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REVIEW
OF THE ENVIRONMENTAL IMPACT STATEMENT
ALASKA HIGHWAY GAS PIPELINE IN THE YUKON TERRITORY

MARCH 1979

**Inland Waters Directorate
Pacific and Yukon Region
Vancouver, B.C.**

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CONTRIBUTIONS TO REVIEW REPORT

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January, 1979

APPENDIX B - Water Planning and Management Branch
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February 23, 1979

APPENDIX C - Hydrology Research Division
Water Resources Branch
Inland Waters Directorate
Calgary, Alta.

May, 1978

November, 1978

February 20, 1979

March 6, 1979

March 14, 1979

APPENDIX D - Glaciology Division
Water Resources Branch
Inland Waters Directorate
Ottawa, Ont.

February 6, 1979

February 8, 1979

ANNEX 1 - Review of Yukon Environmental Terms, Conditions and
Related Guidelines, Alaska Highway Gas Pipeline,
Draft II, dated February 1, 1979

ANNEX 2 - Reports on Studies Related to Alaska Highway Gas Pipeline
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REVIEW OF THE ENVIRONMENTAL IMPACT STATEMENT
ALASKA HIGHWAY GAS PIPELINE IN THE YUKON TERRITORY
INLAND WATERS DIRECTORATE

INTRODUCTION

Preparatory studies for the review of the Foothills' EIS extended over a period of 18 months and culminated in the four-book report entitled "Water Investigations Along The Alaska Highway Pipeline Route In The Yukon Territory", dated December 1978.

The EIS was received on January 15, 1979.

Review of the applicant's proposal constituted an appraisal of:

1. Identification of environmental concerns,
2. Actions proposed for mitigation of the concerns.
3. Methods and basic data upon which the proposals are based.

A brief format was chosen for the report for two reasons:

- a) Limitation in time available, and
- b) Belief that the purpose can be best served by including only the essentials. Further, since the EIS concentrates mainly on principles, theory and assurances, the mile-by-mile approach for the treatment of concerns was considered to be inappropriate; instead only the more critical ones have been selected.

Since the project had received authorization to proceed, conditional only on certain stipulated requirements being satisfied, Foothills should have directed more emphasis to site specifics and mitigation rather than to reassurances. It would now seem that the most effective departmental strategy would be the requirement for the Environmental Terms and Conditions to pick-up the more important outstanding deficiencies.

ENVIRONMENTAL CONCERNS

Many aspects of the design of the pipeline and access roads depend on the nature and frequency of snowmelt and storm related surface and subsurface runoff; further, for regions underlain by permafrost, effect of man-induced changes in the thermal regime on the groundwater flow and icings must be considered. Considerable complexities exist in the hydrologic factors along the Alaska Highway because of the general lack of homogeneity in the manner and intensity that rivers respond to the climatic factors of temperature and precipitation. Processes on individual rivers are locally conditioned by variation in slope, bed and bank material, water velocity and depth. An adequate understanding and consideration of the river's behavior is essential in order to make intelligent design decisions where surface and subsurface hydrology is concerned.

The quality of water is dependent on such aspects as dissolved oxygen concentration, level of dissolved minerals, supply of microorganisms and level of turbidity. Unfortunately the present knowledge of the northern aquatic systems is very limited; also very little can be extrapolated from the much larger southern pool of knowledge of the aquatic systems because of their different characteristics. Consequently, careful attention needs to be paid to the peculiarities of the northern aquatic ecosystems in the planning of various phases of pipeline construction.

A. SCHEDULING

The information collected by Inland Waters Directorate's Water Quality Branch has suggested that oxygen depletion would be a serious concern particularly under winter conditions. Since all three sections of the pipeline route scheduled for winter construction involve the Yukon River Basin, known to experience low dissolved oxygen levels under ice, further information and mitigation would appear to be necessary if proposed schedule is to be retained.

B. DESIGNa. Small Streams

The proponent provided 11 stream and one lake crossing concepts, and a listing of channel characteristics for many streams to illustrate design problems expected at any stream along the route. He used this procedure to display on a step-by-step basis the typical procedures and analytical techniques that would be used in design. Northwest Hydraulics Consultants Ltd. were retained to study streamflow hydrology with the objective of determining design peak flow values (Annex Number 14).

The approach taken utilizes hydrologic equations depending upon regionalized runoff coefficients. These coefficients are estimated from a knowledge of the measured streamflows at hydrometric stations, and from modifications of these as necessary based upon hydrologic judgement. The approach is generally adequate for larger streams, particularly in areas where flow data is available. However, when applying this approach for small streams in areas where there is no hydrometric data, particularly the area west of Haines Junction, the result is almost wholly dependent upon the judgement of the hydrologist. For example,

in attempting to confirm the sample design flood for Beaver Creek, the map listing the coefficients must first be consulted to estimate the appropriate coefficient. (Note that our copy of the EIS did not include this map, although it is referenced in defining the method of computing discharges). The nearest measured streams having known values for the appropriate coefficient are about 80 km to the west in Alaska, in territory that appears to have quite a different hydrologic regime, while in Canada the nearest data is 140 km to the east at the outlet of a large lake. The relevant parameters at these data points vary from 0.60 to 2.22, meaning a difference of almost 400 per cent in computed discharges. The computed flows using this method are completely dependent upon this parameter and the estimation of the parameter is in turn heavily dependent upon the judgement of the hydrologist.

We agree with the statement in the report, "For small steep basins in the Kluane area, where few relevant data are available, the rational and related methods are considered appropriate as a check of other methods", however, there should be additional description of these other methods and of the selection of relevant parameters. Only two short paragraphs are devoted to explaining the "rational and related methods".

Confidence in the intended procedure for estimating expected estimates for a particular stream-crossing area could have been improved substantially by attempting to collect some data given the absence of published information. In fact the consultants, in explaining their recommended technique for calculating design flows for larger streams, state that due "to the limited data base and the extremely non-homogeneous nature of physiography and runoff in South Yukon" other approaches were found to be inappropriate. This should have provided some incentive for a hydrometric program at least at sample crossing sites.

Considering the many streams to be crossed, the non-homogeneity of runoff and the general inadequacy of climatic information, the small stream hydrology study falls short of what is required to judge probable effectiveness of the proposals, including those related to river hydraulics. It is not clear how culvert sizing is to be established. For roads crossing water courses necessitating the installation of culverts, it is necessary that culvert design be related to water flow in such a way as to maintain stream velocities within acceptable limits. Although the proponent states that culvert design will meet certain criteria (pages 3-13, 4-39, 4-50, 4-51, 9-2, 9-3 and 9-7) it is not apparent how hydrological considerations are to be taken into account. Where diversions are proposed such as that of the Congdon Creek, if Kluane Lake crossing is adopted, it is not evident how the proposed flood control works (Annex 10) will be sized. With respect to cross drainage across the right-of-way it is stated on page 4-39 that "size of culvert would depend on the characteristics of each drainage course", and on page 2-29 it is stated that "Depending on the quantity and nature of surface flows, measures will be implemented to direct water in a controlled fashion across all cuts." How will they know the quantity and nature of surface flows?

b. Slope Stability and Erosion - West Shore of Kluane Lake

This is one of the more sensitive terrain sections of the pipeline route that will be subjected to disturbance during construction and operation of the pipeline. Streams originating in the Kluane Mountain Range are high energy streams, have highly variable flow rates and are constantly changing their channels. This complex and dynamic attribute of the drainage constitutes a major threat to the integrity of the pipeline; consequently hydrology and hydraulics in this section of the route require relatively detailed attention, particularly with regard to icings, slope stability, scour and drainage. Very little reference (Section 6.2.4.1 (IV)) is made specifically to West Shore of Kluane Lake and no construction approach is put forward.

Most of these streams carry highly variable seasonal flows and great amounts of bed load. Periodically, a stream breaks out of its channel and cuts a

new course; eventually the process is repeated. Pipeline crossings in this area, therefore, must allow for shifts in watercourses. Consideration should be made for the pipeline to be buried below scour depth over the greater portion of the reach.

The proponent has not provided a specific plan for mitigative action. Information is required on artificial drainage system upslope and across the pipeline that may be required during excavation, and on the technique to be used for calculation of design flows and scour depths. For estimation of design flow, flood characteristics of streams in this area require to be obtained on a site specific basis; also since equations commonly used for calculation of scour depths are applicable to "incised" cross-sections only, a judicious selection of potential scour depth could best be made from results of a drilling program.

c. Erosion Control - Revegetation

The EIS's coverage of revegetation programs to minimize post construction erosion does not provide adequate information nor does it clearly outline the proposed plans of revegetation. A firm commitment by Foothills to a specific revegetation program is lacking. Lack of erosion control was shown to be the major contributing factor to the impact of sedimentation on watercourses in the Alyeska Oil Pipeline experience.

The "Actions Available and Planned" for erosion control (page 2-45 of the Overview Summary), include the statement that "upon completion of construction, disturbed areas will be revegetated". However, no specifics are given as to what types of revegetation will be undertaken or how, i.e., species of grasses, shrubs, hydro-seeding, etc. Even though the EIS reports that "studies of revegetation techniques at representative sites along the entire right of way have been under way for two consecutive seasons", none of these erosion control techniques or their scheduling are discussed. In fact, on page 8-13 of the EIS, the qualification is made that "a major approach to limiting surface erosion will be a program of revegetation on all disturbed areas where vegetative cover is not expected to regenerate naturally". There is

no amplification of where or how much of the disturbed areas are not expected to revegetate naturally. The criteria of natural revegetation capability would appear to be a poor one since time of restabilization of soils is by far the most critical factor. However, no information is provided on natural regeneration time for vegetation along the pipeline route.

In view of the importance of erosion control in protecting the water resources, assurances of revegetation should be accompanied by firm commitment to specifically outlined and scheduled programs. Currently, the EIS identifies no such activity in the construction schedule shown (see Fig. 4.1-1).

d. Sedimentation

The extent and seriousness of potential impacts of sediment loadings to streams from construction activities and subsequent erosion are somewhat underestimated in the EIS. In assessing the effects of siltation, the EIS states that "adverse effects on fishery resources and supportive food webs will be restricted to areas near crossing sites and to a short period during and immediately following construction activities" (page 2-33). However, in the Alyeska Pipeline experience sediment plumes were in certain cases visible 20 to 30 miles downstream from construction sites and latent erosion during subsequent freshets was a serious problem. The treatment of the potential sedimentation impacts, particularly on aquatic habitats, should therefore not be treated too lightly. The rationale that because "endemic aquatic biota are adapted to periodic high suspended sediment loads, most potentially adverse impacts will involve short-term stresses" presupposes that long term or permanent damage will not occur "since normal scour during the subsequent freshet will remove fines from the gravel areas" (page 8-9).

In normal course of events, as the freshet passes, the availability of transportable sediment decreases rapidly and in river reaches where the scour action is great, the bed is left relatively free of fine sediments and the water becomes relatively clear. However, if this normal pattern is altered by the artificial introduction of sediment during the period of declining discharge (i.e., the period when most rivers are scheduled to be crossed) when such sediments would not normally be available to the river,

deposition of sediment will take place in the interstices of the bed materials.

Consequently, minimization of erosion could be the single most important mitigating measure to which Foothills should be firmly committed.

e. Borrow Pits

Although the borrow requirements are estimated to be 2,592,800 cu. yds., EIS states that required quantities will be determined during the final design process. Similarly, the EIS states that at the time of writing borrow pit locations have not been selected.

For the construction of the Alyeska pipeline, gravel borrow was estimated to be 30 million cu. yds., but proved to be a gross underestimation. The higher demand was attributable in part to the shift from buried to elevated installation.

In the EIS the curves in Fig. 4.2-24, page 4-30 demonstrate that very large amounts of insulation and granular material would be required in those places where the frost heave was to be kept within tolerable limits. Should the use of the granular embankment design be more extensive than anticipated, borrow requirements would increase proportionately. This possibility linked with the anticipated need of 9,000,000 cu. yds. for the Shakwak Highway project could stress granular material supplies with increased amounts being removed from floodplains. The EIS notes that while it is anticipated that most borrow will be obtained from upland sites, stream floodplains may occasionally be used (page 4-47). To allow judgement to be made of the effect of such borrow operations information should be provided on borrow pit locations, along with a prioritization listing.

f. Groundwater

Potential involvement of groundwater, which may cause problems of trench drowning, frost heave and icings, is not taken into account in any of the

models on which the mitigative measures listed under 9.1.1.1 are based. The groundwater-related problems may well become an unexpected residual impact.

Answers are required to such questions as:

What methods are proposed to keep culverts ice-free in icing areas?
What impacts are these methods expected to have?

What measures are proposed for dealing with groundwater flows encountered in cuts and in trenching? Impact?

To maintain subsurface drainage patterns in any condition, they have to be known first. Does the company have such knowledge?

Major (and possibly some of the minor) fuel storage facilities should be provided with impervious basin bottoms inside the impervious containment dykes to prevent groundwater contamination in case of spillage.

For further comments on groundwater-related concerns, please see notes by R.O. van Everdingen, Appendix C.

g. Biochemical Oxygen Demand and Oxygen Depletion

On page 2-33, it is acknowledged that increased biochemical oxygen demand is expected to result from increasing sediment loads but the EIS goes on to dismiss this potential impact as not being expected to have significant effects, even immediately below crossing points. No data or substantiation is given for this conclusion and no studies are proposed.

Three studies (item 8.1.2.6, page 8-12) are quoted which show the effect of gas leakage on dissolved oxygen and fish survival. It is pointed out that alkane hydrocarbons have a high solubility in water and this tends to exclude oxygen at a rapid rate. This might not be a serious problem in the summer but certainly will cause problems in the winter under ice cover, and the simplistic response that gas will leak through natural cracks in the stream ice is somewhat unrealistic. Given the already stressed D.O. conditions

under ice cover, such gas leakage might be detrimental and should deserve closer analysis, particularly with regard to remedial measures. The simple statement that "The probability of gas leakage into water courses is extremely remote", should be questioned.

Since the spatial extent of the decrease in oxygen level would depend on the rate and volume of gas leakage, attention is drawn to the planned mainline block valves as shown in Fig. 4.1-3. As a measure of safety, the question is raised as to whether block valves should be located immediately on either side of major river or lake crossings where pipeline leaks or ruptures could cause oxygen depletion impacts. For example, presently the block valves on each side of the crossings of the White and Donjek Rivers and Kluane Lake are approximately 45 km apart; should leaks occur the entire volume of gas between the valves could enter the water.

h. Channel Scour

Annex 13 provides an explanation of scour calculations for 11 streams, representing both incised and braided river channels. It is difficult to agree with two statements on page 10 related to braided streams:

- (1) "For this type of stream the deepest scour is considered to occur at approximately the bankfull stage because increased sediment supply from bank and bar erosion at higher stages tends to reduce the potential for scour depth."
- (2) "If the channel was split or braided, the calculations were based on the portion of the total river flow that is carried by the design sub-channel at bankfull stage, rather than the total river discharge."

Both of these statements are tenuous; statement (1) appears to exclude effect on scour of any flow higher than bankfull, possibly even that which could be caused by a glacier outburst; statement (2) requires apportionment of flow among channels within the floodplain, which could be no better than a rough estimate.

The foregoing indicates that, while deep scour is very likely to occur at major crossings such as the White and Donjek Rivers, estimates of scour depth tend to be crude at best. There should be every incentive for the proponent to carry out field work in order to substantiate some of these hypotheses.

C. FUTURE REQUIREMENTS

a. Short Term Baseline Studies

Channel Scour

Classical empirical scour estimation formulas generally are not applicable to bouldery streambeds and to the coarse alluvial bedded rivers. Also, uncertainties exist as to choice of a design flow value and the apportionment of total river flow to a particular channel within the braided river floodplain. Consequently, scour calculations should be checked at representative streams including Donjek and White Rivers by carrying out one or more of the following:

1. Soundings during extreme flood events in the ensuing years prior to construction.
2. Drilling.
3. Installation of "chain markers". and their re-excavation after the flood event.

Streamflows

The approach put forward by Foothills for determining design flows for large streams is generally adequate, particularly for streams in hydrologic regions where hydrometric data is available. However, for small ungauged basins considerable deficiencies are evident; this is particularly serious because of generally lack of climatic information and the non-homogeneity of physiography and runoff in South Yukon to allow reliable synthesization of data. Foothills should be required to take every opportunity in the period available prior to construction to record hydrologic extremes. The gap in the hydrometric data can be satisfied by operating a crest-stage gauge network on small streams representing as much as possible various hydrologic regions and various types of drainage basins (mountainous, intermediate and flat). The network should be operated from about mid-May to September 30 in the years available prior to construction; type of data should include a stage-discharge relationship, annual maximum peak discharge and channel geometry to permit estimation of extreme values. Several of representative streams

in the network should include water stage recorders so that shape of the flow hydrograph could be estimated at crest-stage gauge locations.

Special attention should be given to hydrology in the alluvial fan area west of Kluane Lake.

Groundwater

Potential problems related to groundwater include trench drowning, frost heave and icings. Where discharge channels include culverts passing under pipeline in a granular embankment, capacity would be critical. The area where most serious problems with groundwater is expected, is that along KP 0-177. Data on subsurface water movement are needed as input parameters for a more adequate frost-heave (and thaw) model. Such information is also required if icing development is to be avoided or controlled at stream crossings and elsewhere along the line. It is recommended that any drilling that is done along this portion of the route should include a program for assessment of groundwater movement - gradients, flow rates, chemistry and temperature.

Glacier-outburst Floods

Annex No. 14 refers in several places to the Glaciology Division Report (1977) concerning the effect of glaciers on hydrology. On page 31 the Annex states: "In summary, the studies discussed do not indicate reason for serious concern about glacier-outburst floods. Such events have to be considered, however, as possibly critical for design purposes on the White and Donjek Rivers". This quotation contains an important contradiction; if outburst floods are possibly critical for design purposes why is there no reason for serious concern? The Glaciology Division Report (1977) clearly stated that further work should be undertaken to assess flood potential. There is no evidence that Foothills have undertaken such studies. Further, Table 10 indicates that a glacier-outburst flood on the Donjek might produce a flow of $2300 \text{ m}^3 \text{ s}^{-1}$. A more recent estimate of peak discharge from the Donjek Lake as given in Glaciology Division memorandum dated 24 January 1978 and appended to IWD (1978) report on the Haines Road which is referenced in Annex No. 14 is $2860 \text{ m}^3 \text{ s}^{-1}$. Clearly, further study of the Donjek glacier outburst is

required before a final selection of the Donjek River design flow could be made.

The potentially much more disastrous situation is the formation of Recent Lake Alsek in the Haines Junction area. The only reference to possible lake formation and pipeline inundation in this area is in Section 6.2.4.1 on page 6-76: "A major surge or advance of the Lowell Glacier could dam the Alsek River and cause an extensive lake to form along it and its tributaries; however, the community of Haines Junction and other low-lying facilities would be affected long before terrain crossed by the pipeline route". The implication of this quotation is that the flood potential is recognized but that it is not important because Haines Junction would be flooded first.

It is not sufficient only to recognize the existence of problems; analyses to assess probabilities of occurrence, likely damage to the pipeline and preventive measures to be taken should also be undertaken. Further studies should include:

- (a) Mapping of the extent and bathymetry of the potential lake at the snout of the Donjek Glacier. This map, together with the map of the glacier snout at time of maximum extent will provide input to a simulation model of glacier-outburst floods.
- (b) Mapping of the extent and bathymetry of Recent Lake Alsek and determine the time it would take for the lake to fill.
- (c) Surveys between Donjek Glacier and the pipeline crossing to permit flood routing down the valley.

b. Monitoring

Although the construction along KP 0-177 is scheduled for winter and the scheduling itself is considered by Foothills as a mitigation for erosion impacts, post-construction monitoring is not included in Foothills schedule plan. As mentioned earlier, latent erosion was a problem following construction of the Alyeska pipeline.

A commitment to post-construction monitoring should be made by Foothills and should be identified in their schedule plan. A post-construction monitoring program including inspection of river crossing sites along the entire alignment, particularly during subsequent freshets, would allow erosion to be identified and remedial actions to be taken by Foothills.

With respect to monitoring for toxic substances such as oils, gasoline and diesel fuels, etc., the following aspect should be considered. A water quality criteria in the Terms and Conditions requiring that no visible oil sheen be allowed to occur on watercourses is meaningless since monitoring for such a condition is impossible during ice cover conditions.

The Alyeska Pipeline experience found that monitoring of toxic substances was not possible in winter under ice conditions when oils and other spilled liquids reached watercourses after saturating work pads and entering watercourses under ice cover. To protect watercourses from such impacts this major recommendation should be an established distance from any watercourse for areas where chronic spillage may occur. Advisors to the Alyeska Pipeline recommended 1500 feet as the minimum distance.

Consideration should also be given to monitoring of effects of fuel storages (particularly underground storages) and sewage lagoons on water quality of groundwater.

D. GENERAL CONCERNS

a. Water Quality

All the water quality data which are reported in the Statement are considered to have concentrations well within the water quality standards, however, all sampling was done during the May - August period when the trend in concentration is low. Highest concentrations usually occur in late winter (March) and no mention of this is made.

Many of the results tabulated in 6.3.3, the chapter on Water Quality, are suspect. The ortho phosphate results are of little value because of their proximity to detection limits and would appear inordinately high.

With the exception of Beaver Creek, the suspended sediment concentrations obtained seemed to be relatively low. In chapter 8.1.2.4 the writer states: "It should be emphasised, however, that many water courses in the southern Yukon Territory are extremely turbid under normal circumstances (Section 6.3) and construction activity may not increase suspended sediment loads beyond levels normally experienced during freshet". It would appear that the writer considers the words turbidity and suspended sediment are synonymous. Reported results for colour in Section 6.3.3 can be relatively high and we suspect high turbidity during freshet may, in part, be caused by high dissolved organics rather than suspended sediments. In view of the foregoing such statements as "endemic fauna is adapted to high suspended sediment loads" are open to question.

Several references are made (example 10.3) to the fact that, in general, high levels of oxygen concentrations were found in Yukon waters. This, it is said, will generally simplify mitigation measures since pollution problems, introduction of organic material and B.O.D. will not cause too great a problem. It is not pointed out that during winter ecological conditions are stressed and often critical with regard to D.O. and that even minor activities in construction, maintenance, repair work and camp discharge may cause a serious D.O. problem. It should at least be pointed out that late winter conditions are more critical and that special attention should be given to any addition of material to the stream during this period.

b. Icings and Frost Heave

Serious efforts have been made to collect multi-discipline background data for stream crossings, leading to more extensive knowledge of locations

subject to icing formation. However, not all stream-crossing sites potentially affected by icings have been recognized; the relationship between icings and groundwater discharge at stream crossings has not been fully appreciated; and the potential for icings at locations away from stream crossings has not received the attention it deserves.

"The maintenance of significant groundwater flow in streambed gravels" was deduced in Annex 13, sub A8(a), para 3. Data on gradients, permeabilities, flow rates, chemistry and temperature of the groundwater are, however, not available. Such data will be needed to improve the chances for reliable predictions of frost penetration and frost heave for the chilled-pipeline section upstream of compressor station FY-1. Such information will also be required if icing development is to be avoided or controlled anywhere along the route.

For further comments on groundwater-related concerns, please see notes by R.O. van Everdingen, Appendix C.

APPENDIX A

APPENDIX A

Vancouver, B.C.
January, 1979

WATER QUALITY BRANCH
INLAND WATERS DIRECTORATE

SUBJECT: E.I.S. PREPARED BY FOOTHILLS PIPE LINES (SOUTH YUKON) LTD
FOR ALASKA HIGHWAY GAS PIPELINE PROJECT

Introduction

Water Quality Branch (I.W.D.) personnel have prepared an initial response to the subject document and these questions and/or comments are listed below. As a general comment we feel that the Impact Statement is well formulated and clearly written however, the subject is covered in very general terms with little specific information; also, the answers to some of the hazards and problems are somewhat simplistic. It will be seen that our detailed comments reflect this inadequacy.

We do not think that any proposal for action is within the mandate of those involved in the review process since this is very much the proponents forte. The Water Quality Branch has reported the results of limited studies on two river basins within the Yukon Territory and is, therefore, in a position to proffer advice in those areas where the subject of queries and our specific expertise coincide.

Reporting of Water Quality Data

All the water quality data which are reported in the Statement are considered to have concentrations well within the water quality standards however, all sampling was done during the May - August period when the trend in concentration is low. Highest concentrations usually occur in late winter (March) and no mention of this is made.

Many of the results tabulated in 6.3.3, the chapter on Water Quality, are suspect. We would be pleased to discuss this with Beak Consultants Ltd., especially on the relationship between conductivity and dissolved solids. The ortho phosphate results are of little value because of their proximity to detection limits and would appear inordinately high.

With the exception of Beaver Creek, the suspended sediment concentrations obtained seemed to be relatively low. In chapter 8.1.2.4 the writer states: "It should be emphasised, however, that many water courses in the southern Yukon Territory are extremely turbid under normal circumstances (Section 6.3) and construction activity may not increase suspended sediment loads beyond levels normally experienced during freshet". It would appear that the writer considers the words turbidity and suspended sediment are synonymous, which is unfortunate to say the least. Reported results for colour in Section 6.3.3 can be relatively high and we suspect high turbidity during freshet may, in part, be caused by high dissolved organics rather than suspended sediments. In view of the foregoing one may take a jaundiced view of such statements as "endemic fauna is adapted to high suspended sediment loads".

One small point. That water quality data reported and attributed to Water Survey of Canada should, we believe, be credited to the Water Quality Branch.

Several references are made (example 10.3) to the fact that, in general, high levels of oxygen concentrations were found in Yukon waters. This, it is said, will generally simplify mitigation measures since pollution problems, introduction of organic material and B.O.D. will not cause too great a problem. It is not pointed out that during winter ecological conditions are stressed and often critical with regard to D.O. and that even minor activities in construction, maintenance, repair work and camp discharge may cause a serious D.O. problem. It should at least be pointed out that late winter conditions are more critical and that special attention should be given to any addition of material to the stream during this period.

Perturbation

The statement is made three times in the report (E.I.S.) that disrupted stream beds in salmon spawning areas will be restored naturally by bedload transport. Is bedload transport sufficiently understood in these areas to ensure that the natural substrate will be replaced?

Will the effects of siltation be limited to locations near crossing sites or might the effects be noted downstream in depositional areas?

Might effects of siltation be delayed at winter construction sites and noted during and/or after breakup? i.e. deposited on spawning beds despite their attempts to avoid this during construction.

No attempt appears to have been made to estimate the potential quantity of the introduced stream bank material, nor to measure the organic and/or nutrient content of these materials.

Biota

The fisheries chapter is conspicuous in the complete absence of information on any other part of the food chain except fish, i.e. there is no discussion of impacts of construction on other trophic levels vital to fish survival (¹⁰ producers, invertebrates, decomposers, etc.). There is no discussion of the feeding preferences of the various fish species described.

Similarly, the effects of toxic spills, gas leaks and O₂ deprivation relate to direct effects on fish rather than indirect and equally lethal effects on other food chain components.

With regard to the transfer of organisms in testing water: current knowledge of hydrostatic pressure effects suggests that all bacteria would survive the cited pipe pressures of 1700 P.S.I. Have the various affected water sheds been surveyed for the occurrence of bacterial fish pathogens?

Pipelaying and Testing

It is suggested that, in the permafrost section, the permafrost will be discontinuous near and/or under watercourses. Does this increase the chances of breakages and leaks near sensitive aquatic environments?

Three studies are quoted which show the effect of gas leakage on dissolved oxygen and fish survival. It is pointed out that alkane hydrocarbons have a high solubility in water and this tends to exclude oxygen at a rapid rate (8.12). This might not be a serious problem in the summer but certainly will cause problems in the winter under ice cover, and the simplistic response that gas will leak through natural cracks in the stream ice is somewhat unrealistic. Given the already stressed D.O. conditions under ice cover, such gas leakage might be detrimental and should deserve closer analysis, particularly with regard to remedial measures. The simple statement that "The probability of gas leakage into water courses is extremely remote", should be questioned.

The Impact Statement points out that 130,000 litres of methanol are needed to dry the pipeline after testing. Presumably methanol picks up water in the process and at some point the water will have to be removed from the alcohol or the wet alcohol discarded. Is this done by distillation in the field or by other chemical means, or is new methanol used every few hundred kilometers? The method is not described, and the transport, handling and reusing of that material should be explained in greater detail.

APPENDIX B

Government of Canada / Gouvernement du Canada

MEMORANDUM

NOTE DE SERVICE

Mr. P. Strilaeff
Inland Waters Directorate
Pacific & Yukon Region

Water Planning & Management Branch
Inland Waters Directorate
Pacific & Yukon Region

SECURITY-CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

554-30

YOUR FILE - V/RÉFÉRENCE

DATE

23 February 1979

SUBJECT
OBJET

Environmental Impact Statement for the Alaska Highway Gas Pipeline Project,
January 1979. Foothills Pipelines (South Yukon) Ltd.

This review of the Environmental Impact Statement for the Alaska Highway Gas Pipeline is primarily for scientific validity and is in effect a deficiency statement that points out relevant gaps in the E.I.S. These comments deal with the completeness of the E.I.S. in describing the effects of the project and the focus is on the environmental impacts that the construction operation will have on the water resource. This review suggests or recommends some modifications that would render the project more environmentally acceptable. Recommendations for additional data collection or monitoring of the construction and post-construction phases of the project are also made.

In general, the E.I.S. presents a reassuring position that the selection of appropriate construction and maintenance techniques along with the use of special designs will reduce environmental impacts to acceptable levels. Since this pipeline project has received authorization to proceed, conditional upon certain stipulated requirements being satisfied, much more emphasis should have been directed to site specifics and mitigation rather than to reassurances.

It now would seem necessary to require the Terms and Conditions for construction of the Alaska Highway Gas Pipeline to pick up some of the outstanding deficiencies and monitoring recommendations. In addition, greater use should be made of the post-impact studies compiled in the Trans-Alaska Oil Pipeline Impact Publications prepared by the Joint State/Federal Fish and Wildlife Advisory Team, in developing the Environmental Terms and Conditions for the Alaska Highway Gas Pipeline Construction.

The attached comments are divided into eight subject areas.



V.G. Bartnik, Head
Water Impact Assessment Division

Bartnik:bhs
Encl.

Comments on the Environmental Impact Statement for the Alaska Highway
Gas Pipeline Project, January 1979. Foothills Pipelines (South Yukon) Ltd.

1. Revegetation Program (Erosion Control)

The E.I.S.'s coverage of revegetation programs to minimize post construction erosion does not provide adequate information nor does it clearly outline the proposed plans of revegetation. A firm commitment by Foothills to a specific revegetation program is lacking. Lack of erosion control was shown to be the major contributing factor to the impact of sedimentation on watercourses in the Alyeska Oil Pipeline experience.

The "Actions Available and Planned" for erosion control (page 2-45 of the Overview Summary), include the statement that "upon completion of construction, disturbed areas will be revegetated". However, no specifics are given as to what types of revegetation will be undertaken or how, i.e., species of grasses, shrubs, hydro-seeding, etc. Even though the E.I.S. reports that "studies of revegetation techniques at representative sites along the entire right of way have been under way for two consecutive seasons", none of these erosion control techniques or their scheduling are discussed. In fact, on pages 8-13 of the E.I.S., the qualification is made that "a major approach to limiting surface erosion will be a program of revegetation on all disturbed areas where vegetative cover is not expected to regenerate naturally". There is no amplification of where or how much of the disturbed areas are not expected to revegetate naturally. The criteria of natural revegetation capability would appear to be a poor one since time of restabilization of soils is by far the most critical factor. However, no information is provided on natural regeneration time for vegetation along the pipeline route.

In view of the importance of erosion control in protecting the water resources, assurances of revegetation should be accompanied by firm commitments to specifically outlined and scheduled programs. Currently, the E.I.S. identifies no such activity in the construction schedule shown (see Fig. 4.1-1).

2. Sedimentation Impacts

The extent and seriousness of potential impacts of sediment loadings to streams from construction activities and subsequent erosion are somewhat underestimated in the E.I.S. In assessing the effects of siltation, the E.I.S. states that "adverse effects on fishery resources and supportive food webs will be restricted to areas near crossing sites and to a short period during and immediately following construction activities" (page 2-33). However, in the Alyeska Pipeline experience sediment plumes were in certain cases visible 20 to 30 miles downstream from construction

sites and latent erosion during subsequent freshets was a serious problem. The treatment of the potential sedimentation impacts, particularly on aquatic habitats, should therefore not be treated too lightly. The rationale that because "endemic aquatic biota are adapted to periodic high suspended sediment loads, most potentially adverse impacts will involve short-term stresses" presupposes that long term or permanent damage to spawning sites will not occur "since normal scour during the subsequent freshet will remove fines from the gravel areas (page 8-9).

In the normal course of events, as the freshet passes, the availability of transportable sediment decreases rapidly and in river reaches where the scour action is great, the bed is left relatively free of fine sediments and the water becomes relatively clear. This annual cycle is considered to be an essential characteristic of rivers in which the best spawning grounds are located. However, if this normal pattern is altered by the artificial introduction of sediment during the period of declining discharge (i.e., the period when most rivers are scheduled to be crossed) when such sediments would not normally be available to the river, deposition of sediment will take place in the interstices of the bed materials. Such sedimentation impacts would clearly affect fall spawning populations of fish and overwintering eggs.

Although only a portion of the 146 streams actually crossed support fish at scheduled crossing times, post construction impacts must be taken into account and also impacts on fish food organisms.

The effects of sediment deposition upon developing fish eggs, juvenile fishes and macro-invertebrate food species (Cordone and Kelly, 1961; Gammon, 1970)¹ has been amply studied. During installation of the Alyeska Pipeline beneath the Salcha River in 1976 an estimated 1,177 tons of construction-related sediment were introduced into the river (Francisco and Dinneford, 1977)². This material can smother pre-emergent fishes and induce invertebrates to move from affected portions of waterways. The biological data collected at the Salcha River site infers that the percentage of spawners below the pipeline crossing site fell considerably due to this construction-related sediment deposition.

Consequently, as discussed in Item 1 above, measures to minimize erosion (i.e., revegetation programs, bank protection, etc.) is perhaps the single most important mitigating measure to which Foothills should be firmly committed.

1. Cordone, Almo J. and Don W. Kelly, 1961. The Influences of Inorganic Sediment on the Aquatic Life of Streams. California Department of Fish and Game, 1961 pp 189-220.
Gammon, J.R. 1970. The Effect of Inorganic Sediment on Stream Biota. Water Quality Office of the Environmental Protection Agency. December 1970.
2. Francisco, Kim and W. Bruce Dinneford 1977. Third Interim Report of the Commerical Fish Technical Evaluation Study. Joint State/Federal Fish and Wildlife Advisory Team.

3. Monitoring.

Although the construction along K.P. 0-177 is scheduled for winter and the scheduling itself is considered by Foothills as a mitigation for erosion impacts, post construction monitoring is not included in Foothills schedule plan. As mentioned earlier, latent erosion was a problem following construction of the Alyeska pipeline.

A commitment to post-construction monitoring, should be made by Foothills and should be identified in their schedule plan. A post-construction monitoring program including inspection of river crossing sites along the entire alignment, particularly during subsequent freshets, would allow erosion to be identified and remedial actions to be taken by Foothills.

With respect to monitoring for toxic substances such as oils, gasoline and diesel fuels, etc., the following aspect should be considered. A water quality criteria in the Terms and Conditions requiring that no visible oil sheen be allowed to occur on watercourses is meaningless since monitoring for such a condition is impossible during ice cover conditions.

The Alyeska Pipeline experience found that monitoring of toxic substances was not possible in winter under ice conditions when oils and other spilled liquids reached watercourses after saturating work pads and entering watercourses under ice cover. To protect watercourses from such impacts this major recommendation should be an established distance from any watercourse for areas where chronic spillage may occur. Advisors to the Alyeska Pipeline recommended 1500 feet as the minimum distance.

4. Small Stream Hydrology.

The E.I.S. reassures that culvert systems will be of "adequate capacity" (p. 2-30). However, no information is provided on hydrology which would indicate that sizing of culverts will be satisfactory. Where discharge channels include culverts passing under pipeline which is buried in a granular embankment (p. 4-39), capacity would be critical. Washouts of such culverts under pipeline could risk pipe rupture and other related effects. In the Alyeska pipeline experience the force of spring run-off caused perpendicular cuts to the work pad when drainage structures were insufficient.

A more detailed coverage of the deficiency of this subject area will be provided by N. Lyons and P. Strilaeff. Their review will also undoubtedly include some recommendations.

5. Borrow Pits.

Although the borrow requirements are estimated to be 2,592,800 cu. yds., the E.I.S. states that the required quantities will be determined during

the final design process. Similarly, the E.I.S. state that at the time of writing borrow pit locations have not been selected.

For the construction of the Alyeska pipeline, gravel borrow was estimated to be 30 million cu. yds, but proved to be a gross underestimation. The higher demand was attributable in part to the shift from buried to elevated installation.

In the E.I.S. the curves in Fig 4.2-24 page 4-30 demonstrate that very large amounts of insulation and granular material would be required in those places where the frost heave was to be kept within tolerable limits. Should the use of the granular embankment design be more extensive than anticipated, borrow requirements would increase proportionately. This possibility linked with the anticipated need of 9,000,000 cu. yds. for the Shakwak Highway project could stress granular material supplies with increased amounts being removed from floodplains. The E.I.S. notes that while it is anticipated that most borrow will be obtained from upland sites, stream floodplains may occasionally be used (p. 4-47). As soon as possible, borrow pit locations, along with a prioritization listing, should be provided to allow sound management decisions on minimizing impacts from borrow operations.

With respect to borrow operations in floodplains, the E.I.S. states that temporary dykes will be constructed where necessary in order to prevent small sub-channels from flowing through areas being mined, "these dykes will be removed upon completion of the mining operation? (page 4-49). During such floodplain borrow operations, the borrow sites should not be excavated below the river bed such that the resulting pits would not trap fish during receding water levels. Such a requirement should also be included in the terms and conditions of construction.

6. Mitigation.

The E.I.S. fails to provide adequate details of mitigation proposed at those locations along the route where impacts are identified. For example, the E.I.S. identifies direct interference with fish migration at six watercourses. However, no serious consideration is given to mitigating measures or their details. Elevated crossings are not even suggested as a possibility.

At numerous places in the E.I.S. mitigating measures are referred to but are never fully described. On page 2-31 reference is made to "other measures" which will be taken to prevent accidental spills but no further details are given.

Two construction methods used during the construction of the Alyeska Pipeline to mitigate erosion impacts at river crossings have not been identified in the E.I.S. under the subject of mitigation. One is with respect to small

stream crossings and involves confining small streams in a closed pipe while excavating and laying the pipeline under the temporary pipe containing the stream flow. Another mitigating measure used in the Alyeska Pipeline but not given consideration in the E.I.S. is the use of temporary bridges at stream crossings to minimize vehicular damage to the terrain at stream crossings.

7. Pipeline Right of Way.

On page 26 of the E.I.S. the Right of Way is shown as being 40 m. in width with increased working area required at river crossings. No justification is given for the chosen 40 m. clearing width nor the increase at river crossings. The Alyeska pipeline required an active pipeline Right of Way of 54 feet (approximately 20 m.) with allowances of up to 200 feet (approximately 70 m.) when construction width requirement could be justified. During the construction of Alyeska it was also found that the work pad could be narrowed from the 54 foot allowance to 15 feet at stream crossings.

Reductions in the amount of vegetation clearing and ground disturbance can minimize potential impacts. More discussion of the right of way requirement would be appropriate.

8. Biochemical Oxygen Demand and Oxygen Depletion Impacts.

The E.I.S. coverage of concerns related to direct interference with overwintering fish, item 8.1.2.3. page 8.8, does not identify oxygen depletion as a significant potential impact. On page 2-33, it is acknowledged that increased biochemical oxygen demand is expected to result from increasing sediment loads but the E.I.S. goes on to dismiss this potential impact as not being expected to have significant effects, even immediately below crossing points. No data or substantiation is given for this conclusion and no studies are proposed.

The information collected by Inland Waters Directorate's Water Quality Branch has suggested that oxygen depletion should be a serious concern particularly under winter conditions. Since all three sections of the pipeline route scheduled for winter construction involve the Yukon River Basin, known to experience low dissolved oxygen levels under ice, further information and mitigation would appear to be necessary.

In addition to increased B.O.D. from organic sediment loadings, the risk of oxygen depletion from gas leaks is also treated by the E.I.S. as being insignificant. The release of natural gas under water does lower dissolved oxygen levels (page 2-34). Since the spatial extent of this decrease in oxygen level would depend on the rate and volume of gas leakage, attention is drawn to the planned mainline block valves as shown in Fig. 4.1-3. As

a measure of safety, the question is raised as to whether block valves should be located immediately on either side of major river or lake crossings where pipeline leaks or ruptures could cause oxygen depletion impacts.

For example, presently the block valves on each side of the crossings of the White and Donjek Rivers are approximately 45 km apart. Should leaks occur at these buried river crossings, the entire volume of gas between the valves could enter the water. During those seasons when fish are migrating, spawning or emerging in these rivers they would be susceptible to the decreased oxygen levels occurring in the vicinity of the pipeline leak. Further consideration should be given to the location of mainline block valves.

Still on the subject of the Kluane Lake crossing, on page 6-159 of the E.I.S. reference is made to reports that Lake Trout spawn near the mouth of Congdon Creek. However, no proposals for verification of this information are made and Map 6.5-2 which identifies areas of importance to selected fish habitat near the Alaska Highway Gas Pipeline route fails to show Lake Trout spawning areas anywhere near the Kluane Lake crossing.

Since the present alignment crosses Kluane Lake near Congdon Creek, consideration should be given to potential impacts of the crossing to probable lake shore spawning and rearing areas. The documented impacts of sedimentation during the Alyeska project referred to earlier once again emphasize the importance of mitigation.

In order to put the preceding comments into perspective with their intent, it is suggested that the covering letter be read once again.

23 February 1979

APPENDIX C

-1-

Icing Reconnaissance-
Klondike and Dempster Highways
and suggested pipeline routes, between
Whitehorse, Y.T. and Inuvik, N.W.T.,
April 25 - 28, 1978.

R. O. van Everdingen

Hydrology Research Division
Environment Canada
Calgary, Alberta
May, 1978

Icing Reconnaissance - Klondike and Dempster
Highways and suggested pipeline routes between
Whitehorse, Y.T. and Inuvik, N.W.T., April 25 - 28, 1978.

Introduction

During the last week of April 1978, the writer accompanied Mr. R. O. Lyons (Water Planning and Management Branch, Vancouver) on a reconnaissance trip along the Klondike and Dempster Highways (Yukon and Northwest Territories). The purpose of the trip was to locate areas where groundwater can be expected to present technical and/or environmental problems in connection with the construction and operation of a chilled-gas pipeline. The reconnaissance survey was concentrated along the two highway routes followed by the suggested pipeline route from the Mackenzie Delta to Whitehorse; three large deviations of the pipeline route (between Blackstone River and Ogilvie River; across the Eagle Plain; and between Fort McPherson and Inuvik) were also surveyed.

The schedule of the reconnaissance trip was:

- April 25 - Whitehorse to Dawson City, by car;
- April 26 - Dawson City to Inuvik, by helicopter;
- April 27 - Inuvik to Dawson City, by helicopter;
- April 28 - Dawson City to Whitehorse, by car.

Snowmelt was well advanced in the southern Yukon but only just starting in the Ogilvie Mountains. New snow in the northern portion of the survey area was light and did not present any problems in the recognition of significant icing areas.

All icings observed were plotted on 1:250,000 scale maps which are available for inspection in the Calgary office of the Hydrology Research Division of Environment Canada, at 4616 Valiant Drive N.W. (telephone (403)-288-0550). A summary of the observations is presented below.

Klondike Highway, Whitehorse to Dawson City

Small icings were observed in several small creeks crossed by the highway. Only one of these apparently presented a problem to the highway; burlap barriers and a burning barrel testified to attempts at control of the icing, to keep the culvert open and the ice off the highway. At the time of observation, snowmelt was well advanced, and the creek was flowing through the culvert without problem.

Several creeks (a.o. Flat Creek and McCabe Creek) showed under-bridge icings, with the creeks flowing over the ice; downstream from the bridges the water was channeling along the banks, having cut channels along the edges of the icings.

North Klondike River and Blackstone River

Icings are widespread in the channel of the North Klondike River; only in two places were small icings observed some distance above the valley bottom (and uphill from the highway). A large icing (2 km long) was present, as expected from airphotos, in the big bend of the North Klondike River. Icings were almost continuous in the N. tributary of North Klondike River.

The area immediately north of North Fork Pass showed extensive icings, at least two of which are fed by groundwater discharging from just below the highway grade. Some frostmounds are present in the low part of the valley. Icing is extensive in the upper 5 km of the East Blackstone River. Groundwater-fed icings were present in a few places up to 1.5 km west of the river.

A large icing (6 km long) was present below the confluence of the Blackstone and East Blackstone Rivers. Icing was intermittent but fairly extensive along Blackstone River as far down as the point where the suggested pipeline route turns west to rejoin the Dempster Highway.

Ogilvie River

No icings were found in the pass through which the highway passes from the Blackstone River to a tributary of the Ogilvie River. Icings were present farther downstream along the tributary of Ogilvie River; in several places icing was found on the uphill side of the highway. Reaches of groundwater-fed open water in the Ogilvie River all had extensive icings downstream. Icing was also present in several tributaries and in some places icing was found on both sides of the highway.

Eagle Plain to Richardson Mountains

Both the highway route and the suggested pipeline route across the Eagle Plain show very little sign of groundwater discharge or

icings. Minor evidence of icing was found both at the suggested pipeline crossing (PLC) of Eagle River and at the Eagle River Bridge on the Dempster Highway.

The suggested pipeline route crosses one unnamed tributary of Eagle River at the location of an obvious spring with extensive associated icing. Icing was also observed at the Rock River PLC, over a reach of about 7 km, and at the PLC of an unnamed tributary of Rock River, over a reach of at least 11 km.

Extensive icings were present in several of the west flowing creeks crossed by the Dempster Highway along the west flank of the Richardson Mountains. All these icings appear to be fed by groundwater from sources some distance upstream from the highway.

Richardson Mountains to Peel River

The pass through the Richardson Mountains, from the Rock River drainage into the Vittrekwa River drainage and thence onto the divide between Stony Creek and Vittrekwa River shows significant problems with groundwater-fed icings. Icings were present in most of the tributaries of Vittrekwa River, either above or below the highway or both. A large icing was present in the main tributary of the Vittrekwa at the highway crossing on the east edge of NTS 116P. Icings fed by discharging groundwater apparently encroach on the highway from both sides in the narrowest portion of the pass. Icings extend considerably higher up the tributary valleys north of the highway.

A detailed study of the groundwater discharge and the formation of associated icings may be required in this area to enable selection of the most suitable routing for a pipeline.

No icings were found along the highway route between the pass and the Peel River.

Peel River to Inuvik

An extensive icing occurrence about 6 km east of Fort McPherson, which originally developed as a result of highway construction, has been partly controlled by construction of a second embankment some distance "upstream" of the highway. Another icing occurrence was found on both sides of the highway in the drainage channel between two lakes, about 18 km east of Fort McPherson.

Icings were found at the suggested PLC's on one small unnamed tributary and on the main stem of Frog Creek; at the PLC on the Rengleng River; and on two unnamed creeks between Rengleng River and Caribou Creek.

Conclusions

1. It is likely that groundwater will present both technical and environmental problems in connection with both construction and operation of a chilled-gas pipeline, at a number of locations along the suggested Dempster Highway - Klondike Highway pipeline route.
2. Most of the potential groundwater problems will be associated with the PLC's of streams, both large and small, in which icings occur under natural conditions.
3. Some problems (groundwater discharge; icing) can be expected at some hillside locations along the North Klondike, Blackstone and Ogilvie Rivers in the Ogilvie Mountains.

4. Significant problems (icing; frost heave) can be expected in the North Fork Pass area.
5. Serious problems (icings; frost heave) may be encountered in the portion of the route that crosses the Richardson Mountains.
6. Icing and frost-heave problems may also be encountered along the route between Fort McPherson and Inuvik, wherever poorly defined surface and subsurface drainage channels are crossed.
7. Wherever the suggested pipeline route follows high or well drained ground (portions of the Klondike Highway route; Eagle Plain; Richardson Mtns. to Peel River) groundwater problems will be minimal or absent.

Springs, Seepage Areas, Open-water Reaches and Icings,

Alaska Highway Pipeline Route,

Watson Lake, Y.T. to Alaska Border,

April, 1978.

(Notes to accompany route maps, scale 1:50,000)

R. O. van Everdingen

Hydrology Research Division

Inland Waters Directorate

Environment Canada

Calgary, Alberta

November, 1978

Springs, Seepage Areas, Open-Water Reaches and Icings,
Alaska Highway Pipeline Route,
Watson Lake, Y. T. to Alaska Border,
April, 1978.

(Notes to accompany route maps, scale 1:50,000)

by

R. O. van Everdingen

Introduction

Color airphotos, taken between April 5 and April 16, 1978, along the Alaska Highway pipeline route for Foothills Pipe Lines (South Yukon) Ltd., were obtained on loan from Inland Waters Directorate, Vancouver, B.C. Springs, seepage areas, open-water reaches and icings, visible on the airphotos, were plotted on 33 route maps (scale 1:50,000) covering the pipeline route from Watson Lake, Y.T. to the Alaska border. The maps were supplied by Foothills Pipe Lines (South Yukon) Ltd. Sheet no. 14A was only partly covered by the above airphotos; sheet no. 15A was not covered at all.

Most of the information marked on the maps is self-explanatory and few detailed comments can be added at this time. Where red or green arrows are marked on the maps they indicate that the condition shown (icing or open water) continues off the edge of either the map or the airphotos.

Springs

Springs visible on the airphotos were presumed to be perennial. In most cases, their setting and the presence of open water downstream from the spring sites left little doubt about this. Additional springs may exist in a number of places along the route; if they do, then their discharge is insufficient to maintain open water visible at the scale of the airphotos. Some of the spring areas warrant special mention.

At least 23 spring locations have been plotted in the drainage area of Mirror Creek and Snag Creek (Sheet no. 1). The area is underlain by stratified glaciolacustrine materials (silt with sand and clay), with or without a cover of peat. Where frozen, these materials are often ice-rich and they could be thaw-sensitive; portions of the area with active groundwater discharge could be frost-sensitive.

Several springs were noted in the valley of Sanpete Creek some distance downstream from the proposed pipeline crossing (Sheet no. 3), located on outwash gravel, sand and silt. These materials are likely water bearing at the pipeline crossing; it is less likely that they are frost- or thaw-sensitive.

Springs are present in an area of fossil flood plain of White River, near the confluence with Koidern River (Sheet no. 3). This indicates that the gravel, sand and silt in both active and fossil flood plains may be water bearing. Springs are also discharging from alluvial fan deposits of Donjek River downstream

from the pipeline crossing (Sheet no. 7).

At least two sizeable perennial springs are discharging from the base of the glaciofluvial or glaciolacustrine terrace on the east side of the valley of Swift River, just west of the Pine Lake airstrip (Sheet no. 25). It is probable that the springs are fed, at least in part, by seepage of water from Rancheria River on the east side of the airstrip, about 700 m east of the springs and approximately 37 m higher in elevation. There is some evidence of progressive failure of the terrace edge at the spring site, by piping. Eventually this will lead to the capture of the headwaters of Rancheria River above the airstrip (drainage area about 680 km^2) by Swift River (drainage area above the springs about 170 km^2). The resulting increase in the effective drainage area of Swift River at the spring site to five times its present size would present problems at the Alaska Highway crossing and likely also at the proposed pipeline crossing.

No data on discharge rates or water chemistry are available for any of the springs at this time.

Seepage Areas.

Areas with brown-colored snow and areas where icings are present along the edges of small ponds and lakes have been marked on a number of the map sheets. It is likely that these phenomena are caused by seepage of groundwater.

Extensive brown-snow areas were found on outwash and moraine deposits from east of Donjek River to about Lewis Creek (Sheets no. 5, 6 and 7). Smaller brown-snow areas occur along Dezadeash River from near Pine Lake to east of the Takhini River crossing (Sheets no. 11-14). Many of these are located in areas of glaciolacustrine deposits which may be thaw-sensitive when ice rich.

Stability problems may be encountered during pipeline construction in these areas if groundwater seepage turns out to be significant; icing problems may result if drainage is impeded by pipeline or road construction.

Open-water Reaches

Open-water reaches in streams during the winter usually indicate that groundwater is being discharged into the stream channel. The one exception to this may be found in open-water reaches in streams immediately below lake outlets. Small open-water areas near the shore line of a lake or pond usually indicate the presence of subaqueous springs.

During the air photo study many open-water reaches were found in large and small streams flowing over a wide range of geological materials in a variety of settings. A number of very small open-water reaches may have been overlooked and additional open-water reaches may have been missed due to snow-bridging of small streams. Many open-water reaches terminate in stream icings.

Stream crossings situated in open-water reaches may suffer from icing problems or from instability of the pipeline ditch, especially in medium- to fine-grained materials.

Icings

Icings form by freezing of water discharged during the winter from springs and seeps (both in and outside river channels) and, under some conditions, by freezing of river-water overflowing onto river ice. The presence of icings, therefore, generally indicates the occurrence of groundwater discharge, usually some distance uphill or upstream, even if no springs or open-water reaches are in evidence.

A large number of icings and icing areas, ranging in size from a few tens of square metres to several square kilometres, were noted during the airphoto study. Some very small icings, as well as icings only active during early winter, have undoubtedly been missed. A number of the icings plotted on the route-map sheets may well be more extensive than shown; snow likely covered some inactive portions of active icings. In addition, the distinctly greenish tinge of the airphoto prints undoubtedly makes it impossible to distinguish some icings or portions of icings.

It was noted that icings appear to form under the bridges on some streams with no obvious icing upstream or downstream of the bridge. Examples are the Alaska Highway bridges on Koidern River, Takhini River, Smart River, Upper and Lower Rancheria River and Little Rancheria River. A similar phenomenon

observed during late April 1978 at the Klondike Highway crossings of Flat Creek and McCabe Creek. It may well occur in other places.

Small icings occur in a number of minor tributary streams on the upstream side of the highway crossings. Such icings often present problems in road maintenance (plugged culverts, ice on roadway, wash-outs during spring runoff). Similar problems may be encountered by pipeline access roads.

Icings and especially the water flows causing the icings may lead to problems during pipeline construction and also during pipeline operation in the chilled mode.

MEMORANDUM NOTE DE SERVICE

DATE February 20, 1979

FROM: R. O. van Everdingen
DE: Hydrology Research Division
Calgary, Alberta

Our file Votre référence

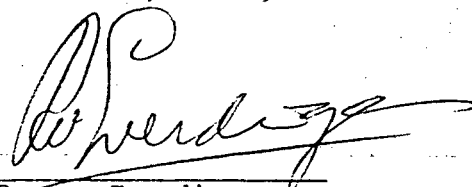
TO: Mr. P. Strilaeff
A: Inland Waters Directorate
502-1001 West Pender Street
Vancouver, B.C.
V6E 2M9

Your file Votre référence

SUBJECT: EIS review - Alaska Highway Pipeline
SUJET:

Attached is a typed version of my initial comments on the Foothills EIS. A copy of these is being sent to Dr. P. J. Williams at Carleton University; as advisor on geotechnical matters to the Environmental Assessment Panel he is interested in comments dealing with frost heave, thaw settlement etc.

I'll let you have my comments on the "Annexes" as soon as I have read them. Please let me know whether you want the "Annexes" returned and, if so, how soon?


R. O. van Everdingen
Research Scientist.

ROVE/ep.
Att. (1).

Comments on Foothills E.I.S. by R. O. van Everdingen, Hydrology Research Division, Calgary, Alberta

Section 3 - Project Setting

- p. 3-9: "The groundwater conditions will be assessed by field measurement". How?
- p. 3-10: "Thermal Analysis". Did this take into account the possible existence of groundwater flow?
- p. 3-10: "Replacement of frost susceptible soils.....with non-frost-susceptible material....." (replacement of frost-sensitive by frost-stable material). Even coarse sand or fine gravel may become "frost sensitive" if ample water supply and proper thermal regime coincide.

Section 4 - Specific Aspects

- p. 4-27: The frost heave model "assumes the formation of 50 percent ground ice upon freezing of the frost susceptible soils", as "..... a result of the suction of water to the freezing front". Why the limit of 50%? Why not also investigate the case where an active groundwater flow system supplies the water?
- p. 4-28: ".....the amount of frost heave is maintained within acceptable limits....."; this may be important for maintaining proper surface drainage. How important is the differential heave to pipeline integrity?
- p. 4-30: The ".....sophisticated two-dimensional finite-element computer model....." does not account for heat transport by groundwater flow, and is therefore likely inappropriate for application in groundwater discharge areas.
- p. 4-31: "Ditch plugs.....will be provided as required to prevent channelization of flow through the backfill materials". Should not be needed if the backfill is frozen by a chilled pipeline. No mention is made of provision to pass groundwater flows through or around the frost bulb.
- p. 4-33: Fig. 4-2-31: how will these culverts and those mentioned under "Mitigation" be kept ice-free, if groundwater discharge creates icing?
- p. 4-38: Thawing of permafrost may also open up new avenues for groundwater discharge.

Section 6-2. Contains no reference to groundwater discharge, springs or icings. Why not?

Section 6-3

Table 6. 3-3: What units are cms?

p. 6-93: "high colour content" is thought to be due to dissolved solids and specific conductivity.
How?

Also: " high colour levels resulted in discrepancies between specific conductivity and dissolved solids concentration".
Is this indeed a cause-and-effect relationship?

p. 6-103: Specific conductance in mg/l ??

Section 8

8.1.1.1,

p. 8-2: How much will the "controlled level of subsidence" be?
Shouldn't there also be a limit on differential subsidence?
The first will affect the severity of erosion problems;
the second may affect pipeline integrity.

8.1.1.2

p. 8-2: "Frost susceptible" (sensitive) is a relative term. Sensitivity depends on both the soil (material and grainsize) and the groundwater hydraulics !! Use of the term "thawed areas" presumes they were frozen earlier; these are better called nonfrozen areas. Nowhere in "Mitigation" is it indicated that these will be determined by test drilling or geophysics, like the areas of sensitive permafrost will be according to 9.1.1.2 (1) and 9.1.3.2. (13).

8.1.1.3,

p. 8-3: How "well ahead of any requirement for emergency repair" will potential problems be detected? Frost blisters at Bear Rock grew 2.9 m. high in 13 days in December '77.

8.1.2.3,

p. 8-8: "The stream crossing at Mirror Creek.....has not been examined". "Of the water courses investigated which may be affected by frost bulb formation, Snag Creek is the only stream with flows during the winter season.....". Both creeks and their tributaries are in a significant groundwater discharge area: they may not contain fish, but could present problems with (1) filling of trench with water during construction; (2) severe frost heave in most soil types; (3) icings as a result of the damming effect of any frost bulb.

Section 9 - Mitigation

9.1: Potential involvement of groundwater, which may cause problems of trench drowning, frost heave and icings, is not taken into account in any of the models on which the mitigative measures listed under 9.1.1.1 are based. The groundwater-related problems may well become an unexpected residual impact.

9.1.1.2 (12), 9.1.2.2 (15), 9.1.3.2 (16) and 9.2.1.2 (9):

What methods are proposed to keep culverts ice-free in icing areas? What impacts are these methods expected to have?

9.1.1.2 (9): What measures are proposed for dealing with groundwater flows encountered in cuts and in trenching? Impact?

9.2.2.2 (32): To maintain subsurface drainage patterns in any condition, they have to be known first. Does the company have such knowledge?

9.2.2.2 (38): Major (and possibly some of the minor) fuel storage facilities should be provided with impervious basin bottoms inside the impervious containment dikes to prevent groundwater contamination in case of spillage.

Comments re open-water areas and fish

- A. All five wintering areas identified correspond to open water areas (plus icing) identified from April 1978 airphotos.
- B. 29 of 33 areas identified as spawning or migration areas correspond to icing and/or open-water areas identified on April 1978 airphotos; of the remaining 4, two are located at the mouth of creeks, where icing may be present. Beaver Creek and Koidern River (3) did not show evidence of either icing or open water, although both were identified as potential spawning areas.
- C. Open water and icings are in most cases ascribed to groundwater discharge (except Yukon River below Marsh Lake, Teslin River below Teslin Lake and Morley River below Morley Lake).
- D. It therefore appears likely that groundwater discharge plays an important role in fish overwintering and spawning in this region.

February 20, 1979

Government
of CanadaGouvernement
du Canada

MEMORANDUM

NOTE DE SERVICE

TO: Mr. P. Strilaeff
Inland Waters Directorate
502 - 1001 West Pender Street
Vancouver, B.C.
V6E 2M9

FROM:
DE:

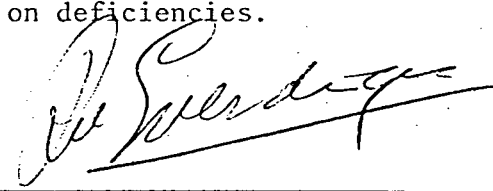
R. O. van Everdingen
Hydrology Research Division
Calgary, Alberta

SECURITY CLASSIFICATION DE SECURITE
OUR FILE - N/REFERENCE
YOUR FILE - V/REFERENCE
DATE March 6, 1979

SUBJECT
OBJET

Foothills Pipe Lines (South Yukon) Ltd. EIS

Attached as promised are comments on the Annex reports number 02, 03, 06, 09, 11, 12 and 13 of the above EIS, as well as a statement on deficiencies.


R. O. van Everdingen
Research Scientist.

ROVE/ep.
Encl.

Deficiencies in Environmental Impact Statement for the Alaska Highway
Gas Pipeline Project, Foothills Pipe Lines (South Yukon) Ltd.

1. The frost-heave model (Section 4.2.2 and Annex 02) is inadequate; it can predict neither frost penetration around and below a chilled pipeline nor the frost heave below such a pipeline in situations where subsurface water movement and the frost bulb created by the pipeline interact.
2. Data on subsurface water movement (gradients, flow rates, chemistry, temperature) are needed as input parameters for a more adequate frost-heave (and thaw) model. Such information is also required if icing development is to be avoided or controlled at stream crossings and elsewhere along the line. At present such information is not available.

R. O. van Everdingen
Hydrology Research Division
Calgary, Alberta
March 6, 1977.

- Page 9, para 1 - Soil stratigraphy is given as well as thermal properties. Information on subsurface water conditions is lacking, although "sloughing of gravel" prevented further augering, and "caving of unfrozen sand into the drillhole" prevented taking of SPT and SY samples (Fig. 4, page 11). These observations could be indicative of a groundwater problem not accounted for by the model.
- Page 19, 4.1 - a "capability to develop criteria for more site specific designs" has not been demonstrated as long as no consideration is given to hydraulic characteristics of soil materials and hydraulic conditions at specific sites.
- Page 19-4.2.1 - "...to reduce the depth of frost penetration and consequently the amount of heaving." Model frost heave will be reduced by reduction of frost penetration because it was assumed to be a direct function of frost penetration. It is, however, quite possible to have less heave with more frost penetration or more heave with less frost penetration. The model is unable to give useven a qualitative indication about that, because it completely omits consideration of subsurface water movement (and its attendant transport of both heat and latent heat).
- Page 29, Figure 11 - according to the illustrated model results, freezing proceeds from the bottom of the thaw zone only, not from the top as would normally be expected, even with the insulation in place (the shortest path for the escape of heat is still from the top of the insulation, through the pipe which, by convection of inside air, may even act as an efficient heat pump).
- Page 34, Figure 14 - does not show "Frost Heave versus Time" as the caption claims, does it? If it does, the curves indicate more heave for lower ice content and original water content.
- Page 36, para 2 - is there a difference between "frost stable" and "non-frost susceptible"?

R. O. van Everdingen
Hydrology Research Division
Calgary, Alberta
March 5, 1979.

Comments on "Geothermal Evaluation of Frost Heave", Annex Number 02,
Foothills Pipe Lines (South Yukon) Ltd. EIS.

Page 2, para 1 - the migration process can only result in consolidation if the moisture content of the remaining nonfrozen material decreases (same comment for para 3, point c).

Page 3, para 2 - by leaving out the water-transport aspect, the model may give correct answers in some cases, but it will give wrong answers in a number of others. It will indicate frost heave in excess of actual occurrence if water supply is small. It will indicate frost heave smaller than actual where water supply is ample and continuous (in that case, "frost susceptible" or frost sensitive may well include a wider range of materials).

Page 3, para 3 - mass transfer appears to be considered only insofar as it results from a temperature-induced potential gradient. Or not at all? (no data are given for frozen and nonfrozen hydraulic conductivities of any of the materials).

Page 3, para 3 - what was the accuracy of the "adequate" prediction of pipeline behaviour by the model? As "the accuracy level of the model is a function of the variability of the input parameters", how will the use of different parameter values, for a different site, affect the accuracy of the model results?

Page 4, para 1 - assumption of the formation of 50 percent (or any other fixed percentage) excess ground ice makes heave solely dependent on frost penetration; - the above assumption, requiring energy for the extraction of latent heat, leads to unrealistically low predicted frost penetration compared to what it would be when less excess ice were formed; this in turn gives inadequate indication of the effect of the frost bulb on movement of subsurface water.

Page 4, para 1 - what is the definition of frost susceptible (better called frost sensitive) soil? Is it a laboratory definition, depending on soil parameters (grainsize, material etc) only, or is it a field definition, also dependent on hydraulic conditions?

Page 4, para 2 - what happens when more water is available e.g. for the gravel? Could it also display frost sensitivity under the proper conditions?

Page 6, para 1 - "Future evaluation of the frost susceptibility of the soils should allow a less conservative (less than 50 percent heave) design criteria".
(a) how will the degree of susceptibility (frost sensitivity) be determined (see comment page 4, para 1)?
(b) it should not a priori be assumed that heave will be less than 50 percent of the depth of frost penetration in all cases. It undoubtedly will be larger in some cases.

Comments on: "Geothermal Evaluation for Thawing Conditions", Annex Number 03,
Foothills Pipe Lines (South Yukon) Ltd. EIS.

Page 2, para 2 - Hwang (1976) mentioned evapotranspiration, surface emissivity and absorptivity for surfaces other than snow, and greenhouse factor (depending on cloud cover). These are not mentioned in Annex Number 03. Hwang (1976) also stated "The model does not account for effects of heat convection in the soil". A statement detailing the assumptions made, the limitations of the model as well as the expected accuracy of the results is lacking from Annex Number 03.

- the model was verified by field observation and monitoring at the Norman Wells Test Site. Can the model be transferred to other situations without major adjustments? Is the accuracy level of the model independent of the variability of the input parameters?

Page 10, Table 4 - average wind velocity for March 15 seems excessive.

Page 33, para 5 - moisture content for White River ash is not given; are data available?

Page 15, para 3 - ".....retention time (of sewage) of one year was used". What happens after that? And why was the sewage assumed to remain in the lagoon for 4 years in the model analysis? This would give an unrealistic result because it would avoid the heating supplied by the sewage from years two, three and four;

- capacity for 1.2 m depth of sewage will be exceeded in year 1;
- sewage will overtop the 1.7 m high dikes before the end of year 2, especially in view of precipitation input.
- why are imperial gallons used, when lagoon dimensions are given in metres?

Page 18, Figure 5 - comparison of this with Figure 11 shows that the partial impervious liner may be inadequate, as thaw will penetrate into the "Undisturbed Soil" and leakage of sewage may result.

R. O. van Everdingen
Hydrology Research Division
Calgary, Alberta
March 5, 1979.

Comments on Annexes 06, 09, 11, 12 and 13, Foothills Pipe Lines
(South Yukon) Ltd. EIS.

Serious efforts have been made to collect multi-discipline background data for stream crossings, leading to more extensive knowledge of locations subject to icing formation. However, not all stream-crossing sites potentially affected by icings have been recognized; the relationship between icings and groundwater discharge at stream crossings has not been fully appreciated; and the potential for icings at locations away from stream crossings has not received the attention it deserves.

"The maintenance of significant groundwater flow in streambed gravels" was deduced in Annex 13, sub A8 (a), para 3. Data on gradients, permeabilities, flow rates, chemistry and temperature of the groundwater are, however, not available. Such data will be needed to improve the chances for reliable predictions of frost penetration and frost heave for the chilled-pipeline section upstream of compressor station FY-1. Such information will also be required if icing development is to be avoided or controlled anywhere along the route.

Concern for aufeis formation is expressed in the explanation for column 13 of the tables in Annex 11 (Nov. 1978). Sources of information do not mention the April 1978 airphotos which showed icings and open-water reaches at 23 crossings where Annex 11 does not mention their occurrence. Many of these are, however, mentioned in Annex 12 (Aug. 1978).

Annex 12, p. 20 and 22 on ice thickness - Observations listed in Table 4 do not confirm the suggested expectation of near normal or slightly greater than normal ice thickness in 1978; of the six measured, 2 are larger than the annual mean, 1 is the same as the annual mean and 3 are smaller than the annual mean.

Same place, on aufeis thickness - in many cases, a colder winter will indeed lead to thicker aufeis (with a smaller areal extent) because the flow rate of groundwater discharge that feeds the icings (and consequently the total icing volume) may be unaffected by winter temperatures. It is also possible that lower temperatures restrict the flow rate, which would restrict the icing volume. Lighter snow cover, encouraging deeper frost penetration, may restrict flow rates and icing volume or the more extensive frost penetration may shut off some outlets and increase the flow (and the resulting icing volume) at others. A general observation is that icings extend farther downstream in milder winters.

Page 37, conclusion 4 - potential icing occurrences and control measures should not only be considered in (access) road design, but also in the design of pipeline berm culverts.

Mirror Creek- the occurrence of extensive open water from groundwater discharge was apparently not noticed.

Snag Creek - winter flow was mentioned as "may be spring fed" (result of groundwater discharge); does winterflow have significance only if fish are involved?

Beaver Creek -the present channel bottom is 1.75 m above the low portion of the north (or left) floodplain; highwater caused by channel obstruction may overtop the low banks towards the north floodplain.

White River - Annex 09, Fig. 2 H(2) - the right-hand photo shows east bank, not west bank, eroding.

Donjek River-Annex 09, Fig. 4C - shows HW mark at left (706.25 m) as much higher than June 1978 waterlevel (706.27m), which in turn is about equally high as the next June 1978 waterlevel (705.22 m). One of these must be wrong.

Duke River - HW mark is 97.6 m (Annex 09, Fig. 5.C); design HW is 97.0 m (Annex 06, FSY 1063-5); design HW is 97.3 m (Annex 13, Fig. E.2). Both design high water levels seem inadequate.

Takhini Hot Springs - Whitehorse Alternative Route A, on Figure A-3 of Annex 12, runs between the Hot Springs and Takhini River. Crossing of the discharge channel from the springs may be subject to icing and/or groundwater problems.

Slim's River- "no indication of significant aufeis". Widespread aufeis was, however, shown by April 1978 airphotos. Photo 8. 16 is not looking downstream but upstream, isn't it? It shows icing immediately upstream as well as downstream of the bridge.

Mendenhall River - icing may be more widespread than indicated by Annex 12.

R. O. van Everdingen
Hydrology Research Division
Calgary, Alberta
March 6, 1979.

Comments on "Evaluation of Alternatives", Foothills Pipe Lines (South Yukon)
Ltd. EIS, section 5.0

1. Pickhandle Lake area

Alternative C was not covered by the April 1978 airphotos; therefore no opinion can be given on the likelihood of significant icing or other groundwater-related problems at the numerous small stream crossings on alternative C.

Both crossings of Koidern River that are avoided by alternative C, showed icing and/or open water on the April 1978 airphotos; they were identified as being utilized by fish in migration, spawning and overwintering (Map 6.5-2); they are therefore likely located in groundwater discharge areas that could add geotechnical disadvantages to the environmental disadvantages identified in Table 5.4-1. These may be outweighed, however, by the geotechnical advantage of avoiding a significant stretch of ice-rich soil when alternative B is used.

2. Ibex Pass

Alternative A was not covered by the April 1978 airphotos between 459,000 m E and 514,000 m E (UTM zone 8); no information is therefore available on the occurrence of icing or other groundwater related problems on that part of the Ibex Pass route. It can be expected, however, that the portion of the route along Ibex River, between 460,000 m E and 474,000 m E is subject to groundwater discharge problems; the same observation applies to the Louise Lake/Fish Creek area and the Wolf Creek and Shadow Lake areas. These could pose a geotechnical disadvantage and possibly an environmental (fisheries) disadvantage.

3. Squanga Lake area

All three alternatives cross the Judas Creek drainage, which is likely to present some problems with groundwater discharge and icings. Alternate A also crosses the Little Squanga Lake to Squanga Lake drainage and Squanga Creek, which both may present groundwater and icing problems in addition to environmental disadvantages. Alternate B follows a valley system containing Little Atlin River, Squan Lake and Summit Lake; any problems on this route resulting from groundwater related phenomena can be expected to be mostly geotechnical.

R. O. van Everdingen
Hydrology Research Division
Calgary, Alberta
March 14, 1979.

APPENDIX D

Government of Canada Gouvernement du Canada

MEMORANDUM

NOTE DE SERVICE

Mr. P.W. Strilaeff,
Inland Waters Directorate,
Pacific and Yukon Region.

G.J. Young
Glaciology Division,
Inland Waters Directorate.

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N/RÉFÉRENCE
YOUR FILE - V/RÉFÉRENCE
DATE February 6, 1979

SUBJECT
OBJET

Environmental Impact Statement for the Alaska Highway Gas Pipeline Project.

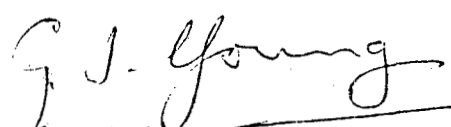
As requested, I have examined this document with respect to the adequacy with which glacier - related floods have been treated. My attention has focussed on the Donjek River crossing where scour may be significant at times of glacier outburst floods and on the Haines Junction area where the pipeline may be submerged should Lowell Glacier dam the Alsek Valley.

Donjek River - I find references to the Donjek Crossing in Sections 6.3.2.1 and 8.1.2. References are made to possible problems, but I see no evidence of any studies conducted by the pipeline proponents to evaluate flood damage resulting from sudden outbursts from glacier dammed lakes.

Haines Junction Area - The only reference I can find to possible lake formation and pipeline inundation in this area is in Section 6.2.4.1. on p. 6-76; "A major surge or advance of the Lowell Glacier could dam the Alsek River and cause an extensive lake to form along it and its tributaries; however, the community of Haines Junction and other low-lying facilities would be affected long before terrain crossed by the pipeline route". The implication of this quotation is that the flood potential is recognized but that it is not important because Haines Junction would be flooded first. Again I see no further analysis of this problem in the E.I.S.

I suggest that it is not sufficient only to recognize the existence of problems; analyses to assess probabilities of occurrence, likely damage to the pipeline and preventive measures to be taken should also be undertaken.

I should point out that I have not had a chance to read the annexed report which may answer these concerns. However, I am not yet satisfied that the flood risks have been properly considered.


Gordon J. Young
Research Scientist

Government
of CanadaGouvernement
du Canada

MEMORANDUM

NOTE DE SERVICE

TO
AMr. P.W. Strilaeff
Inland Waters Directorate
Pacific & Yukon RegionFROM
DEGlaciology Division
Inland Waters Directorate

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

YOUR FILE - V/RÉFÉRENCE

DATE

February 8, 1979

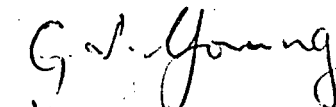
SUBJECT
OBJETEnvironmental Impact Statement for the Alaska Highway Gas Pipeline Project

This is a follow-up to my previous memorandum of 6 February 1979. Since then I have been able to study Annex No. 14, Assessment of South Yukon Flood Hydrology prepared by Northwest Hydraulic Consultants Ltd. Again I restrict my comments to glacier outburst floods on the Donjek and the possible flooding by glacier-dammed lake formation in the Haines Junction area. I am satisfied that possible glacier-related flood events on the White and Slims Rivers have been adequately considered.

Annex No. 14 refers in several places to the Glaciology Division Report (1977) concerning the effect of glaciers on hydrology, particularly on pages 30 and 31. I quote from p. 31 - "In summary, the studies discussed do not indicate reason for serious concern about glacier-outburst floods. Such events have to be considered, however, as possibly critical for design purposes on the White and Donjek Rivers". This quotation contains an important contradiction; if outburst floods are possibly critical for design purposes why is there no reason for serious concern? The Glaciology Division Report (1977) was not a final report and it clearly stated that further work should be undertaken to assess flood potential. I see no evidence that the proponents have undertaken such studies.

Table 10 does indicate that a glacier outburst flood on the Donjek might produce a flow of $2300 \text{ m}^3 \text{ s}^{-1}$. My more recent estimate of peak discharge from the Donjek Lake is $2860 \text{ m}^3 \text{ s}^{-1}$. (I communicated this figure to your office by memorandum on 24 January 1978. The memorandum was included within the IWD (1978) report on the Haines Road which is referenced in Annex No. 14). It is not clear to me which of these discharge estimates has been utilized for designing the pipeline structure at the Donjek crossing.

The potentially much more disastrous situation in the Haines Junction area should Recent Lake Alsek reform is dismissed very lightly in Annex No. 14. As indicated in my memorandum to you of 6 February 1979, I find this quite unacceptable.


Gordon J. Young
Research Scientist

Inland Waters Directorate
Vancouver, B.C.
March 16, 1979

REVIEW OF YUKON ENVIRONMENTAL TERMS, CONDITIONS AND RELATED GUIDELINES,
ALASKA HIGHWAY GAS PIPELINE, DRAFT II, DATED FEBRUARY 1, 1979

1. The use of such statements as "adequate level of site-specific data on hydrological and geotechnical regime" in section 2.16.1, "natural hydrologic regimes" in section 2.17.1(a) and "pre-construction levels" of suspended sediment in section 4.8.16(a) are problematical because of the general lack of baseline data. For these statements to be creditable, the Terms and Conditions must carry the provision: "Because of the general lack of hydrologic data the company shall take every opportunity in the period available prior to construction to record hydrometric and suspended sediment information in order to obtain a more adequate understanding of the natural hydrologic regimes."
2. Water quality standards in section 4.4.1 should be flagged with references.
3. With respect to guideline 4.4.1(b) dissolved oxygen levels have been observed as low as 3 mg/l under natural conditions. A reduction of this level by 20% may be too severe. For further information on natural D.O. depressions reference should be made to Inland Waters Directorate report entitled Water Quality Processes and Conditions in the Ogilvie and Swift River Basins, Yukon Territory, and EPA 660/3/74/008 report entitled Low Winter Dissolved Oxygen in Some Alaskan Rivers.
4. Guideline 4.4.1(g) would be of no value for winter months as an oil or grease sheen would not be visible when under ice cover.
5. Guideline 4.4.3 assumes close relationship between turbidity and suspended sediments. During a freshet apparent high turbidity could be caused by high dissolved organics rather than suspended sediments. Accordingly, the following sentence should be added to the guideline: "Where high levels of dissolved organics are observed, a procedure based on direct sampling of suspended sediment concentration should be used."

REPORTS ON STUDIES RELATED TO ALASKA HIGHWAY GAS PIPELINE IN YUKON TERRITORY

INLAND WATERS DIRECTORATE

1. Alaska Highway Pipeline Investigations, Preliminary Report
- June 3, 1977
2. Investigations of Alternative Routes to Alaska Highway Pipeline, Preliminary Report
- June 8, 1977
3. An Assessment of the Yukon Section of the Alcan Pipeline Emphasizing Water Quality Problems
- June 30, 1977 (Revised July 10, 1977)
4. Water Investigations Along The Alaska Highway Pipeline Route In The Yukon Territory
 Main Report
 Appendix A - Streamflow and Suspended Sediment at Selected Sites Along the Alaska Highway Pipeline Route in the Yukon Territory
 Appendix B - A Study of Selected Hydrologic Quantities of the Yukon Territory for Examination of Pipeline Proposals
 Appendix C - Channel Geometry of Streams in the Yukon Territory
 Appendix D - Kinematic Wave Model
 Appendix E - Water Quality Processes and Conditions in the Ogilvie and Swift River Basins, Yukon Territory
 Appendix F - Microbial Water Quality of the Ogilvie and Swift River Basins
- December 1978
5. Review of the Environmental Impact Statement Alaska Highway Gas Pipeline in the Yukon Territory
- March 1979