ENVIRONMENTAL SERVICES

PROJECT DESCRIPTION AND UPDATE FOR ADDENDA SUBMISSIONS

SUBMISSION 2-1

AUGUST, 1981

Foothills Pipe Lines (South Yukon) Ltd.

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PROJECT DESCRIPTION AND UPDATE
FOR
ADDENDA SUBMISSIONS
SUBMISSION 2-1

AUGUST, 1981

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

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

Foothills Pipe Lines (South Yukon) Ltd.

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

1. Introduction to Addenda Submissions.

2. Project Description and Update for Addenda Submissions.

3. Alternative Routes.

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

5. Fisheries, Wildlife and Scheduling Issues.

6. Issues Related to Pipeline Facilities.

7. Other Issues.

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1.0 INTRODUCTION

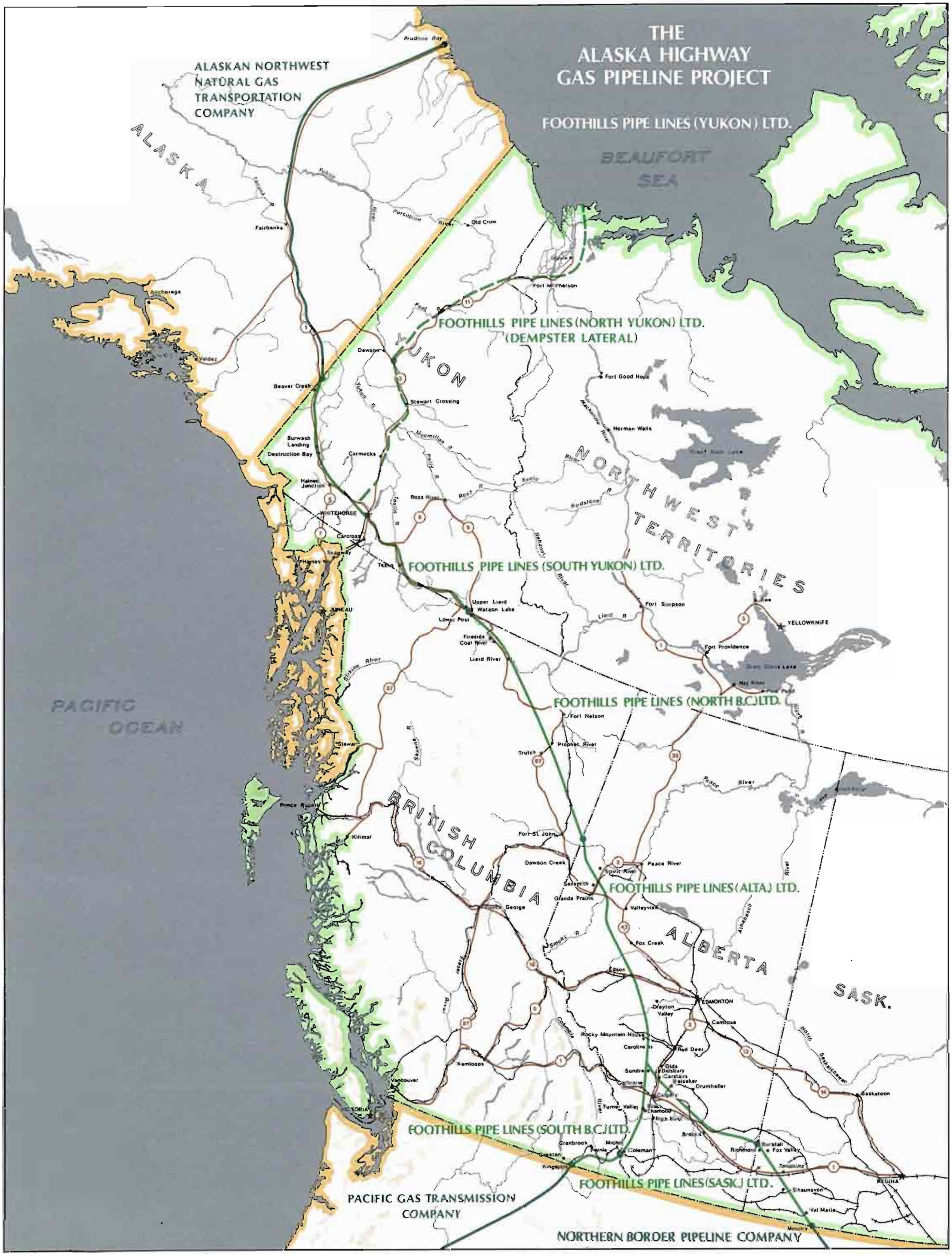
This document has been prepared as one of a series of submissions to the Federal Environmental Assessment and Review Office which is reviewing plans for the Alaska Highway Gas Pipeline in Yukon Territory. The purpose of this particular submission is to briefly describe the pipeline project so that reviewers will have available an overall project description against which to view plans and statements presented in other subject-specific submissions. The format and content of this project overview closely parallels a similar presentation made by the Project as part of previous submissions but includes changes in project plans made in the interim period. This update presents an overview of the project up to the time of the submission preparation (May, 1981). In four section of the pipeline route in Yukon Territory, several alternative alignments are under consideration at the time of submission preparation; the alignments which have been choosen through the route selection process are the ones which are presented in this project description. Finalization of the pipeline route will not be possible until the EAR Panel has completed its review of all addenda submissions.

2.0 THE PIPELINE SYSTEM IN YUKON TERRITORY

The Alaska Highway Gas Pipeline is designed to carry Prudhoe Bay gas from Alaska to southern market areas in United States as well as Mackenzie Valley gas to Canadian markets. The pipeline route follows the existing Alyeska Oil Pipeline right-of-way south from Prudhoe Bay to the junction with the Alaska Highway at Delta Junction, Alaska, and thence along the Alaska Highway alignment through southern Yukon Territory to British Columbia. In central Alberta, the line divides, one easterly route entering the United States near Monchy, Saskatchewan, and one westerly route entering the United States near Kingsgate, British Columbia. The pipeline system entering Canada at the Yukon Territory border is 1219 mm outside diameter (O.D.). The pipe diameter increases to 1422 mm in the vicinity of the City of Whitehorse, to allow for the future tie-in of the Dempster Lateral Pipeline which would transport gas from the Mackenzie Valley region. The size of the pipeline system remains at 1422 mm throughout Yukon Territory and northern British Columbia, to the point in central Alberta where the system divides into Eastern and Western Legs.

The pipeline system planned in the Yukon segment will consist of 829.5 km of pipeline connecting to similar pipeline systems in both Alaska and northern British Columbia. The Yukon segment will include approximately 378.1 km of 1219-mm (48-inch) O.D. pipe between the Alaska/Yukon Territory border and a point near Whitehorse, and approximately 451.4 km of 1422-mm (56-inch) O.D. pipe between Whitehorse and the British Columbia border at KP 829.5. Five compressor stations will be in use initially, with four additional stations required as gas flows increase. A system map is presented in Figure 2-1.1; route maps of a scale of 1:50,000 showing facility locations for Yukon Territory accompany this submission. Several sections of the route just described will be finalized only after review by the EAR Panel. The routing presented here and discussed in the project description is based on the route choosen by the Project.

Operating pressures in 1219-mm sections will not exceed 8690 kPa while those in 1422-mm sections will not exceed 7450 kPa.


THE
ALASKA HIGHWAY
GAS PIPELINE PROJECT
FOOTHILLS PIPE LINES (YUKON) LTD.
ALASKAN NORTHWEST
NATURAL GAS
TRANSPORTATION
COMPANY
ALASKA
BEAUFORT
SEA
FOOTHILLS PIPE LINES (NORTH YUKON) LTD.
(DEMPSTER LATERAL)
YUKON
NORTHWEST
TERRITORIES
FOOTHILLS PIPE LINES (SOUTH YUKON) LTD.
PACIFIC
OCEAN
FOOTHILLS PIPE LINES (NORTH B.C.) LTD.
BRITISH
COLUMBIA
FOOTHILLS PIPE LINES (ALTA.) LTD.
ALBERTA
SASK.
FOOTHILLS PIPE LINES (SOUTH B.C.) LTD.
FOOTHILLS PIPE LINES (SASK.) LTD.
PACIFIC GAS TRANSMISSION
COMPANY
NORTHERN BORDER PIPELINE COMPANY
Prudhoe Bay
Fairbanks
Anchorage
Valdez
Beaver Creek
Dawson
Old Crow
Fort McPherson
Stewart Crossing
Burwash Landing
Destruction Bay
Haines Junction
Carmacks
WHITEHORSE
Carcross
Skagway
Haines
JUNEAU
Teslin
Ross River
Upper Liard
Watson Lake
Lower Post
Fort Good Hope
Norman Wells
Fort Simpson
YELLOWKNIFE
Fort Providence
Hay River
Fort Nelson
Prophet River
Trutch
Liard River
Stewart
Prince Rupert
Kitimat
Fort St. John
Dawson Creek
Peace River
Spirit River
Grande Prairie
Valleyview
Fox Creek
Edson
EDMONTON
Drayton Valley
Camrose
Rocky Mountain House
Red Deer
Olds
Didsbury
Carstairs
Drumheller
Kamloops
Vancouver
VICTORIA
Turner Valley
Brooks
Cranbrook
Coleman
Kingsgate
Richmound
Burstall
Fox Valley
Shaunavon
Val Marie
Monchy
REGINA
Saskatoon

For the first 64.7 km between the Alaskan border and compressor station STA-311, the pipeline will carry chilled gas; that is, gas below 0°C. The gas temperature is currently planned to be allowed to rise, and will generally remain above 0°C from compressor station STA-311 southward.

2.1 DESIGN CRITERIA

2.1.1 System Deliveries

The Yukon segment of the Alaska Highway Gas Pipeline is expected to transmit an initial average volume of 56.66 million cubic metres per day ($10^6 m^3/d$) received at Prudhoe Bay less fuel and offline deliveries in Alaska. The resulting volume received at the Alaska/Yukon Territory border from Alaska Northwest Natural Gas Transportation Company is expected to average approximately 54.94 million cubic metres on a daily basis. The resulting annual throughput would be approximately 20.0 billion cubic metres. Total fuel consumption in the Yukon is projected at approximately 126.7 million cubic metres annually.

2.1.2 Gas Properties

The single source of gas supply to the Alaska Highway Gas Pipeline during the initial years of operation will be gas plant(s) at Prudhoe Bay in Alaska. Current estimates of the mole percent composition of the pipeline quality gas to be received from the Prudhoe Bay gas plant are as follows: methane, 90.99 percent; ethane, 4.43 percent; propane, 1.73 percent; carbon dioxide, 0.49 percent; nitrogen, 0.60 percent; combined butanes, pentanes, hexanes plus, 1.76 percent; and hydrogen sulphide, 0.00 percent. Other gas properties include a specific gravity of 0.625, and higher heating value, 40.952 MJ/m^3 at 101.325 kPa, 15°C, Dry, Ideal.

2.1.3 Codes, Standards and Material Specifications

The pipeline will be designed, constructed, tested and operated in accordance with the Gas Pipeline Regulations (SOR/74233) made pursuant to subsection 39(2) of the National Energy Board Act. These regulations require compliance with the instructions set forth in CSA Standard Z.184-M1979 Gas Pipeline Systems. These two documents provide detailed design and operating requirements. In addition, the CSA Standard requires compliance with numerous other codes and standards dealing with specific design areas.

Foothills will use materials specifications to detail the specific requirements for each individual major component to be included in the pipeline. Included will be the specific selection of one of the materials standards allowed by CSA Z.184, the selection of options permitted by the material standard, and the additional requirements necessitated by the service conditions.

Pipe specifications will cover line pipe, heavy wall pipe (river and road crossings), and station pipe. These specifications will be designed to preclude a brittle fracture. In addition, high toughness is being specified to maximize the resistance to fracture initiation. The line pipe will have sufficient toughness specified to limit the length of a propagating fracture if it should ever occur.

Materials specifications will include, but not be limited to valves, fittings, compressors, turbines, electric motor drives, pressure vessels, aerial coolers, pipe coatings and corrosion prevention systems.

2.1.4 Environmental Policy

It is Foothills policy that all project activities will meet the requirements of existing Canadian laws respecting environmental matters.

To this end, all project plans will be subjected to review to ensure that environmental and land-use values associated with lands used by the project are taken into account.

In considering environmental values and use of lands granted to the project, the transmission of natural gas will be recognized as the primary land-use. Secondary land-uses that do not conflict with the primary land-use will be protected or maintained through project actions to the maximum extent practicable.

A further component of company policy is the development of protection plans for all major construction and operation activities. These protection plans will become an integral part of project planning and execution.

2.2 SYSTEM CAPACITY

2.2.1 System Design

The pipeline system in southern Yukon Territory will consist of two segments. The first extends from the Alaska/Yukon Territory border to a point of interconnection with the proposed Dempster Lateral in the vicinity of Whitehorse; and the second from this Whitehorse junction to the Yukon Territory/British Columbia border south of Watson Lake (KP 829.5). The pipe in the first segment is to be 1219 mm O.D. with an allowable operating pressure of 8690 kPa, while in the second it is to be 1422 mm O.D. with an operating pressure of 7450 kPa.

The 1219-mm O.D. segment has been designed as an integral part of the whole Prudhoe Bay-to-Whitehorse supply lateral. The initial flow condition for this segment is 56.66 x $10^6 m^3/d$ on an average day basis, or 63.7 x $10^6 m^3/d$ on a peak-day basis, received at Prudhoe Bay. The ultimate peak-day flow of 87.8 x $10^6 m^3/d$ received at Prudhoe Bay will result in a flow of

84.1 x $10^6 m^3/d$ at the Alaska/Yukon Territory border, which is the nominal ultimate design capacity of the 1219-mm O.D. segment in Yukon Territory. Five compressor stations are required for the ultimate flow. Installation of compressor horsepower will be required at only the first, third and fifth stations to accommodate the initial 63.7 x $10^6 m^3/d$ Prudhoe Bay flow case.

For the segment from Whitehorse to the Yukon Territory/British Columbia border, an established flow condition was that the minimum flow capacity of the pipeline must accommodate annual average flows of 68.0 x $10^6 m^3/d$ from Prudhoe Bay and 34.0 x $10^6 m^3/d$ from the Mackenzie Delta. The expected peak-day flow at Whitehorse corresponding to these Prudhoe Bay and Mackenzie Delta receipts was in the order of 105 x $10^6 m^3/d$ to 106 x $10^6 m^3/d$. As this resulting Whitehorse volume was within the range of the economic optimum for a 1422-mm O.D. pipeline, the pipeline segment from Whitehorse to the Yukon Territory/British Columbia border (and in turn to Prophet River, B.C.) was designed on the basis that this Whitehorse volume would also be the ultimate system capacity. The nominal capacity given the pipeline was 108.4 x $10^6 m^3/d$ peak-day flow. The initial Prudhoe Bay 63.7 x $10^6 m^3/d$ peak-day flow is much lower than the ultimate design capacity of the pipeline; only approximately one half of the ultimate compression power will be required initially. Of the four stations to be located along the 1422-mm O.D. line in Yukon Territory, only the second and fourth stations are required for the initial flow.

2.2.2 Operational Flexibility

The 1219-mm O.D. pipeline segment from the Alaska/Yukon Territory border to the Whitehorse junction has been designed to handle initial and ultimate flows from Prudhoe Bay of 63.7 x $10^6 m^3/d$ peak day and 87.8 x $10^6 m^3/d$ peak day respectively. In this 1219-mm O.D. segment, three compressor stations of nominal 20060-21625 (ISO) kilowatts each are required to handle the initial Prudhoe Bay flow. One station, STA-311, will also be equipped with a standby unit. An additional 11.3 x $10^6 m^3/d$ from Prudhoe Bay could be accommodated in the pipeline by the addition of horsepower at the remaining two existing station sites. Two intermediate compressor stations would be required for flows greater than 75.0 x $10^6 m^3/d$ received at Prudhoe Bay, the ultimate capacity without any looping being approximately 87.8 x $10^6 m^3/d$.

In the 1422-mm O.D. segment from Whitehorse to the Yukon Territory/British Columbia border, two compressor stations of 21625 (ISO) kilowatts each are required for the initial Prudhoe Bay flow of 63.7 x $10^6 m^3/d$ peak day. The ultimate capacity of this 1422-mm O.D. pipeline system comprising four 40120-43250 (ISO) kilowatt compressor stations is 108.4 x $10^6 m^3/d$ peak-day flow received at Whitehorse. Thus, the flow range of the 1422-mm O.D. pipeline segment is from 61.3 x $10^6 m^3/d$ initial to 108.4 x $10^6 m^3/d$ ultimate. Any number of flow increases within this range could be accommodated by additional kilowatt and compressor station combinations.

2.3 HYDRAULICS

2.3.1 Pipe Pressure Design

The pipeline is designed to operate at 80 percent of the specified minimum yield strength of the line pipe. Pipe with a wall thickness of 13.71 mm and 483 MPa minimum yield strength was determined to be the most suitable pipe commercially available in large quantities in Canada. For the chilled segment of the pipeline, 15.24-mm wall pipe (grade 448) was selected to match that in Alaska. These pipe selections result in a maximum allowable operating pressure of 8690 kPa for the 1219-mm pipe from Alaska to the future Dempster Lateral connection near Whitehorse, and 7450 kPa for the 1422-mm pipe downstream from there.

2.3.2 Pressure Gradients

At a 63.7 x $10^6 m^3/d$ peak-day Prudhoe Bay volume, both the 1219-mm and 1422-mm segments would be operated significantly below capacity and pressure gradients would remain relatively small. In the 1219-mm O.D. segment, the pressure gradient would be about 10.5 kPa/km, while in the 1422-mm O.D. segment it would be about 5.6 kPa/km. At full flow, the pressure gradient in the 1219-mm O.D. segment would be approximately 19 to 20 kPa/km, while in the 1422-mm O.D. segment it would be approximately 18 kPa/km.

2.3.3 Thermal Gradients

As the pipeline system in Alaska is to be operated in a "chilled" mode, gas will be delivered into the Foothills system at the Alaska/Yukon Territory border in a chilled state (<0°C). The gas will continue in a chilled state until it reaches the first compressor station in Yukon Territory, when the temperature is currently planned to be permitted to rise above 0°C, and will in general be maintained at temperatures above 0°C at downstream points in the pipeline system.

For the relatively low initial flow conditions the gas temperatures will be sensitive to the ground subsurface temperatures and therefore tend towards them. Thus, during the summer months, the flowing temperatures would always remain above freezing, while in the winter they could, if permitted, drop below freezing as the soil temperatures dropped. To prevent this from occurring, a gas heater is planned for station STA-311. Under full flow conditions, the gas temperatures would become less sensitive to the soil temperatures and the heat of compression would become the dominant factor, forcing the gas temperatures upwards at each compressor station site. To prevent temperatures from reaching unacceptably high levels, gas cooling in the form of aerial gas coolers, or where practical, water-cooled systems, would be installed at each compressor station. However, cooling will not be required in Yukon Territory during the initial years of operation as temperatures will not rise to unacceptable levels.

2.4 PIPE PLACEMENT DESIGNS

Pipeline design constraints present in Yukon Territory include the use of both warm and cold flow options (described above), the presence of frozen and unfrozen soils, the effect of wide differences between installation and operating temperatures and the possibility of seismic-induced soil instability. These, together with the normal requirements for pipeline design create, in some cases, a situation in which other than conventional designs are necessary.

In total, ten basic designs have been developed to meet conditions present in Yukon Territory. Eight of these designs involve below-grade placement of the pipe while two require above-grade placement. Table 2-1.1 lists the ten designs and indicates above vs. below-grade placement together with anticipated use in cold and warm flow situations. Selection of specific designs will be based on site-specific terrain conditions as well as anticipated operating conditions at the site involved. The approximate locations of above-grade construction presently under consideration are illustrated in Map 2-1.1, and on 1:50,000 scale alignment sheets accompanying this submission.

Detailed accounts of factors involved in design development, selection and preliminary location for warm flow are included in Submission 4-1 which deals with the environmental aspects of alternative pipe-placement designs. The basis of design for cold flow has not been finalized, and may not be treated with the same level of detail. Brief descriptions of designs follow.

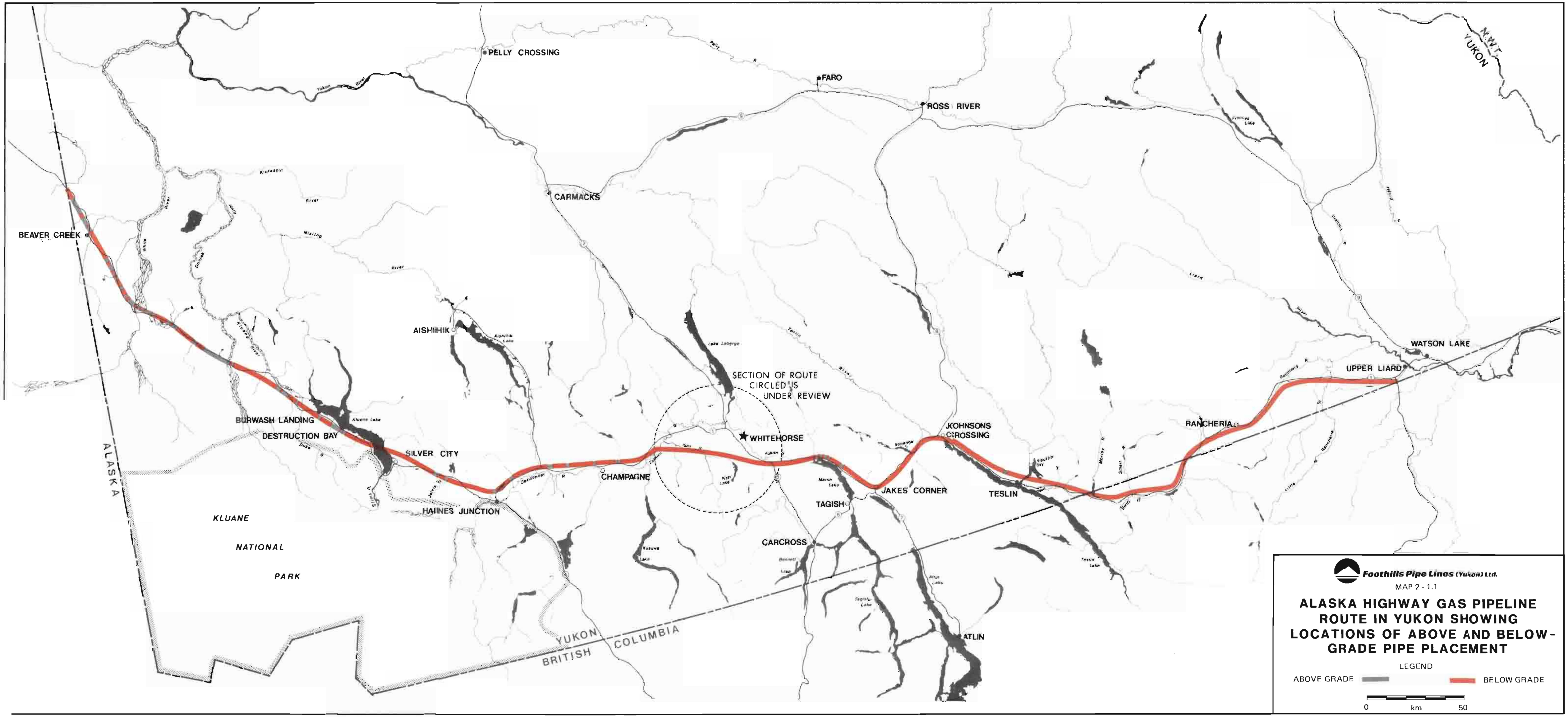
TABLE 2-1.1

DESIGN OPTIONS AVAILABLE

BELOW-GRADE DESIGNS	WARM FLOW	COLD FLOW
Standard Burial	yes	yes
Saddle-Weighted Burial	yes	yes
Continuous-Weighted Burial	yes	yes
Unweighted Burial	yes	no
Deep Burial	yes	no
Buried Heat-Traced, Watercrossing	no	yes
Standard Burial, Heat-Traced, Insulated	no	yes
Road Crossing	no	yes
ABOVE-GRADE DESIGNS*		
Embankment**	yes	yes
Concrete Restrained	yes	yes

*Both above-grade designs include a limited free span option used for crossing deep ravines or watercourses. In addition, free spans can be used to cross similarly difficult terrain from buried modes.

**Embankment design for warm flow includes an insulated gravel work and travelway. In cold flow situations, the travelway is not insultated, and the pad beneath the pipe may or may not be insulated. See text for details.


PELLY CROSSING
FARO
ROSS RIVER
CARMACKS
BEAVER CREEK
AISHIHIK
WATSON LAKE
UPPER LIARD
SECTION OF ROUTE CIRCLED IS UNDER REVIEW
BURWASH LANDING
DESTRUCTION BAY
SILVER CITY
WHITEHORSE
JOHNSONS CROSSING
RANCHERIA
CHAMPAGNE
JAKES CORNER
TESLIN
TAGISH
HAINES JUNCTION
KLUANE NATIONAL PARK
CARCROSS
ATLIN
ALASKA
YUKON
BRITISH COLUMBIA
N.W.T.
Foothills Pipe Lines (Yukon) Ltd.
MAP 2 - 1.1
ALASKA HIGHWAY GAS PIPELINE ROUTE IN YUKON SHOWING LOCATIONS OF ABOVE AND BELOW-GRADE PIPE PLACEMENT
LEGEND
ABOVE GRADE
BELOW GRADE
0
km
50

2.4.1 Below-grade Designs

Eight below-grade designs are being considered. These range from a completely conventional approach through several designs that deal with bouyancy problems and potential thaw settlement to special designs for stream and road crossings under difficult conditions.

Standard Burial

Standard burial will be used over most of the pipeline route in Yukon Territory in both warm and cold flow conditions. In the warm flow case, this mode will be used in dry, well-drained, stable soils with a water table lying below the pipe as illustrated in Figure 2-1.2. In these situations anticipated pipe settlement will be less than that allowable. In cold flow situations the mode will be used in all deep permafrost areas where pre-operational bouyancy control will not be required (Figure 2-1.3).

Saddle-Weighted Burial

Saddle weights (or swamp weights) will be used in some warm flow areas where negative bouyancy is required. This approach is illustrated in Figure 2-1.4. In these areas the pipeline will be buried in stable soil with an anticipated settlement less than the maximum allowable. In the case of chilled flow, saddle weights will be placed over the pipe in permafrost areas. In this case the water table will be at ground surface during seasonal active layer thawing prior to operation (Figure 2-1.5).

Continuous-Weighted Burial

Pipe weighted with a continuous concrete coating or with pre-cast concrete bolt-on weights as illustrated in Figure 2-1.6 will be used at

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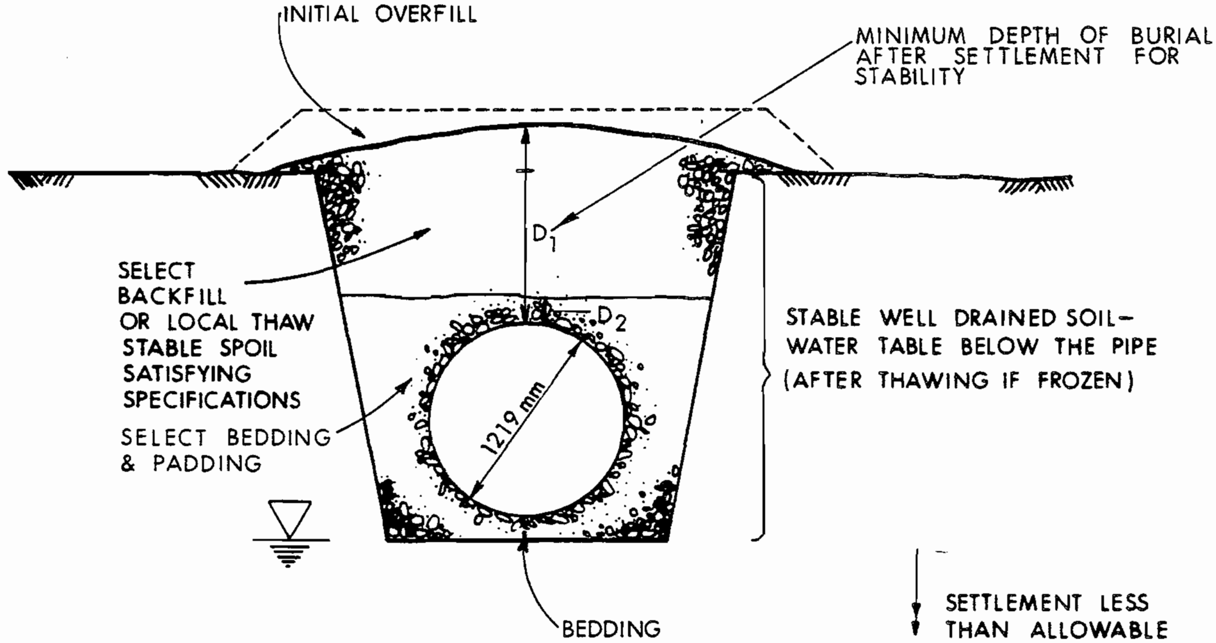


NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

MODE I

Foothills Pipe Lines (South Yukon) Ltd.

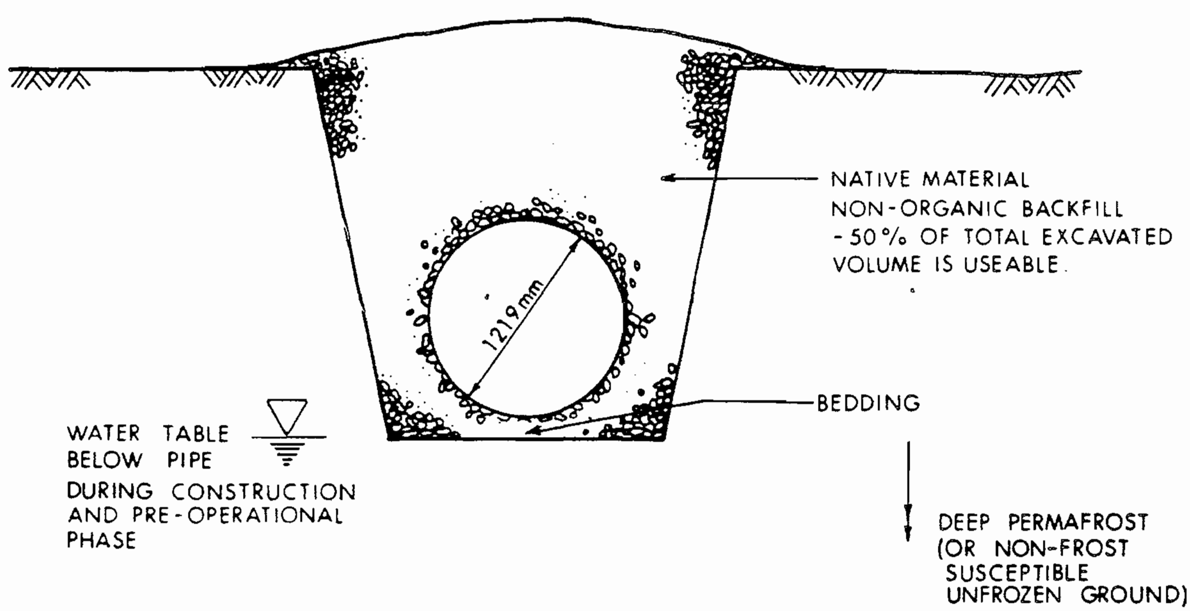
TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

STANDARD BURIAL WARM PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	V.J.R.	RPT	[illegible]	
DATE	81 04 02	81 04 29	81 [illegible]	

SCALE N.T.S. | PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.2



NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

REV 81-06-25

MODE CI

Foothills Pipe Lines (South Yukon) Ltd.

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

STANDARD BURIAL CHILLED PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	B. C.	[illegible]		
DATE	81 06 16	[illegible] 7		

SCALE N. T. S.

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.3

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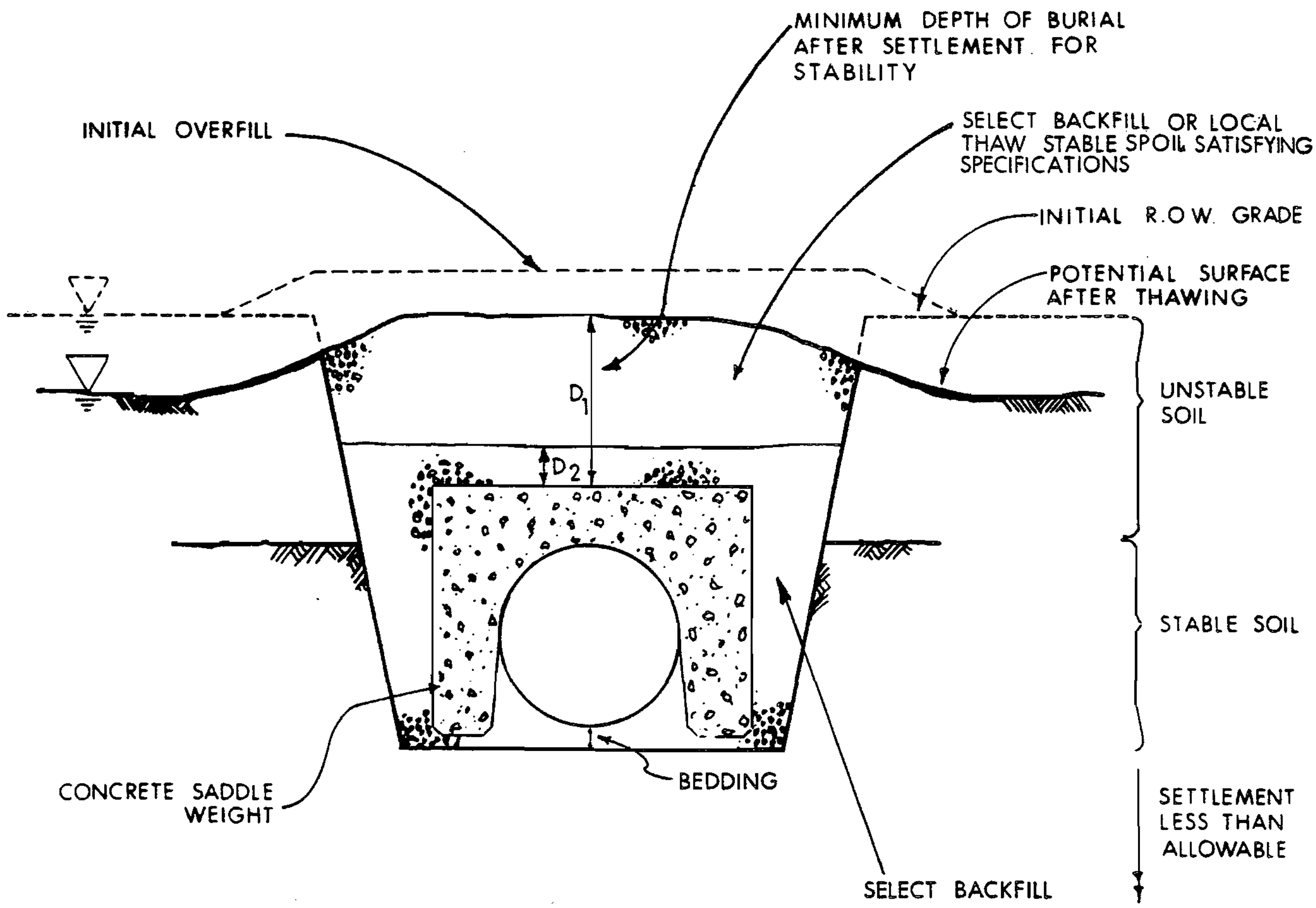
REV: 81 11 02



NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

MODE 2

Foothills Pipe Lines (South Yukon) Ltd.

TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

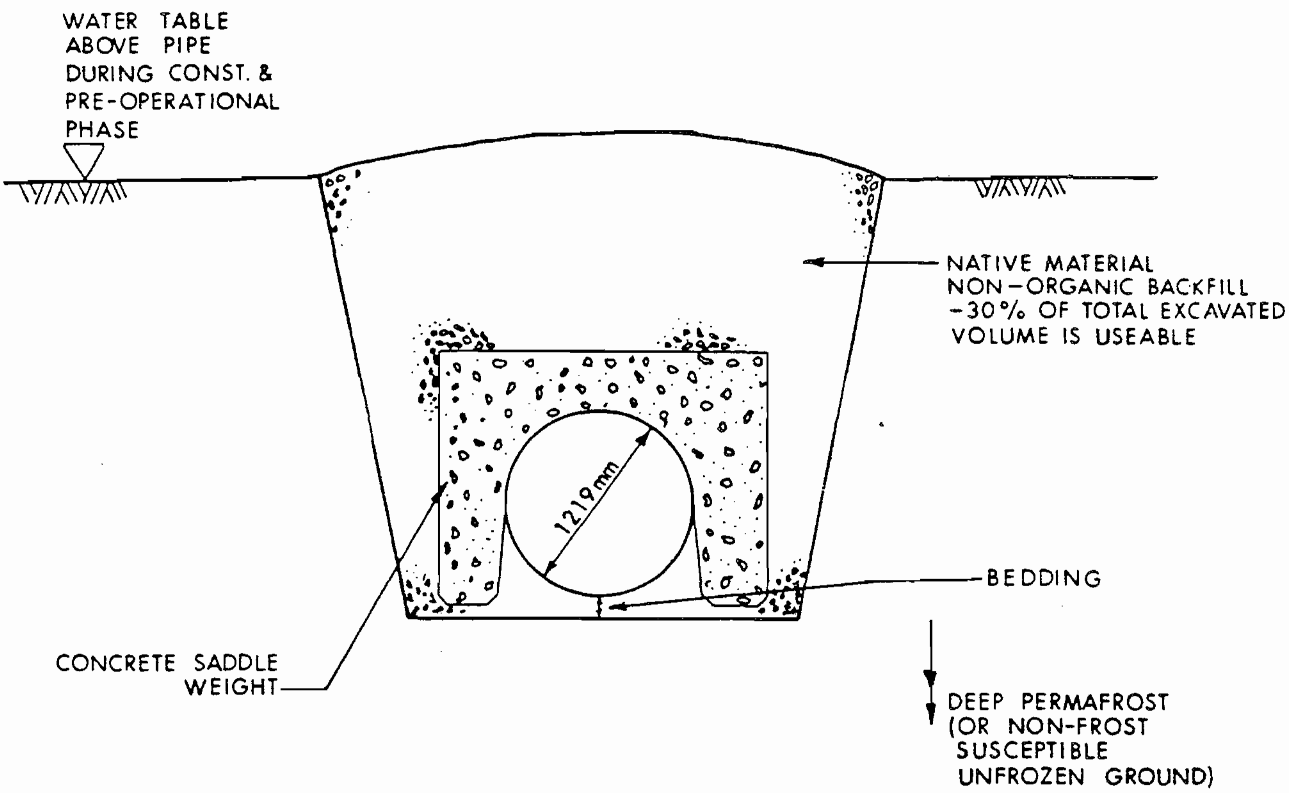
SADDLE-WEIGHTED WARM PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	S.J.G.			
DATE	81 04 02	81 04 23	81-05 04	

SCALE N.T.S. PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.4

A4 FORM 258



NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

REV 81-06-25

MODE C2

Foothills Pipe Lines (South Yukon) Ltd.

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

SADDLE-WEIGHTED CHILLED PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	B. C.	[signature]		
DATE	81 06 16	81 06 17		

SCALE N.T.S

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.5

A4 FORM 258

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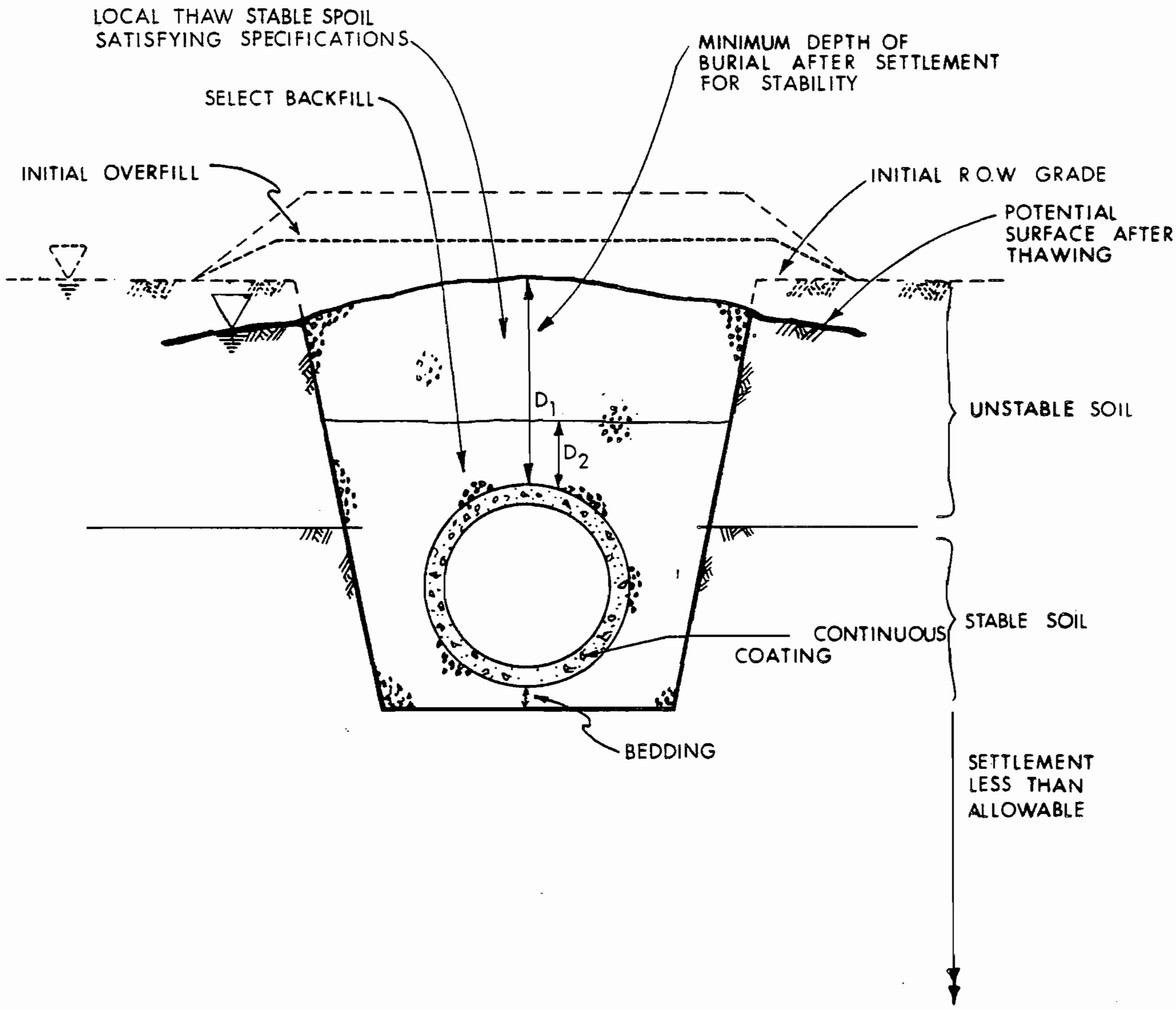

NOTE:
DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

MODE 3

Foothills Pipe Lines (South Yukon) Ltd.

TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

CONTINUOUS – WEIGHTED
WARM PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	S.J.G.	RPT	[illegible]	
DATE	81 04 02	81 04 29	81 05 04	

SCALE N.T.S. PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.6

some river crossings, some stream crossings and some muskeg areas. The pipeline in these situations will be buried in stable soils.

Unweighted Burial

This mode is illustrated by Figure 2-1.7 and will be the standard burial configuration for most of the warm flow sections of the pipeline in initially frozen areas where stable soil is accessible at pipe depth and in which the ditch will not have water during construction. The water table could be at the ground surface after thawing.

Deep Burial

In warm flow situations this mode (illustrated by Figure 2-1.8) will be used in areas where stable soils are accessible at greater depths than those for the previous four modes. This mode is actually the limiting case of the unweighted burial mode with the maximum depth of burial generally being limited by comparative economics. Deep burial will not be used in cold flow situations.

Buried Heat-Traced, Watercrossing

This mode will be used in cold flow situations only within the unfrozen active channels of some major rivers and streams. The minimum cover will be determined by scour depth criteria. Electrical cables will be located on the outer periphery of the insulation to prevent frost penetration into the surrounding ground (i.e. to prevent frost heave under the pipe and ice formation above the pipe). The mode is illustrated in Figure 2-1.9.

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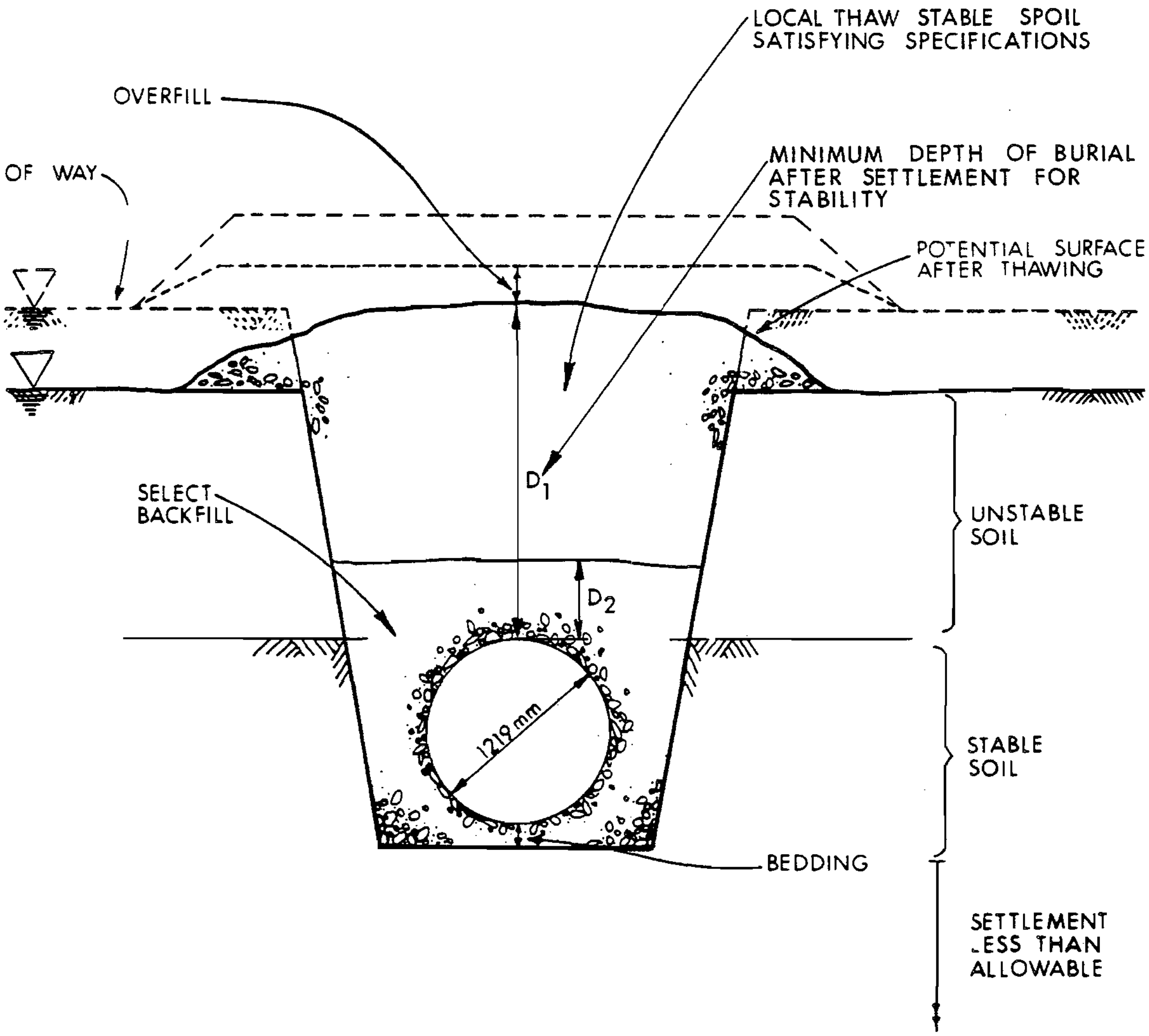

NOTE:
DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING PIPE GEOMETRY AND SOIL CONDITIONS

PRELIMINARY

MODE 4

Foothills Pipe Lines (South Yukon) Ltd.

TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

UNWEIGHTED BURIAL WARM PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	V J. R.	RPT	[illegible]	
DATE	81 04 02	81 04 29	81-05-04	

SCALE N.T.S. PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.7

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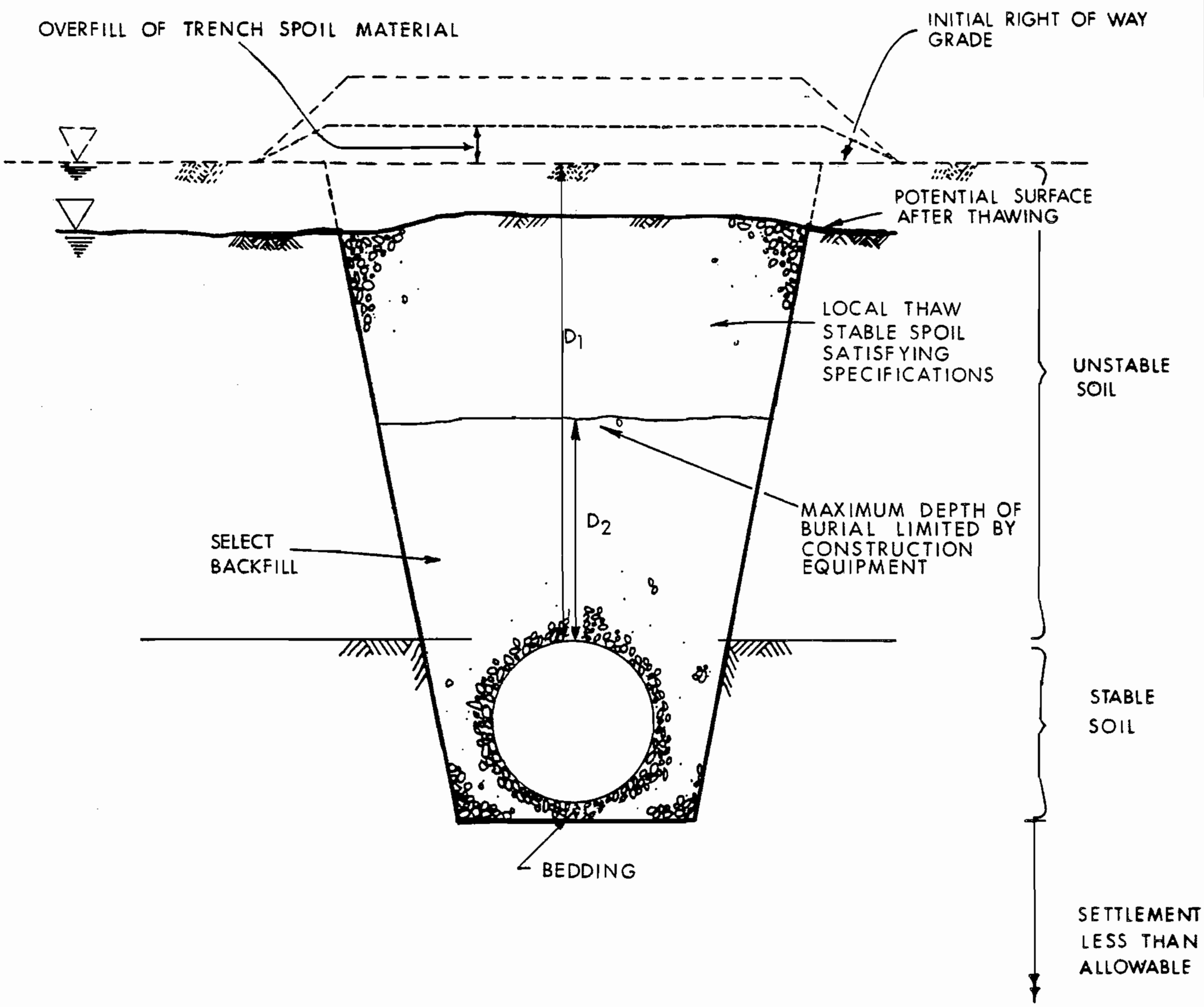


NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

MODE 5

Foothills Pipe Lines (South Yukon) Ltd.

TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

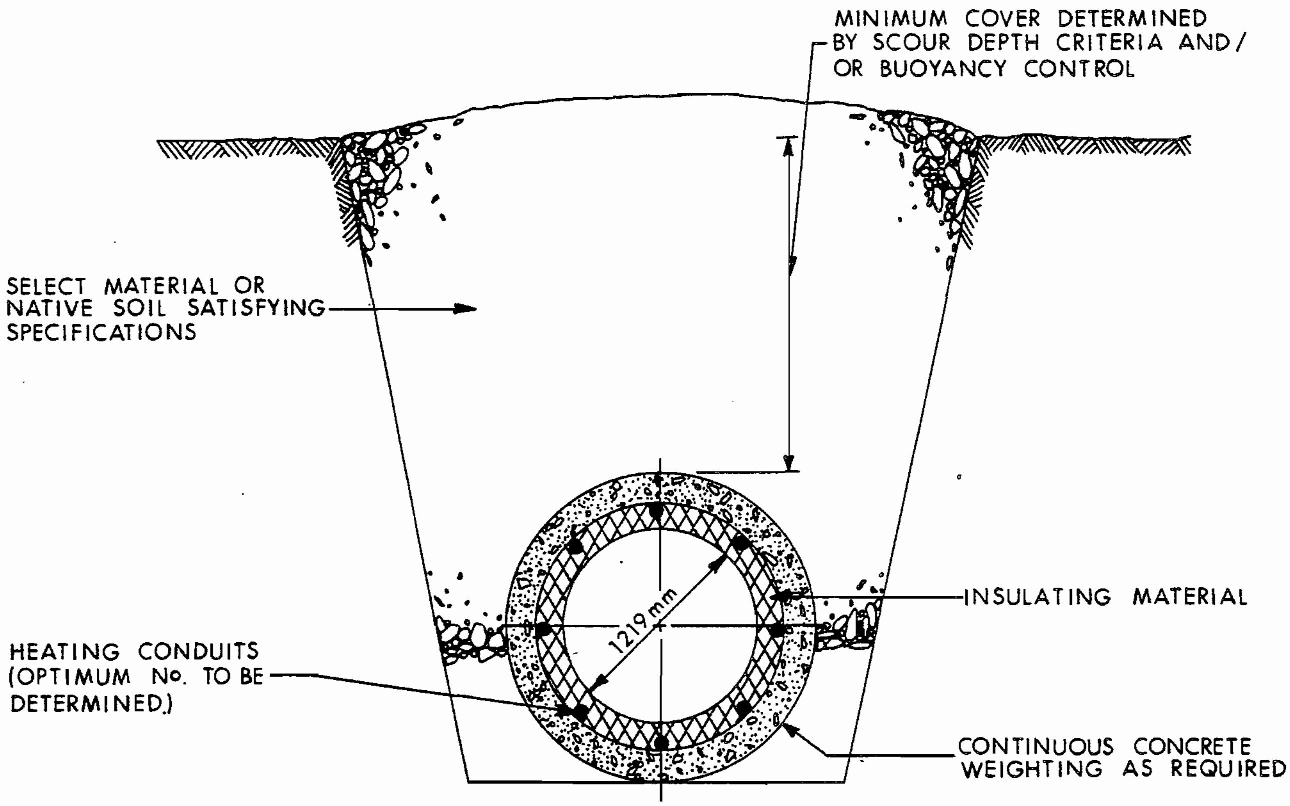
DEEP BURIAL WARM PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	T.A.O.	R.P.T.	W	
DATE	81 04 02	81 04 29	[illegible]	

SCALE N.T.S. | PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.8

FORM 258



NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

MODE C6

Foothills Pipe Lines (South Yukon) Ltd.

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

BURIED HEAT-TRACED WATER CROSSING
CHILLED PIPE

	DRAWN	CHECKED	APPROVED	APPROVED
BY	V. J. R.	RPY		
DATE	81 01 18	80 01 18		

SCALE N. T. S. — PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2 - 1.9

FORM 258

Standard Burial, Heat-Traced, Insulated

This mode, illustrated by Figure 2-1.10, could be used under cold flow situations where the ditch would be dry during construction. Depth of burial using granular material would be chosen for buoyancy control and for minimum uplift resistance requirements.

Road Crossing

This mode could be used for major and secondary highway crossings in cold flow situations where it is necessary to prevent freezing above the pipeline. The mode is illustrated in Figure 2-1.11.

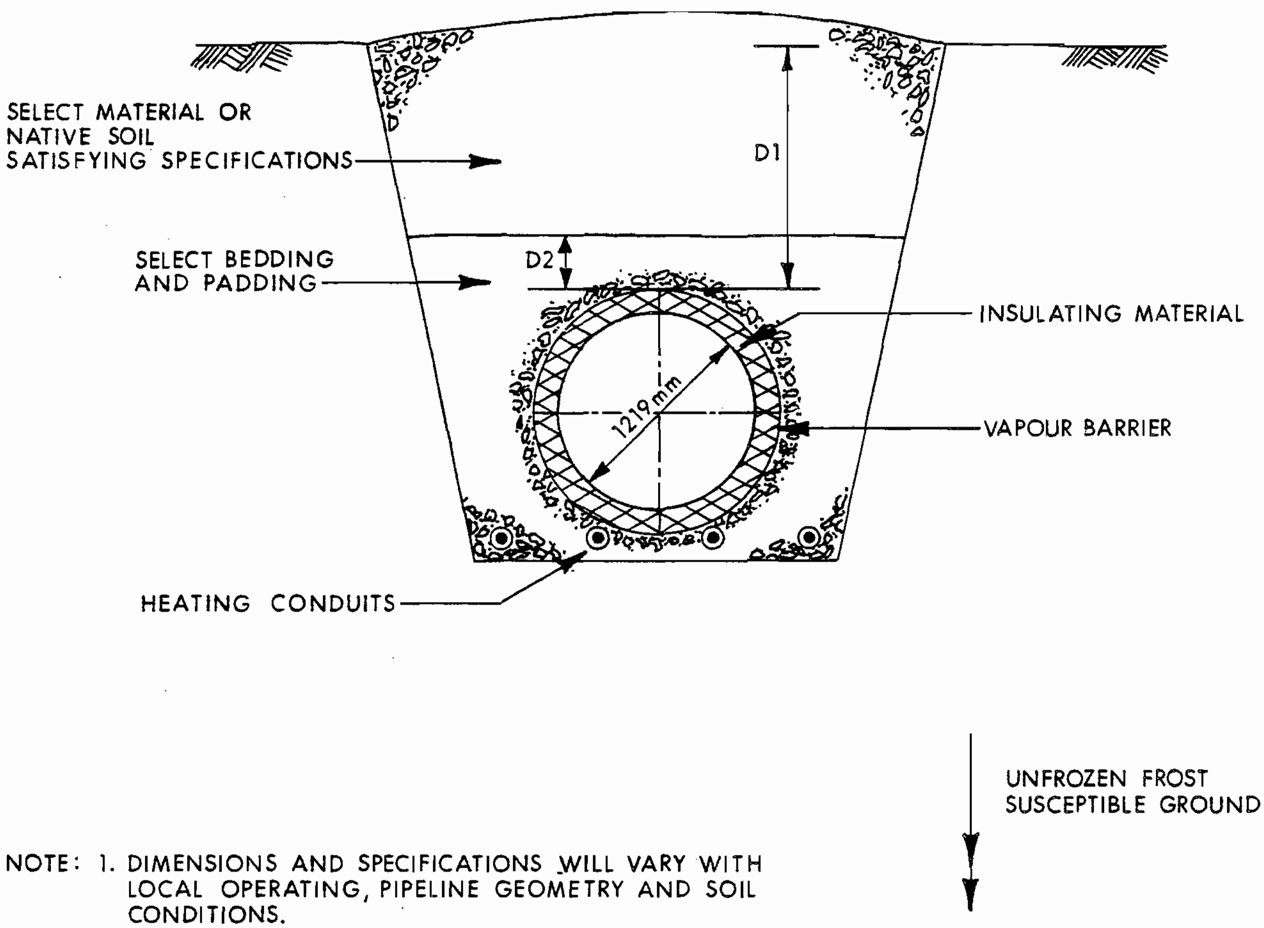
2.4.2 Above-grade Designs

Two above-grade designs have been developed, one which involves construction of a gravel embankment, and a second design in which a concrete covering is applied to the pipe which is placed on a gravel pad.

Embankment

The embankment mode consists of a gravel pad upon which the pipe is placed and restrained within a gravel berm. In warm flow situations, both the embankment and gravel workpad are insulated. This pipe placement design is available as an option where anticipated thaw settlement exceeds the degree of control supplied by below-grade installation options. The insulated embankment mode is illustrated in Figures 2-1.12 and 2-1.13.

Design for cold flow embankment is presently in the conceptual stage. With the cold flow embankment mode, no insulation is placed in the travelway, and insulation may or may not be required beneath the pipe in



NOTE:
1. DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.
2. INSULATION OPTIONAL DEPENDING ON POWER SUPPLY AND THERMAL EFFICIENCY REQUIRED.
3. WRAP AROUND INSULATION MAY BE REPLACED WITH BOARD INSULATION ON DITCH BOTTOM AND SIDES.
4. D1 = 750mm MINIMUM WITH ADDITIONAL DEPTH WHERE REQUIRED FOR BUOYANCY CONTROL.

PRELIMINARY

MODE C3

Foothills Pipe Lines (South Yukon) Ltd.

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

STANDARD BURIAL-CHILLED PIPE
WITH HEAT TRACING
AND INSULATION

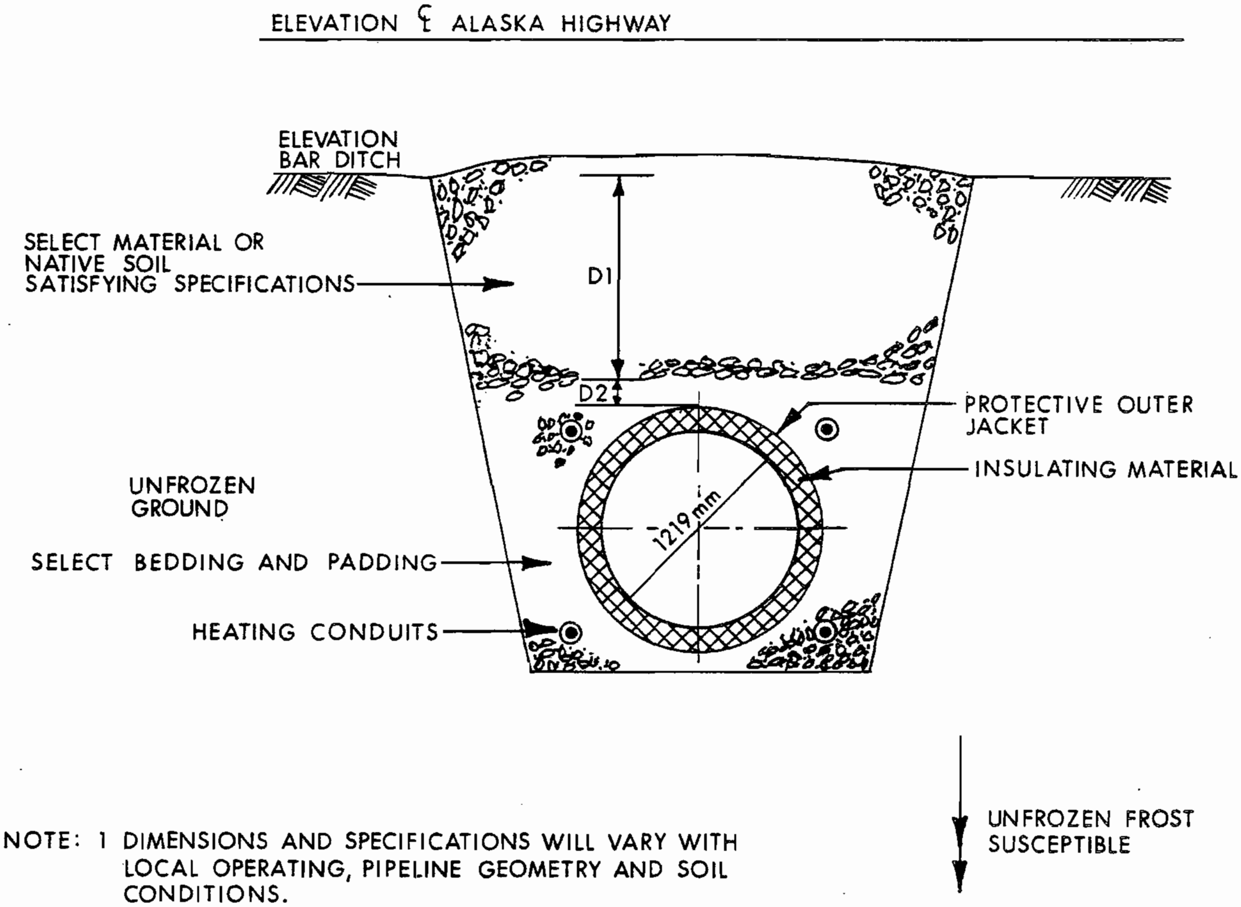
	DRAWN	CHECKED	APPROVED	APPROVED
BY	R. STEELE	RGT		

SCALE N.T.S

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.10

FORM 258



NOTE: 1 DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPELINE GEOMETRY AND SOIL CONDITIONS.

2. D1 VARIES TO SUIT ROAD CROSSING SPECIFICATION.

PRELIMINARY

MODE C5

Foothills Pipe Lines (South Yukon) Ltd.

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

ROAD CROSSING-CHILLED PIPE

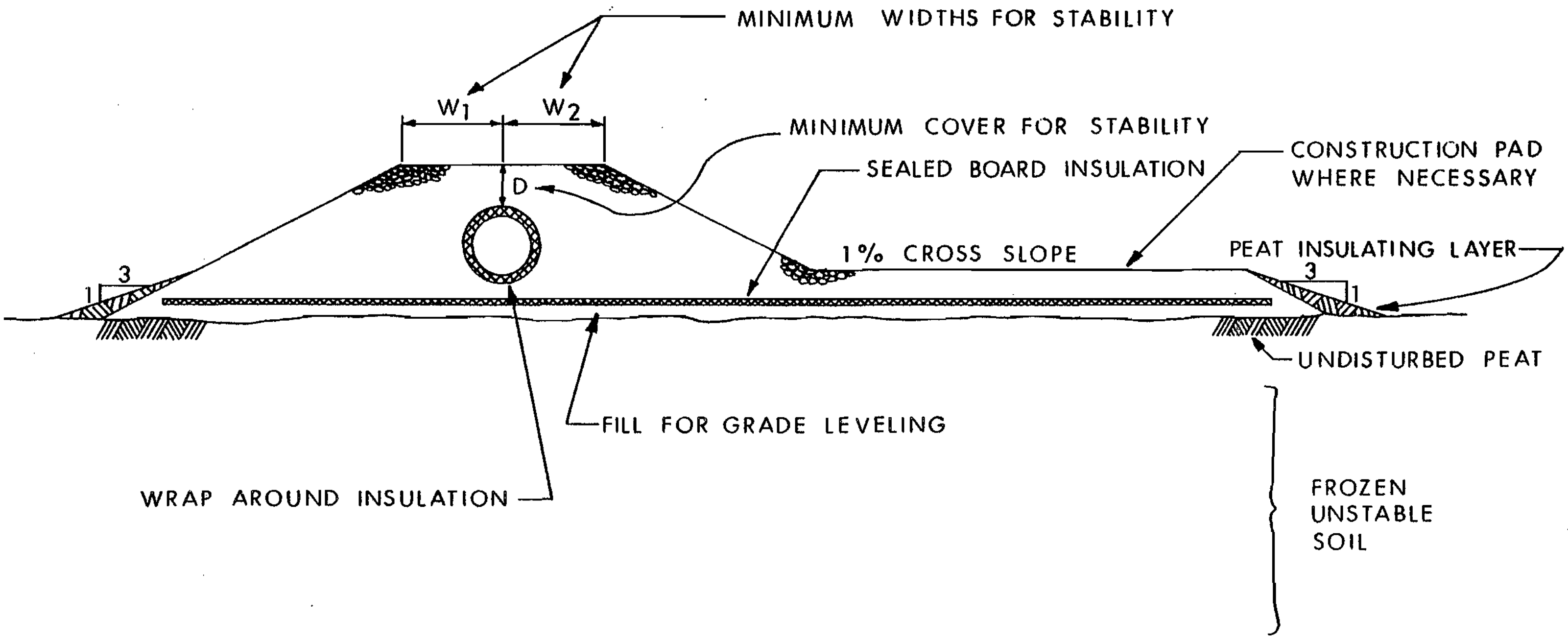
	DRAWN	CHECKED	APPROVED	APPROVED
BY	R. STEELE			

SCALE N.T.S.

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2 - 1.11

FORM 258



NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING PIPE GEOMETRY AND SOIL CONDITIONS.

PRELIMINARY

MODE 6

REV: 81 07 27

Foothills Pipe Lines (South Yukon) Ltd.

	DRAWN	CHECKED	APPROVED	APPROVED
BY	G.Y.	RPT	GY	
DATE	81 04 29	81 04 29	81-05-04	

TITLE

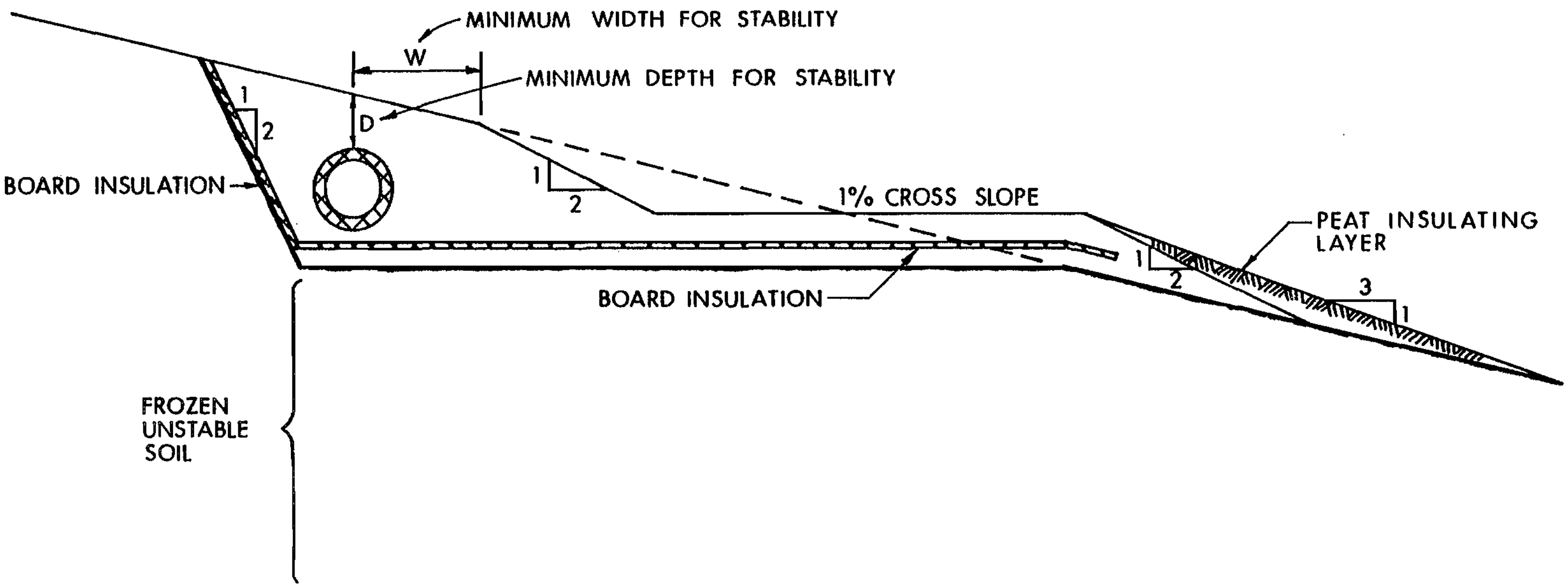
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

INSULATED EMBANKMENT WARM PIPE

SCALE N.T.S.

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.12



PRELIMINARY

REV: 81 07 27

MODE 6

Foothills Pipe Lines (South Yukon) Ltd.

	DRAWN	CHECKED	APPROVED	APPROVED
BY	A. M.	RP	LY	
DATE	81 04 29	81 04 29	81-05-04	

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

INSULATED EMBANKMENT
WARM PIPE
CUT-FILL SECTION

SCALE NTS

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.13

the gravel embankment. This mode would be a secondary option where anticipated frost heave exceeds the degree of control offered by below-grade installations. A conceptual illustration of this mode is presented in Figure 2.1-14.

Concrete Restrained

A second above-grade design option, the concrete-restrained mode, consists of an insulated gravel travel/workway supporting the pipe. The mode involves the use of keyed linked concrete weights which provide the required weight to stabilize and restrain the line. The mode is illustrated by Figures 2-1.15, 2-1.16 and 2-1.17 for warm flow flat terrain, warm flow cross slope and cold flow flat terrain situations respectively.

FORM 258

Foothills Pipe Lines (South Yukon) Ltd.

DRAWN	CHECKED	APPROVED	APPROVED
V.J.R.			

TITLE

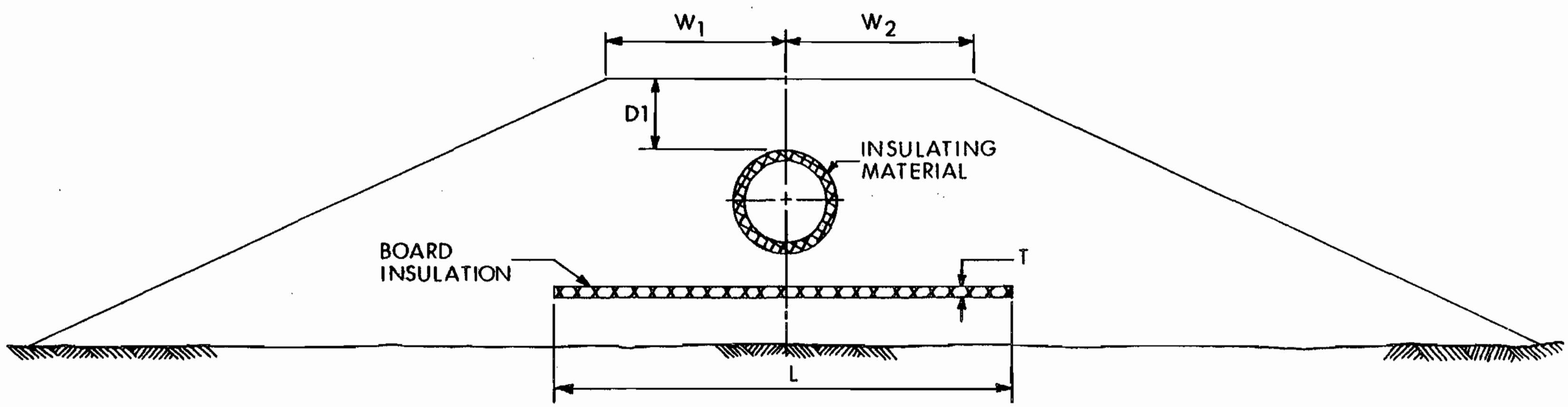
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

EMBANKMENT
CHILLED PIPE

SCALE N.T.S.

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-11A



NOTES
1. THE GRANULAR EMBANKMENT FOR ABOVE GROUND PIPE PLACEMENT CHILLED FLOW WILL BE FURTHER ANALYSED IF REQUIRED.
2. D1 = 750 mm MINIMUM

MODE C8

PRELIMINARY

A4 FORM 250

Foothills Pipe Lines (South Yukon) Ltd.

	DRAWN	CHECKED	APPROVED	APPROVED
BY	G.Y.		"	
DATE	81 04 29	81 04 30	81-05-04	

REV: 81 07 27

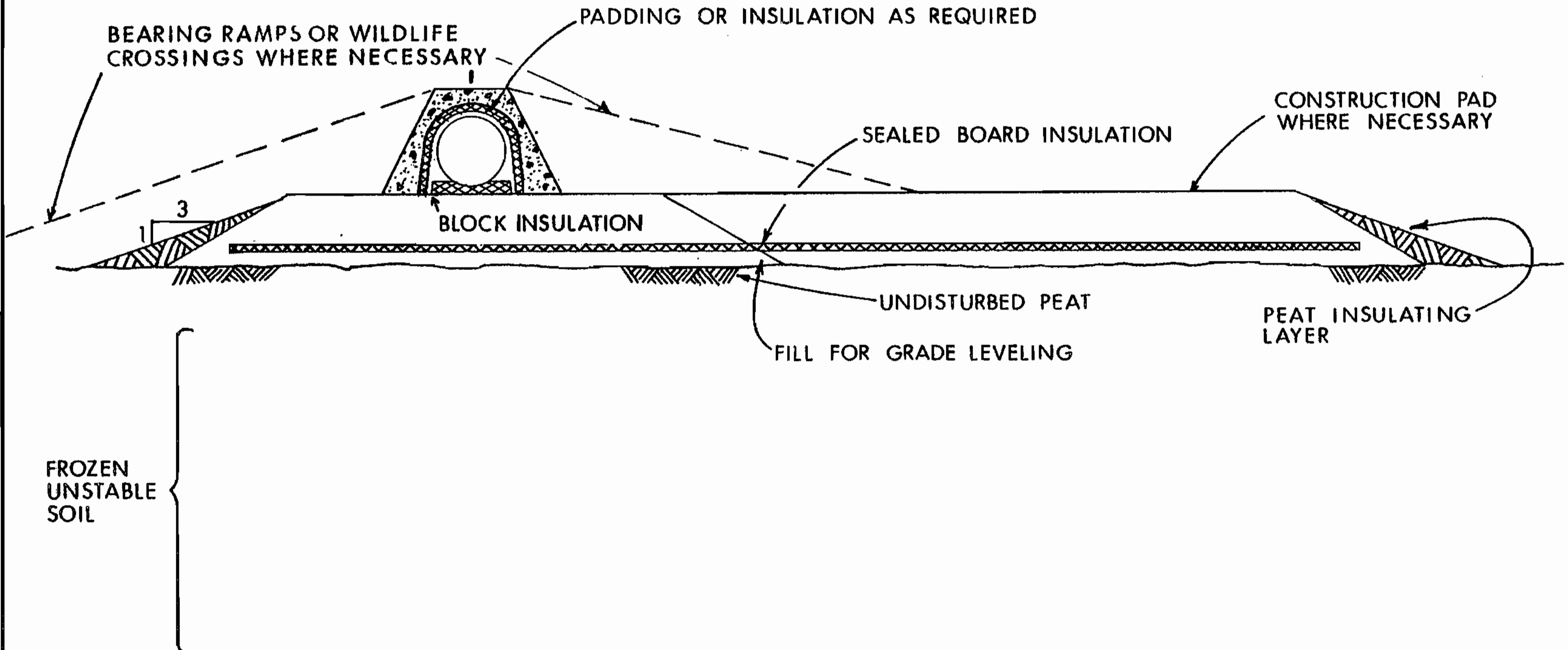
TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

CONCRETE-RESTRAINED WARM PIPE

SCALE N.T.S.

PREPARED BY YUKON PIPELINE DESIGN

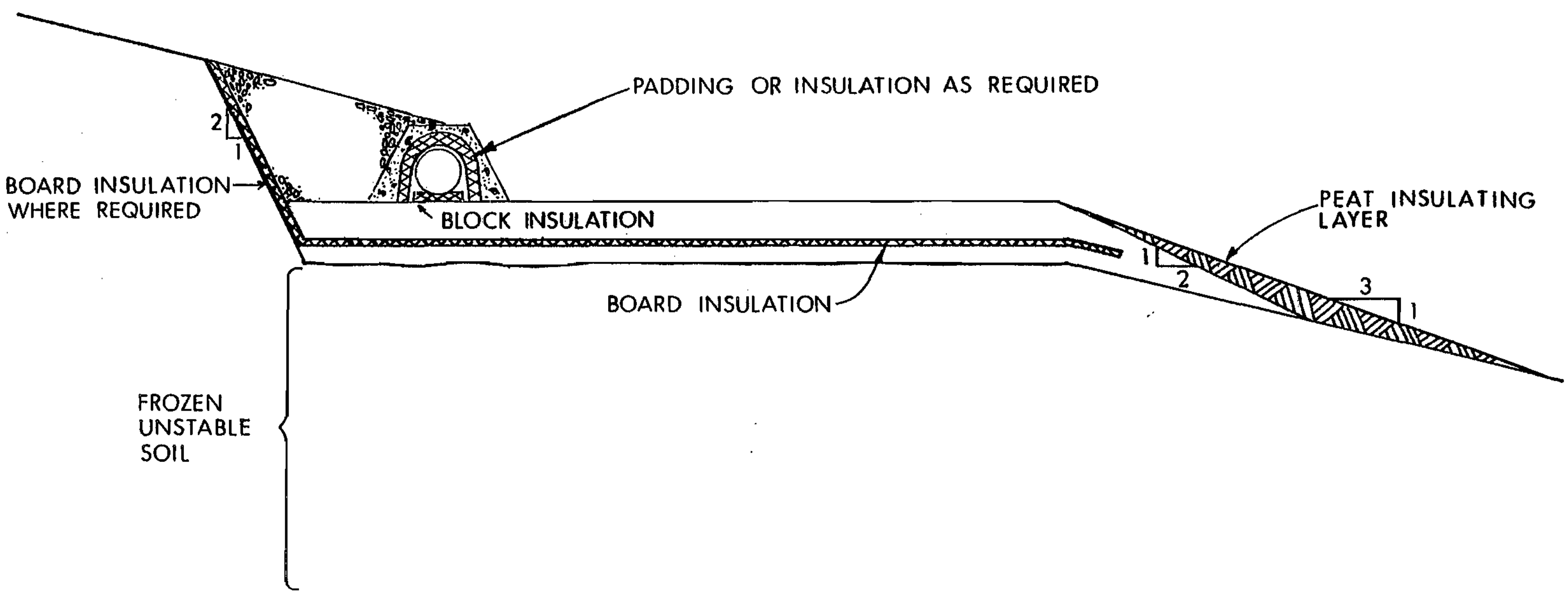
MODE 7



NOTE: DIMENSIONS AND SPECIFICATIONS WILL VARY WITH LOCAL OPERATING, PIPE GEOMETRY AND SOIL CONDITION

PRELIMINARY

FIGURE 2 - 1.15



PRELIMINARY

REV: 81 07 27

MODE 7

Foothills Pipe Lines (South Yukon) Ltd.

	DRAWN	CHECKED	APPROVED	APPROVED
BY	S. J. G.			
DATE	81 04 30			

TITLE

THE ALASKA HIGHWAY GAS PIPELINE PROJECT

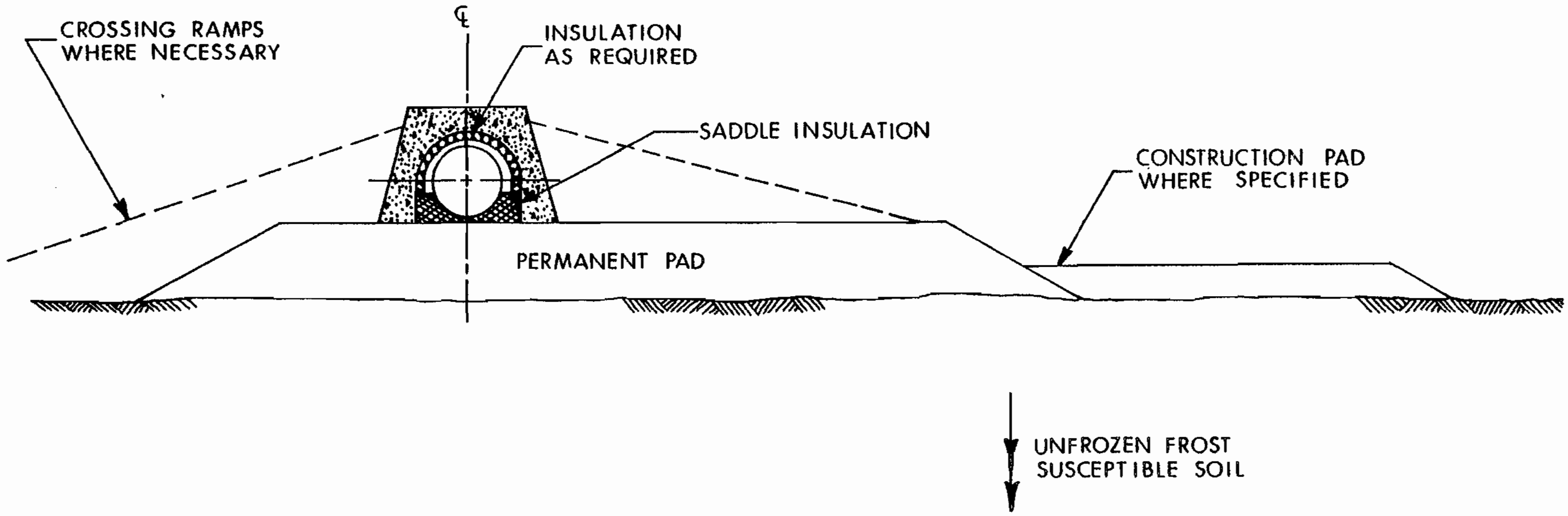
CONCRETE-RESTRAINED WARM PIPE CUT-FILL SECTION

SCALE N.T.S.

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2-1.16

FORM 258



NOTES 1. DIMENSIONS AND SPECIFICATIONS ARE PRELIMINARY AND WILL VARY WITH LOCAL OPERATING, PIPE GEOMETRY AND SOIL CONDITIONS.

MODE C7

PRELIMINARY

Foothills Pipe Lines (South Yukon) Ltd.

BY	DRAWN	CHECKED	APPROVED	APPROVED
	V.J.R.			

TITLE
THE ALASKA HIGHWAY GAS PIPELINE PROJECT

CONCRETE-RESTRAINED
CHILLED PIPE

SCALE N.T.S.

PREPARED BY YUKON PIPELINE DESIGN

FIGURE 2 - 1.17

3.0 COMPRESSOR FACILITIES IN YUKON TERRITORY

Frictional forces opposing the flow of gas in the pipeline will reduce the pressure of the gas as it flows along the line. To maintain the efficiency of transmission at a high level, the pressure will have to be boosted by means of compressor stations. Consequently, the pipeline will have a number of compressor stations where the gas will be compressed back to the maximum pressure permitted by the line or required for existing flow conditions. At each compressor station, and at intermediate points along the line, block valves will be provided to shut down the flow of gas for maintenance and repair.

3.1 DESIGN CRITERIA

Compressor stations will be self-contained, fully automated, and capable of being started, stopped, and otherwise controlled from a control centre at Whitehorse. The stations will be of conventional design with emphasis on reliable operation at the extreme low temperatures experienced in Yukon Territory. Silencing equipment will be applied to the gas turbine intake and exhaust systems. Exhaust emission from the gas turbines will be controlled such that ground level concentrations of combustion by-products do not exceed the applicable standards established by the Federal Clean Air Act.

During a commissioning and run-in period, stations will be manned 24 hours per day. After a suitable period of demonstrated reliability, the operations and maintenance personnel will be withdrawn to area offices. Subsequent visits to the stations will be made to carry out preventative, emergency and routine maintenance.

The basis of design is that as the available gas to be transported increases, expansion of stations can be accommodated by one of the following alternatives, depending on the most appropriate option at that time: (1) additional gas turbine units, (2) the use of electric motor drives if hydro-electric power is available, or (3) the use of waste-heat recovery systems.

3.1.1 Hydraulics

For the initial years of pipeline operation when the only gas volumes to be transported are 63.7 x $10^6 m^3/d$ peak-day Prudhoe Bay volumes, the pipeline system will be operated at substantially less than capacity. For the 1219-mm O.D. segment from the Alaska/Yukon Territory border to the Whitehorse junction, the expected receipt volume from Alaskan Northwest Natural Gas Transportation Company is approximately 61.6 x $10^6 m^3/d$ peak day, whereas the pipeline capacity is approximately 87.8 x $10^6 m^3/d$. Hence this segment of the pipeline will be operated at 70 percent capacity in the early years of operation, and relatively low gas compressor kilowatts will be required.

In the segment from the Whitehorse junction to the Yukon Territory/British Columbia border, the initial volume at Whitehorse when flowing Prudhoe Bay gas only will be approximately 61.3 x $10^6 m^3/d$, whereas the pipeline capacity is 108.4 x $10^6 m^3/d$. Therefore the 1422-mm O.D. pipeline will be operated at less than 60 percent of capacity during the early years of operation. The compression requirements will be less than 20 percent of the requirements for full flow.

In the 1219-mm O.D. segment from the Alaska border to Whitehorse, volumes greater than the initial 63.7 x $10^6 m^3/d$ from Prudhoe Bay are not anticipated for several years. Hence only three compressor stations, located at approximately 156.5-km intervals and of 20060-21625 (ISO) kilowatt size, will provide the necessary compression requirements. One station, STA-311, will also be equipped with a similarly-sized standby unit.

In the 1422-mm O.D. Whitehorse to Watson Lake segment, only two of four stations are required for the initial Prudhoe Bay flow case. These will be located at approximately 180-km intervals and would be of 21625 (ISO) kilowatt size. With the introduction of Dempster Lateral gas, all four stations in this segment would be required, and assuming a full flow condition, each would be of nominal 40120-43250 (ISO) kilowatt size.

3.2 SPECIFICATIONS

The compressor stations will be designed, constructed, tested, and operated in compliance with the National Energy Board Act P.D. 1974-807 Regulations Respecting Gas Pipelines.

3.2.1 Compressors

The compressor specifications are detailed in the Gas Turbine/ Compressor Engineering Specifications. This document references all applicable regulations and codes, including those for noise attenuation, and also outlines the operating conditions to which the compressors will be subjected.

The gas compressors used will be of the centrifugal type. Input shaft power is used to compress pipeline gas by means of an impeller which scoops up gas and forces it into rotary motion at a high velocity. The gas then passes into the diffuser section which converts this velocity head into static pressure prior to discharge into the pipeline.

3.2.2 Drivers

The driver specifications are detailed in the Gas Turbine Electric Motor Engineering Specifications. This document references all applicable codes and regulations, and also outlines the operating conditions to which the drivers will be subjected.

The gas compressor will receive its shaft power from gas turbine driver units of approximately 20060-21625 (ISO) kilowatt size. The preferred units will be light-weight, reliable, and easily installed, and may be replaced very quickly if mechanical problems occur. The use of this type of machine simplifies foundation design which must take into account seismic and permafrost concerns.

3.2.3 Piping

Most compressor station piping will be buried to protect it from low ambient temperatures and also to reduce radiated noise. The station piping layout will be designed so any future addition of compression facilities can be accommodated with a minimum of disruption. The design of all station piping in the Yukon Territory section will allow for additional stresses that could result from ground motion caused by earthquakes.

3.2.4 Buildings

Buildings will be designed in accordance with the latest edition of "The National Building Code of Canada". Generally, buildings will be steel-framed or of rigid-frame construction, although lighter utility buildings may be self-framed. Buildings that house equipment containing hydrocarbon vapours and liquids that might escape will have ventilating systems capable of six air changes per hour. Safety doors will be provided as required and lighting will meet good engineering standards. The compressor and control buildings will be connected by utilidors.

3.2.5 Foundations

Foundations will be designed on a site-specific basis in accordance with applicable codes and good practice to support the structures within tolerable limits of settlement. The foundation types that may be used include gravel pads, footings and piles. In high ice-content permafrost areas where thaw consolidation could be significant, foundations will be designed to account for, or prevent, permafrost degradation.

3.2.6 Auxiliaries

Compressor station auxiliaries will include the support systems necessary to keep compression equipment functioning in a remote-controlled unattended mode and ensure the comfort and safety of any personnel attending the station. The major auxiliary systems are electric power generation and distribution, station heating and ventilating, fuel and utility gas, and sewer and water services.

4.0 ANCILLARY FACILITIES IN YUKON TERRITORY

The following ancillary facilities will be necessary to ensure efficient operation and maintenance of the pipeline system.

4.1 CONTROL SYSTEMS

Each compressor station will contain electronic equipment to control, protect and acquire data from the station mechanical equipment. Computer-type equipment will communicate with the supervisory master computers at the Whitehorse Regional Control Centre and the Canadian Division Control Centre in Alberta. Regional control centres will also be established in Vancouver and Edmonton. The function of the Regional Control Centre will be to acquire and process detailed information from the stations in the region to aid station maintenance. An abbreviated form of this information will be acquired from all three regions by the Canadian Division Control Centre which will also transmit start/stop commands and optimal setpoints to Canadian stations. A higher level of coordination called System Control will also be established at the Canadian Division Control Centre to exchange information with the Alaska, Northern Border and Pacific Gas Transmission divisions and thereby coordinate operations of the entire Alaska Highway Gas Pipeline.

4.2 COMMUNICATIONS SYSTEM

Voice and data communications are required for pre-construction, construction and operation of the pipeline system. It is Foothills' intention to utilize the services offered by the common carrier, Northwest Telecommunications Inc., to satisfy the majority of the requirements for communications in Yukon Territory. The pre-construction system will consist of a series of mobile radio repeaters in existing NorthwesTel stations that parallel the pipeline route. During construction there will be a requirement for installation of several business lines, pay phones and data circuits into each construction camp. These will be provided by constructing microwave spurs between the NorthwesTel microwave backbone stations and the construction camps, although some camps might be more effectively served via cable or satellite. A much smaller number of circuits will be needed for pipeline operations for voice and data links between the compressor stations, the operations and maintenance bases, the mobile radio repeaters, and the Whitehorse Regional Control Centre. These will also be supplied by NorthwesTel. Some form of back-up for critical circuits needed for operation will be provided.

4.3 ACCESS ROADS

Permanent access roads will be constructed to all compressor station sites and intermediate block valves from the Alaska Highway and to the maintenance bases and area office sites from existing local roads.

Roads and road structures will be designed and constructed generally in accordance with the standards set forth in the Highways Regulations affixed to the Highways Ordinance of the Yukon Territory. The proposed road design classification is RLU 70 as defined in the "Geometric Design Standards for Canadian Roads and Streets" published by the Roads and Transportation Association of Canada, 1976. Should revisions be necessary, the revised standards will be submitted to the Director of Highways and Public Works for approval in accordance with clause 3(a)V of the Highway Regulations.

All crossings for waterways by permanent access roads will be designed for the 100-year flood peak. Culverts will be sized to discharge the peak design flow at a maximum headwater depth on the invert of 1.5 pipe diameters or as limited by the height of road grade. Freeboard at design flow will be in the order of 0.5 m. Rip-rap will be sized to the required dimensions and placed at the pipe outlet and inlet to prevent erosion. In fish-bearing watercourses, culverts will be designed and installed in accordance with "Guidelines for the Protection of the Fish Resources of the Northwest Territories During Highway Construction and Operation".

4.4 MAINTENANCE BASES

Maintenance bases will be located strategically along the pipeline to provide maintenance facilities, supervisory offices, standby heavy equipment, bulk materials, and line pipe storage.

Although the system will be designed for remote-controlled unattended operation of compressor station facilities, temporary accommodations will be provided at compressor stations for operations and maintenance staff who will be required to perform routine maintenance and major overhaul of equipment.

4.5 OFFICE FACILITIES

An operations and administrative centre at Whitehorse will provide space for management, administration and operations personnel, and will include a communications and gas control centre for remote monitoring and supervision of the operating pipeline system. Other offices at maintenance bases will be located in a maintenance shop-office building within a fenced enclosure.

4.6 PERSONNEL HOUSING

A housing policy will be developed which will attract and retain employees without imposing an excessive housing burden on operations and maintenance staff.

4.7 UTILITIES AND SERVICES

All construction, operations, and maintenance facilities will be designed to provide the usual utilities and services such as water, sewer, power, and telephone. All plans and designs will be in accordance with applicable local, territorial, and federal statutes, codes and regulations.

4.7.1 Water Supply

Water supply for construction camps and compressor stations will be obtained from groundwater or surface sources. Tanks will be installed at each location to store the raw and treated water. As a minimum standard, water will be treated to meet the acceptable limits set out in the current Canadian Drinking Water Standards and Objectives. Water supply for area office locations will be obtained from municipal systems, wells or truck delivery.

4.7.2 Waste Treatment

Sewage will be treated to a secondary treatment standard. Methods of sewage treatment under consideration for construction camps and compressor stations include: biological plants, tanks with disposal fields, lagoons, and removal from holding tanks by truck to existing lagoons. The treated effluent will be discharged to streams at a controlled rate to maintain dissolved oxygen and biochemical oxygen demand requirements. Sewage from area office locations will generally be disposed of at existing community sewage lagoons. The sewage treatment system selected will comply with regulatory requirements.

Disposal of solid wastes generated during construction will follow an overall waste disposal plan developed for the Project as part of the final design procedure. This plan, or sections of it, will be used in preparing bid specifications for all project-related work to ensure that pipeline contractors dispose of solid wastes in a way that meets regulatory and pipeline project requirements. Details of disposal methods will depend to some extent upon local conditions, local disposal sites, and upon regulations that are presently being created by municipal, territorial, and federal agencies. However, the following approaches will likely apply to all types of solid wastes expected.

The preferred method of disposing of combustible solid materials will be burial; however, the availability of suitable burial locations will control the use of this approach. In the absence of adequate burial sites, incineration will be used. Incinerators will be located at campsites or other central locations. Ash and other non-combustible materials from incinerators will be hauled to the nearest suitable land-fill site.

Non-combustible by-products of pipeline activities will include used miscellaneous metal waste. Items in this category will be disposed of through recycling or at available landfill sites.

Solid wastes from compressor stations will be disposed of in compliance with regulatory requirements. Disposal methods will be determined on a site-specific basis during final design and may include incineration, on-site sanitary landfill, or trucking to an existing landfill site. Landfill regulatory criteria for stream, habitation, and highway set-back distances, surface run-off control and groundwater protection will be met.

Landfill sites exist at all communities where area offices are planned. Discussions will be held with local and Territorial Government authorities to determine the adequacy of the sites and of the garbage collection services for disposal of solid wastes.

5.0 DESCRIPTION OF CONSTRUCTION PHASE

5.1 SCHEDULE

The pipeline route has been divided into 13 sections of varying lengths scheduled for construction as follows:

Section Number	Kilometre Posts	Length km	Construction Schedule
1	0 to 55	55	Winter 1985
2	55 to 110	55	Winter 1984
3	110 to 165	55	Winter 1983
4	165 to 220	55	Winter 1983
Lake Crossing	220 to 226	6	Summer 1984
5	226 to 300	74	Summer 1983
6	300 to 378	78	Summer 1983
7	378 to 452	74	Summer 1984
8	452 to 537	85	Summer 1984
9	537 to 598	61	Winter 1984
10	598 to 661	63	Winter 1985
11	661 to 718	57	Winter 1984
12a	718 to 760	42	Summer 1984
b	785 to 800	15	Summer 1984
13a	760 to 785	25	Winter 1985
b	800 to 829	29	Winter 1985

The construction schedule is presented graphically in Figure 2-1.18.

5.2 MAINLINE ACTIVITIES

Temporary access is created where necessary for the initial clearing operation. After clearing the right-of-way, normal pipeline

Foothills Pipe Lines (South Yukon) Ltd.

FIGURE 2-1.18

CONSTRUCTION SCHEDULE, YUKON TERRITORY

Region	Zone	Location	Section No.	Accumulated K.P.	Section Length	1983 Winter	1983 Summer	1984 Winter	1984 Summer	1985 Winter	1985 Summer
SOUTH YUKON	1		1	55	55					█	
		White R.	2	110	55			█			
		Donjek R.	3	165	55	█					
		Duke R.	4	220	55	█					
		Kluane L. (286)		226	6				█		
			5	300	74		█				
			6	378	78		█				
	2	Takhini R.	7	452	74				█		
		Yukon R. / M'Clintock	8	537	85				█		
		Teslin R.	9	598	61			█			
		Nisutlin B. (291)	10	661	63					█	
			11	718	57			█			
			12a	760	42				█		
			13a	785	25					█	
			12b	800	15				█		
			13b	829	29					█	
SPREADS						2	2	3	3	3	

PRELIMINARY

001- 81-02-19

construction sequence is as follows: grading of right-of-way, ditch excavation, hauling and stringing of pipe, bending, line-up, welding, coating, lowering-in, weighting, backfill, installation of appurtenances, gauging and cleaning, and testing. A description of above-grade construction is also presented, following the discussion of normal pipeline construction activities.

5.2.1 Temporary Access

Temporary access roads will be required from the Alaska Highway to the pipeline route for mainline construction. Where practicable, existing or abandoned trails will be used. The exact locations for new access roads will be determined immediately prior to mainline construction in collaboration with the land-use authority. The right-of-way widths will be the minimum practical and the roads built with a minimum of grading. Where culverts are required, they will be sized to discharge the estimated seasonal flows and installed with proper rip-rap to prevent erosion.

5.2.2 Clearing

The pipeline right-of-way will be cleared of all trees, brush and obstacles that could interfere with construction to provide a working surface of approximately 40 m. A width in excess of 40 m may be required at highway and river crossings; any additional clearing would depend on the nature of the crossing, the bank conditions and the construction method chosen for the crossing. Machine clearing will be conducted in most areas of the right-of-way. In sensitive areas, such as terrain underlain by near surface, ice-rich permafrost in erodible soils, steeply sloping terrain or adjacent fish-bearing watercourses, hand clearing or a combination of hand clearing and machine clearing may be employed. Clearing will be conducted one year in advance of mainline construction in Sections 3 and 4, while clearing will be conducted for the remainder of construction sections immediately prior to mainline activities.

5.2.3 Grading

Grading of the pipeline right-of-way is required to provide a suitable working surface for the pipeline construction equipment and to prepare the ground surface to a profile that allows the pipe to be bent to conform to the ditch bottom without excessive excavation by the ditching operation. Where rock is encountered, the right-of-way will be prepared by ripping or by drilling and blasting.

The grading schedule has been planned to complete grading of most sensitive terrain areas during winter months. In areas scheduled for summer construction, and where intermittent lengths of sensitive permafrost terrain or muskeg are encountered, it may be necessary to construct a granular work-pad as part of the grading operation.

5.2.4 Ditching

The mainline ditch will be a minimum of 1.7 m wide with an average depth of 2.1 m.

The method of ditch excavation depends on soil conditions. A ditching machine will be used wherever possible; otherwise, backhoes will be used. Rock too hard to rip will be drilled and blasted, then removed with backhoes. The bottom of the ditch will be contoured to support the pipe. In some areas this will be done by the ditching machine. Where there are irregularities in the ditch bottom, sand or other fine granular material will be placed before the pipe is layed.

5.2.5 Handling, Hauling and Stringing

The pipe, and other materials such as valves, fittings and coating materials, will be stored at stockpile locations and transported to the job site as needed. The pipe will be hauled to the pipeline right-of-way and strung alongside the ditch as outlined in Foothills' construction specifications.

All material on the job will be stored and protected as required. Materials such as explosives will be stored in accordance with local and federal laws.

5.2.6 Bending

Cold bending of the pipe will be required to fit the pipe to the alignment and contour of the ditch. Conventional bending machines will be employed to produce bends which conform to the requirements of CSA Z.184-M1979.

5.2.7 Line-up

After the pipe has been strung alongside the ditch, each joint or double joint must be aligned and welded together. The line-up operation will be mechanically accomplished with either internal or external line-up clamps. The internal line-up method will be the primary method used. When long sections of pipe are joined together (tie-in), an external line-up clamp is required.

5.2.8 Welding

Welding of the pipeline will be in accordance with company specifications and the requirements set forth in CSA Z.184-M1979. All welding personnel will be qualified to use the welding procedures approved by Foothills. All field welds will be radiographed for quality control.

5.2.9 Coating

The pipe will be suitably coated in coating plants or by line travel machines in the field. In the case of plant-coated pipe, the welds will be coated in the field. After coating, and prior to lowering-in the pipe, the coating will be inspected with an electric holiday detector which locates possible defects. Any fault in the coating would be repaired prior to lowering-in of the pipe.

5.2.10 Lower-in

After the ditch has been properly prepared, the welding completed, and the coating applied and checked, the pipe will be lowered into the ditch in sections. Section lengths will be determined by the necessity for gaps in the welded sections at road and water crossings, and other natural barriers. Typically, several heavy side-boom tractors line up alongside the pipe, pick up and lower the section into the ditch. Where permissible, the pipe may be cradled directly into the ditch following the coating operation. Short sections for road, water and other crossings are tied into the line at a later date following excavation of these crossings.

5.2.11 Weighting

Concrete will be used to provide the required negative buoyancy to the pipe at river and stream crossings or in areas of high water table. Weighting is also necessary in areas where the effective weight of the backfill is not sufficient to overcome the pipe buoyancy.

5.2.12 Bedding and Backfill

The combined operation of bedding and backfill consists of preparing and placing bedding material in the ditch bottom prior to lowering-in the welded and coated pipe, and placing (usually) the excavated material over the pipe.

Bedding is required where the ditch passes through rock or other coarse material that could damage the pipe coating material. The bedding material can be silt, sand or other fine-grained material. Boulderless gravels could be used, with a fine-grained material placed over the gravel. This second layer is "padding" and extends around the pipe. The final fill material placed on top is usually the originally excavated material.

5.2.13 Installation of Appurtenances

Intermediate block valves will be installed at intervals specified in the design of the pipeline. Valves will be set on suitable foundations and the line will be anchored as required to prevent movement.

Scraper trap assemblies will be installed at compressor stations.

Cathodic protection system test leads will be attached to the pipe at approximately 1.5-km intervals and brought to the surface into test stations. Where possible, test stations will be at convenient locations such as road or water crossings. Pipeline markers will be installed at all road crossings.

5.2.14 Gauging and Cleaning

Sections of the constructed pipeline will be checked for roundness and cleared of any foreign debris by using two types of pipeline pigs. One is referred to as a standard cleaning pig and the other is a sizing pig.

The cleaning pig for the mainline pipe has cups and brushes mounted on a shaft. As the pig is forced through the pipe by air pressure, all foreign material is scraped from the walls and carried out ahead of the pig.

The sizing pig consists of either a steel sizing plate or a measuring system that locates all areas where the pipe is smaller in diameter than is acceptable. Any section of the pipe that has less than the permitted inside diameter will be excavated and replaced if necessary.

5.2.15 Testing

On completion of long sections of line, hydrostatic testing will be carried out to ensure that the line is free of leaks and to prove its integrity at the operating pressure.

Sections will be filled with water. Where necessary test water will be heated to prevent freezing. Sections will then be pumped to the test pressure, which will be maintained for a specified period of time.

Water will be drawn from available sources. Water intake structures will conform with design standards outlined in the Department of Fisheries and Oceans specifications in the publication "Water Intake Fish Protection Facilities". The quality of the test fluid effluent will not be toxic to aquatic fauna; toxicity testing as outlined in "Petroleum Refinery Effluent Regulations and Guidelines" will be conducted on any hydrostatic test fluid effluent if toxicity of the fluid is in question.

Hydrostatic testing will be conducted in a manner that there is no transfer of water between the Yukon, Alsek or Liard drainage basins. Care will be taken to restrict the source and usage of water within the limitations imposed by authorities with jurisdiction over water use and disposal.

5.2.16 Construction of Above-grade Modes

A brief description of construction techniques for the embankment and concrete-restrained modes is presented here for orientation. The reader is referred to Submission 4-1, "Engineering, Construction and Environmental Aspects of Alternative Design Modes" for a further discussion of this topic.

Where above-grade modes are employed, the right-of-way will be graded only to the extent necessary to establish a trafficable surface and satisfactory work area. Cut areas will be minimized with preference given to use of fill for surface leveling and smoothing.

Cut and fill surfaces will be prepared such that a minimum of 15 cm of granular material is in place below insulation slabs (where the design specifies an insulation layer), to allow for sub-slab drainage. The slab insulation will be approximately 100 mm in thickness, and will cover the entire levelled surface. The insulation layer will then be covered with approximately 600 mm of granular material, compacted to ensure the integrity of the insulation layer. In designs where there is no insulation in the pad, the gravel pad would be prepared in a comparable manner. A bedding trench will be formed in the compacted pad along the centre line alignment of the pipe.

The pipe placement operations will be conducted with equipment restricted to the work surface. Pipe line-up, welding, insulating and jacketing will be carried out in the final pipe alignment position.

In the embankment mode, granular fill will be applied to either side of the pipe, in two steps. The granular fill will be applied up to the midline of the pipe, then compacted. The remainder of the embankment will be constructed of uncompacted granular material placed over the pipe. The operation will be completed by placing a solar radiation barrier of peat over the exposed lower sides of the embankment.

In the concrete-restrained mode, the keyed concrete weights will be applied over the pipe and fastened together. The operation will be completed by placing a solar radiation barrier of peat over the exposed lower sides of the work pad.

5.3 COMPRESSOR STATION CONSTRUCTION

A total of nine compressor stations have been planned. For the initial years of operation five stations are required, which will be constructed according to the following schedule:

			Construction Schedule		
Compressor Station No.	Kilometre Post	Station Name	Site Preparation	Foundations & Buildings	Turbo-machinery
*STA-311	64.7	White River	Fall 1982	Summer 1983	Summer 1984
STA-312	146.2	Donjek River		Future	
*STA-313	214.2	Kluane Lake	Fall 1982	Summer 1983	Summer 1984
STA-314	294.6	Pine Lake		Future	
*STA-315	378.3	Takhini River	Fall 1982	Summer 1983	Summer 1984
STA-321	456.0	Yukon River		Future	
*STA-322	553.9	Teslin River	Fall 1983	Summer 1984	Summer 1985
STA-323	650.0	Mount Hazel		Future	
*STA-324	739.2	Rancheria	Fall 1983	Summer 1984	Summer 1985

*Constructed for initial operations.

Construction will commence with installation of a permanent access road, followed by site grading and gravelling. A steel security fence will be erected immediately. A concrete foundation will be installed, upon which a temporary building will be constructed. The temporary structure will be chilled if necessary to maintain frozen terrain. Permanent buildings will be erected to replace the temporary structures, and piping, electrical and vessel installation will commence. This will be followed by installation of the turbomachinery.

5.4 STOCKPILE AND STORAGE SITES

Stockpile sites will range in size from 2 to 8 ha, depending on the quantity of pipe being stored at each location. Stockpile sites will be established at the locations identified in Table 2-1.2. A typical layout for a stockpile site is illustrated in Figure 2-1.19.

Potentially hazardous chemicals will be stored in the containers in which they are received within a fenced, secured area on the mainline storage sites. All empty containers will be returned to the supplier.

Fuel will be stored in above-ground tanks. Where tanks are larger than 4600 l in capacity, the storage area will be surrounded by a dyke of impervious material. An absolute minimum of storage will occur on the pipeline right-of-way. Fuel storage locations have been tentatively identified and these are shown on the alignment maps provided with this submission, and are presented in Table 2-1.2.

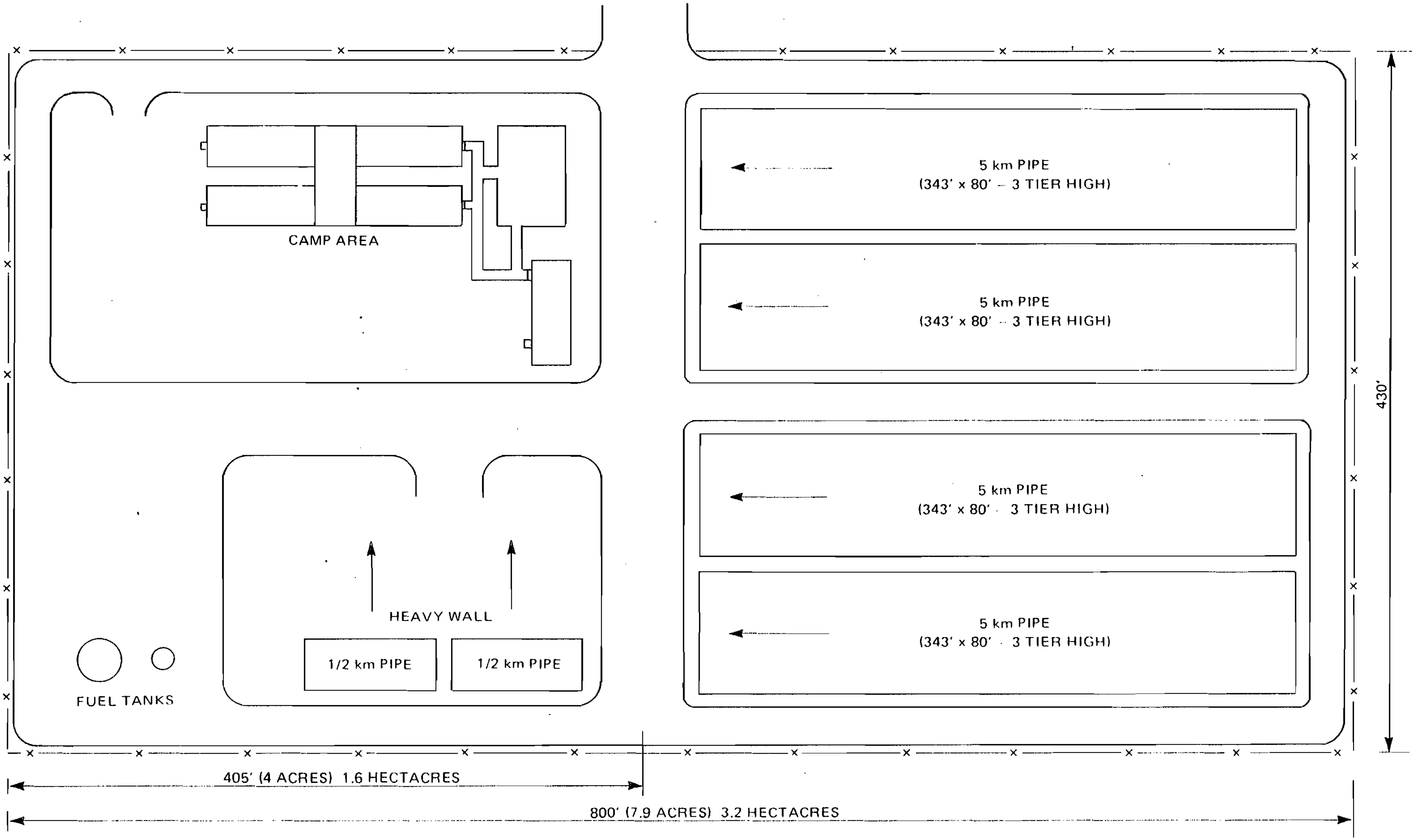
Fuel will be required at compressor station sites during construction and for the operations and maintenance (O & M) phase. The fuel will be stored on site within the fenced enclosure at compressor station sites. Figure 2-1.20 presents a typical layout for a compressor station construction camp, and Figure 2-1.21 illustrates a typical station plot plan.

For the O & M phase, lubricating oil will be stored in steel drums on racks within the fenced site enclosure.

TABLE 2-1.2

STOCKPILE AND STORAGE SITE LOCATIONS

Section Number	Fuel Storage Locations (KP)	Pipe Storage Locations (KP)
1	21.5	21.5
1		42.0
2		59.3
2	75.5	75.5
2		94.0
3		108.8
3	142.6	146.0
3		163.3
4		178.5
4	204.5	204.5
Lake Crossing		219.5
5		250.4
5		268.3
5		281.7
5	278.2	294.6
6		317.9
6		332.2
6		356.5
6		373.0
7		405.0
7		440.0
8		467.0
8		486.0
8		529.0
9	549.0	549.0
9		570.9
9		597.2
10	612.2	612.2
10		642.0
11		666.0
11	698.0	686.0
11 & 12	714.0	714.0
12a		746.5
13a	771.0	771.0
12b		797.0
13b		816.0



PRELIMINARY

FIGURE 2-1.19

TYPICAL STOCKPILE SITE

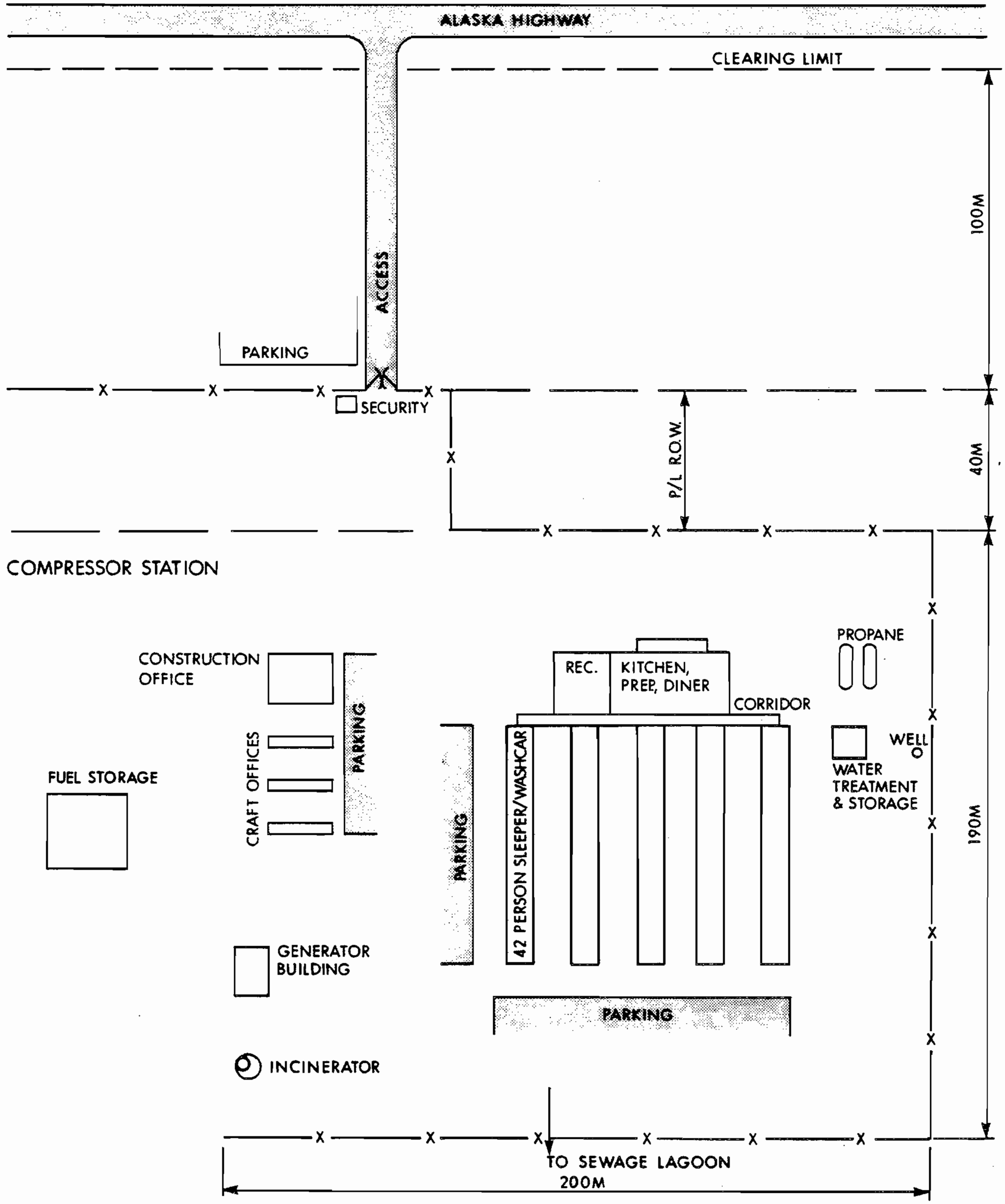


FIGURE 2-1.20

TYPICAL COMPRESSOR STATION CAMP LAYOUT

NOMINAL CAPACITY: 200

PRELIMINARY

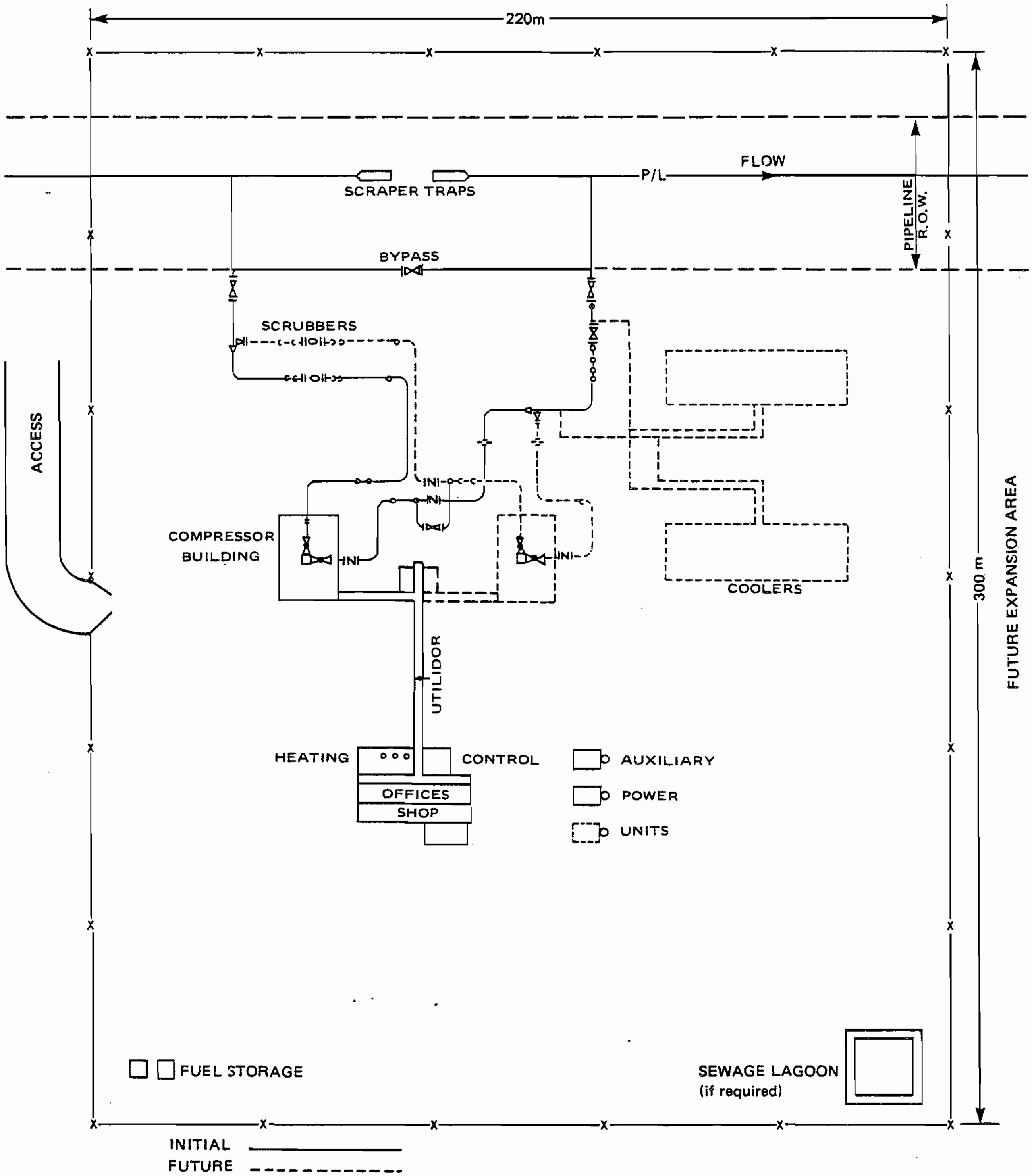


FIGURE 2-1.21

TYPICAL COMPRESSOR STATION PLOT PLAN

PRELIMINARY

5.5 CONSTRUCTION CAMPS

During construction of the pipeline system, 12 mainline camps are planned (Table 2-1.3), as well as five construction camps at compressor station locations. Mainline camps will house between 200 and 1400 personnel while compressor station sites are planned to accommodate approximately 150 personnel. Construction camps will be enclosed by a security fence, and the entrance manned by security personnel. Each camp will provide washroom/sleeping accommodation, a recreational centre, kitchen/diner, and laundry/warehouse facility. A typical pipeline camp is shown in Figure 2-1.22.

5.6 BORROW SITES

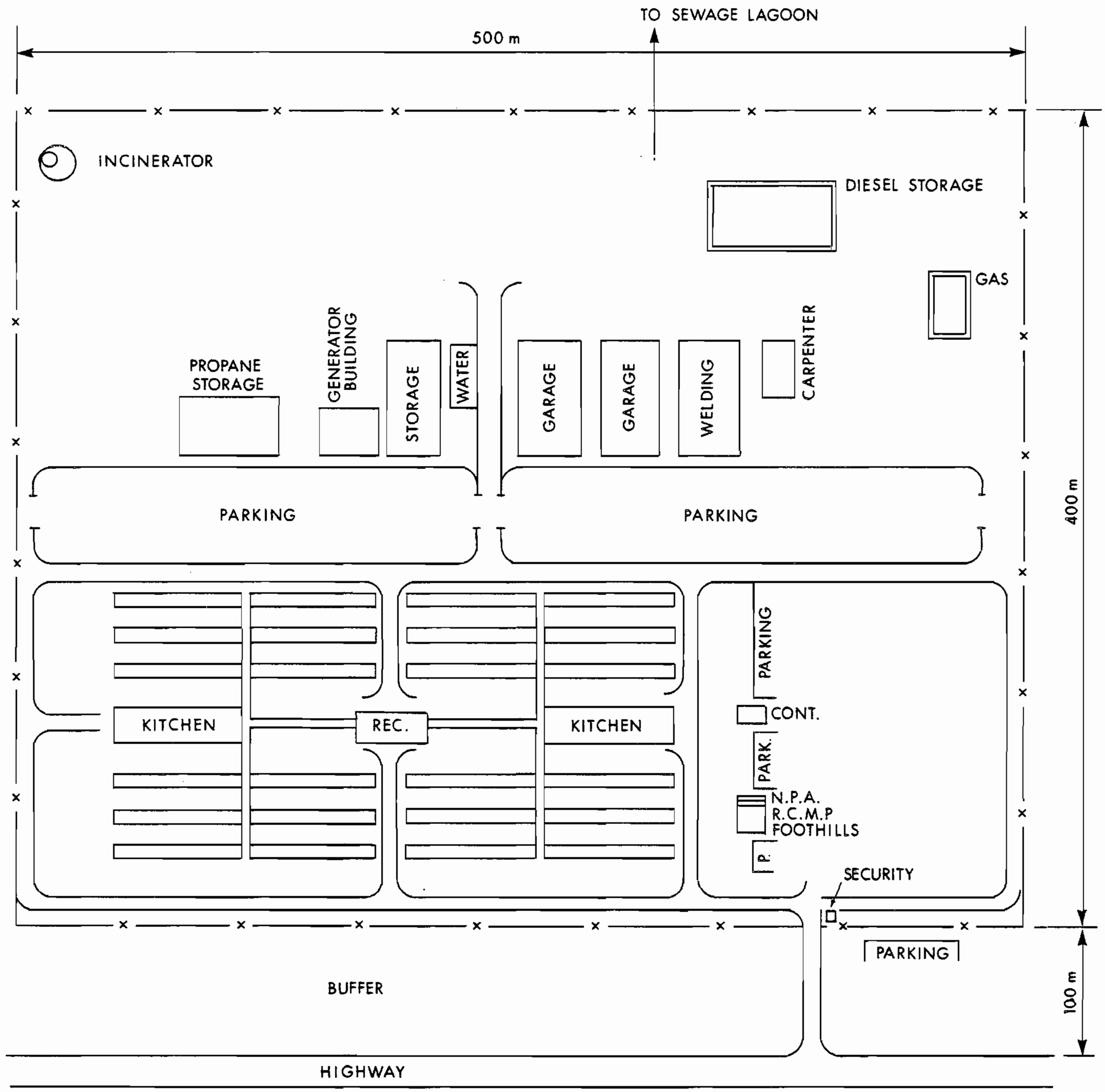
During the final design process, the required quantities of granular materials such as concrete aggregate, granular fill and rip-rap will be determined. These quantities and knowledge of the general location where each is required will be used in locating and defining borrow sources.

Concrete aggregate will be required at compressor station sites and operation and maintenance bases for building foundations, and at sites chosen for the fabrication of pipe weights. A lower-grade granular material will be required in much greater quantities for the construction of such facilities as compressor station and stockpile site pads, permanent access roads, above-grade pipe placement and for select ditch backfill. The estimate of granular material required for above-grade pipe placement is based on an estimated requirement of 36.2 m^3 of granular material per metre of pipe. An estimate of granular material requirements is presented in Table 2-1.4. Readers should note that granular estimates for the above-grade mode (Table 2-1.4) are based on the assumption all above-grade construction will be concrete restrained.

TABLE 2-1.3

LOCATION OF MAINLINE CONSTRUCTION CAMPS

Section Number	Approximate Kilometre Post	Maximum Anticipated Size (Personnel)	Mainline Construction Schedule
1	18.2	1200	Winter 1985
2	75.5	1200	Winter 1984
3	146.0	1400	Winter 1983
4	214.0	1400	Winter 1983
4	214.0	200	Summer 1984
5	262.5	900	Summer 1983
6	356.5	900	Summer 1983
7	440.0	1100	Summer 1984
8	497.0	900	Summer 1984
9	570.9	1400	Winter 1984
10	616.5	1200	Winter 1985
11	686.0	800	Winter 1984
12	767.0	1200	Summer 1984
13	767.0	1200	Winter 1985



PRELIMINARY

FIGURE 2-1.22

TYPICAL PIPELINE CONSTRUCTION CAMP LAYOUT

NOMINAL CAPACITY: 1000

TABLE 2-1.4

GRANULAR MATERIAL REQUIREMENTS AND ESTIMATE OF MATERIAL AVAILABILITY (m³)

Section Number	Kilometre Post From	Kilometre Post To	Length km	Pipeline Construction Schedule	Above-Grade Mode*	Bedding and Padding	Select Backfill	Crushed Gravel	Concrete Aggregate	Erosion Control	Pit Run Gravel	Total	Available Material (X10⁶)
1	0	55	55	W85	565,390	225,059	10,479	87,000	46,250	82,707	948,236	1,965,121	4.68
2	55	110	55	W84	557,780	277,437	51,822	129,721	38,262	69,711	523,286	1,648,019	4.18
3	110	165	55	W83	676,940	104,553	58,359	165,800	37,583	50,605	728,500	1,822,340	2.27
4	165	220	55	W83	297,140	158,874	47,042	126,200	48,196	49,939	158,000	885,391	>5.54
5	226	300	74	S83	94,320	74,086	-	87,040	15,729	41,310	183,300	495,785	>6.23
6	300	378	78	S83	130,620	54,895	-	82,000	13,013	31,748	175,000	487,276	>3.14
7	378	452	74	S84	-	215,223	-	99,700	5,496	41,157	687,600	1,049,176	>9.05
8	452	537	85	S84	98,040	111,241	-	88,700	15,739	37,868	134,300	485,888	>10.22
9	537	598	61	W84	7,540	57,647	-	127,400	13,417	30,586	212,320	448,910	>7.68
10	598	661	63	W85	-	83,337	-	76,141	25,232	25,382	102,040	312,132	>10.54
11	661	718	57	W84	-	43,579	-	26,000	6,498	14,144	56,720	146,941	0.85
12	718 785	760 800	57	S84	-	101,304	-	41,000	7,805	24,465	195,200	369,774	15.00
13	760 800	785 829	54	W85	-	46,867	-	69,000	11,469	16,821	121,440	265,597	5.12
					2,427,770	1,554,102	167,702	1,205,702	284,689	516,443	4,225,942	10,382,350	>84.50

* based on a requirement of 36.2 m³ of gravel/lineal m of right-of-way (excluding concrete restraints)

Discussions have been held between the Project, Department of Indian and Northern Affairs and Department of Public Works to identify borrow sites that are located along the Alaska Highway and that may be available for use by the Project. Additional discussions are taking place as more accurate estimates of quantity, quality, and locations are developed. In areas where more granular material is required than can be obtained from these sites, other sources will be located.

After potential new borrow sources have been identified by photo-interpretation methods, the quantity and quality of the granular materials will be determined by a combination of photo-interpretation, borehole drilling, test pitting, and geophysical methods. A plan for the mining and restoration of the borrow site will then be prepared.

While it is anticipated that most borrow will be obtained from upland sites, stream floodplains may occasionally be used. In any such case, the Project will take the necessary precautions to assure that the regime of the stream is not changed to the detriment of the environment or adjacent manmade facilities.

It is estimated that Foothills' borrow requirements will be approximately 10,400,000 m^3. A government inventory indicates that there are at least 140 open pits along the Alaska Highway from which the required granular material might be available. Other suitable borrow areas have been identified within 1 km of the pipeline right-of-way and/or the Alaska Highway. The total estimate of suitable granular material identified from these sources exceeds 84,500,000 m^3 (Table 2-1.4).

As indicated in the application, the intent is to use borrow pits that will require the shortest possible haul on the Alaska Highway so as to reduce truck traffic and offer the most economic supply.

6.0 CLEAN-UP AND RESTORATION

Upon completion of each pipeline section or compressor station, temporary structures and facilities will be removed and the sites returned as closely as possible to pre-construction condition.

Access roads not required during the operations phase will be returned as closely as possible to pre-construction condition unless directed otherwise by the appropriate regulatory agency.

Where appropriate, granular material borrow areas will be restored to conditions that facilitate their continued use by others. Where a borrow area is to be abandoned, restoration will be discussed with other users and carried out in compliance with instructions from the appropriate regulatory authority.

6.1 REVEGETATION

The purpose of revegetation efforts in disturbed areas will be to reduce the impact of the pipeline on existing and potential land-uses. Specific objectives of the revegetation program are long-term reduction of erosion in areas subject to potential or actual erosion, and re-introduction of vegetative cover to all disturbed areas in a manner which will protect secondary land-use values. It must be recognized that the transport of natural gas is the primary land-use on lands granted to the project.

Activities designed to reduce potential or actual erosion will in most cases involve active revegetation efforts (seeding), while reclamation of other disturbed areas may involve active or passive revegetation approaches (surface manipulation to encourage reinvasion by native plants) depending on site-specific circumstances. The objectives of the revegetation program will be coordinated with planning, construction and operational procedures, and will be achieved through (1) minimizing the extent of initial disturbance; (2) manipulation of surface materials in order to assist revegetation efforts, and; (3) use of agronomic skills and materials. These procedures are described in detail in the revegetation plan prepared by the Project.

7.0 OPERATIONS AND MAINTENANCE IN YUKON TERRITORY

The role of Operations and Maintenance is to ensure that all facilities in the pipeline system are operated efficiently and maintained at a high standard so that natural gas will be transported safely through the system. This responsibility includes compliance with all existing gas industry codes and regulations of government agencies having jurisdiction over the operation of the pipeline.

A set of operating manuals will be developed which will define and detail the company's policies and procedures with respect to the operation and maintenance of all compression, measurement, and pipeline facilities. These manuals will cover the technical, environmental, and socio-economic aspects of the entire operation and will contain:

(1) Operating Policy - mandatory requirements relative to the operation and maintenance of all compression, measurement, and pipeline facilities and equipment.

(2) Operating Instructions - instructions and detailed procedures relative to the operation and maintenance of all equipment.

(3) Technicial Information - equipment manuals and brochures or specially-prepared technical documents relating to a piece of equipment or area of operation.

(4) Industry codes and governmental regulations that apply to the operation of the pipeline system.

The operations and maintenance procedures as required by the regulatory authority will be filed with the authority before the system is placed into service. The development of these procedures will commence as equipment is selected and continue throughout the final engineering and construction phases.

The Operations Head Office will develop and administer company policy and procedures pertaining to personnel relations, engineering, environmental matters, and operations and maintenance. The preparation and implementation of contingency plans for line breaks, station outages and fires will be a combined effort of both the Operations Head Office and area offices.

Each area office will be the coordinating centre for all operations and maintenance activities in the area. It will provide for the inspection and maintenance of the pipeline, compressor stations, meter stations, corrosion control, vehicles, work equipment and ancillary facilities.

7.1 PIPELINE

Principal maintenance objectives for gas transmission lines include keeping the facilities in proper operating condition, providing the lowest cost of service, ensuring continuity of service, and maintaining transmission at design capacity. Proper maintenance includes preservation of ground surface over the pipeline, control of stresses on pipe due to displacements, and prevention of metal loss by corrosion.

To achieve these objectives, pipeline design will include the following:

(1) Cathodic protection system test stations at regular intervals along the pipeline to monitor the effectiveness of the cathodic protection facilities that will be installed to protect the pipeline from corrosion attack.

    The primary method of corrosion control will be coating of all buried steel, supplemented by an impressed current cathodic protection system with rectifier units and buried ground beds or sacrificial anodes installed as required along the pipeline system. The effectiveness of the cathodic protection will be monitored by means of test leads installed at many points along the pipeline. These test leads will terminate in above-ground boxes for accessibility.

All above-ground facilities will be painted where necessary from a corrosion or aesthetic viewpoint. Exceptions would be materials, such as stainless steel, that do not corrode to a significant extent in this type of service.

(2) Pipeline "pig traps" at compressor stations. These facilities will permit regular "pigging" or cleaning of the pipeline to maintain pipeline efficiency. These traps will also permit the running of monitoring devices that will examine the pipeline for:

- metal loss, internal and external;
- cracking;
- pipe movement;
- dents.

(3) Erosion control measures in all areas, with special emphasis on design and maintenance of such measures in sensitive permafrost soils.

7.2 COMPRESSOR STATIONS

Programs will be developed to detail preventative maintenance of all equipment, systems and plants on a daily, weekly, monthly, quarterly, semi-annual, and annual basis.

Maintenance information data available through the facilities of the Maintenance Information System will provide an early indication of compressor unit distress and mechanical wear. The overall maintenance program will be structured to permit the scheduling of routine maintenance inspections and hence minimize the number and duration of outages. Technical specialists will be available to advise and assist with operations and maintenance problems when necessary.

Servicing of compressor units and auxiliary support systems will be performed by maintenance personnel during routine and special visits to the stations. Maintenance programs will be developed to schedule inspection and repairs of equipment and controls at regular intervals before deterioration of any individual unit or control sequence results in an unscheduled shutdown. Maintenance personnel will investigate station alarms and correct any malfunctions in operating equipment, thus providing maximum reliability and availability of compressor stations. Compressor stations will have the necessary instrumentation to measure the amount of gas transported and fuel gas used.

7.3 RIGHT-OF-WAY MAINTENANCE

The pipeline route encounters many changes in topography and environment; therefore, maintenance procedures will be developed in each area to meet the varied conditions.

Personnel in each area will be responsible for inspection and maintenance of an assigned portion of the right-of-way while avoiding as much as possible disturbance of the terrain and environment.

7.4 PERMANENT ACCESS ROADS

The operations and maintenance group will be responsible for routine road and road structure maintenance.

Icing of culverts may be a significant maintenance factor in Yukon Territory. Should construction of roads in icing areas be unavoidable, active measures will be taken to control the ice formation. Some of these measures include drainage of seepage areas and encouragement of icing in areas away from the road by inducing frost penetration through excavation or diking. Other active methods include raising the road grade and increasing the culvert size.

Dust will be controlled through the application of dust palliatives such as water, calcium chloride or sodium chloride.

7.5 CONTINGENCY PLANS

The Operations and Maintenance Plan places high priority on contingency repair capabilities to assure the gas user of continuity of service, and equally important, to balance that requirement with concern for the known environmental sensitivities in the terrain along the pipeline route.

The quantity and variety of equipment, pipe and materials available for contingency operations, stored at numerous locations along the pipeline route will not often be required, but will enable major repairs to be performed efficiently with minimal damage to the environment.

The contingencies that have highest priority on handling are:

(1) pipeline failure or major leaks,

(2) major right-of-way washout or slope movement, and

(3) fire on Foothills' property or adjacent land.

8.0 ABANDONMENT

The design life of the proposed pipeline is over 30 years, and plans for the termination of the line itself or of related facilities have not been developed. Development of such plans are not appropriate at this time in view of the fact that details of pipeline design have not been completed. Also, because of the extended period of time before abandonment, regulations governing abandonment may be changed. In addition, experience in the abandonment of large diameter gas pipelines is extremely limited at this time because most installed systems are still in operation.

The experience the industry has gained to date is reflected in regulations governing abandonment. In Canada such regulations include conditions set down by the Canadian Standards Association, which are included in the National Energy Board Act.

In the event that relocation or termination of part or all of the pipeline and related facilities is necessary in the future, the company would comply with all applicable codes and regulations in existence at that time.