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Analysis of Environmental Protection Activities for the Alaska Highway Gas Pipeline Project

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ANALYSIS OF ENVIRONMENTAL PROTECTION ACTIVITIES FOR THE ALASKA HIGHWAY GAS PIPELINE PROJECT

prepared by staff of
the Environmental Impact Control Directorate and
the Pacific and Northwest Regions

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SUMMARY

The purpose of this document is to place on record the analyses made to determine the resources deemed necessary to achieve adequate environmental protection on the Alaska Highway gas pipeline project. The document gives the numbers and qualifications of design review and of field inspection staff and the probable time schedule for these resource requirements for the entire pipeline project.

If the challenge of controlling the design, construction and operation of the pipeline is to be met, three key tasks must be performed. First, regulatory documents must be prepared well in advance of the Pipeline Company's preliminary design submissions so that the Company can comply with the regulations in their plans, designs and schedules. Second, preliminary and final design reviews must be conducted to ensure that the Company's plans and designs are environmentally sound. Third, a team of trained personnel must be fielded to inspect pre-construction, construction and post-construction activities. In addition design, construction and operation alternatives must be developed and agreed upon as well as contingency measures should these become necessary as the project is carried out.

An early start is essential if these tasks are to be accomplished. The analyses show that design review staff of geotechnical, hydrological and civil engineers, botanists, foresters, environmental specialists, biologists, planners, systems analysts, and other specialists such as archaeologists should have commenced their work in 1977. While some of this work was undertaken within departments, it is essential that it be coordinated at the earliest possible date. At the peak of the design activity a staff of sixty-five will be required.

A field inspection staff of up to forty-four people will be required at the peak of construction. A considerable number of them will be required immediately after field activities commence. Lead time to train and familiarize this staff may be required. It may be advantageous therefore to transfer some design review staff to field inspection to take advantage of developed expertise.

This document is intended primarily as advice to the Northern Pipeline Agency, the authority charged, on behalf of the Government of Canada, with the management of the pipeline development. The statements made in the document

are intended to fit into the overall framework of federal/provincial and federal/territorial responsibilities and accords which are the mandate of the Agency. Reference is also made to the Interim Report of the Alaska Highway Pipeline Environmental Assessment Panel, keeping in mind that further Panel recommendations are anticipated later in 1978.

RÉSUMÉ

Le présent document a pour objet de consigner les études qui ont servi à estimer les ressources humaines nécessaires pour protéger adéquatement le milieu aux stades de la planification et de la construction du pipe-line projeté le long de la route de l'Alaska. Il établit le nombre et les qualifications des personnes qu'il faudra affecter à l'examen des devis et aux tâches d'inspection sur le terrain et il fixe les délais qu'il faut prévoir pour le recrutement, la formation et l'affectation de ce personnel tant que dureront les travaux.

Le défi d'une surveillance adéquate de la conception, de la construction et du fonctionnement du pipe-line, nous impose trois tâches essentielles. D'abord, il faut préparer des règlements bien avant que l'entrepreneur fasse sa présentation préliminaire pour qu'il puisse tenir compte des règles établies dans sa conception, ses plans et son calendrier. En second lieu des examens préliminaire et final de la conception sont nécessaires pour contrôler la valeur environnemental des plans et devis du constructeur. Enfin, il doit y avoir sur place une équipe bien formée pour vérifier les phases d'avant-projet, de construction et de fonctionnement de l'entreprise. De plus des solutions de rechange doivent être mises au point et acceptés afin de parer à toute éventualité durant les trois phases des travaux.

Pour mener à bien cette mission, il faut se mettre à la tâche sans retard. A compter de 1977, il faudra que s'active une équipe d'examen composée d'ingénieurs soit civils, soit en géotechnique et en hydrologie, de botanistes, de spécialistes en foresterie et en sciences environnementales, de biologistes, de planificateurs, d'analystes des systèmes, d'archéologues et autres scientifiques. Bien que certains ministères aient déjà amorcé le travail, il est indispensable d'en assurer la coordination dans les plus brefs délais. Lorsque les activités de conception atteindront leur sommet, l'équipe devra rassembler 65 personnes.

Par ailleurs, un groupe d'inspection fonctionnant sur place devra réunir 44 personnes au plus fort des travaux. Plusieurs d'entre elles devront être en poste dès le début du chantier.

Il faut prévoir un certain temps pour former et initier ce personnel. Il pourrait donc être avantageux de muter certaines personnes affectées à l'examen des devis à des tâches d'inspection sur le terrain pour profiter au maximum de la formation qu'on leur aura donnée.

Le début du présent document est essentiellement de faire des recommendations à la Northern Pipeline Agency, représentant officiel du gouvernement du Canada, sur la manière d'administrer les travaux du pipe-line. Ces recommandations s'insèrent dans le cadre du partage des responsabilités et des ententes fédérales-provinciales et territoriales qui forment le mandat de l'organisme de contrôle. Bien que d'autres recommandations soient attendues au cours de 1978, le document fait néanmoins référence à celles contenues dans le rapport provisoire de la Commission d'évaluation environnementale sur le pipe-line de la route de l'alaska.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1 INTRODUCTION

In 1976, the Environmental Protection Service, utilizing consultants (Templeton Engineering Company), undertook an assessment of environmental protection requirements for the then proposed Mackenzie Valley gas pipeline project. The report was published by EPS as document EPS-2-NW-76-1. Recent decisions have made it necessary to undertake a similar exercise for the Alaska Highway gas pipeline project. This document is largely a revision and update of the previous EPS report.

Reference is made to Foothills Pipe Line (Yukon) Ltd. (henceforth referred to as the Company) and to the Northern Pipeline Agency (henceforth referred to as the Agency). The Company includes Foothills Pipe Line (Yukon) Limited (parent company), Westcoast Transmission Company Ltd., Alberta Gas Trunk Line (Canada) Ltd., and Alberta Natural Gas Company Ltd.

The purpose of this document is to place on record the analyses made to determine the resouces deemed necessary to achieve adequate environmental protection on the pipeline project.

The terms of reference for this study are:

1) to assess the Company's schedules of activities;
2) to assess the Agency's schedule of key activities;
3) to assess the probable resource requirements in terms of numbers of people and their qualifications; and
4) to assess the probable time schedule for these resource requirements.

The contents of this document are technical/environmental and relate to the entire pipeline project from the Alaska-Yukon border to the 49th parallel. The separate federal, provincial and territorial environmental jurisdictions and responsibilities are not specifically addressed since it is anticipated that there will be close cooperation between the respective governments and with the Company through the mechanism provided by the Agency and pertinent agreements and contracts related to the pipeline project.

It should be noted also that an Environmental Assessment Panel has been established to conduct a formal review of the pipeline route in the Yukon. The Panel is responsible for issuing guidelines for the preparation of an

Environmental Impact Statement by the Company (Fisheries and Environment Canada, 1977a), reviewing the Statement with technical experts and the public, and reporting its recommendations to the Minister of Fisheries and Environment on the action to be taken. To this end, in July 1977, the Panel prepared an Interim Report (Fisheries and Environment Canada, 1977b) to the Minister of Fisheries and Environment on environmental issues raised by the Company in its preliminary environmental report and by technical reviewers and public organizations and individuals. The Panel will review the Environmental Impact Statement prepared by the Company on the basis of major issues raised in the Interim Report. This Statement will contain recommendations for environmental impact mitigation and these will have a major effect on proposed environmental protection activities. Following this review, the Panel will report to the Minister on the adequacy of environmental planning on the pipeline project.

It should be noted also that the Environmental Protection Service has published "Interim Recommended Environmental Practices for the Proposed Alaska Highway Gas Pipeline" (Fisheries and Environment Canada, 1978) which provide preliminary advice to the Agency on the types of terms and conditions which might be imposed on the Company for various phases of pipeline construction.

To aid the Company the Atmospheric Environment Service can provide consultation and assistance concerning climatological factors which may affect certain design aspects such as location of compressor stations and airstrips, construction of snow roads, etc. AES may also be expected to provide climatological and weather information for construction and operational activities; this may be for engine fuel estimates for cold weather, estimates of ice fog incidence at airstrips, etc. The resources which may be needed by AES to provide this service to the Company are not addressed in this document.

2 PROJECT SCHEDULE

The schedule and the complexity of operations of the construction activities for the Alaska Highway gas pipeline are impressive. During pipeline installation, crews of 800 men each, could be simultaneously at work at up to ten different locations along the entire route. The actual pipelaying will be preceded by site preparation and construction activities required to build camps, roads, airstrips, and bridges. Preparation activities will include clearing and grading of right-of-way and commencement of deposition of fuel and pipeline supplies. In the Yukon, these activities may begin two years ahead of the actual pipelaying. Some construction in the southern Alberta, B.C. and Saskatchewan sections may begin in mid-1979. Station construction and river crossing will proceed concurrently with pipelaying. In short once construction starts, it will continue throughout the project area year-round for three and a half years to meet the gas delivery deadline in January 1983.

The schedule of pre-construction activities is proportionately immense. A large range of decisions and commitments must be made before any construction begins. The types of equipment, seasonal limits, and environmental constraints must be decided upon. Sites for borrow pits, stations, and bridges must be investigated and finalized. Access to these sites must be obtained. Designs, specifications, and contract documents must be prepared. Most of these pre-construction activities carry serious environmental implications for the project.

An understanding of both the pre-construction and construction activities is essential for those who would control the environmental impact of this massive endeavour.

2.1 Information Available

Two major sources of information on the Alaska Highway gas pipeline project are: the Company's application to the Department of Indian and Northern Affairs (DINA) for authorization to use land, and to the National Energy Board (NEB) for a certificate of public convenience and necessity. Additional information sources include the Lysyk and Berger Enquiry Reports and the Interim Report of the Alaska Highway Gas Pipeline Environmental Assessment Panel.

Information from the applications is frequently general, sometimes sparse. The construction plans provide only preliminary information on routes and construction schedules. However, it is deemed that enough information is available at the present time on project scheduling to discuss various aspects of the project as they bear on environmental concerns. Construction activities are dealt with first.

2.2 Construction Activities

The project will cover the entire length of the pipeline from the Alaska-Yukon border to the 49th parallel in approximately 27 construction sections. The location of the pipeline route is shown in Figure 1.

It is convenient to discuss the project in terms of the major components: surveys, support facilities, pipeline, compressor and meter stations, and operating and maintenance facilities. These are discussed briefly in the following paragraphs to provide some understanding of what is involved.

2.2.1 Surveys. Line location surveys will be completed early in construction and will involve the clearing of a 4-meter-wide boundary line between previously established control points. Hand clearing in summer is anticipated where trees are sparse and the survey crews can move by helicopter. Bulldozer clearing will be used in forested areas. Construction surveys will be carried out just before related construction activities with flagging along the sides of the right-of-way (r-o-w) and at the areas to be cleared at particular sites (compressor stations, staging and off-loading sites etc.). These surveys will also lay out the lines and grades for sites and facilities.

2.2.2 Support Facilities Construction. In many of the locations, camps must be built before major operations can begin. In the early stages of construction, camps will be approximately 20-man units. For site preparation, materials receiving, and station construction, camp sizes will increase to accommodate 200 men. During pipe laying, 500 to 800-man camps will be required. Camp construction is anticipated to start in 1979.

In addition, permanent roads, airstrips, and pads will be built to serve stockpile areas and station sites. Temporary construction roads, frequently snow/ice roads, will provide access along the r-o-w.

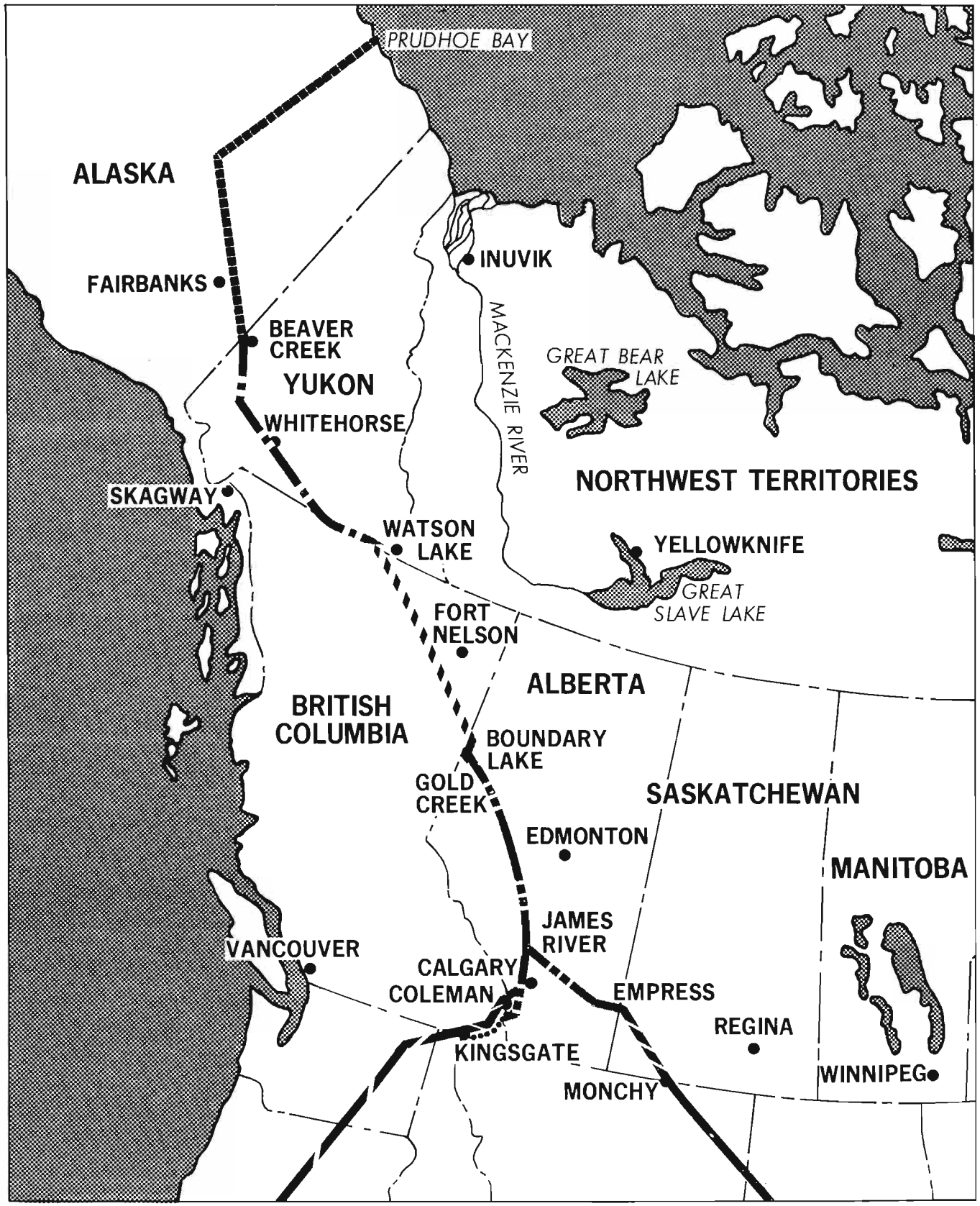

FIGURE 1 Alaska Highway Gas Pipeline Route
Adapted from: National Energy Board (1977)

2.2.3 Pipe Laying. Pipe laying is scheduled to begin in 1981, but may commence earlier in the southern portions of British Columbia, Alberta, and Saskatchewan. Specific site investigations such as construction surveys, center-line drilling, and r-o-w clearing and grading may precede pipe laying by a full year. Pipe laying across major rivers will take place during the summer months. Revegetation and restoration will be carried out immediately following pipe laying.

2.2.4 Compressor and Meter Stations. Station construction is planned to take place over a period of approximately two and a half years.

2.2.5 Operating and Maintenance Facilities Construction. Regional control centers will be scheduled for completion in phase with gas delivery commitments.

2.2.6 Scheduling. Figure 2 gives some perspective on the start-up and timing of the pipe laying in relation to other activities. Once pipe laying begins it will continue almost year round to the scheduled completion date. All other construction activities will be phased to the pipeline work.

Recognizing the magnitude, diversity, and duration of the construction, it is particularly convenient to examine the project by construction sections. Given this approach, the construction activity can be divided into five work elements:

- civil engineering (camps, roads, bridges, borrow areas, etc);
- right-of-way (clearing, grading);
- materials (hauling, stockpiling);
- pipe laying (ditching, welding, wrapping, etc.); and
- restoration (clean-up, revegetation).

It is apparent from Figure 2 that the Company's project component schedule is only of very preliminary nature. Information is sparse on location and size of sections and of ancillary facilities. More comprehensive information is necessary to refine manpower and timing requirements for the Agency.

It should be noted that a diversity of environmentally significant activities will occur concurrently with mainline construction. The diversity coupled with the intensity of the general work schedule demands that a high degree of very close coordination occur between the Agency and the Company.

ACTIVITY	SEGMENT	COMPANY	SECTION	M P to M P	WORK
CIVIL ENGINEERING	YUKON	FOOTHILLS	1	0-30	W - E
			2	30-71	W - E
			3	71-111	E - W
			4	111-216	W - E
			5	216-321	W - E
			6	321-416	W - E
	YUKON	FOOTHILLS	7	416-513	W - E
	B.C.	WESTCOAST	1-7		
	ALBERTA	TRUNK LINE	1-9		
	ALTA/ B.C.	NAT.GAS			
	SASKATCHEWAN	FOOTHILLS			
RIGHT-OF-WAY	YUKON	FOOTHILLS	1	0-30	W - E
			2	30-71	W - E
			3	71-111	E - W
			4	111-216	W - E
			5	216-321	W - E
			6	321-416	W - E
	YUKON	FOOTHILLS	7	416-513	W - E
	B.C.	WESTCOAST	1-7		
	ALBERTA	TRUNK LINE	1-9		
	ALTA/ B.C.	NAT.GAS			
	SASKATCHEWAN	FOOTHILLS			
MATERIALS	YUKON	FOOTHILLS	1	0-30	W - E
			2	30-71	W - E
			3	71-111	E - W
			4	111-216	W - E
			5	216-321	W - E
			6	321-416	W - E
	YUKON	FOOTHILLS	7	416-513	W - E
	B.C.	WESTCOAST	1-7		
	ALBERTA	TRUNK LINE	1-9		
	ALTA/ B.C.	NAT.GAS			
	SASKATCHEWAN	FOOTHILLS			
PIPE LAYING	YUKON	FOOTHILLS	1	0-30	W - E
			2	30-71	W - E
			3	71-111	E - W
			4	111-216	W - E
			5	216-321	W - E
			6	321-416	W - E
	YUKON	FOOTHILLS	7	416-513	W - E
	B.C.	WESTCOAST	1-7		
	ALBERTA	TRUNK LINE	1-9		
	ALTA/ B.C.	NAT.GAS			
	SASKATCHEWAN	FOOTHILLS			
RESTORATION	YUKON	FOOTHILLS	1	0-30	W - E
			2	30-71	W - E
			3	71-111	E - W
			4	111-216	W - E
			5	216-321	W - E
			6	321-416	W - E
	YUKON	FOOTHILLS	7	416-513	W - E
	B.C.	WESTCOAST	1-7		
	ALBERTA	TRUNK LINE	1-9		
	ALTA/ B.C.	NAT.GAS			
	SASKATCHEWAN	FOOTHILLS			

FIGURE 2: CONSTRUCTION ACTIVITIES

NOTE s INDICATES NUMBER of CONSTRUCTION SECTIONS

Prepared from information provided by the Pipeline companies

2.3 Pre-construction Activities

While details on pre-construction or planning activities for this project are not available, the general information provided allows a broad view to be taken of the activities that must precede actual construction in the field. The information available is given in Figure 3.

Considerable effort will have to be expended in preparatory field investigations and preliminary design before final designs can be arrived at. Detailed specifications must be prepared for all contracts before they can be put out to tender. It is assumed that much work could be done on a cost-plus basis with contractors, since this would allow for the most expeditious scheduling of activities for project management. However, specifications would still need to be prepared to govern the contractual arrangements. Whether contracts are bid on a cost-plus or fixed-job basis, it will be necessary to provide for a tender period, for subsequent evaluation of all tenders received, and for final negotiations leading to the actual award of major contracts. It is only when a contract has been awarded that a contractor can commence mobilization of resources to carry out the work.

A major point concerning Figure 3 is that it applies to preparations leading to the first year of pipeline laying and will thus have to be applied all over again to preparations for the second year of pipe installation. This fact becomes significant later when manpower requirements for design review are examined.

2.4 Operations and Maintenance Activities

The environmental concerns will not end with completion of pipe line construction. The Agency will find it necessary to provide project follow-up which will include routine monitoring and surveillance, and supervision of operations and of maintenance activities.

2.5 Conclusions

The construction schedule for this project, as currently proposed, may result in almost continuous field activities along the pipeline route for a period of four years. Many of these activities will be year round and will not be confined to any one geographic location.

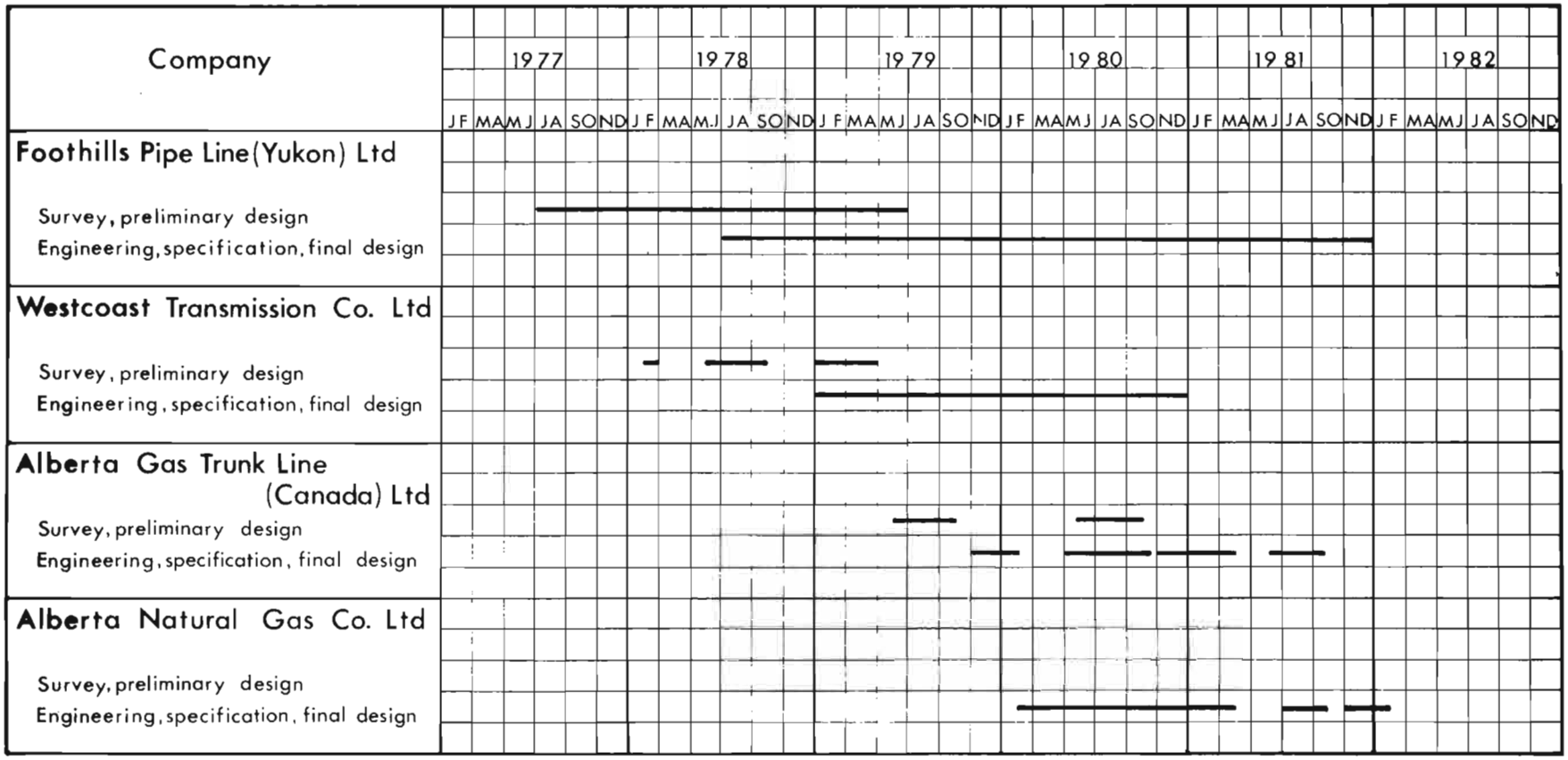

Figure 3 Pre-Construction Activities

Prepared from information provided by the Pipeline Companies

Preceding and concurrent with these construction activities, there will be several years of continuous pre-construction design, site confirmation, specification preparation, and drafting of contracts in preparation for mainline construction. Environmental and other concerns will necessitate the development of terms and conditions that apply to the Company, their contractors, subcontractors, suppliers, transportation companies, and the like. These terms and conditions will recommend a thorough review and approval of all construction plans, schedules, designs, and contracts, and thus considerably extend the effort required for pre-construction activities. Also at this time, the post-construction monitoring and surveillance mechanisms and activities will have to be developed in detail.

3 KEY ACTIVITIES FOR CONTROL FROM AN ENVIRONMENTAL PERSPECTIVE

The key activities required for achieving environmental control of this project, can best be appreciated by working backwards from the actual construction phase. Environmental inspection of mainline activities, performed by a team of trained inspectors aided by comprehensive manuals, is obviously a key activity. But for this to be effective, it must be preceded by two other key activities: an initial review and approval of preliminary designs, plans, etc., followed by a final review and approval of final designs, specifications, and tender documents prepared by the Company. These endeavours will ensure that all plans and schedules are environmentally sound, and thereby make it possible for the field inspectors to do an effective job.

In turn, the initial and final reviews will need to be preceded by a fourth key activity: the preparation of guidelines, stipulations, and codes. The Company must have these regulatory documents in hand well in advance of their submissions of plans, designs, and schedules, to ensure maximum compliance. If regulatory documents are not prepared, then there will be no formal basis on which the design reviews can take place. Such a situation would greatly hinder the effectiveness of any environmental control program.

Key activities, such as preparing regulatory documentation and conducting reviews and approvals, will require considerable lead time, but this is believed to be essential if environmental control is to be achieved on the project.

3.1 Pre-Construction

If detailed construction plans and schedules were to be prepared without regulatory review and approval, it is highly unlikely that the project field procedures and schedules of the Company would automatically meet the requirements of regulatory authorities charged with protecting the environment. As a result, field inspectors would be confronted with enormous cost and schedule implications for any rulings which they might deem necessary and which would result in construction delays or significant changes. For example, consider an early spring thaw that could cause deterioration of snow/ice roads. Inspectors would be faced daily with decisions on terminating travel or removing ice bridges. The implications of such delays for project costs, for project management, and for

Canada would be substantial. It is evident that schedules, procedures, and contingency plans should be established and agreed to before such situations develop.

As another example, consider what could occur at many of the watercourses to be crossed. Because of steep banks at a crossing location, the Company's project design may call for substantial cutting and grading of river banks - environmentally unwise procedures in most cases. Inspectors would be confronted with powerful arguments as to why changes in the design could not be made. Changes could require redesign of the crossing, something that would have to be done in a distant office. The resulting delays could cost millions, interfere with testing progress, delay restoration, and so on.

Similarly, an inspector might find himself at a borrow pit confronted by a potentially detrimental situation. He might ask the local operator to cease operations for a time, only to hear from the operator that his contract is to deliver X cubic meters @ $P/cubic meter to a stockpile site, he has obtained a permit, and he cannot stop without jeopardizing his contract or the subsequent construction activities that depend on his completing his contract on schedule.

The purpose of these examples is not to downgrade field inspection, but to give some indication that field inspection alone will meet with limited success in achieving environmental protection unless it is preceded by the three key activities: preparation of regulatory documents, and reviews of initial and final environmental designs.

If the Company is to submit plans, designs, schedules, etc. for preliminary review and approval, then the level of detail required and what standards are to be met should be clearly stated. If this information is not provided, the Company will determine for itself what to submit. To offset this problem, it is recommended that the Agency set out in detail the requirements for preliminary design submissions. This should be done by preparing guidelines, codes and stipulations in advance.

The preparation of stipulations etc. requires a coordinated effort by all those currently involved in a legislative or advisory role. It is a key activity for the achievement of environmental protection. Furthermore, it will be most important to the Company because it will be against this base that the adequacy of preliminary designs will be gauged. If the rules are set down beforehand,

inefficient negotiations, arbitrations, and appeals can be minimized. Otherwise, waiting until the preliminary designs have been submitted to decide what they ought to include will lead to an arbitrary and uncoordinated approach. Both the Company and the Agency must know well beforehand what will be required. The Company must know well in advance in order to present the required information in each submission.

In establishing times and procedures for the reviews, the approach detailed in "Towards an Environmental Code" (Environment Protection Board, 1974) may be a guide. The following summarizes the procedure outlined in that report:

a) construction shall not be initiated without the written approval of the Agency;

b) a summary work schedule analysis for the entire pipeline system shall be submitted to the Agency. This would include: data collection activities; submittal and approval activities; pre-construction, construction and commissioning activities; and other pertinent data required by the Agency. The schedule would be regularly updated;

c) the preliminary design for a construction segment shall be submitted for approval. Up to 180 days would be allowed for review. In appropriate cases this requirement could be waived;

d) a Notice to Proceed may be applied for on construction segments for which the preliminary design has been approved. This submission will be supported by a final design, reports, data, schedules, etc.;

e) the Agency shall review each such application within 90 days and issue a Notice to Proceed when all matters are in conformity with regulations, codes, statutes, etc. Such a notice shall authorize construction on that construction segment only;

f) the Company may appeal a decision of the Agency within 30 days to the appropriate authority; and

g) the Agency may at all times inspect on-site activities of the Permittee and may issue suspension decisions should any activity threaten to cause serious or irreparable harm.

As a particular example, the timing and juxtaposition of major decision points for preconstruction activities are given in Figure 4. Because the necessary information is unavailable at present on the Alaska Highway gas pipe line project, both Figure 4 and the discussion following have been taken from the EPS document on the Mackenzie Valley gas pipeline project (Environment Canada, 1976). It would appear appropriate, therefore, that the Agency obtain from the Company, as soon as possible, all the needed information on preconstruction scheduling including a critical path analysis.

Referring to Figure 4, it is recognized that while the timing of the decision points may differ to some extent from that shown, their actual occurence is critical to the logical development of this project. In fact, some decision points may have been passed already and while others may be imminent.

Consider the first item in the list of project components - location surveys. It is recommended that the specifications for carrying out location surveys in any spread should be reviewed and approved before contracts are tendered. This is indicated by a triangle (∇) at the appropriate point on the schedule and an estimate of the number of days such a review would take is indicated. The persons needed to make the review would be proportional to the task itself and the number of construction sections coming up for review at one time.

It is also recommended that preliminary designs and the selection of sites for the many sizes of camps be given preliminary review, and that following final design and the preparation of specifications, a final review and approval be undertaken. Final reviews are indicated by a solid triangle (▼) and an estimate of the number of days required is indicated. If everything were resolved by the reviews, a "Notice to Proceed" with camp construction could be issued. A similar approach for roads, borrow and staging areas, and communication towers is required. In the case of supplies and fuel, a single review and approval would be sufficient since it is assumed that siting has been determined by the location of major facilities and would be taken into account when those are being reviewed and approved. In the case of snow/ice roads, a review is recommended of preliminary route selection and design, followed by a final review when designs and specifications have all been worked out.

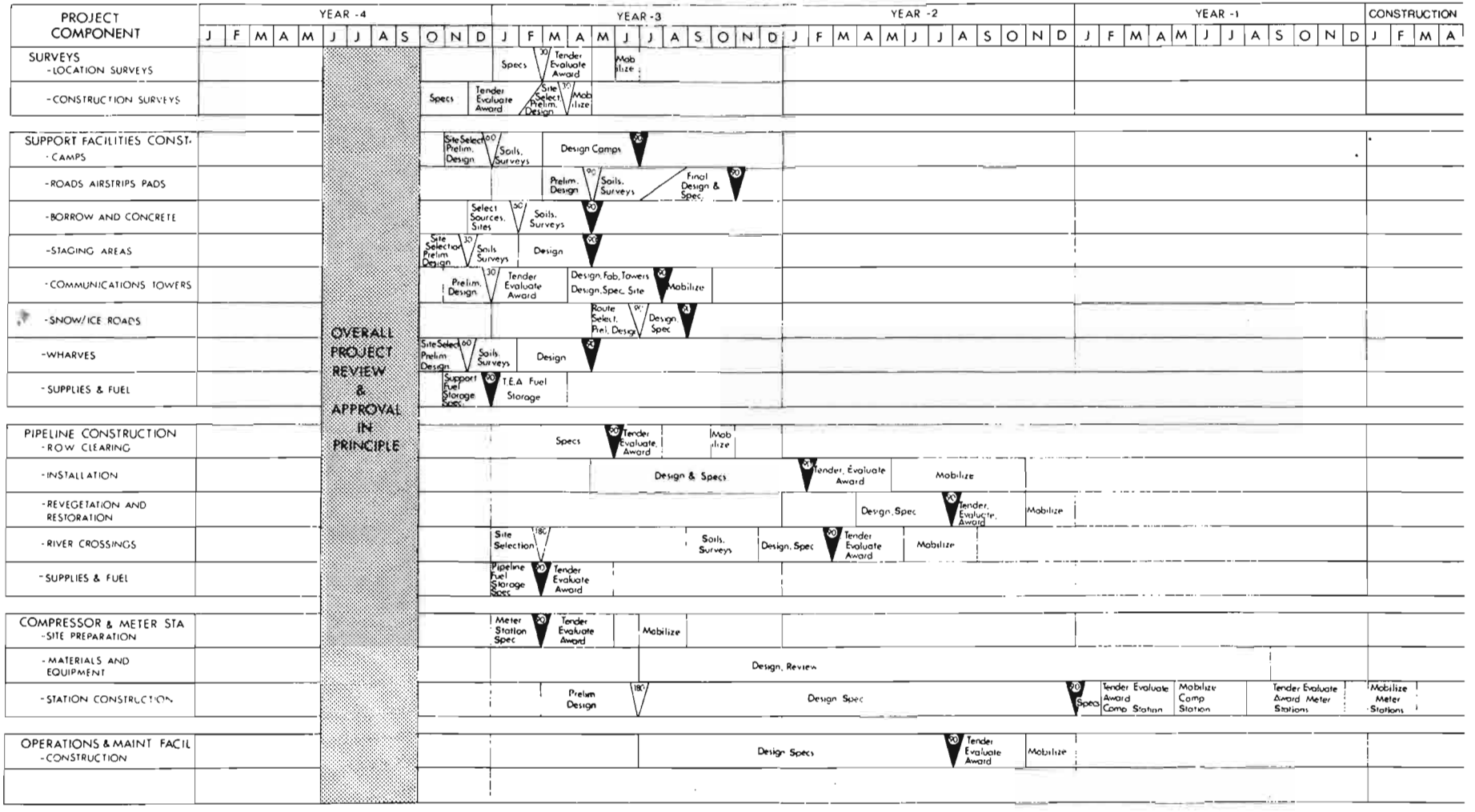

FIGURE 4 Example of Detailed Pre-Construction Activities
Adapted from: Environmental Protection Service (1976)

Project components, listed under support facilities, could possibly be contracted on a cost-plus basis. Thus, associated with each contract, there would be a separate set of documents describing the equipment and manpower required for the contract. These would be put out to tender and contractors would bid unit prices for the rental of the equipment, wage rates, and a time schedule for the contract. General equipment specifications would then need to be approved. Once these were approved, it would not be necessary to review them in every instance. Accordingly, such review and approval is not shown in Figure 4. In essence, it is anticipated that the successful contractor would mobilize his forces and then receive the detailed designs and specifications to proceed with the job.

The detailed designs and specifications would describe the facility, plant, or site to be constructed, and the construction methods. These documents would not necessarily have to be in the form of a conventional contract document; since the contract for the work would be covered by the previously described tender document. The information could be in the form of a description or a data sheet. Whatever the format, the details must be set down for critical review and approval and to enable field inspectors to perform compliance checks.

In the case of pipeline construction proper, it is worth noting that many of the siting, route, and access locations will have been determined during the preceding survey and support facility siting activities. Hence, the advantage of the two-staged approval. Two-staged approval also means that less review is required for the final specifications. Referring to Figure 4, it is indicated that a single final review of the detailed clearing specifications will be adequate, although the time to carry out such final reviews has generally been set at 90 days. The same applies to installation and revegetation specifications. In the case of river crossings, preliminary reviews will be required, but they will have to be done in phase with the route location surveys, otherwise crossing sites and therefore the route may have to be altered at an advanced stage of construction. Station design should be examined in two stages: first when such matters as slope stability, proximity to rivers, archaeological resources, and wildlife areas are considered; and second when the final design is complete but before the station goes out for tender.

In most cases then, two design review functions are essential if environmental protection is to be achieved. If the Agency neglects these reviews, the field inspection staff will be faced with an impossible task.

The final pre-construction work assignment of the Agency will be to identify site-specific problems that will be important during design reviews and that will require the attention of field inspectors later on. For some locations, site-specific concerns will not have been identified when codes, etc. were being prepared. Thus the Agency should be continuously updating this information as it becomes available from many different sources.

The types of site-specific concerns are numerous. One can anticipate for example that an occupied raptor nest should not be disturbed by aircraft or quarrying activities, or that the status of a particular site might change from year-to-year. Site specific concerns may be related to vegetation and they may be reflected in limitations on disturbance. The timing of locally important fish runs and river-related activities is another example or a particular area could be important to local recreation. It will be difficult to properly identify many such concerns, particularly those that depend on information from local people.

To recapitulate, guidelines, codes, and stipulations must be prepared and be in possession of the Company sufficient time before construction begins so that the Company can prepare preliminary plans in compliance with them. Designs and plans must then receive preliminary approval and specifications, tender documents, and final designs must receive final review and approval before any construction activities commence. There is also a continuing need to compile the many site-specific concerns for consideration during design review and to assist field inspectors at a later date.

3.2 Construction

Environmental stipulations and design reviews must be complemented by a strong, active environmental inspection and monitoring program. The fielding of a competent inspection team is key to the achievement of environmental protection on this project. If regulations go unenforced, the field situations will deteriorate, and then arguments of custom and habit will confront those who try to upgrade enforcement at some later date.

The job of inspection will not be a simple one. It will require people of considerable experience, capable of weighing alternatives and making field decisions. It is important to have inspectors on site during preliminary surveys and investigations because considerable environmental damage can occur at these

times. Land is being committed to certain uses, and subsequent project activities merely increase the level of use. If sites or routes are poorly chosen, they will remain so during construction activities. A competent, well-trained inspector with good support, readily available, will thus be required.

Table 1 summarizes many of the project activities that will require inspection and indicates the broad expertise that an inspector might need to carry out his job.

It should be recognized also that the Alaska Highway will be the major supply artery. Roadway deterioration because of the increased traffic and heavy loads will necessitate increased maintenance activities. These activities may involve reconstruction of road sections and stream crossings, changes in drainage and slopes, disturbance of permafrost areas, etc. These in turn may result in environmental impacts.

In addition, factors not directly related to construction activities will constitute a potential for developing environmental problems. Pipelaying, construction and camp activities will increase the fire hazard. During dry spells in densely forested areas this will call for additional controls and surveillance. Unless there is adequate supervision, it is likely that oily machinery will be washed while parked in a stream or on a shore. Hunting pressures will increase substantially and will require strict supervision.

Because of tight scheduling, pipelaying will require long working hours by construction crews. If environmental concerns are to receive adequate attention, delays in environmental decisions cannot be entertained; it is most unlikely that construction will be held up until an inspector is available. In particular, unforseen technical or environmental problems, which may arise very rapidly, will demand prompt and decisive action by the inspectors.

Monitoring the long-term environmental effects of certain operations will be a continuing activity for inspectors. If there is a potential problem, one that is definable in terms of measurable quantities, then measurements should be taken at appropriate intervals. In such cases, predetermined tolerances would be established such that remedial action would be required by the project if these levels were exceeded. Such continuing monitoring that feeds back into the control function of the project is valuable and necessary.

TABLE 1 AREAS OF RESPONSIBILITY FOR STATION SITE AND PIPELINE INSPECTORS (adapted from Environment Canada 1976)

Construction Phase	Activity	Inspector Responsibility: Station Sites	Inspector Responsibility: Pipeline	Disciplines	Potential Problems
Surveys & Site Investigations	Cutlines for surveys (hand/machine)	X	X	Forestry	-
	Preliminary location of borrow areas, airstrips and roads	X		Civil Eng. Geotechnical Eng.	Drainage, erosion, designs Slope stability, permafrost
	Preliminary location of station pads and pipeline		X	Civil Eng. Geotechnical Eng. Archaeology	Drainage, erosion, designs, slope stability, permafrost
	Subsurface investigations for facilities	X		Geotechnical Eng.	Slope stability, permafrost
	Subsurface investigations for stations and pipeline		X	Geotechnical Eng.	Slope stability, permafrost
	Clearing for subsurface investigations	X	X	Forestry	-
	Fuel storage and handling	X	X	Civil Eng.	-
	Aircraft overflights	X	X	Biology	Birds, mammals
	Water supply, sewage and waste disposal	X		Civil Eng. Geotechnical Eng.	-
	Archaeological resources protection	X	X	Archaeology	-
Clear, Grade Support Facilities Construction	Clear areas for station pads, roads airstrips, borrow areas, and offloading areas. Stack marketable timber	X		Forestry, Geotechnical Eng.	Clearing, permafrost
	Clear pipeline r.o.w. Stack marketable timber		X	Forestry, Geotechnical Eng.	Clearing, permafrost
	Burning of slash and brush	X	X	Vegetation Forestry Geotechnical Eng.	Fire safety, permafrost, terrain damage

TABLE 1 (Cont'd) AREAS OF RESPONSIBILITY FOR STATION SITE AND PIPELINE INSPECTORS (adapted from Environment Canada 1976)

Construction Phase	Activity	Inspector Responsibility: Station Sites	Inspector Responsibility: Pipeline	Disciplines	Potential Problems
	Fuel storage and handling	X	X	Civil Eng.	-
	Fuel spill prevention and clean-up	X	X	Civil Eng. Biology	Fire hazard, environmental contamination
	Borrow, crush, sort and stockpile material	X		Civil Eng. Biology	Drainage, materials, blasting
	Aircraft overflights	X	X	Biology	Birds, mammals
	Construction of station pads, roads, airstrips	X		Civil Eng.	-
	Drainage interruption from clearing and construction	X	X	Civil Eng. Hydrology	-
	Water supply, waste and sewage disposal	X		Civil Eng. Biology	Design, wildlife and fish
	Harvest snow for roads from lakes, etc.		X	Biology	Fish
	Snow/ice road construction		X	Civil Eng.	-
	Ice bridges		X	Civil Eng. Biology	-
	Surplus construction material disposal	X		Civil Eng. Biology	-
	Communication towers	X		Civil Eng.	-
	Concrete batching	X		Civil Eng.	-
	Clear staging areas and construct pads	X (staging site)		Forestry Civil Eng.	-
	Construct warehousing	X (staging site)		Civil Eng.	-

TABLE 1 (Cont'd) AREAS OF RESPONSIBILITY FOR STATION SITE AND PIPELINE INSPECTORS (adapted from Environment Canada 1976)

Construction Phase	Activity	Inspector Responsibility: Station Sites	Inspector Responsibility: Pipeline	Disciplines	Potential Problems
	Archaeological resource protection	X	X	Archaeology	-
Pipeline and Station Construction	Water supply, waste and sewage disposal	X		Civil Eng. Biology	Operation, wildlife and fish
	r.o.w. grading, ditching, pipelaying and backfill		X	Vegetation Civil Eng. Geotechnical Eng. Gas systems	Construction, permafrost
	Blasting on r.o.w.		X	Biology	Birds, mammals
	Fuel storage and handling	X	X	Civil Eng.	-
	Fuel spill prevention and clean-up	X	X	Civil Eng. Biology	Fire hazard, environmental contamination
	Disposal of testing fluid		X	Biology	Fish, water quality
	Clearing and site preparation for river crossings		X	Forestry Civil Eng. Geotechnical Eng.	Clearing, burning, design, slope stability, permafrost
	Blasting for river crossings		X	Biology	Fish, water quality
	Ice bridges		X	Civil Eng. Biology	-
	River bed excavation		X	Civil Eng. Biology	-
	River bank excavation		X	Civil Eng. Geotechnical Eng.	Slope stability, design, permafrost

TABLE 1 (Cont'd) AREAS OF RESPONSIBILITY FOR STATION SITE AND PIPELINE INSPECTORS (adapted from Environment Canada 1976)

Construction Phase	Activity	Inspector Responsibility: Station Sites	Inspector Responsibility: Pipeline	Disciplines	Potential Problems
	River berm fill		X	Civil Eng. Biology	-
	Aircraft overflights	X	X	Biology	Wildlife and fish
	Surplus construction material disposal	X		Civil Eng. Biology	-
	Minor river and stream crossings		X	Civil Eng. Geotechnical Eng. Biology	Design, slope stability, permafrost, fish and water quality
	Hunting and fishing	X	X	Biology	-
	Archaeological resource protection	X	X	Archaeology	-
	Drainage interruptions from construction		X	Civil Eng. Hydrology	-
Revegetation	Re-contour and stabilize disturbed r.o.w. areas		X	Civil Eng. Geotechnical Eng. Botany	-
	Re-contour borrow areas and seed	X		Civil Eng. Geotechnical Eng. Botany	-
	Cleanup pipeline spoil, debris, etc.		X		-
	Replace vegetation mat on ditch and seed		X	Botany	-
	Clean out stream crossings of snow, brush, and ice bridges		X	Biology	-

TABLE 1 (Cont'd) AREAS OF RESPONSIBILITY FOR STATION SITE AND PIPELINE INSPECTORS (adapted from Environment Canada 1976)

Construction Phase	Activity	Inspector Responsibility: Station Sites	Inspector Responsibility: Pipeline	Disciplines	Potential Problems
	Clean up temporary roads and revegetate where necessary	X	X	Botany	-
	Clean up station sites and revegetate where necessary	X		Botany	-
	Clean up river crossing sites and revegetate where necessary		X	Botany	-
	Install culverts and drains where required		X	Civil Eng. Hydrology Biology	Fish passage
	Clean up river berms		X		-
	Aircraft overflights	X	X	Biology	Birds, mammals

3.3 Operations and Maintenance

Activities of the Agency will lead to laying the foundations for activities in the operations and maintenance phase. In this regard it is clear that certain project operations will require close attention: emergency activities, planned maintenance to the right-of-way, erosion control, slope stabilization, frost heave and icing problems, routine aircraft patrols, station supply activities, and scheduling of major overhauls. Most of these operations will require coordinating and reporting with the Agency, particularly in the early years as experience is being built up in operating the system. The establishment of channels, for direct communication and information exchanges, will be the key to maintaining environmental quality during the operational phase of the pipeline.

3.4 Conclusion

The preparation of stipulations, guidelines, and/or codes before any plans are submitted by the Company is of prime importance. This is necessary because the Agency should consolidate and coordinate governmental requirements into one body of information which will then facilitate administration and control procedures. This will also be important to the Company because otherwise they will be confronted with a multitude of requirements being imposed on them from different sources. In addition, it will allow the Company to prepare submissions in compliance with these stipulations and thus avoid delays and confusion in the review and approval process.

Generally, two stages of approval seem desirable: one at a preliminary design stage, and the second at the final design stage before contracts are tendered.

Field inspection will be important for the achievement of environmental protection. Inspectors will need to be well-trained and be ready to commence inspection before the field activities of the Company get underway. As particular problems arise, they will require the support of additional expertise. Response to site-specific problems must be rapid.

Continuing review and inspection of pipeline r-o-w maintenance plans and procedures will be required for some time following the completion of construction.

Close cooperation between the Agency and the Company is a key element in the execution of all pipeline project phases. In addition to timely and decisive action in regard to all environmental concerns, this cooperation will make it possible to develop and agree upon any design, construction and operation alternatives, and on any contingency measures should these become necessary as the project is carried out.

4 ESTIMATED MANPOWER AND TIMING REQUIREMENTS

It is understood that the Agency will soon be formed. It is considered to be vitally necessary to finalize, for immediate operation and decision making, the technical and scientific level of the Agency.

4.1 Pre-construction

The Company is currently making decisions on acquisitions of trucks, pipe, construction equipment, etc. Many of these decisions must allow for long delivery times and may have significant environmental ramifications. Therefore, the Agency must be prepared to review them before they are acted upon.

Statements made by the Company's officials at the Environmental Assessment Panel hearing in Whitehorse indicated that designs for compressor station equipment were well underway. Delivery time of gas turbines and compressors is estimated to be 18 months from time of letting the contract.

Therefore the current status of the project demands that the Agency be operational at the working level with utmost urgency, and should be staffed with personnel trained in the following fields:

- geotechnical, hydrological and civil engineers,
- botanists and foresters,
- environmental engineers (not limited to specifically those with engineering backgrounds),
- fish and wildlife biologists,
- planners and systems analysts, and
- archaeologists and personnel for other resources.

The Comapny's schedule at present is rudimentary and allows only the most preliminary judgements as to man-years and phasing needs. A first estimate is presented in Figure 5 and indicates an initial review staff of twenty to mid-1978 reaching a peak of 65 people in 1979 and 1980. Staffing needs are shown for the entire pipeline. Adjustments and refinements must be expected as more advanced scheduling information is received from the Company.

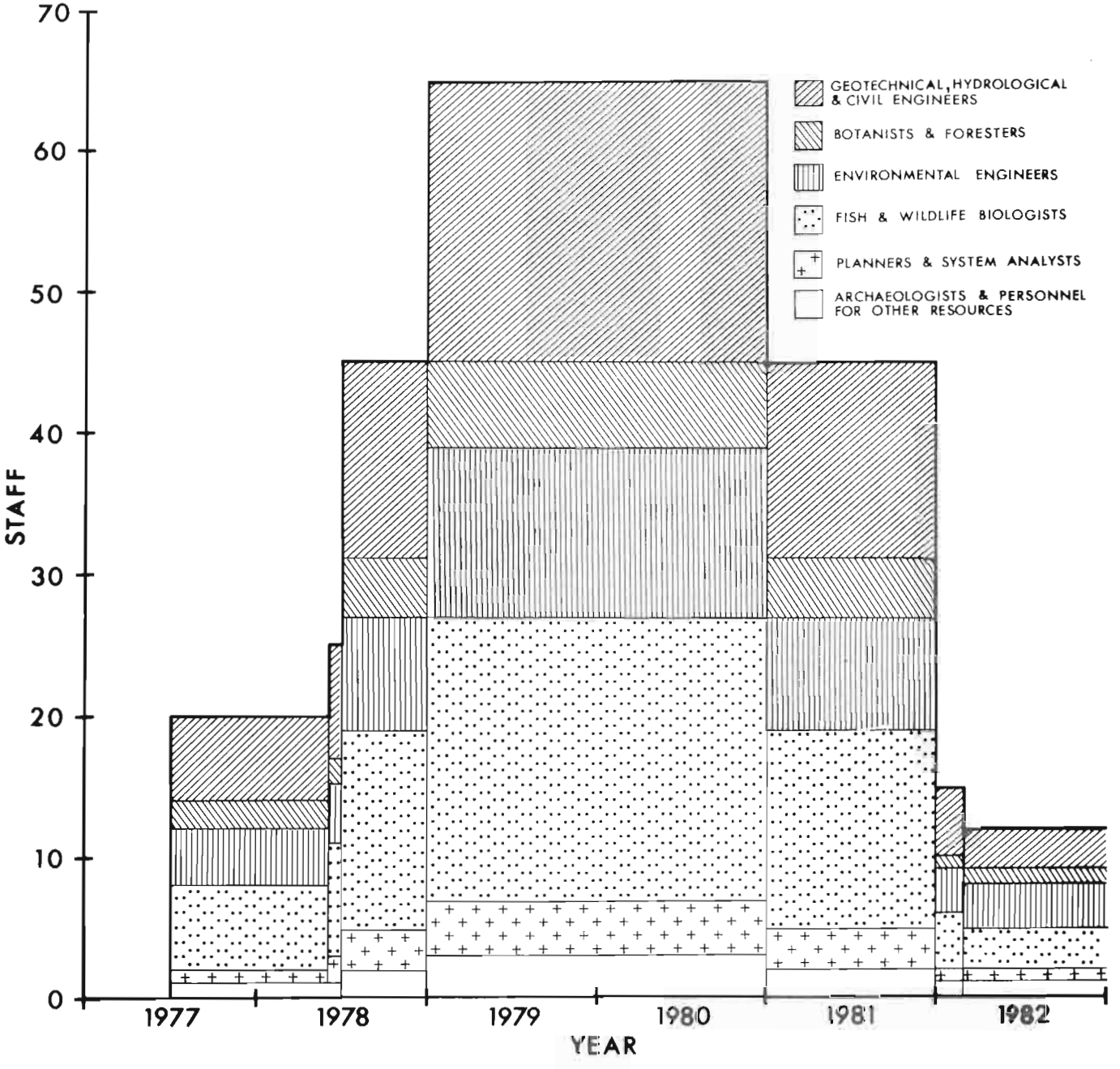

Figure 5 Design Review Manpower Requirements

During the pre-construction phase, surveys and subsurface investigations of borrow areas, station sites, roads, airstirps and pipeline routes will be required to determine suitability of location, etc. It was estimated that two inspectors will be needed at each section during the work: one for facilities and borrow areas, and one for the pipeline route and station sites. This function can be considered as part of the total field inspection activity and is included in the field inspection manpower estimate.

4.2 Construction

To determine manpower requirements for construction and restoration inspection, the construction plans were examined in terms of the breakdown in Figure 2. This made it possible to determine approximately how many inspectors would be required for each construction section according to the type of activity going on there. As with the pre-construction phase, the manpower resources needed were calculated from estimates of maximum and minimum requirements. The level of effort and totals for the entire pipeline are given below.

Development of borrow areas and conduct of civil engineering work such as construction of camps, roads, airstrips and of other facilities will precede pipelaying. It was estimated that one inspector will be needed for each section during this work.

Following surveys and site investigations, right-of-way clearing and grading operations will begin. It was estimated that one inspector will be needed for each section. The inspector from the civil engineering function could also be used to assist on these operations when available.

Preceding the pipelaying operation, materials and fuel will be stockpiled at strategic locations and other supplies will be brought in. It was estimated that one inspector will be needed for each section and that inspectors from other functions could assist when available.

During pipelaying and construction of compressor stations it was estimated that three inspectors will be required for each section: two for pipelaying and one for stations. Inspectors from "civil construction", "right-of-way" and "materials" could also be used here as additional support when available. Summer construction of major river crossings will require two inspectors at each crossing.

It was estimated that one inspector will be required for restoration on each section.

Using the estimated levels of effort described above, Figure 6 has been prepared for field inspection manpower requirements. It appears that 44 field inspectors will be required in the peak years. The Agency may find it advisable to allow 40% for staff rotation, turnover, vacations, sick leave etc. in the north, and 20% in the south.

It is recognized that inspectors will not be able to address all matters before them with full competence. Similarly, it is recognized that it is impractical to staff at such level that all disciplines are represented at all construction sites. Nevertheless, it is deemed that the job of construction inspection can be carried out in an effective fashion: by using the general category of inspector; by thoroughly training these people; and by supplementing them with regional expertise drawn, with diligent attention to overall scheduling of resources, from office review staff at such centers as Whitehorse, Edmonton, and Vancouver. The Agency may find it advantageous, therefore, to transfer at least some of the design review staff, when this project phase has been completed, to field inspection to take advantage of their project and regional expertise. Inspection staff should also be provided with the necessary means of transportation to allow maximum mobility and availability on site when needed.

4.3 Operations and Maintenance

At this point in the planning process it may be estimated that initially about 15 people will be required which will include inspectors and regional environmental supervisors.

4.4 Conclusions

Months before any field activity begins, the Company will be making decisions and commitments for equipment and supplies that have extended delivery times. The Agency must therefore be prepared at that time to review and approve those decisions that have environmental consequences.

A design review staff will be needed with a peak requirement of 65 persons in 1979 and 1980.

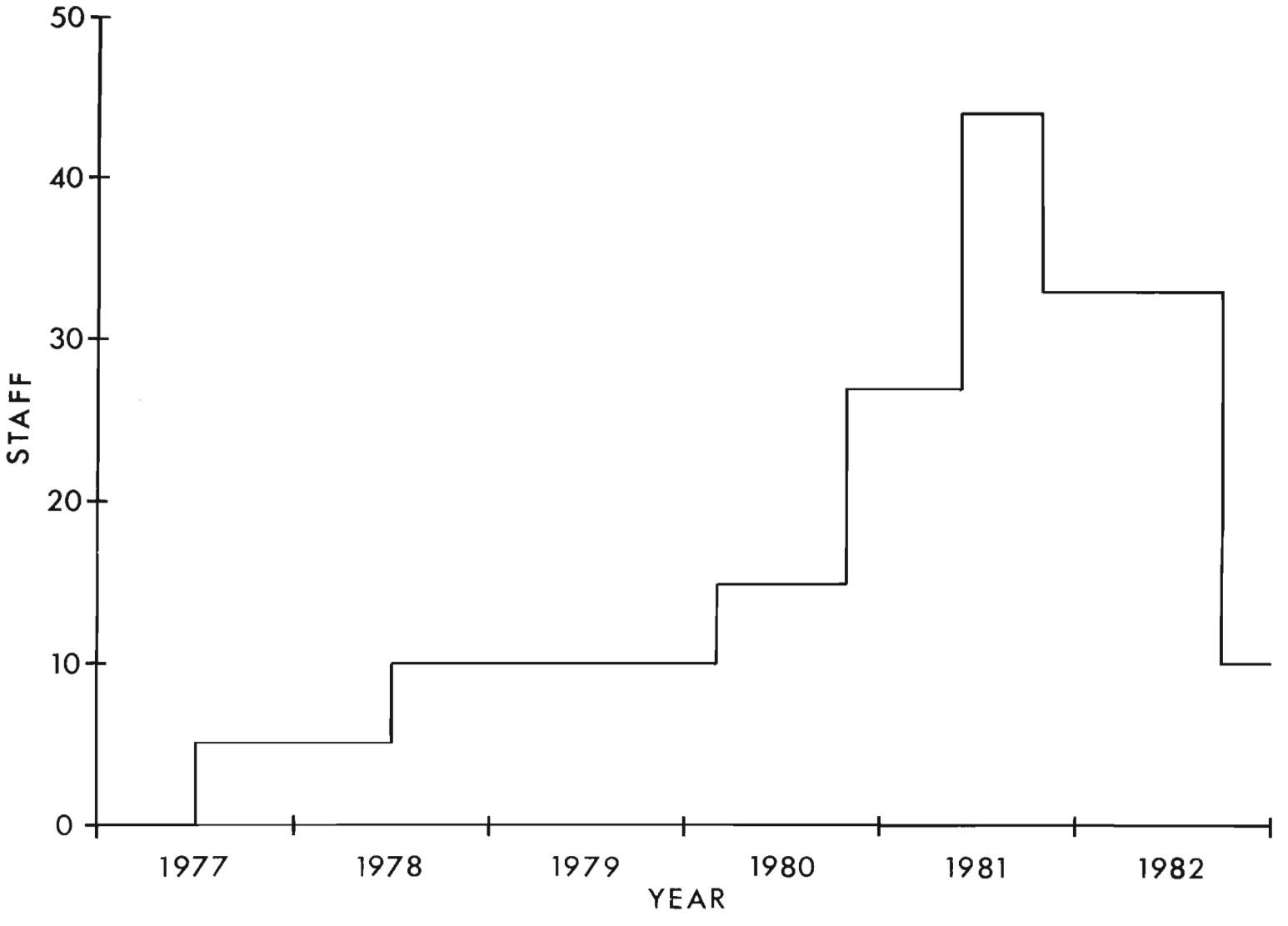

Figure 6 Field Inspection Manpower Requirements

A field inspection staff of 44 people will be required at the peak of construction. A considerable number of these will be required immediately after field activities commence. Lead time to train and familiarize this staff may be required. It may be advantageous therefore to transfer some design review staff to field inspection to take advantage of developed expertise.

Summing the above two staff requirements provides an indication of the total staff needed for the point in the schedule for which the summation is made.

We should not lose sight of the problem of finding staff of the necessary caliber for both the design review and field inspection activities. To this end, an early inventory of in-house expertise and assessment of the availability of competent and experienced consultants should be undertaken.

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