A PRELIMINARY REVIEW OF ENVIRONMENTAL CONCERNS ASSOCIATED WITH THE FOOTHILLS PIPELINE PROPOSAL AND SELECTED ALTERNATIVE PIPELINE CORRIDORS

A BRIEF PRESENTED BY THE
CANADA DEPARTMENT OF FISHERIES AND THE ENVIRONMENT
TO THE
ENVIRONMENTAL ASSESSMENT PANEL

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TABLE OF CONTENTS

I. INTRODUCTION

The intention of this brief is to provide a preliminary review of environmental concerns as identified by the Department of Fisheries and the Environment (DFE) at this point in time with respect to:

a) Foothills (Yukon) Pipeline Co. submissions to the Federal Government in support of its application to build a 48 inch diameter natural gas pipeline;

b) selected alternative pipeline corridors and routes.

Further information as obtained by DFE will be supplied to the Environmental Assessment Panel during the more formal hearings which are scheduled for July 1977. In addition, at that time, DFE experts will be available, to comment on more specific aspects than will be dealt with in this brief.

In recognition of the split in responsibilities for resources between various departments and governments such as DFE, Energy, Mines and Resources, Department of Indian Affairs and Northern Development and the Yukon Territorial Government, reference to environmental concerns, which are more appropriately covered by other agencies, will be kept to a minimum. However, it is recognized that some overlap will no doubt occur since environmental issues frequently transgress departmental mandates.

II. ENVIRONMENTAL CONCERNS - FOOTHILLS PIPELINE APPLICATION

A. Hydrology and Terrain Concerns

Hydrology

1. Drainage Disruption

One of the major areas of environmental concern is the drainage disruption that would ensure in permafrost terrain during construction and maintenance of the pipeline. The numerous small, high energy streams with actively moving beds of silt, volcanic ash, gravel and boulders that descend from Kluane Range and empty into Kluane Lake are considered to be a serious potential problem. The channels are contained in the mountains by channel walls, but on the fans they are unconstrained and are free to shift their courses. During floods the bed material chokes the channel, causing the streams to abruptly flow out of the channel and find a new one elsewhere, where it scours down a similar channel. Highway maintenance personnel are in a continuous battle with these streams as they bulldoze gravel to lower the bed and to form dykes to keep the streams from shifting their courses. The question is, what happens when an excavation transverses the general drainage pattern of these alluvial fans, underlain with permafrost? Will it become a channel for surface and ground water flow?

Impact

Although these glacial fed streams generally carry high sediment loads during floods, the initial pipeline trenching and ongoing maintenance activity (re-trenching) in this unstable area could result in increased loads of silt entering Kluane Lake.

Proponent's Submission

The proponent recognizes that "the natural drainage patterns will be exposed to potential change by construction of both the proposed pipeline and ancillary structures". (Pages 376-378). However, this statement is devoid of site-specific information and fails to comment on

siltation, its effect on aquatic ecology and proposed measures to mitigate negative impacts.

It is suggested that location of the pipeline along the foothills above the head of the alluvial fans be considered as a preventative action; the pipeline should be buried below scour depth over the entire reach from about mile 115 to 145.

No data is available on the natural sediment transport into Kluane Lake on which to extrapolate the increases that would result from pipeline construction and maintenance. The development of a sediment program for study of siltation on the west shore of Kluane Lake would be necessary to fill this gap.

Also, more detailed information on the location, discontinuity and characteristics of permafrost is required as it is one of the prime parameters in the study of mass movement of material within the alluvial fans.

2. River Crossings - Bank and Channel Bed Stability

Major river crossings, particlularly in the permafrost areas west of Whitehorse, require special attention with respect to bank stability and scour. Thawing of river banks at construction sites may be serious on the White, Donjek, Duke and Slims Rivers and in particular, on the first two. In the fine soils that are prevalent at these crossings (aggravated by permafrost and/or ground-ice), the stability (or only near stability) of channel banks is partly dependent upon the maintenance of frozen ground near the channel banks. Examples of major slumps along the river banks were observed during the reconnaissance survey, May 16-20, 1977.

Another problem is the degradation of the channel bed. The silt, sand and gravel are moved along the river beds in dune and sheet transport. During this activity a seasonal scour can occur, the extent of which can be determined best by observation. Under ice cover, an increase in discharge is partly met by ice heaving and partly by an increase in stream velocity, thus producing increase in bed scour potential. During a flood discharge, the stream bed may alternately degrade and aggrade with rise and fall of discharges. Only a thorough morphological study of these rivers will clarify the situation regarding the depth at which the pipeline should be buried.

Within White, Donjek and Slims drainage basins there are known to be some 40 lakes which are dammed by glaciers. Glacier dammed lakes can suddenly drain, causing floods of catastrophic proportions. The likelihood of sudden, unexpected release of lake waters is increased greatly when the lakes are found in association with surging glaciers which can change their configuration very rapidly. Such floods could endanger the integrity of the pipeline.

The pipeline route parallels Teslin Lake for about 35 miles and about 25 tributaries are crossed. Morley River and Morley Lake are paralleled for another 20 miles and 9 of their tributaries are crossed. The Smart and Swift River system is paralleled for a further 32 miles and at least 12 of its tributaries are crossed. No known streamflow data are available on these tributaries. Under natural conditions these streams appear to be running relatively free of suspended sediments. However, because of the silt terraces and sharply incised channels, construction activity will inevitably cause serious stream and lake-shore siltation. For assessment of this problem's potential, an estimate of range of discharge of several inflow streams is needed. In addition, an estimate of sediment concentration during summer storms would be valuable.

In the Liard River Basin there is no evidence of lacustrine sediments or any severe hydrologic problems. The relic moraines in the Rancheria system appear stable; however, benches seem to be poorly drained and could represent concentrations of fine materials subject to degradation with disturbance. On the second Rancheria River crossing, the switching of thalweg from left bank above bridge to right bank around mid-channel shoals below, is an indication of possible channel stability problems and that care is required in restoration of regime during construction. For estimation of the potential of these concerns, as above, an estimate of range of discharge of several streams in the area is warranted. Currently there are no stream-flow stations on the tributaries in the Liard River drainage basin.

Impact

Both the White and Donjek Rivers have steep banks in fine-grained

soils and erosion could cause serious stream siltation. However, both rivers already carry very heavy sediment loads. The White River is noted as a fish migration route downstream of the proposed pipeline crossing and upstream of the proposed crossing is a site considered to be acceptable for spawning. Physical disruption and its interference with fish movements during proposed construction and maintenance appears to be the main potential effect on environment.

3. Other Hydrological Concerns

Studies of the water quality of 36 Alaska Arctic and Sub-Arctic rivers between 1969 and 1972 identified a severe winter dissolved oxygen depression phenomenon in many rivers (EPA-660/3-74-008; Ecological Research Series). The trend observed in many rivers was that the dissolved oxygen depletion usually became more severe when proceeding from the headwaters toward the mouth.

The Yukon River was found to contain 10.5 mg (73% saturation) dissolved oxygen at the Canadian Border, but only 1.9 mg (13% saturation) near the mouth in Alaska. Since the White, Teslin and Takhini River drainage basin tributary crossings could each contribute to an increased deposition of organic material in the Yukon River Basin, the concern over a further depression of dissolved oxygen in downstream reaches of the Yukon is warranted.

It is not known what happens when a corridor of impervious material, whether permafrost or hardpan, is torn out, a pipe laid and backfilled with what may no longer be an impervious seal. For instance, when the excavation line follows, longitudinally, the general drainage pattern of a basin, will it become another channel for surface and ground water which will, in effect, drain or reduce the water levels in their natural confines? This is a question of considerable importance in terms of water quality since there does not appear to be sufficient data regarding such intrusions, nor is there adequate permafrost information available for the region.

Many swampy area will have to be temporarily drained to bury the pipeline. Muskegs occur in depressions and flat areas and most often consist of a tightly interwoven network affecting large areas. The

drainage of such areas is of major concern since these waters have low pH and high organic matter content. The Teslin Lake area and Haines Road seemed most likely to be affected by this problem.

The excavation of a deep trench might affect the groundwater regime over extensive areas, disturbing both vegetation and river regimes. The occurrence of potential aquifers should be examined for this reason. Should the proposed route cross the Yukon River upstream of Whitehorse at Marsh Lake, adequate measures should be implemented to protect this waterway from the introduction of contaminants during construction and operation since the system feeds into Schwatka Lake, a water supply for the City of Whitehorse.

In the vicinity of Quill Creek, west of Kluane Lake, is an abandoned or discontinued mining operation (Hudson Bay Smelting), where the proposed pipeline runs immediately adjacent to the old tailings pond. The proponent should take adequate measures to ensure the ground water in the vicinity not be disturbed so as to tap the pollutants underlying this deposition.

Proponent's Submission

No mention is made of potential hazards to the ground water regime. While this concern is minimal in the NW section of the Foothills route, it is nevertheless of potential importance near Whitehorse. Also, there is no acknowledgement of hazard to surface waters through draining of swampy areas or trenching a corridor of impervious material.

Finally, reference is made to placer activities in Carlick and Burwash Creeks but no mention of old mine tailings as a potential source of water pollution is made. Attention should be drawn to the occurrence of such tailings so that these areas can be avoided in the route selection.

Terrain

1. Permafrost

The southern limit of widespread discontinuous Permafrost passes through Destruction Bay which is at approximately milepost 125 of the pipeline. The permafrost in this area is discontinuous but widespread

with some permanently frozen soils containing massive ice inclusions. The most sensitive terrain is in this section as the surficial soils are mainly peat, highly erodable volcanic ash, fine sands and silts.

Permafrost throughout the balance of the pipeline is more discontinuous and probably is present less than 30 percent of the distance between milepost 125 to 215 and from 11 to 15 percent over the balance of the route.

Special precautions to retain the permafrost within the area of the pipeline trench by chilling the gas at or below $0^{o}C$ is only proposed for the first 40.8 miles. At mileage 40.8 the gas will be heated and maintained at a temperature of between $15^{o}C$ and $27^{o}C$ throughout the balance of the pipeline route in the Yukon. Thus, operations of the proposed warm pipeline will cause significant changes to the permafrost. In that portion where chilled gas will be piped, some permafrost degradation prior to activation of the pipeline will occur.

Further permafrost degradation can also be anticipated when the pipeline is abandoned and areas previously frozen by the cold pipeline thaw and settle.

In the warm pipeline section and particularly in the areas where the soil is ice-rich, permafrost degradation could lead to a number of problems such as ground settlement, diverted drainage, slope failures and erosion. From an environmental standpoint, the major impact would be on established surface water runoff sources and possibly groundwater sources if the pipeline trench acts as a trench drain. There will be a need to protect adjacent landforms from erosion and to protect existing streams from increased siltation particularly in areas which would impact on fish and domestic water supplies.

2. Granular Materials

Foothills has estimated that 2,100,000 cubic yards of granular material will be required for backfill, surface gravel on sites and roads and concrete aggregate. The estimated amount of granular material required will in all probability be exceeded. If this is the case, then new borrow areas will have to be developed along with the

necessary access haul roads. This concern is based upon the fact that:

a) No allowances have been made for rip-rap and granular bankets which will probably be required for bank stabilization at river crossings.

b) If the pipeline is laid on a ground pad and covered with a granular borrow at fault zones, this again could increase requirements for granular materials considerably.

c) It is questioned if adequate allowance has been made for the amount of rip-rap and granular material required for toe embarkments and slope stabilitization to control earth movement on the steeper slopes crossed by the pipeline.

In addition, there is a concern that demands for additional granular resources of the region will arise due to the Shakwak project.

The methods of dealing with overburden materials in the borrow pit areas and the disposal of fine-grained, high-ice content materials from trench excavation have not been discussed.

These materials, if improperly dealt with, could have a considerable impact on the siltation of adjacent streams well beyond the initial construction period.

B. Vegetation (Forestry) Concerns

The following issues have been perceived, tentatively at least, as areas which may be of significant environmental concern. These may be substantiated or refuted by further information.

1) The deviation of the proposed pipeline route from the Alaska Highway will mean traversing currently undisturbed land. This in itself will create a concern and every effort should be made to stay as close to the highway right-of-way as possible. The fact that the highway offers all-weather access for construction and maintenance, plus the minimization of the need to create disturbances in pristine areas should rank high in the site selection of such a pipeline.

2) There will be disruption of drainage patterns along the pipeline route, which will result in changes in ground and surface water regimes and subsequent vegetation changes which may lead

to the elimination of significant tracks of forest, loss of merchantable timber, land and mudslides, slumping and thermokarst which could also result in threats to the integrity of the pipeline itself. The results of maintenance and repair activities may add additional impacts beyond that of initial construction of the pipeline. To protect against probable drainage problems, areas where these are likely to occur should be identified.

3) The pipeline corridor will maintain its own unique environment for decades and should therefore be considered in the context of future land uses in the area.

4) Direct vegetation loss along the pipeline right-of-way, at compressor station sites, work camp locations and borrow areas will produce an aesthetically displeasing effect. As well, exposed river banks, hillsides and bared slopes will be subjected to sheet and gully erosion, and thermokarst slumping in permafrost areas. The above may result in potential danger to the integrity of the line itself with subsequent maintenance and repair activities having the potential for further damage to the environment.

5) The risk of forest and grass fires is high during clearing and construction in the Yukon and prairie areas. The immediate danger from this is the destruction of timber, vegetation and some wildlife followed by the erosion of soil from areas exposed by the burn. In the grazing areas, the danger from the fire itself is similar, but a further underlying problem created by fires is the removal of forage, which might place a heavy economic burden on domestic livestock operations.

6) There is the possibility of plant community destruction from spills of sewage or other toxic or hazardous materials along the right-of-way of highways, access roads, and at compressor stations, work camps, storage and/or waste disposal sites.

7) The proposed pipeline route runs through the most productive forest areas in the Yukon, particularly in the valley bottoms.

The direct effects of a pipeline in such areas could be the loss or partial loss of merchantable timber now and the preclusion of forest production along the pipeline right-of-way for decades. Indirectly, forest stands flanking the cleared pipeline right-of-way would be exposed to wind damage, frost cracks, sun scalding, and subsequently these stands would be subject to insect and fungal infestation. The final result could be a disruption of forest productivity over areas extending beyond the cleared right-of-way.

8) The proposed pipeline route traverses an area within which the degree of baseline information on vegetation varies between slim and none. There is the possibility therefore, that unique plant communities may be damaged or destroyed.

9) As an alternative means to the disposal of slash material as proposed in the submission, (e.g., burning over the covered pipeline trench), consideration could be given to using the slash as an insulation material.

10) It is probable that demands placed on local industries for construction materials will provide pressures for increases in forest products. This could result in the ultimate reduction of the capacity of Yukon forests to yield an annual harvest at a sustained level.

C. Climatological and Air Quality

1. The siting of compressor stations to minimize "air quality" effects

The dispersive capability of an air volume is directly related to the air flow through the volume, and the air stability within the volume. These, in turn, are directly related to the topographical constraints on the air volume. Volume 5B-1 contains no documented discussion of these topographic effects, nor of their consideration in the siting of the compressor stations.

2. The adequacy of presently available meteorological data to estimate the dispersion capability of the air volumes at each of the seven compressor stations

Listed wind data (para. 2.1.2.1, Page 59) are obtained from obsolete wind normals. Canadian Normals Vol. 3 (1975), in addition to containing updated wind information for Snag, Teslin, Watson Lake

and Whitehorse, contains wind data for Burwash and Haines Junction, while the publication, "Monthly Record of Meteorological Observations in Canada" contains wind data for Beaver Creek and Kluane Lake. Wind analyses for Snag, Whitehorse, Teslin and Watson Lake are not accompanied by discussion on the relevance of these to compressor sites, and only data for annual, January and July wind frequencies are included.

No attempt was made to analyze radiosonde data for Whitehorse, or to quote published normals (a Preliminary Climatology of Ground-Based Inversions in Canada - R.E. Munn) in order to discuss the low-level air stability in the vicinity of compressor stations.

Probable and possible ground-level concentrations of CO, SO_2, and NO_x in the vicinity of compressor stations are not calculated, and attempts to relate such concentrations to effects on lichens, etc., have not been made.

3. Effects of water vapour emitted at the seven compressor stations by the burning of natural gas (methane) as fuel

Para. 2.1.2.1 (Page 382) contains a brief reference to the fact that ice fog could occur, while Tables 13 and 14 list visibility restrictions documented in the 1941-1951 period. Much later and more complete visibility data are available.

It should have been noted that a gas turbine compressor of 29,000 (ISO) H.P. consumes 4,316 cubic metres of natural gas (methane) per hour and emits approximately 8,200 kilograms of water vapour per hour. Using normal daily wintertime temperatures and relative humidities for the southwestern Yukon, the addition of only 8,700 kilograms of water vapour is sufficient to saturate the air within one half mile of the compressor station to a depth of 100 feet. Accordingly, if a compressor station is located next to, or just upwind of, the Alaska Highway, that section of the highway may be subject to extended periods of dense ice fog in winter, with a consequent effect on road traffic and airport activity. This may be the major "air quality" effect of the pipeline.

4. Emission of sound due to the operation of compressors

Para. 2.1.2.1 (Page 383) does not contain mention of the effects of cold temperatures and low-level inversions on the transportation of sound from the compressors.

In summary, no clear relationship between meteorology, topography and "air quality" has been shown in Volume 5B-1 such that they can be incorporated in the siting of compressor stations, while the use of the latest complete meteorological data is recommended.

D. Wildlife Concerns

As indicated in the introductory remarks, concerns respecting non-migratory birds (raptors and upland birds) and mammals (ungulates and fur-bearers) are being covered by the Yukon Territorial Government.

The Wildlife section of the N.E.B. submission, Volume 5B by Foothills Pipelines Ltd. gives a good account of published information but contains very little new data. Because of this, the statements made and conclusions reached in the report are of little value to specifically address environmental impact assessment of a proposed pipeline in the Alaska Highway corridor. Data presented in the report may be used to plan more intensive wildlife studies necessary for the preparation of an environmental impact statement.

1. Migratory birds

Activities associated with the pipeline construction and its operation interact with the migratory bird resource in a number of ways. These interactions or impacts, in a general vein, are amply discussed in various existing impact statements that deal with northern projects. The proposed Pipeline raises similar concerns. The Canadian Wildlife Service is concerned about the harmful effects of the subject proposal on migratory birds and their habitat. Birds may be affected directly or through their habitat requirements, during breeding, brood rearing, molting or migrating. General concerns may be grouped as follows:

1) direct loss of habitat due to requirements for right-of-way and pipeline associated facilities;
2) impairment of wetland habitat due to changes brought on by the pipeline in the water regime;
3) disturbance of birds during construction;
4) disturbance of birds during operation;
(the above two points refer to presence and activities

of humans and their machines, i.e. heavy equipment, aircraft, compressor stations.)

5) direct mortality caused by toxic substances accidentally or otherwise released;

6) increased human use, recreational or otherwise brought about by the provision of increased access.

Data is lacking in this regard along the Alaska Highway in the Yukon. Without such data it is not possible to make acceptable prediction on the magnitude, frequency or likelihood of adverse impacts or to propose specific mitigating measures. Some specific comments on the N.E.B. submission follow:

a) information on species and numbers of even the major avian groups utilizing the area is lacking;

b) ground truth surveys for all aspects of bird use are lacking;

c) some wetland areas have been identified as migration and production areas but their relative importance to the Yukon have not been considered;

d) waterfowl habitat in addition to major wetland complexes has not been identified and very little attention was paid to submergent vegetation in ponds and lakes;

e) such bird groups as shorebirds and passerines were all but ignored.

2. Non-migratory birds

Lack of site specific information relative to such bird groups as raptors and upland game birds precludes the assessment of impact of the proposed pipeline.

3. Mammals

a) Moose in the Yukon, unlike those in more southern areas, tend to concentrate at certain seasons (Preliminary survey information, Yukon Game Br.). This information is not entirely in agreement with the report. The problem of increased exploitation due to increased access should be identified as an impact of the pipeline. In light of the above, investigations into moose habitat (i.e., limiting factors, discreteness, productivity) may be regarded as

part of an impact statement. Such data is lacking.

b) While the proponent has recognized the potential for impact upon sheep and that this impact may extend beyond the construction phase, protection measures deal almost entirely with the construction phase and concentrate search for solutions to potential problems in the areas of timing of construction, employee training and route refinement. The possibility of realignment in critical sheep habitat needs further examination.

c) In spite of a virtual absence of baseline data on caribou, an impact prediction is formulated which tends to minimize conflict. More information is required to add credibility to the proponents prediction.

d) Grizzly populations in the Donjek and Kluane ranges and in the Alsek River Valley are of concern from the point of view of protecting denning areas and individual animals which may become camp nuisances. Therefore information on denning areas should be refined. Bears located outside the Kluane - Donjek area, which may have other habitat requirements are not generally covered in the report. Field studies have not been done to support the statement that denning areas will not be bothered because of their altitude.

e) Furbearer habitat and potential impact of the pipeline on these animals has been handled in a somewhat superficial manner. More information on sensitivity to construction activities on the behaviour of fur bearers is needed.

E. Fisheries Concerns

1. Summary of Comments on the Environmental Atlas

The atlas provides a very coarse, yet graphic, glossary of the pipeline-resource conflict. From a fisheries resource stance the information in the atlas is vague, not quantified and incomplete.

The information presented on fisheries utilization may be incorrect in view of recent data on overwintering sites, spawning and rearing areas provided by Fisheries Service studies. Species composition, abundance and timing would be a beneficial and essential supplement to the atlas.

2. Summary of Comments on the Environmental Report

The present environmental statement of Foothills Pipelines is very limited in any aquatic resource data. Available data was used to provide information on the environmental setting and the technical project information. As a result of obvious data shortages in these areas, the report itself presents a very limited base to assess a potential impact to the aquatic resource, as a consequence of pipeline construction.

There is no solid information on species composition, distribution and abundance, timing and utilization by fish in rivers adjacent to the pipeline corridor.

From a fish resource viewpoint, the major impact of pipeline construction will be specific to the crossing site. Obstruction to fish passage (upstream and downstream), channelization and siltation at and downstream from the crossing site are major sources of impact. To effectively mitigate the impact on the resource, data specific to the impact area is required. Aquatic habitat characteristics, timing of life cycle stages, and species composition are essential parameters to be assessed. With this data, stream crossings can be timed to minimize impacts on the fishery resource. Ideal timing would be a period when incubation had ceased, yet neither spawning nor overwintering timing would be affected.

The environmental statement by Foothills Pipelines does not provide the necessary information for mitigation. This information must be substantially upgraded before an effective statement can be made to determine, quantify and mitigate the environmental impacts of the proposed pipeline route.

3. Summary of Social-Economic Concerns

The "contemporary perspective" section of the submission makes limited reference to fishing activity. It is implied, but not supported, that commercial fishing has limited potential. There is no assessment of the importance of domestic fishing.

Recreational fishing (and other forms of water-related recreation) are not discussed in sufficient detail. Considering the importance of tourism and of access to recreation opportunities for local people as well as transient workers in the Yukon, this is a serious omission. The special needs of the native populations regarding fishing are not specifically addressed.

F. Pipeline Construction and Related Facilities

1. Winter Construction Period

Concern has been expressed that the winter season may not be long enough to adequately protect the ground surface through the use of snow roads. This criticism is based on the concern that adequate consideration has not been given to annual variations in climate, snowfall and frost penetration.

The winter construction period would be critical for the 40.8 mile sections where the pipeline would operate below $0^{o}C$. If winter conditions were such that the pipeline section could not be completed without damage to the surface insulating mat, then the pipeline completion could be delayed for another year. With respect to the balance of the pipeline route where gas above $15^{o}C$ would be flowing, thermal degradation of permafrost adjacent to the pipeline trench will take place irrespective of proposal construction practices. This concern then is primarily for the section of the right-of-way outside the thermal zone of influence of the heated pipeline. However, on areas of permafrost, where grading and slope cuts are proposed, the concerns are also academic unless some form of insulation to protect the permafrost is contemplated. If insulation of the exposed mineral soil is being considered, it has not been illustrated in any of the available Foothills material received to date.

On the same topic, in the submission of the Technical Project Description, section 4.2.1 Construction - Yukon Section, the applicant speaks of curtailing construction operations during cold winter months, and under Environmental Concerns and Protection Measures, section 1.2.1

Natural Slopes, speaks of areas of sensitive permafrost terrain, and preparation of right-of-way will be carried out in winter.

The applicant's reference to winter construction schedules is not supported by reasoning based on climatological data. Weather conditions such as extreme cold, blizzards, which may curtail construction activity are not specified. Threshold conditions necessary for winter construction in sensitive permafrost terrain (i.e. temperature, frost penetration, snow cover) are not specified. The concern is that, on the basis of information provided, no adequate assessment can be made as to whether or not the applicant's construction schedule is in fact realistic.

There is a need therefore for further specification as to under what climatological conditions "construction of right-of-way will be carried out in winter, in sensitive permafrost terrain," as well as the threshold conditions which will curtail winter construction activity, and supported by climatological data, estimate the number of days during a winter the construction would be curtailed because of weather.

2. Construction Camps and Storage Depots

Foothills is considering several different categories of construction camps required for the project. These include the mainline pipeline construction crew camps, the mainline auxiliary (front-end) camps, small logistics (material transfer location) camps, and compressor station construction camps, all of which would be equipped with their own kitchens and service facilities.

Except for compressor station camp sites, none of the construction camp sites or material and fuel stockpile locations have been selected closer than a milepost designation. All camp and storage sites, other than for compressor stations, will be selected in close proximity to the Alaska Highway or other existing all-weather roads.

The information contained above is not sufficiently site-specific to enable an environmental evaluation to be made. The rationale for the auxiliary camp sites is also questionable in consideration of winter working conditions. One could expect that portable camp sites with a minimum of kitchen and washroom facilities would be provided. If

this were to occur, their water supply would be trucked in and the method of holding and treating waste could change considerably from that for a fixed camp operation.

3. Camp Water Supply, Sewage Disposal and Solid Waste Management

These are to be designed according to site-specific conditions. An environmental evaluation can therefore not be made except in a very general nature.

Foothills has indicated that sewage from construction camps will receive the equivalent of secondary treatment prior to discharge. This may not be adequate treatment for discharges into some of the smaller streams frequented by fish, and particularly during the low winter stream discharge periods.

Design of treatment plants should also consider the fact that work camp sewage is stronger in BOD_5 and suspended solids from that of an equivalent number of people in a domestic situation. Consideration will also have to be given to the peak loading periods and its impact on treatment plant operations.

More information is also required on operator requirements and how continuity of trained system operators will be maintained. Information is also required on the startup and shutdown procedures for all of the treatment systems proposed.

Foothills has also supplied a minimum of information on solid waste handling procedures for the project. More information is required on the types and classes of solid wastes to be handled; on volumes generated; summer and winter operating procedures on the widespread discontinuous permafrost areas; disposal of hazardous and toxic materials; disposal of construction materials, drum, and discarded and/or broken equipment; selection standards for and types of incinerators being considered; etc.

4. Handling and Storage of Hazardous Material and Fuel

With respect to hazardous materials, fuel storage and handling, and equipment maintenance, Volume 2 Section 2 contains certain statements which hopefully will be refined by the company as further information is acquired. Such statements are also found in Volume 5 Page 11, e.g., "contingency plans and strict controls over toxic substances will minimize the number and effects of accidental spills". However, pages 481-483 inclusive of Volume 5 indicate that the company does in fact have a reasonably strong awareness of the type of problems which may arise and how they should be avoided or their effects minimized.

Comments from Volume 5B pages 480, 492 and 493 also indicate an awareness of the necessity for contingency plans.

Protection measures and personnel training have also been addressed in the documents; however, more information will also be needed on these areas.

The following is a list of comments and questions which have arisen out of the review of the Foothills document.

a. The use of methanol or water/methanol is listed in Volume 7 as a hydrostatic fluid. In volume 5B there are two references to the use of methanol, but in both cases the text indicates it will not be used. Also in Volume 5B, methanol is included in a list of substances likely to be encountered under spill circumstances. Clarification is needed in this situation.

b. In volume 5B there are several references to the dyking and location of dykes. In one section the dyke was to be impervious and "where possible away from critical aquatic habitat". Further on in the same volume, "All fuels and other toxic materials will be stored away from aquatic systems and within impervious dykes." The second statement better represents good handling and environmental concern by leaving out "where possible" and "critical". This inconsistency should be pointed out to Foothills and the second statement inserted in the final document.

c. Specifications for ensuring impermeability of all dykes for fuel and toxic/hazardous materials should be provided by Foothills.

d. In the outline on Pages 463-481-482-483, Volume 5B, the company admits the plan is primarily meant for petroleum products, indicating that due to small volumes, other hazardous materials will not be environmentally significant. The company should amend this plan to ensure adequate protection measures in the event of a spill other than hydrocarbons. The importance of proper hazardous material control and spill clean-up procedures must be recognized.

e. The "Recommended Environmental Standards for the Design and Construction of a Mackenzie Valley Gas Pipeline" uses 3,800 litres storage tank capacity as the lower limit for dyking such tanks. The Foothills application indicates "large" fuel storage areas will be dyked. It is anticipated that a similar standard will be made applicable to the Foothills Company should it bid successfully on a northern pipeline.

f. There was no mention of landfill as a disposal technique. There should be a statement on this technique if it is proposed.

g. Much more work is required by the applicant on restoration of spill sites. At present, the applicant states, Page 412, Volume 5B, "If deemed necessary, the affected area will be rehabilitated following site inspection."

In conclusion, the applicant has provided a minimum of detail concerning the acquisition, type, use for, emergency handling and disposal of hazardous materials.

5. Restoration, Revegetation and Abandonment

In regard to the Foothills submission concerning abandonment, restoration and revegetation the following deficiencies were identified:

a) "Clean-up", as used by Foothills, apparently means site restoration. Clean-up plans relating to removal of equipment and debris are not specifically addressed by Foothills.

b) Foothills plans to restore the construction zone "as nearly as is feasible to its original condition to provide restoration of natural drainage patterns..." "Borrow pits are to be graded to allow for revegetation where desired." Restoration would include either erosion control measures and revegetation, or deposition of gravel fill as appropriate for stabilization of the right-of-way. Erosion control measures including placing of granular fill, right-of-way berms and diversion trenches across the right-of-way, and installation of backfill and rip-rap at stream banks would all be completed immediately following winter construction". Applicant's plans for repairing excavations, grading cut banks, removing dykes, closing airstrips and roads, replacing topsoil, constructing berm breaks, phasing out sewage lagoons and recreating natural drainage patterns are not specifically addressed.

Foothills revegetation plan is not sufficiently detailed to permit an assessment. The applicant has conducted good research into species performance under varying conditions, and apparently will have adequate supplies of native species seeds. Deficiencies are:

1) Foothills plans to revegetate only "where it is deemed necessary..."
2) Aerial seeding is planned but only ground seeding has been tested;
3) A minimum acceptable level of revegetation success has not been specified nor has their monitoring program been presented;
4) Seeds or stock free of parasites, disease or fungicides have not been specified;
5) Methods of use of aircraft or ground vehicles during revegetation to prevent disturbance to wildlife and to the vegetation mat have not been specified.

G. General Concerns

In addition to the preceding comments, there are a number of general concerns that have been identified. These are as follows:

1. Little information is provided on the total or combined environmental impact of the proposal on the Region or indeed on the longer term implications of establishing an energy corridor which may be expanded to accommodate additional facilities (such as pipelines) at a later date.

2. The paving of the Alaska Highway from Haines Junction north to the Alaskan border, and the connecting road south to Haines, Alaska up to the B.C.-Alaska border will have a definite impact on approximately the northern 200 miles of the proposed Foothills pipeline. Although they would span different time periods, these two projects should not be considered in isolation with one and another. However, some of the construction scheduling conflicts could be resolved, if they both proceed, to the benefit of protecting the environment.

Consideration should therefore be given to the use of the abandoned right-of-way and bridge structures for the support of the pipeline. In addition, it may be possible to design the new bridge crossings so as to support the additional weight of a pipeline. Camp site and storage site usage could be coordinated.

3. The rationale for major pipeline routing deviations from the highways right-of-way in such areas as Teslin Lake, Kluane area and Squanga Lake have not been well documented. In addition, the environmental effects of new rights-of-way and access roads to these previously inaccessible areas is a concern which has not been dealt with in an adequate manner.

III. A PRELIMINARY EVALUATION OF CONCERNS ON THE TINTINA TRENCH, THE DEMPSTER AND THE KLONDIKE VALLEY ALTERNATES

Concerns on these three alternate pipeline routes are essentially the same as those determined for the Foothills route. However, this statement and the following information on the above areas must be considered at best tentative at this time and are likely to change either in amplitude or direction with further field input.

A. Hydrology and Terrain Concerns

Permafrost, rough terrain and delicate vegetation complexes on the tundra are considered to be of great concern in the alternates at this time. As can be seen by the following information -

1. Dempster Highway

The major environmental concern on this route is like to be permafrost. At mile 50 (North Fork Pass), the following information has been brought forth:

Alpine Tundra under permafrost regime. Very delicate, as can be seen from a few construction cuts which have become gullies. Great care is being taken by road builders to avoid cuts. How can this problem be overcome in pipeline construction?

In the Eagle Plains, (Mile 152-225) there is continuous permafrost at ½' to 1' below surface. Road follows summits and crests of gently sloping hills showing exposure of shale and sandstone.

Construction in this area will likely result in an increase in suspended sediments and organic materials in streams and rivers; possible drainage diversion.

In the footslopes of the Richardson Mountain, (Mile 242) there is very fragile tundra with permafrost at ½'. Tributaries to major streams

do not have exposed channels but form distinct seepage lines. Drainage was observed in active layer near surface. Pipeline excavation might trigger development of new drainage patterns.

2. Klondike Valley

Concerns along the Klondike Valley route relate largely to bank and channel bed stability.

In the area from Carmacks to Minto on the Yukon River, the road follows the Yukon River along eastern banks where slope stability could be a problem. This is most evident at Tatchun Creek crossing where extensive slumping has occurred on the southern banks; gullies are evident on the northern slope. There is also permafrost.

The impact of construction here could produce a possible increase in suspended sediment load and organic material during construction and maintenance could cause serious depression of dissolved oxygen during discharge under ice cover.

From Stewart Crossing to Slough Creek along the Stewart River there is a very active and wide river bed with frequent channel changes. Old banks are steep and high, actively eroding along outer banks of meanders. Both the north and south banks are susceptible. Special consideration should be given to permafrost areas.

In the area of the Flat Creek Junction with the Klondike River, bank undercutting at junction with Klondike River is common. Placer activity in various Flat Creek tributary introduces additional sediment load. There are bedrock exposures along the sideslope with a small relatively steep footslope of debris at the base. The road crosses this footslope in several places. The Klondike River then crosses extensive reworked placer gravel from 1900 Klondike mining activity.

Flat Creek and Klondike River already carry heavy sediment load as a result of man-made activity; further impact in this area from pipeline construction may be a factor which requires further investigation.

3. Tintina Trench

Due to the rugged terrain in the Tintina Trench, special consideration should be given to overcoming environmental concerns associated with permafrost. The 60 miles of Tintina Trench where no man-made activities now exist must be paid special attention in the introduction of such activities.

B. Vegetation (Forestry) Concerns

In identifying general concerns regarding these alternate routes, the issues previously identified in the review of the Foothills' document are generally applicable. The initial concerns are identified as follows:

1. Clearing and/or construction of the pipeline and its ancillary facilities will remove or alter significant areas of vegetation cover. Also, because new access will be necessary on the alternate routes, the land to be disturbed will be considerably greater than if the currently existing highway right-of-way was to be used.

2. Drainage patterns will, as with the Foothills proposal, be disrupted and will likely result in vegetation changes.

3. SO_2 from compressor stations may have some effect on sensitive organisms and plants.

4. If alternate routes are used, it is likely that several proposed ecological reserves will be crossed.

5. In permafrost areas, the removal of plant cover could lead to thawing which may cause changes in drainage patterns, land and mud slides, slumping, thermokarst and ultimately re-vegetation problems.

6. When pipelines and access roads cross stream valleys, clearing of right-of-way and surface disturbance will remove portions of the most productive plant community in the area.

7. Deficiencies in information - The most obvious deficiency lies in the fact that no group has yet looked specifically at the alternate route corridors on a concentrated effort basis.

C. Climatology and Air Quality Concerns

1. Because of the lack of meteorological data along the route, it is difficult to assess (a) the dispersive capability at sites of compressor stations and hence the appropriateness of their locations, (b) ground-level concentrations of emitted pollutants, (c) the effects of these pollutants on sensitive flora and fauna.

2. A major concern is the formation of ice fog in winter resulting from the emission of water vapour, with its consequent effect on highway traffic and on possible construction and maintenance airfields which may be located adjacent to compressor stations.

3. Emission and transport of sound due to the operation of compressors.

To satisfy these concerns, it is desirable to establish a network of meteorological stations to obtain baseline data on low-level air circulation, temperature, precipitation and air stability.

D. Wildlife Concerns

Information on migratory and non-migratory birds, as well as ungulates, is minimal and in most cases non-existent along the alternate routes considered. This lack of information precludes a meaningful comparison with the proposed Foothills route. Information, however, on the yearly life cycles of these animals along the alternate routes is essential both for a comparison with the Foothills proposed route and also for an evaluation of environmental impact within those corridors.

In summary, the general points of concern are:

1) Direct loss of habitat (and displacement)
2) Impairment of habitat
3) Disturbance during construction and operation
4) Direct mortality due to toxic substances
5) Increased human access to animal populations

Some information does exist on the biology of the Porcupine Caribou herd and its relation to the Dempster Highway. Such information indicates that activities and noise associated with highway construction have a disturbing effect on the animals.

E. Fisheries Concerns

The virtual absence of information on the fisheries resource in the alternative route zones precludes the detailing of concerns at this time respecting overwintering sites, spawning and rearing areas, species composition, distribution, abundance, as well as present use of the fish resource.

F. Pipeline Construction and Related Facilities

The general concerns at this time regarding these alternatives is that the information required to prepare guidelines for design and construction is unavailable. Nevertheless, several factors emerge even at this early date as potential problem areas. These are as follows:

1. Dempster Lateral

Problem areas regarding borrow operations, cuts and fills in permafrost areas and alignment.

(a) Water Supply

The supply of potable water for large camp installations will be a problem, especially in the Eagle Plain area. Some of the highway construction camps with much smaller crews than those envisioned for a pipeline had to haul water from various distances. The magnitude of this problem will depend on camp size, location and season of operation.

(b) Waste Disposal

i Sewage

All camp sewages will require at least secondary equivalent treatment and have appropriate cold weather protection.

In the Eagle Plain area, especially, effluent disposal from large camps will be a problem since there are few receiving waters.

The problem is site specific and depends on camp size, location, season, and duration.

ii Solid Waste Disposal

Disposal of large amounts of camp-type solid waste could create problems in the higher portions of the route. Discontinuous permafrost and lack of borrow material could

restrict the use of landfill sites.

Disposal methods and locations will have to be specified.

iii Air Quality

Areas where open burning is to be carried out should be specified. If incinerators are to be used for solid waste reduction they should meet the federal incinerator specifications.

(c) Transportation of Men, Supplies and Equipment

The majority of material transported to the construction zone will move along the Dempster Highway both from the south and the north.

The initial concern is the construction schedule since movements will be affected by weather and wildlife restrictions.

The siting of staging and stockpile sites, especially if men will be accommodated as well, will produce waste management requirements.

2. Klondike Highway

This proposed route follows a well established highway corridor and therefore the concerns would be similar to those for the Alcan route.

With respect to waste supply and waste management and disposal, information is required on camp location, size and type. Operational requirements could be site specific. Availability of water supplies and waste receiving waters would not be as critical as for the Dempster lateral.

(a) Transport of Men, Supplies and Equipment

The proposed route parallels an existing transportation route, hence there should be a minimum of environmental disruptions by the moving of men and material. If there are supply camps involved, waste management concerns listed previously would be applicable.

3. Tintina Trench Route

For this route proposal, very little is known about it other than a line on a map. In general, however, those concerns listed above on water supply and waste management would be applicable, i.e., more route specific and site-specific information.

G. General Concerns

It is likely that all alternate routes including the Dempster lateral will require major access road construction paralleling the pipeline route to supply materials and manpower. This will put an added stress on the surrounding environment, both during the construction phase; as a result of the additions of manpower, materials, and the extension of the amount of time which must be spent in the area to complete the additional work, and after construction; as the new access roads will open up previously inaccessible areas. Concerns regarding such supporting facilities may equal or even exceed those of the actual pipeline itself.

H. Summary

For all three routes proposed there are the following information deficiencies:

- specific route locations
- proposed construction schedules
- construction spread lengths
- construction camp sizes, locations and types
- compressor station locations
- transportation methods and schedules
- management of fuels and hazardous materials

Also to be considered are:

Alignment - interference with small water bodies
- runoff interference
- slope stability and erosion
- permafrost conditions

Borrow Pits - location
- screening
- volume of material

Construction - clearing, less than one year in advance of construction
- off right-of-way travel restrictions
- possible restrictions on gravel removal from stream or active flood plain
- similar environmental consideration for all peripheral activities, eg., borrow pit and access road construction
- revegetation measures
- maintenance of drainage patterns