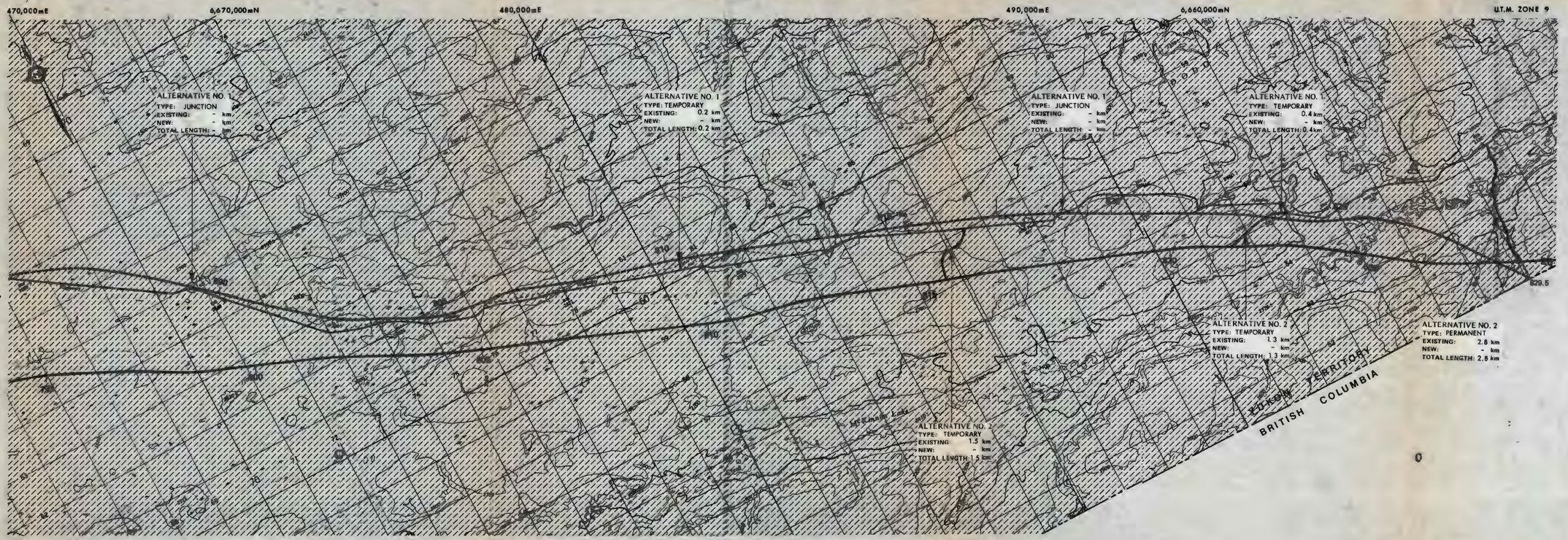
ALTERNATIVE No. 1

ALTERNATIVE No. 2

Scale 1:50,000

0 1 2 Miles

1000 500 0 1000 2000 3000 Metres



MAP 3-4.3

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

WOODLAND CARIBOU AND MOOSE WINTER RANGES; PIPELINE ACCESS REQUIREMENTS

SHEET 5 OF 5

ALTENATIVE No.
TYPE.
EXISTING:
NEW:
TOTAL LENGTH:

ACCESS ROAD INFORMATION

MOOSE WINTER RANGE

WOODLAND CARIBOU WINTER RANGE

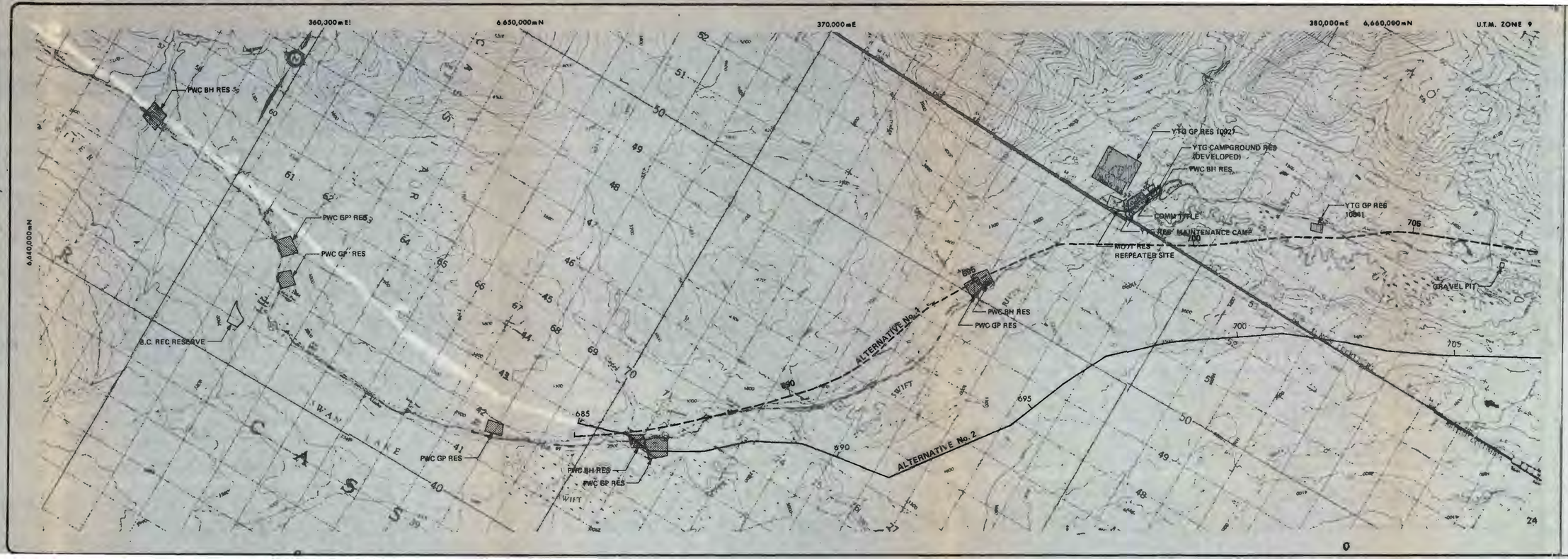
ALTERNATIVE No. 1

ALTERNATIVE No. 2

Scale 1:50,000

Miles

1000 500 0 1000 2000 3000 Metres



MAP 3-4.4

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

LAND STATUS

SHEET 1 OF 5

ALTERNATIVE No.1 – – – –
ALTERNATIVE No.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) — DIAND
  - INDIAN AND INUIT AFFAIRS — I & IA RES
  - MINING CLAIMS
  - 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 — ⊙
  - 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 — △

Miles
1000 500 0 1000 2000 3000 Metres
Scale 1:50 000

MAP 3-4.4

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

LAND STATUS

SHEET 2 OF 5

ALTERNATIVE No.1 – – – –
ALTERNATIVE No.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) — DIAND
  - INDIAN AND INUIT AFFAIRS — I & IA RES
  - MINING CLAIMS
  - 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

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(TERRITORIAL LANDS COMMISSIONER ADMINISTERED)
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- 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 PLAN DOCK — △

0 2 Miles
1000 500 0 1000 2000 3000 Metres
Scale 1:50000

MAP 3-4.4

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

LAND STATUS

SHEET 3 OF 5

ALTERNATIVE No.1 – – – –

ALTERNATIVE No.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) — DIAND
  - INDIAN AND INUIT AFFAIRS — I & IA RES
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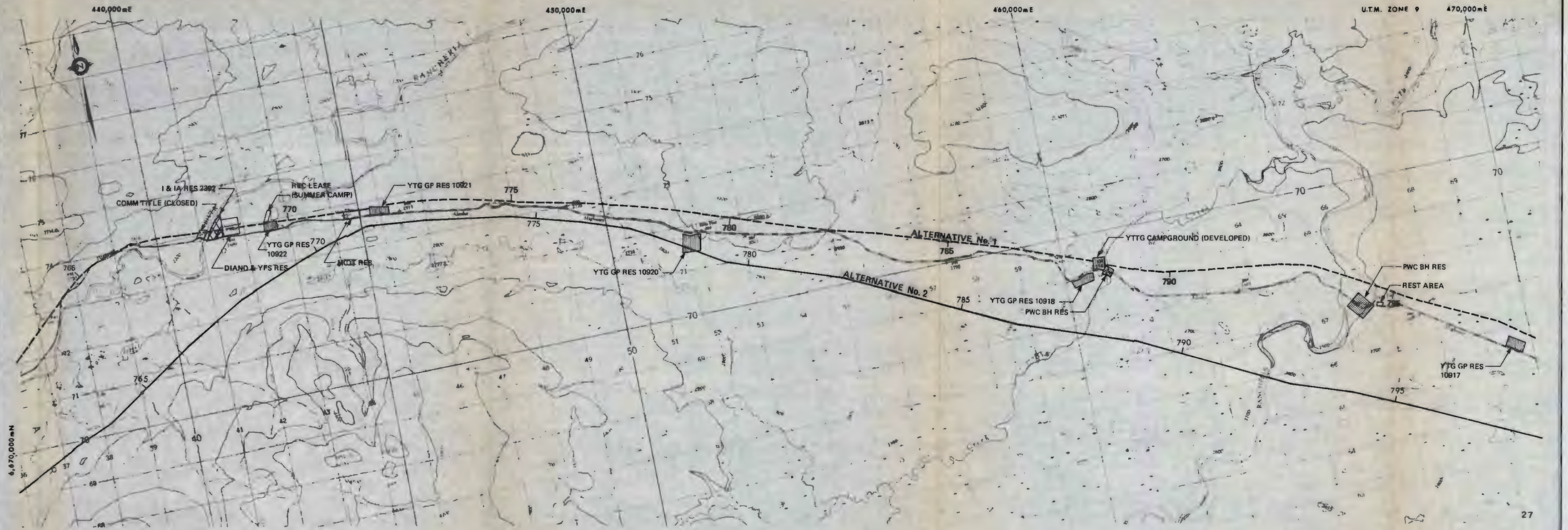
PRIVATE LANDS
- RESIDENTIAL, RECREATIONAL OR COMMERCIAL LEASE/TITLE

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

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

1 0 1 2 3 Miles
1000 500 0 1000 2000 3000 Metres
Scale 1:50000



MAP 3-4.4

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

LAND STATUS

SHEET 4 OF 5

ALTERNATIVE No. 1 ----

ALTERNATIVE No. 2 ——

LEGEND

YUKON TERRITORY

TERRITORIAL LANDS
(GOVERNMENT OF CANADA ADMINISTERED)
- ENVIRONMENT CANADA
  - KLUANE NATIONAL PARK
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- DEPT. INDIAN AFFAIRS AND NORTHERN DEVELOPMENT (NORTHERN PROGRAM) — DIAND
  - INDIAN AND INUIT AFFAIRS — I & IA RES
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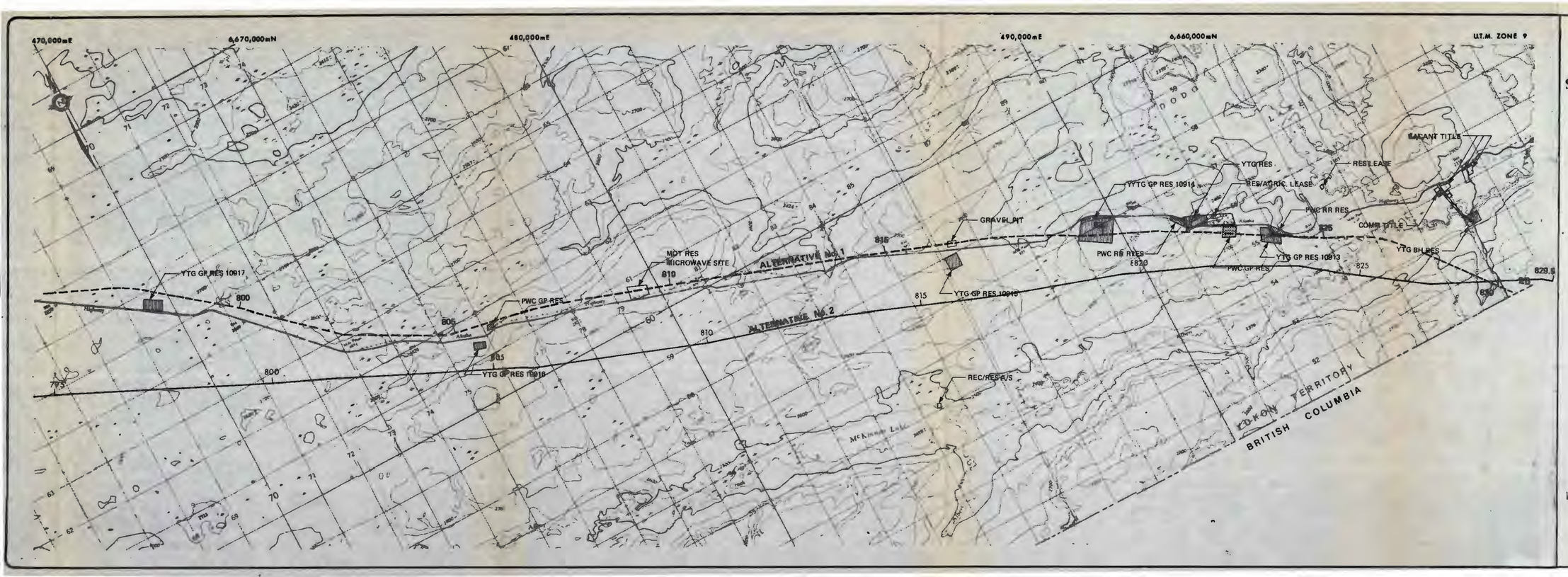
BRITISH COLUMBIA
- MINISTRY OF LANDS, PARKS AND HOUSING:
  - B.C. RECREATION RESERVE

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

3 Miles
1000 500 0 1000 2000 3000 Metres
Scale 1:50000



MAP 3-4.4

SWIFT RIVER/RANCHERIA VALLEY ALTERNATIVES:

LAND STATUS

SHEET 5 OF 5

ALTERNATIVE No.1 ———
ALTERNATIVE No.2 ═══

LEGEND

YUKON TERRITORY

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- COMMUNITY WATER WELL OR INTAKE — ⊘
- FLOAT PLAN DOCK — ⚓

2 0 2 Miles
1000 500 0 1000 2000 3000 Metres
Scale 1:50000