ESTIMATED COSTS AND ENVIRONMENTAL IMPACTS OF A NATURAL GAS PIPELINE SYSTEM LINKING FAIRBANKS WITH COOK INLET AREA

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Stone & Webster Engineering Corporation
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1.0 EXECUTIVE SUMMARY

The energy needs at Fairbanks are currently met through electric power generation, steam generation, heating oil and to a minor extent propane and wood. There is no natural gas utilized or available at present in Fairbanks.

The closest sources of large volumes of gas to Fairbanks are on the North Slope and at Cook Inlet. This study evaluates the cost and feasibility of a pipeline connecting Fairbanks to the Cook Inlet reserves. The major elements of this study include a future demand forecast, system sizing, pipeline route selection, environmental acceptability, and capital and operating costs determination.

1.1 Demand Forecast

Energy demand forecasts to the year 2020 have been developed for the prime market sectors - residential, commercial and electric power generation. Potentially, the largest volume customers would be power plants serving Fairbanks, University of Alaska, and U.S. Military bases in the area. Two separate demand forecasts have been developed as Department of Defense energy policies encourage the use of coal at certain U.S. Military bases and the policy may inhibit conversion of plants to natural gas firing.

The Baseline Case forecast covers residential, commercial, and non-military power generation in Fairbanks; the Military Case forecast includes supply of gas to the Fort Wainwright, Eielson and Clear military bases.

Future demand volumes have been developed on the basis of fuel consumption estimates made in 1981 and adjusted to reflect growth to 1987 and normal weather conditions. Further growth to the year 2020 is based on the Institute of Social and Economic Research (University of Alaska) survey of residential energy end use with an appropriate gas penetration adjustment.

Factors for gas market penetration for Fairbanks were based on similar analyses performed by Stone & Webster for equivalent climatic areas including the Yukon, Northwest Territories and Anchorage.

A summary of the natural gas demand forecasts is provided as follows:

Year 2020 Case	Category		Demand (MMcf) Annual	Peak Day
Baseline	Residential		3,378	23.20
	Commercial		2,245	15.42
	Electric Power		5,842	22.73
		Subtotal	11,465	61.35
Military	Electric Power		5,946	26.95
		Total	17,411	88.30

1.2 System Design

The most convenient point for connection of a Fairbanks pipeline to the Cook Inlet reserves is via a connection to the Beluga pipeline in the vicinity of Knik. Gas in the Beluga line has already been conditioned to gas transmission quality. The Knik connection would be only 7-1/2 miles from the proposed alignment of the Fairbanks pipeline along the Parks Highway.

Hydraulic analyses were conducted on various configurations of pipe size and inlet compression to determine the most effective system.

The results of the 16 inch diameter analysis showed that such a line was capable of moving the Baseline Case volumes without compression. The line also had the capability of transporting the Military Case volumes with the addition of inlet or intermediate compression stations. The 16 inch configuration without compression was therefore selected as the basis of the cost estimate.

The use of a 20 inch line, as has been suggested by others, was evaluated. Such a line has the capability of transporting approximately 80 percent more volume than a 16 inch line for an incremental capital cost increase in the range of 20-25 percent.

However, a cost increase of some $45 million is not warranted for throughput volumes that can be handled by the 16 inch line. Should compression facilities be required to meet the full Military Case volumes these could be installed for under $10 million.

It has also been suggested that a 20 inch line could be used to backfeed gas to Anchorage should North Slope gas ever be routed through Fairbanks. The analysis of such a scenario is outside the scope of the present study.

Additional facilities identified as a necessary part of the overall pipeline system include a custody transfer metering station at the Beluga supply junction, a city gate station for metering and pressure control at Fairbanks and intermediate take-off facilities at communities along the route.

1.3 Pipeline Route

The optimum route between the Cook Inlet area and Fairbanks is via the existing transportation corridor formed by the Alaska Railroad and the George Parks Highway.

A direct cross country route, though shorter, would be much more costly due to the rugged terrain and lack of logistical support infrastructure.

The highway corridor provides both road and rail systems for the delivery of pipe and materials as well as the movement of men and equipment during construction. Also, the highway is adjacent or close to several communities along the route which would presumably request connection to the gas line.

Most importantly, the easement for the highway is of sufficient width to accommodate a 16" pipeline thus ensuring minimal additional disturbances to the environment.

Within the general concept of following the highway alignment there are two sections in which alternates have been identified. We can anticipate there will be legal difficulties in gaining permission to lay a pipeline within a National Park boundary. Therefore, at Denali National Park the alternate route leaves the highway to stay outside the park a distance of almost 8 miles.

Towards the northern end of the line, approximately 10 miles south of Nenana, the terrain provides an opportunity to take a shorter, direct cross-country route to Fairbanks. Although the cost estimate indicates that this option is approximately $2.5 million more expensive than staying with the highway, we recommend that a final decision should be delayed until additional studies have been completed at the detailed engineering stage.

The total length of the proposed route is 298 miles. The split of land ownership along the route is Federal 15%; State 45%; Borough 9%; Private 31%.

1.4 Environmental Impact

Nearly seventy-nine percent of the pipeline route would parallel the Parks Highway and share a portion of its right-of-way. Right-of-way clearing requirements are minimized by this approach and impacts are substantially lessened as a result of close access to the Parks Highway and Alaska Railroad. In total, clearing of vegetation for right-of-way preparation would disturb approximately 3,150 acres. The remaining twenty-one percent of the route is located in roadless areas. Selection of the most direct route in those areas would result in minimizing clearing requirements.

No threatened or endangered species are expected to be impacted. Impacts to wetlands would be mitigated by construction timing and specialized construction methods such as snow/ice roads and transportation of excess fill to upland areas.

The proposed pipeline route crosses a minimum of 144 streams and rivers, 40 of which are classified as anadromous fisheries. This is clearly the most significant environmental aspect of the pipeline routing. Specialized construction techniques must be employed at water crossings including fluming, channel diversion, and rehabilitation of stream banks and bottom material. These measures, coupled with construction timing, would minimize the effects of downstream siltation on fisheries.

No environmental impacts have been identified that would not be successfully mitigated and none are considered significant enough to seriously restrict project development.

1.5 Project Costs

The total cost of the mainline between Cook Inlet and Fairbanks including metering and pressure/flow regulations at each end of the line is estimated at $190 million.

The construction cost segment of the total installed cost was based on a construction plan of four spreads working over a sixteen month time frame. Three of these spreads are summer spreads working on sections paralleling the highway. The fourth spread would be responsible for the winter installation sections at each end of the line.

A summary of pipeline installation costs by spread is provided as follows:

Spread	Miles	Design Inspection Materials	Construction	Total	Cost/Mile
1	91.7	$17,626,551	$33,172,742	$50,799,293	$553,973
2	87.3	$17,818,910	$30,273,084	$48,091,994	$550,882
3	64.3	$12,658,962	$26,360,577	$39,019,539	$606,836
4A	7.4	$1,935,785	$5,266,283	$7,202,068	$973,252
4B	48.0	$12,939,665	$29,359,065	$42,298,730	$881,224
SUBTOTAL	298.7	$62,979,873	$124,431,751	$187,411,624	$627,424
OpFac		$1,937,825	$634,112	$2,571,937	$8,610
TOTAL	298.7	$64,917,698	$125,065,863	$189,983,561	$636,035

Contingency funds have been built into the above summary costs at two levels. Firstly, conservative estimating and production factors have been used in the estimate development; and secondly, an additional 5 percent contingency allowance has been added to cover unknown conditions.

Non-construction costs included in the above table at $64.92 million, include R.O.W. acquisition, permitting, procurement of all major materials, engineering and design, and construction supervision and inspection. These costs represent 34% of the total installed cost.

In addition to the above mainline costs, the cost of the gas distribution system in Fairbanks is estimated at $33,840,000 in 1988 dollars. This cost is based on the infrastructure requirements needed to supply approximately 12,000 residential/commercial units as well as three power stations at the time the transmission pipeline is completed.

2.0 SCOPE OF STUDY

The Alaska Power Authority has authorized a study by Stone & Webster Engineering Corporation to develop the capital cost, the operations and maintenance costs and the environmental impacts of a natural gas pipeline system linking the city of Fairbanks with the Cook Inlet area of Alaska.

The results of this system study will be utilized by the Alaska Power Authority as part of an overall feasibility study to evaluate upgrading the electrical transmission system within the Railbelt area.

Prime considerations in the preparation of a solidly based cost estimate for any pipeline system are the determination of both the size and associated facilities of the line together with an accurate definition of the proposed route.

A number of key sub-elements have been developed within the study to provide the necessary data base for route selection, system sizing and final costs. These include system demand forecasts, route alternates, conceptual engineering designs, environmental impacts and mitigation, land ownership and project permitting requirements.

2.1 Pipeline Capacity

Estimates have been prepared for maximum peak day requirements of gas over a 30 year period. Estimates are based on existing forecasts for economic and population growth, electricity demand and historical energy use, comparative pricing of alternate energy sources and market penetration factors.

Two scenarios have been developed. The baseline case considers all non-military gas usage in Fairbanks for residential, commercial and power generation needs. The military case includes additional loads assuming the three military generating centers in the area are converted to natural gas firing.

2.2 Route Selection

The terrain and transportation corridors between Cook Inlet and Fairbanks have been evaluated and catalogued to determine the most cost effective route within acceptable environmental and socio-economic constraints.

2.3 Conceptual Engineering

Based on the gas demand forecast, the mainline pipe size and associated infrastructure facilities have been determined for optimum cost and future throughput.

Conceptual designs have been developed for all major system facilities including metering and pressure regulation terminals, scraper stations, mainline valve stations, highway and water crossings and local distribution systems.

2.4 Environmental Assessment

The pipeline route will cross varied terrain and will interact with fish and wildlife resources during the construction operation and maintenance periods. This is a key concern for most pipelines but is especially relevant in Alaska with its unique variety of wildlife and sensitive terrain forms. The preferred route has been selected so that the pipeline can be installed and operated within acceptable levels of environmental impact. Where necessary mitigative plans are identified; in most cases mitigation is achieved by careful routing, rescheduling of seasonally sensitive activities, and modification of construction methods.

2.5 Land Ownership and Permitting

Land acquisition and regulatory permitting are significant aspects of preconstruction activity. Land ownership has been evaluated to identify the pattern of ownership along the pipeline route and to assess the relative holdings of federal, state, native and private lands, especially those that could impact easement acquisition such as national park and military land holdings. Ownership data has been cataloged on 1:250,000 scale pipeline route maps.

Regulatory requirements for a gas pipeline in Alaska will involve a considerable body of permits, licenses and right-of-way agreements at the federal, state and local level. A listing of the majority of permits required by the various agencies has been prepared together with a selection of typical right-of-way agreements for the various categories of landownership along the pipeline route.

2.6 Cost Estimates

Cost estimates have been developed for:

1. Capital cost for 16" pipeline between Cook Inlet and Fairbanks.

2. Capital cost for local distribution system within the Fairbanks area.

3. Operating and maintenance costs both for the 16" mainline and the local distribution system in Fairbanks.

3.0 SYSTEM CAPACITY

As part of Stone & Webster's development of the costs and environmental impacts of a proposed natural gas pipeline to serve the Fairbanks area, we have estimated peak day capacity requirements in order to provide the basis for designing the pipeline. These estimates were developed by analyzing and forecasting gas demand for individual market sectors for the period through the year 2020. Annual energy demand forecasts for the residential and commercial sectors were obtained for "normal" weather conditions using 14,274 annual heating degree days.

Gas market penetration for the Fairbanks area was estimated based on an analysis of market penetration in similar climates including Yukon, Northwest Territories and the Anchorage areas as well as considering the results of the recent residential end use survey conducted by the Institute of Social and Economic Research at the University of Alaska (ISER).

Demand forecasts for large-volume customers including electric power generation plants, U.S. military bases and the University of Alaska at Fairbanks were based on Stone & Webster's analysis of natural gas conversion at six existing sites in the Fairbanks area which was performed for ENSTAR Natural Gas Company during the fall of 1986.

While these rough estimates of potential gas demand are necessary and appropriate for sizing the pipeline for cost estimating purposes, it should be noted that more careful consideration of natural gas demand will be provided in The Power Authority's overall Railbelt economic analysis to which this volume contributes.

3.1 Forecast Results

The following tables summarize the results of Stone & Webster's demand analysis and forecasts. Peak day requirements for the temperature sensitive residential and commercial sectors were calculated considering a design peak day of 98 heating degree days. Table 3.1 shows the projected total gas demand for the years 2000, 2010 and 2020 on an annual and peak day basis for each consuming sector. The electric power sector includes conversion of the North Pole station of Golden Valley Electric Association (GVEA), the downtown Fairbanks coal-fired generating facilities of the Fairbanks Municipal Utilities System (FMUS) and the University of Alaska at Fairbanks, steam plant. The electric power gas loads are assumed to convert shortly after completion of the pipeline (mid-1990's conversion date). No additional gas demand for electric power generation beyond these initial conversions is included here for the Fairbanks area through 2020. Any additional growth in electricity demand could be met from cogeneration or power plants located outside of the Fairbanks area.

With reference to Table 3.1, the constant load demand of 5842 MMcf for electric power is equivalent to 378,000 Mwh of electrical output.

Table 3.1
Fairbanks Area Gas Demand Excluding U.S. Military Bases
(MMcf)

	2000	2010	2020
Annual Use			
Residential	2,377	2,868	3,378
Commercial	1,644	1,954	2,245
Electric Power	5,842	5,842	5,842
Total	9,863	10,664	11,466
Peak Day			
Residential	16.32	19.70	23.20
Commercial	11.29	13.42	15.42
Electric Power	22.73	22.73	22.73
Total	50.34	55.85	61.35

Table 3.2 shows the total projected gas demand including potential conversions by the military bases at Fort Wainwright, Eielson Air Force Base and Clear Air Force Station. The conversion of these military bases to gas is considered separately from the base-case forecasts due to the possibility that current Department of Defense energy policies such as those described in the 1982 Military Construction Codification Act and the 1986 Defense Appropriation Report, encourage the use of coal at U.S. military bases and may inhibit conversions from coal to natural gas.

Table 3.2
Fairbanks Area Gas Demand Including U.S. Military Consumption
(MMcf)

	2000	2010	2020
Annual Use			
Residential	2,377	2,868	3,378
Commercial	1,644	1,954	2,245
Electrical Power	5,842	5,842	5,842
Military	5,946	5,946	5,946
Total	15,809	16,610	17,412
Peak Day			
Residential	16.32	19.70	23.20
Commercial	11.29	13.42	15.42
Electric Power	22.73	22.73	22.73
Military	26.95	26.95	26.95
Total	77.29	82.80	88.30

Table 3.3 provides a summary of the forecast results for residential and commercial natural gas demand. Demand is split into two major use categories: space and water heating, and lighting and appliances for each sector as well as by gas penetration for each competing fuel. In order to estimate the amount of natural gas which would be consumed in these sectors for a market area in which gas service is not currently available, it is necessary to forecast the demand attributed to each fuel source and apply gas penetration rates to determine the gas volumes required.

Table 3.3
Annual Residential and Commercial Natural Gas Demand
Fairbanks Area
(MMcf)

	Gas Penetration %	2000	2010	2020
Residential				
Space & Water Heating				
Fuel Oil/Propane	97.0	1,831	2,209	2,602
Wood	10.0	17	20	24
Electricity	90.0	351	424	499
Other	80.0	147	178	210
Lighting & Appliances				
Propane	98.0	19	23	27
Electricity	10.0	12	14	17
Total Residential		2,377	2,868	3,379
Commercial				
Space & Water Heating				
Fuel Oil/Propane	98.0	1,290	1,533	1,762
Electricity	95.0	167	198	228
Steam	0.0	--	--	--
Lighting & Appliances				
Propane	95.0	155	184	211
Electricity	10.0	32	38	44
Total Commercial		1,644	1,953	2,245

3.2 Forecast Assumptions and Methodology

Stone & Webster's natural gas demand forecasts for the residential and commercial sectors were developed from a base year (1981) in which fuel consumption estimates were available. The base year consumption data were adjusted to reflect normal weather conditions. There is no significant industrial process fuel consumption and therefore no separate industrial forecast or analysis. The electric power and military sector demand forecasts are based on previous Stone & Webster evaluation of the fuel consumption and conversion characteristics at the eight major facilities in the Fairbanks area. The fuel demand by three of these facilities: GVEA's North Pole station, FMUS's downtown Fairbanks plant and the University of Alaska at Fairbanks comprise the base case electric power sector demand. The alternate case forecast adds the gas demand from three military bases: Fort Wainwright, Eielson Air Force Base and Clear Air Force Station to the base case total demand.

The residential and commercial forecast methodologies and assumptions are described in more detail in the following discussions.

3.3 Residential

Using 1981 fuel consumption estimates as the base year, residential consumption was brought forward to yield 1987 estimated consumption (adjusted for normal weather). The space and water heating energy consumption was developed using energy use factors (energy use/household/DD) adjusted for conservation. New housing unit additions in the Fairbanks area for the years 1981 to 1986 were combined with 1981 total residential units to obtain the number of occupied residential units in 1987. Lighting and appliance energy consumption was increased in conjunction with the growth in total housing units. The 1987 consumption estimates were based on the fuel-use splits indicated by the ISER residential energy survey. Table 3.4 shows the 1987 residential energy consumption by fuel and major use category for the proposed gas service area in Fairbanks.

Table 3.4
1987 Fairbanks Service Area Estimated Residential Energy Consumption
(Adjusted for Normal Weather)
(MMBtu)

Space and Water Heating	
Fuel Oil/Propane	1,801,921
Wood	137,878
Electricity	242,475
Other	175,913
Lighting & Appliances	
Propane	16,023
Electricity	97,684
Total	2,471,894

The residential housing unit growth rate projection for the Middle A Case prepared by ISER was used as the basis to forecast residential energy demand through 2020. Table 3.5 shows the number of residential customers which could be serviced with natural gas and the Fairbanks area population data used in the residential energy demand forecast. By 1987 most of the conservation adjustments by residential users are assumed to have been completed. The forecasts assume that the average residential customer will use 235 MCF annually for space and water heating. Gas market penetration factors and furnace efficiency adjustments were applied to the projected energy demand to obtain natural gas demand forecasts. Table 3.6 shows the residential fuel oil and natural gas prices on which the development of the market penetration factors were based. The fuel oil prices are based on APA's middle growth rate forecast and the natural gas prices.

Table 3.5
Residential Demand Forecast Basis:
Housing Units and Population

Year	Residential Units in the Fairbanks Gas Service Area	Fairbanks Area Population
1987	10,033	68,391
2000	12,120	79,286
2010	14,627	94,260
2020	17,227	108,320

Table 3.6
Residential Fuel Oil and Natural Gas Price Assumptions
(1987 $ per MMBtu)

Year	Natural Gas	Fuel Oil
1990	3.47	6.08
2000	4.04	7.09
2010	4.15	8.11
2020	4.63	9.41

3.4 Commercial

The commercial energy demand forecast utilized 1981 consumption estimates as well as an estimate of the total energy consuming commercial building area (square feet) in existence corresponding to the 1981 energy consumption. Energy consumption was adjusted to reflect normal weather conditions. Commercial building area was increased throughout the forecast in accordance with the projected growth in Fairbanks area population. Commercial energy use factors reflecting energy use per square foot of occupied space were used and adjusted to account for energy conservation. The conservation factor is based on EIA survey data for commercial buildings in areas with more than 7,000 annual heating degree days. Table 3.7 shows the 1987 estimated commercial energy consumption for the Fairbanks area. Table 3.8 shows the projected commercial building area used to develop the commercial energy demand forecasts. The commercial energy use factor utilized for the forecasts assumes that conservation ajustments have substantially occurred by 1987. The use factor of 0.281 MMbtu annual consumption per square foot of commercial floor space yields an average annual use of about 976 Mcf per commercial customer. The natural gas demand forecasts were obtained by applying commercial gas penetration factors to the total energy demand forecasts in the same manner as was used to obtain the residential natural gas forecasts.

Table 3.7
1987 Estimated Commercial Energy Consumption for the Fairbanks Area (Adjusted for Normal Weather)

	MMBtu
Space and Water Heating	
Fuel Oil/Propane	1,135,259
Electricity	151,368
Steam	227,052
Lighting & Appliances	
Propane	140,532
Electricity	278,967
Total	1,933,178

Table 3.8
Fairbanks Commercial Building Area (Sq. Ft.)

Year	Building Area
1987	6,884,500
2000	7,981,232
2010	9,488,573
2020	10,903,906

3.5 References

Alaska State Legislature, House of Representative, Research Agency Memorandum. An Analysis of the Wasilla-Fairbanks Gas Pipeline Proposal Research Request 88.095. March 16, 1988.

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Institute of Social and Economic Research, University of Alaska Anchorage. Economic and Demographic Projections for the Alaska Railbelt: 1988-2010 Draft. June 17, 1988.

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4.0 SYSTEM DESIGN

4.1 System Overview

The proposed system consists of a gas transmission pipeline, approximately 298 miles long, linking the gas reserves in the Cook Inlet area with the City of Fairbanks, Alaska. The selected route starts at a point on the existing Beluga Pipeline (M.P.39) which is approximately 7.4 miles south of the intersection of Big Lake Road and the George Parks Highway. At this point the pipeline enters the George Parks Highway alignment and remains within the right of way, except for a short diversion around McKinley Park until it reaches Julius (at Hwy MP 295). The pipeline then leaves the highway alignment and takes a direct path across open country to Fairbanks.

A number of small communities are located along the highway and could be supplied through individual town border stations. Seven communities have been identified for possible connection to the mainline with a total estimated current population of approximately 3000 persons.

The system infrastructure includes metering facilities at the Beluga connection point, intermediate block valves and scraper stations, and metering/pressure reduction facilities at the Fairbanks delivery point. Alternate system cases that are based on pressures above that available from the Beluga Pipeline would also include a compressor station facility at that connection point.

4.2 System Analysis

The system design and optimization process entails the analysis and evaluation of different line size and compression options capable of satisfying forecast load demands.

The flow analysis was performed for a range of peak day volumes that spanned the two demand forecast cases developed in Section 3.

	Peak Day (mmscfd)	
Year	Baseline Case	Military Case
2000	50.3	77.3
2010	55.9	82.8
2020	61.3	88.3

In addition to calculating line size options for various loads, the impact of adding compression at the supply point was also evaluated.

A number of basic parameters have been assumed in the flow analysis.

1. Length of pipe between Beluga connection and Fairbanks 298 miles.

2. Gas composition of gas transported by the Beluga Line.

Component	Mol %
Methane	99.0655
Ethane	0.0260
Carbon Dioxide	0.2705
Nitrogen	0.6380
Total	100.0000

MW = 16.99
Gas Gravity = 0.56 (air = 1.0)
K = 1.30

3. Gas Properties

Based on the gas composition, physical properties were determined using the Ken Starling Equation of State and were used as input into the hydraulic analysis. The properties include the compressibility factor (Z, dimensionless), the specific heat (Cp, Btu/lbm), and the Joule Thompson Coefficient (Jt, DegF/psi).

P	Z	Cp	Jt
100	0.986	0.532	0.057
200	0.982	0.544	0.057
300	0.058	0.555	0.056
400	0.944	0.568	0.056
500	0.931	0.582	0.055
600	0.918	0.596	0.054
700	0.906	0.611	0.054
800	0.894	0.627	0.053
900	0.882	0.643	0.051
1000	0.872	0.661	0.050

4. Minimum pressure delivered at Fairbanks city gate station has been assumed as 550 psig.

Flow analysis was performed using the AGA flow equation which determines flow based on the following formula which includes a kinetic energy correction factor to account for changes in elevation of the pipeline:

$$Q = 38.77 \frac{Tb}{Pb} F D^{2.5} \left[\frac{P1^2 - P2^2 - \frac{0.0375\ G\ H\ Pav^2}{Tav\ \ Zav}}{G\ \ Tav\ \ L\ \ Zav} \right]^{0.5}$$

Where
- P1 = Upstream pressure, psia
- P2 = Downstream pressure, psia
- Pav = 2/3 Average pressure, psia
- Pb = Base pressure, 14,7 psia
- Zav = Average compressibility
- Tav = Average temperature, Rankine
- Tb = Base temperature, Rankine
- L = Length, feet
- G = Gas Gravity, (Air = 1)
- D = Internal Diameter of Pipe, inches
- H = Differential elevation, feet
- Q = Gas flow rate, scfd
- F = Transmission Factor = 4 Log [3.7 D/Ke]
- Ke = Effective roughness of pipe wall, 0.0018 inches

The pipeline is divided into 20 equal segments and the above equation is solved for the downstream pressure in each segment. The steady state conditions of inlet and outlet pressure are used to determine the average compressibility factor.

The temperature drop in each pipeline segment was determined by considering thermal transfer to the surrounding soil and the Joule-Thompson effect. The soil ambient temperature was taken as 40 deg F and the depth of cover over the pipeline as 3 feet.

Gas inlet temperatures at Knik are expected to not exceed 35 deg F during the summer and will be in the 25 deg F range during winter. The pipline will therefore be operating at or below freezing point and will not have a significant effect on the small pockets of permafrost along the edge of the Parks Highway routing.

The elevation of the pipeline at each segment is used to provide for a kinetic energy pressure correction factor in the AGA flow equation.
A typical flow analysis output is presented in Table 4.2.

TABLE 4.2

BELUGA-FAIRBANKS GAS PIPELINE ANALYSIS

Flow 61.3 mmscfd
Diameter= 16 " x 0.3125 " wt

Mile Post	Elev (feet)	Comp. (psi)	Psi (psig)	Psi Out	Zavg dim	Ta degf	Temp degf
0.0	125	-	1015	1001	0.872	31.8	35.0
14.9	175	-	1001	987	0.872	31.8	31.8
29.8	200	-	987	973	0.882	31.7	31.8
44.7	250	-	973	957	0.882	31.7	31.7
59.6	350	-	957	938	0.882	31.6	31.7
74.5	550	-	938	920	0.882	31.6	31.6
89.4	750	-	920	902	0.882	31.6	31.6
104.3	900	-	902	881	0.882	31.5	31.6
119.2	1200	-	881	857	0.894	31.4	31.5
134.1	1600	-	857	829	0.894	31.2	31.4
149.0	2200	-	829	813	0.894	31.7	31.2
163.9	2225	-	813	796	0.894	31.7	31.7
178.8	2250	-	796	778	0.906	31.7	31.7
193.7	2300	-	778	766	0.906	32.0	31.7
208.6	2000	-	766	760	0.906	32.3	32.0
223.5	1400	-	760	749	0.906	32.1	32.3
238.4	1000	-	749	738	0.906	32.1	32.1
253.3	600	-	738	721	0.906	31.8	32.1
268.2	550	-	721	703	0.906	31.8	31.8
283.1	500	-	703	685	0.906	31.7	31.8
298.0	450	-	685		0.918		

4.3 Optimization

A range of flow, diameter and pressure cases were analyzed in order to determine an economic and effective pipeline solution capable of meeting short and long term system flow demands. Three prime cases were evaluated as described below.

In each case the outlet delivery pressure at Fairbanks was calculated for various pipe diameters and flows based on a fixed inlet pressure at the Beluga connection point.

Case 1: Free flow with no inlet compression and 1000 psig supply from the Beluga line.

Case 2: Initial Compression to 1260 psig at Beluga connection.

Case 3: Maximum inlet compression at Beluga connection based on a 1440 psig system.

The results from this analysis are provided in Table 4.3.1.

In addition, discrete analysis for the Baseline and Military Cases was performed at peakday flow predictions for years 2000, 2010 and 2020. These results are displayed in Tables 4.3.2 and 4.3.3.

The results of the flow analysis are summarized graphically in Fig. 4.3.1. The pipeline outlet at Fairbanks was assumed to require a constant delivery pressure of 550 psig. The inlet pressures were individually set at 1000 psig, 1260 psig and 1440 psig and a curve representing gas flow versus diameter developed for each case.

The projected peak day flow rate in year 2020 is represented by a horizontal line at 61.35 mmscfd (Baseline Case). This represents a combination of gas consumption by three power generating stations and residential/small commercial consumption. A second horizontal line at 88.30 mmscfd (Military Case) represents the maximum anticipated consumption assuming additional gas volumes to supply generation facilities at military bases.

TABLE 4.3.1

THROUGHPUT (MMSCFD) (OUTLET=550 PSIG)					
P(PSIG)	DIAMETERS				
	12	14	16	18	20
1000	32.5	49.2	69.0	94.8	123.7
1260	44.4	65.7	92.4	127.3	166.4
1440	50.8	75.5	108.8	147.1	192.7

TABLE 4.3.2

NORMAL: CALCULATED FAIRBANKS PRESSURE (PSIG) (INLET=1000 PSIG)						
YEAR	Q(mmSCFD)	DIAMETERS				
		12	14	16	18	20
2000	50.3	-	-	790	891	934
2010	55.8	-	-	736	865	920
2020	61.3	-	-	670	837	905

TABLE 4.3.3

MILITARY: CALCULATED FAIRBANKS PRESSURE (PSIG) (INLET=1000 PSIG)						
YEAR	Q(mmSCFD)	DIAMETERS				
		12	14	16	18	20
2000	77.3	-	-	-	730	848
2010	82.8	-	-	-	683	825
2020	88.3	-	-	-	628	799

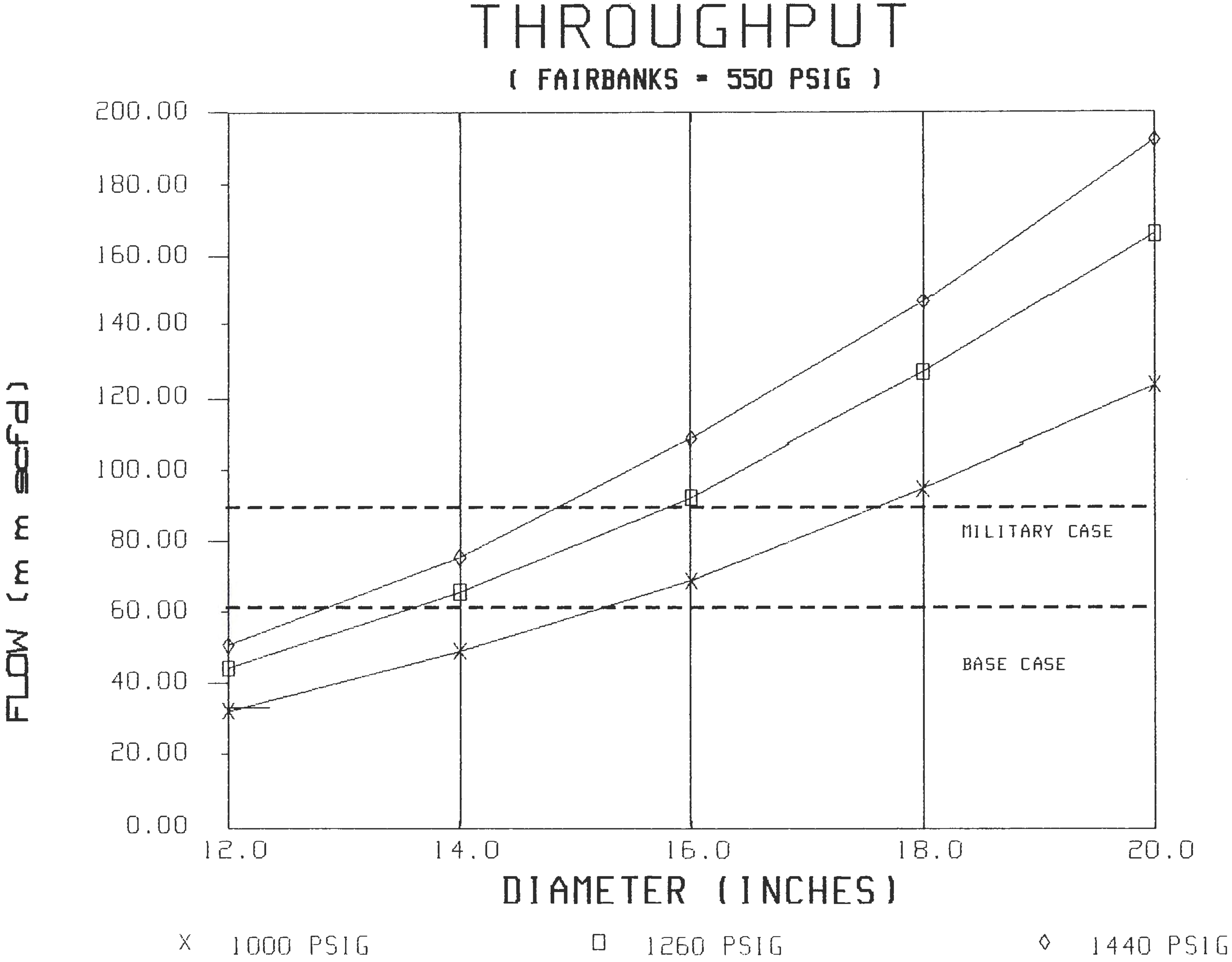

THROUGHPUT
(FAIRBANKS = 550 PSIG)
FLOW (m m scfd)
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
12.0
14.0
16.0
18.0
20.0
DIAMETER (INCHES)
MILITARY CASE
BASE CASE
X 1000 PSIG
□ 1260 PSIG
◇ 1440 PSIG

FIG 4.3.1

Examination of the throughput curves provides the following information.

- o The 14" line with full inlet compression (1440 psig) can supply the base line case volume. It would however be operating at peak capacity with no potential for meeting military case volumes or further throughput expansion.

- o The 16" line can handle the baseline case volumes with a 1000 psig inlet (i.e. freeflow direct from Beluga line). Inlet compression would have to be added for military case volumes while at the 1440 psig maximum case the system would have some surplus capacity of approximately 20 mmscfd above the military case peak day demand.

- o The 18" line in the freeflow mode (1000 psig inlet pressure) can easily handle baseline case volumes and would be just capable of transporting the military case volumes. Ultimate capacity of the 18" system is approximately 145 mmscfd.

- o The 20" line can easily handle the forecast volumes for both the baseline and military cases without any inlet compression. Ultimate capacity is approximately 185 mmscfd or twice more than the military case demand.

4.3.1 Conclusion

The 14" line is too small; with full inlet compression the system would operate with only a small margin of extra capacity above the baseline case volumes.

The 20" line is too large and would provide excess surplus capacity above the larger military case volume even when operating without inlet compression.

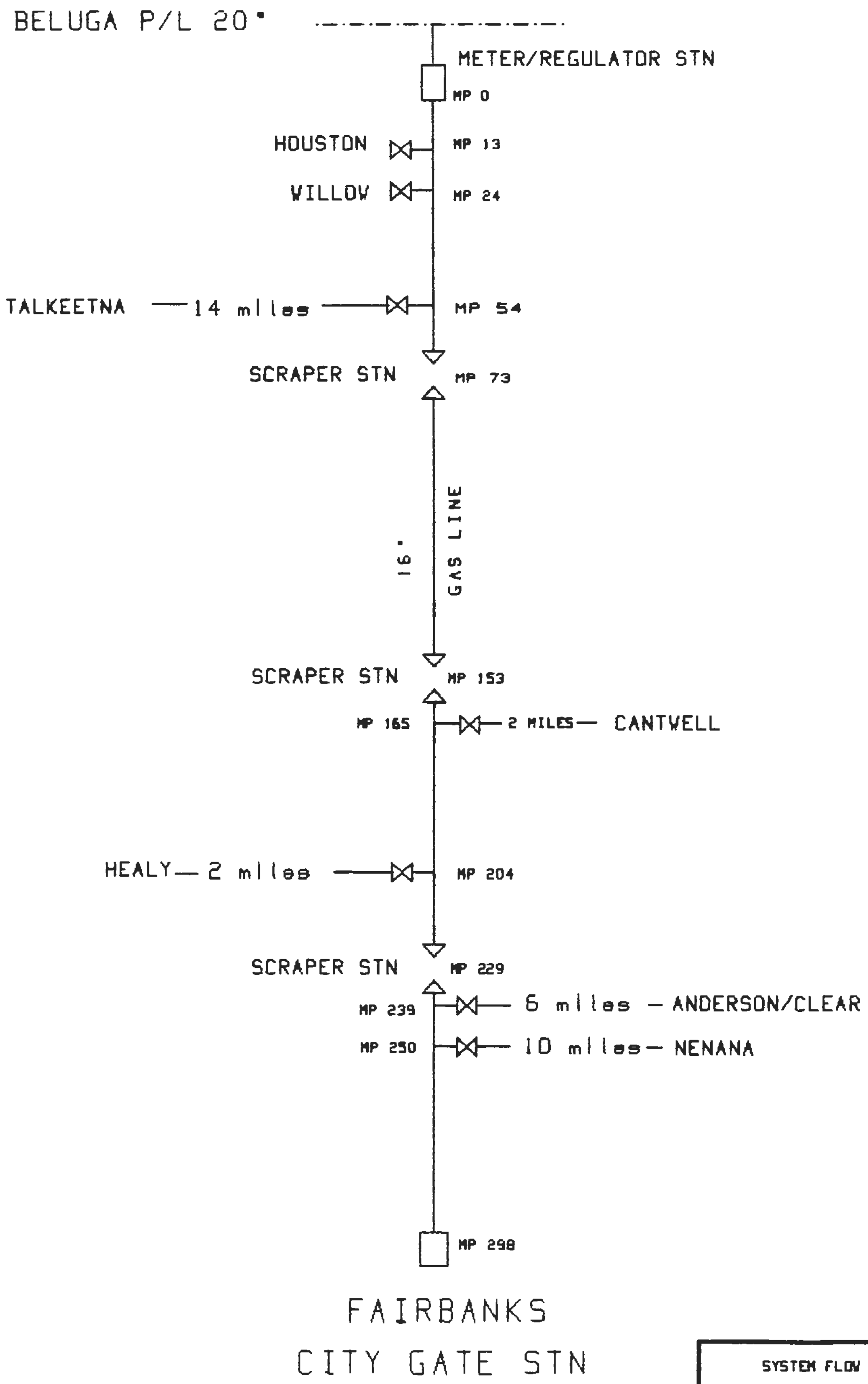
The 16" and 18" lines can accommodate the baseline case volumes without compression. To satisfy the military case demand the 18" would require minimal inlet compression addition while the 16" line would require approximately 1250 horsepower for compression.

The 16" pipeline system is recommended as the basis of the preliminary design and cost estimate. It can accommodate projected residential/commercial consumption, and if required its capacity can be expanded with compression to accommodate the additional but uncertain military consumption.

4.4 Flow Diagram

Data developed from the routing evaluation, community gas supply identification and system analysis has been brought together in a System Flow Diagram Fig 4.4.

The flow diagram indicates the relationship of all major facilities including metering stations, scraper stations, community side taps, and spur lines. Not shown are individual mainline valve locations; the total number of which is estimated at twenty-two.



SYSTEM FLOW DIAGRAM
COOK INLET FAIRBANKS
16" GAS PIPELINE
FIG. 4.4

5.0 ROUTE SELECTION

5.1 General Routing

In selection of a pipeline route between the Anchorage area and the city of Fairbanks the prime consideration is a route that provides for minimum installed cost of the pipeline combined with acceptable environmental and social impacts.

The major factors affecting cost for any given size of pipe are length of line, special design requirements, difficulty of construction and the need for logistical and temporary support facilities. These two latter factors in cases of remote cross country pipelines, especially those in cold region climates, can be very significant cost items.

In the case of an Anchorage-Fairbanks pipeline there is already a major highway corridor which is not much longer than a direct cross country route. Since a cross-country route would cross rugged and difficult terrain, would require major support facilities and access roads to be built, and would bypass communities that could utilize a gas supply, the cross country option was rejected in favor of the natural transportation corridor provided by the George Parks Highway.

The highway route was evaluated in some detail to ensure that pipeline construction could be completed safely, economically and without major compromise of community and highway infrastructure along its length. This detailed examination also provides an accurate data base for development of the pipeline cost estimate.

U.S.G.S. topographical maps of the proposed route (U.S.G.S. - Topographical) are provided in Section 10 of this report.

Within the overall approach of paralleling the George Parks Highway a small number of route options or alternates have been identified.

At the start of the line a connection has to be made between the highway alignment and the source of the gas supply in the Beluga gas pipeline. A convenient point on the Beluga line both in terms of a physical connection and proximity to the highway route is at M.P. 39 on the gas line in the vicinity of Knik. At this point there are existing in-line facilities and sufficient land area for making a connection between the two gas lines together with attendant metering and compression facilities as required. The distance between Knik and the highway at Big Lake Junction is approximately seven and one half miles. The terrain although swampy in areas presents no undue construction difficulty if constructed during the winter.

At the other end of the line there are two options for the final fifty miles beyond Julius into Fairbanks.

1. Continue to follow the highway alignment between Nenana and Fairbanks. This section of the highway follows a series of ridges and is generally more choppy with tighter bends than is found on the majority of the

highway route. Termination of the mainline would be on the western extremity of Fairbanks which is not ideal if gas also has to be supplied to the east of Fairbanks such as Wainwright, North Pole and Eielson. The length of this segment, from Julius to Fairbanks, is approximately 60 miles.

2. Diverge from the highway south of Nenana at Julius and take a cross-country route northeast towards Fairbanks. The terrain is flat and swampy, crossing many streams and small rivers. Installation would have to be during the frozen winter season. The majority of this route alternate lies within the Fort Wainwright Military Reservation. Termination of the line on the southern extremity of the city is favorable both for distribution within Fairbanks and extension to the east towards Fort Wainwright, North Pole, and Eielson. The length of this alternate is approximately 48 miles.

Both alternates are viable options. However final selection should be withheld until a comprehensive evaluation of environmental and military ownership constraints has been completed at the preliminary engineering stage.

Along the remainder of the highway section there is only one area of significant concern; the Denali National Park. Although this section is tight in a construction sense the main cause of concern is the likely legal difficulty in obtaining permission to lay a natural gas pipeline within a National Park boundary. Accordingly an eight mile long bypass that keeps the pipeline entirely out of the park has been selected as an alternate.

5.2 Environmental Assessment

Initial investigations of potential alternative routes narrowed the list of alternatives to a single route paralleling the Parks Highway from the Big Lake Junction to Julius about 10 miles south of Nenana. A single general route heading north from the Beluga Gas Pipeline along the Knik Road to the Big Lake Junction along the Parks Highway was also selected because of the availability of tie-in facilities at that point of the Beluga Gas Pipeline. North of Julius the route could either follow the Parks Highway to Fairbanks or turn northeast and travel cross-country south of the Tanana River to Fairbanks. Both northern routes as well as the route south of Big Lake Junction were investigated for potential environmental impacts of routing the gas pipeline.

5.2.1 Vegetation and Wetlands

<u>Knik Road to Big Lake Junction</u>

A mosaic of vegetation types exist between the connection with the Beluga Gas Pipeline along the Knik Road and the Parks Highway at Big Lake Junction. The pipeline would cross approximately 7 miles of closed paper birch forest, closed paper birch - white spruce mixed forest, closed and open black spruce forest, and sphagnum bogs. The cleared right-of-way would be 100 feet wide in this section. Depending upon the final routing, up to 40 percent of this section could occur in wetland types which would require Section 404 permitting by the U.S. Army Corps of Engineers. Threatened or endangered plant species would not be anticipated in this area.

Though there are existing roads which would provide some construction access, most of this section would necessitate winter construction techniques. The discontinuity of the uplands and separation of uplands by wet bog areas restricts access to the uplands. Larger paper birch and white spruce trees (e.g., more than 6 inches DBH) would need to felled and cut up by hand methods; this could be completed during the summer. Smaller trees (e.g., black spruce, alder, and immature paper birch and white spruce) could be cleared by hand during summer or by hydroax during the winter after the ground was sufficiently frozen. Since construction must be done during the winter, clearing by hyroax, as appropriate, would be recommended because of its higher efficiency on smaller shrubs.

For areas with road access in this section, trees cut from the right-of-way should be salvaged for sale or provided to the public for firewood.

Once this section of the pipeline was installed a requirement to fertilize and artificially revegetate disturbed areas could be anticipated. Natural revegetation of native plant species should also be encouraged. The first 10-15 years of shrub re-growth would provide excellent moose forage. Maintenance clearing would not be required in this section.

Big Lake Junction to Susitna River

The overstory vegetation adjacent to the Parks Highway in the Big Lake Junction to Susitna River crossing section is primarily mature paper birch forest with occasional white spruce. In some areas the paper birch forest is immature or of medium age category. The understory is primarily immature paper birch, white spruce, alder, and willow. Few sphagnum bog wetlands occur in this section. The existing cleared right-of-way for the Parks Highway varies from 150-300 feet wide total, with the clearing split approximately equally on each side in most areas. Clearing for the pipeline should generally avoid removing the visual screen of forest between the Parks Highway right-of-way and the adjacent Alaska Railroad or small transmission lines paralleling the highway. In general, the left side of the road (while travelling north) would be better for placement of a pipeline within the Parks Highway right-of-way in this section. Generally, an average of about 30 feet of additional clearing of forest to widen the highway right-of-way would be required in this section to accommodate the 80 foot wide pipeline right-of-way. Most of the existing highway right-of-way would need to be hydroaxed to prepare it for construction. In most cases a screen of trees could not be left between the highway and pipeline right-of-ways in this section. Following construction, artificial revegetation of grasses in disturbed areas by hydroseeding methods would discourage attraction of moose to the highway right-of-way.

Susitna River to Little Coal Creek

The dominant overstory vegetation is mature to overly mature closed and open paper birch - white spruce mixed forest. The cleared portion of the highway right-of-way contains alder and balsam poplar shrubs which are up to 20 feet in height. The portion of the right-of-way cleared of trees varies from 5-50 feet from the toe of the highway fill. Clearing of trees to make an 80 foot wide right-of-way would need to be done by hand, while the shrubs could be hydroaxed. A few black spruce bogs occur as the highway nears Little Coal Creek. The pipeline right-of-way would be adjacent to the highway right-of-way in nearly all cases.

Little Coal Creek to Moody Bridge

Vegetation types change along the Parks Highway as the road changes elevation and exposure. North of Little Coal Creek stunted spruce are more dominant while paper birch becomes less predominant and shorter in stature. The cleared right-of-way is less than 5 feet from the toe of the road in many areas. As the road climbs higher in elevation to the north, woodland spruce and scattered balsam poplar replaces paper birch in the overstory. For an approximately 4 mile stretch of highway around Hurricane Gulch an alder shrubland replaces the overstory trees. North of Hurricane Gulch the alder shrubland grades into woodland and open white spruce forest, and eventually back to a paper birch - white spruce mixed forest. Willows, alder, and resin birch dominate the understory.

North of the Middle Fork Chulitna River the road travels for about 20 miles through a low ericaceous shrub/scrub with willows, resin birch, and an occasional bog wetland. An open white spruce forest with an increasing aspen component begins north of the Nenana Bridge No. 1 (MP 215.7) and generally continues through the Moody Bridge crossing of the Nenana River. Confined working conditions through such areas as the Nenana River Gorge may narrow the pipeline right-of-way, but generally the right-of-way would remain at 80 feet. Only at river crossings would the pipeline route diverge for a short distance away from the road. Much of the clearing in this section could be completed by hydroax, with the exception of the larger trees. Stunted and dwarf trees would lend themselves well to clearing by hydroax. Only a few bog wetlands occur in this section.

Moody Bridge to Julius

From Moody Bridge to the Healy turn-off there are few trees to clear. Occasional stands of dwarf white/black spruce occur, but the dominant vegetation is low alder and willow. Right-of-way widening in this area could be completed entirely by hydroax. North of Healy the dominant vegetation is dwarf aspen and balsam poplar, with tall willow and alder in the understory. Stands of woodland spruce also occur, often less than 15 feet in height. Occasional black spruce bogs occur within the road right-of-way. As the highway nears Julius the vegetation changes to a mosaic of immature aspen/balsam poplar/paper birch and scattered hardwood - spruce mixed forest indicative of forests with a history of fire. With the exception of the larger mature trees, most of this section could be cleared by hydroax.

Julius to Fairbanks

The cross-country route from Julius to Fairbanks traverses a mosaic of aspen, white spruce, black spruce bogs, open bog wetlands, and low shrubland communities on almost level terrain. The larger trees will be located nearer the Tanana River, where the pipeline would be routed to avoid as much of the Fort Wainwright Military Reservation as possible. Clearing of a 100 foot wide corridor in this section would introduce a visual linear feature quite distinct from the meandering Tanana River. Winter construction techniques including a snow road would minimize surface impacts of construction but the cleared right-of-way would be obvious for many years. Were the pipeline routed further east into the military reservation, the mosaic pattern of vegetation types increase which would tend to separate the right-of-way into smaller, discontinuous segments. Hand clearing could be accomplished during summer, but larger mechanized equipment such as hydroaxes could not gain access until winter when the ground was frozen. From 60-80 percent of the section may be classified as wetlands, which would be subject to CORPS Section 404 permitting. Excess fill from trenching operations may need to be hauled to adjacent uplands to satisfy CORPS requirements. A minimum of 50 or more streams and rivers would need to be crossed through this section; stream banks and shoreline vegetation of each stream and river would need to be re-established. Artificial reseeding of graminoids in disturbed areas of wetland bogs may also be required. Permafrost may be present in many areas along this section.

The alternate pipeline route from Julius to Fairbanks traverses primarily aspen forest with white spruce interspersed along sweeping curves of the Parks Highway. Moderately steep side slopes would require the pipeline to be separated from the highway at the top of slopes or toe of road fills in several locations. Dense alder understory could be cleared by hydroax following hand removal of the larger trees. The existing cleared road right-of-way is relatively narrow, and an additional 80 feet or more would need to be cleared for the adjacent pipeline right-of-way. The Tanana River at Nenana, Little Goldstream Creek, and Chena River at Fairbanks would be the only streams and rivers which would need to be crossed by this alternate route.

5.2.2 Wildlife and Fisheries

Construction and operation of the gas pipeline should have little direct adverse impact upon wildlife. Removal of trees and shrub cover would decrease habitat for birds, yet the type of vegetation to be disturbed is very common throughout southcentral and interior Alaska. The forest would be expected, over time, to regenerate itself within the portions of the pipeline right-of-way not subject to maintenance clearing for the Parks Highway right-of-way. An important issue may be the passive attraction of wintering moose to the highway right-of-way during the first 10-15 years after construction, and the inevitable vehicle - moose collisions which will follow. This potential is greatest in areas subject to existing winter concentrations of moose. One avenue of mitigation in these specific areas may be frequent (e.g., every 3-4 years) hydroax clearing to maintain shrub heights less than about 3 feet.

Another issue during construction of the pipeline will be the potential impact to anadromous and resident fish resulting from the numerous river and stream crossings. With only two exceptions, all water crossings are proposed to be buried beneath the stream channel. Disturbance of stream banks and stream beds and downstream sedimentation are sensitive issues with the Alaska Department of Fish and Game (ADF&G). It should be anticipated that special construction techniques (e.g., fluming) will be required for most stream crossings which harbor anadromous fish. It should also be anticipated that stream bank restoration, and perhaps stream bank artificial revegetation, will also be required at all crossings. ADF&G will also impose construction timing restrictions on stream crossings. ADF&G prefers the typical construction window of May 15 through July 15 during the high water period when salmon fry are outmigrating. Since it is impractical to cross all streams during this narrow window, plus the larger streams and rivers are best crossed during low water, it can be anticipated that ADF&G will work with an applicant to arrive at a mutually agreeable solution. ADF&G will probably impose more stringent construction methods if stream crossings are to be completed during more critical periods for fish.

Generally, the more sensitive streams for anadromous fish are those south of Cantwell, with the exception of the larger northern rivers such as the Nenana River, Tanana River, and Chena River. Most streams north of Cantwell would have less stringent crossing restrictions than the streams south of Cantwell.

Along the northern cross-country route from Julius to Fairbanks, numerous streams (e.g., about 40) would be crossed. Stream bank stabilization and downstream siltation will be the major issues for most of these streams. A crossing plan would be required for each stream. Because ADF&G does not have detailed information on fish in most of those streams, the pipeline project would be expected to support fish studies for most of the streams.

5.3 Geotechnical Assessment

The gas pipeline route crosses three land resource areas of Alaska including the Cook Inlet - Susitna Lowlands, the Alaska Range and the Interior Alaskan Lowlands. Each area is characterized by a unique pattern of topography, soils and permafrost conditions.

The southern portion of the route, from Knik to Hurricane (Hwy MP 174) is located in the Cook Inlet - Susitna Lowlands area. The soils here consist of glacial and alluvial deposits ranging in composition from clean gravel to gravelly, silty, sand. These deposits are commonly mantled by a layer of silty loess that occasionally contains thin bands of volcanic ash. The area is topographically low lying and is characterized by low moraines interspersed with many lakes, bogs and broad outwash plains. The poorly drained low lying areas typically contain silty peat deposits up to 10 feet thick. Permafrost is not expected to be present along this portion of the pipeline alignment. Several borrow sites for trench backfill material have been identified and developed along this portion of the George Parks Highway. The pipeline route crosses several creeks and rivers within the Cook Inlet-Susitna Lowlands area. In general these water courses tend to be relatively shallow and fast and subject to high spring runoff conditions. Scour protection such as riprap will be necessary for buried stream crossings. Geotechnical design considerations for this portion of the pipeline route include 1) the presence of shallow water tables with potential construction dewatering requirements and pipeline buoyancy forces and 2) silt and peat deposits that would have to be replaced with nonfrost susceptible material as pipeline trench backfill. A pipeline buried to a depth of 3 feet will be located in the soil active zone and will be subjected to annual freezing and thawing. It is therefore necessary to replace any potentially frost susceptible material excavated from the trench with free draining nonfrost susceptible material.

The pipeline route continues for approximately 100 miles through the Alaska Range after leaving the Cook Inlet- Susitna Lowlands. The route follows the highway alignment which parallels the Chuitna River and then passes through the Nenana River Gorge from Cantwell to Moody. The soils along this portion of the alignment consist of glacial and alluvial outwash gravel, sand and silt. This area is generally well drained with a few local boggy peat deposits up to 6 feet thick. Bedrock is present at several locations along the route at depths of 0 to 5 feet. Isolated occurrences of permafrost have been found at depths of 2.5 to 4 feet below ground surface in this area. Although ice rich permafrost has been identified in exploratory boreholes drilled along the highway alignment, the construction of the highway failed to expose significant amounts of permafrost that would require special treatment. The pipeline route crosses the Chulitna and Nenana rivers in several places. These crossings, where buried, will require scour protection such as riprap. The principle geotechnical design considerations for this portion of the pipeline route are 1) the occurrence of shallow bedrock which presents more difficult trenching conditions and 2) the presence of discontinuous ice-rich permafrost and the associated settlement potential due to ground warming.

The northern portion of the pipeline route from Windy to Fairbanks is situated in the Interior Alaskan Lowlands. The predominant soil types in this portion of the route consist of glacial and alluvial gravels with varying amounts of sand and silt overlain by up to 3 feet of silty loess and/or peat. Poorly drained soils in low lying areas have shallow (1 to 3 feet deep) ice-rich permafrost. Permafrost under higher well drained soil is either very deep or absent. The specific pipeline route will be chosen to minimize the amount of poorly drained soils through which it must pass. Consequently, significant occurrences of ice rich permafrost are not expected to impact the construction of the pipeline. The geotechnical design considerations for this portion of the pipeline route are 1) the presence of shallow water tables and the associated construction dewatering requirements and pipeline buoyancy concerns, 2) the presence of peat and silt deposits that are unsuitable for trench backfill and 3) the occurrence of permafrost and the associated settlement potential.

The preferred pipeline route passes through soil and bedrock conditions that, while requiring special designs to insure the integrity of the pipeline, are well within the realm of current cold regions engineering design and construction capabilities.

5.4 Route Catalog

As part of the route selection process the George Parks Highway section of the pipeline plus the two cross country segments at each end of the line were evaluated directly in the field and supported by examination of one-inch-to-mile mapping and Department of Highways reports.

The on-site physical evaluation was carried out by a helicopter overflight of the entire route and by a road survey along the George Parks Highway.

The results and findings of the routing surveys have been cataloged to provide a baseline summary of site specific data necessary for route optimization and development of an installation cost estimate. The catalog provides a mile-by-mile listing of significant physical features such as major rail, road and water crossings together with environmental and geotechnical details that impact the pipeline location and possible special design requirements.

Since the pipeline follows the George Parks Highway for the majority of its length a dual system of mile post reference is utilized in the tables. Hwy MP (Highway Mile Post) refers to the official MP designations along the highway while mileage of the pipeline commencing at the Beluga Pipeline connection is designated P/L MP (Pipeline Mile Post).

Table 5.4.1
Potential Gas Service Communities

P/L MP	HWY MP	Community	Population	Connection
12.7	57.5	Houston	725	Adjacent to P/L
24.2	69.0	Willow	494	Adjacent to P/L
53.9	98.7	Talkeetna	441	14 mile spur line
165.1	209.9	Cantwell	100	2 mile spur line
203.9	248.7	Healy	334	2 mile spur line
238.7	283.5	Anderson/Clear	370	6 mile spur line
--	304.5	Nenana	540	10 mile spur line
298	358.0	Fairbanks	79,814	City Gate Station

Table 5.4.2
Highway and Rail Crossings

P/L MP	Hwy MP	Crossing Type
11.7	56.5	Railroad
21.3	66.1	Railroad
46.9	91.7	Railroad
55.6	100.4	Railroad
86.7	131.5	Highway
124.3	169.1	Railroad
149.7	194.5	Railroad
156.4	201.2	Railroad
198.1	242.9	Highway
198.2	243.0	Railroad
198.3	243.1	Highway
231.4	276.2	Railroad

Table 5.4.3
Environmental Catalog

HWY MP	Description
Knik Road to MP 52.3 at Big Lake Junction	The proposed route starts at the Beluga gas pipeline at the Knik Road and proceeds approximately 7 miles due north to the Parks Highway at the Big Lake Junction. The route passes through a mosaic of vegetation types: closed and open paper birch forest, occassional white spruce, closed black spruce forest, open black spruce/sphagnum bogs, and sphagnum bogs. The final route would skirt the numerous small lakes occurring in the area. The route parallels a 100 foot wide transmission line right-of-way. The route crosses Lucile Creek about 1.25 miles south of the Big Lake Junction and Little Meadow Creek at the Big Lake Junction, both of which are salmon spawning streams. Road access would be available at distinct locations along this portion of the line, but winter construction techniques would be required over most of the area because the uplands are separated by numerous low-lying bogs. Other than winter construction methods, no particularly sensitive environmental issues would be raised in this section. There are numerous parcels of private property as the route nears the Big Lake area, and the final routing would need to take this into consideration.
MP 52.3 - 56.3	ROW cleared from about 100' on right side; most shrubs about 4-6' tall composed of aspen, balsam poplar, and paper birch. ROW may need to be cleared wider as ROW on right side is about 75' from ditch line on road. Varies to 150-200' clearing in places. Hasn't been hydroaxed for 4-5 years, no recent evidence of hydroaxing. Pipeline would cross some driveways. Right or left side of the road would be O.K. To widen ROW would require clearing of mostly paper birch with basal diameters 3-8" DBH, some alder/willow understory, some white spruce. Railroad crossing at MP 56.3
MP 56.3 - 57.1	Starting at MP 56.5 is Houston Business District. T-line starts on left side of road about 200 ft. from edge of road, narrow ROW clearing for t-line. Little Susitna River at MP 57.1. Could cross on either side here. To hang pipe from bridge would restrict access under the bridge.
MP 57.1 - 67.3	Small stream at MP 58.0. ROW narrowing, but still varies from 50-60 ft. from edge of road. T-line on right side of road at MP 59.0, about 200' or more from edge of road with a narrow ROW. The railroad is on

HWY MP	Description
	left side of road about 300' from edge of road at about MP 59.5. Small stream at about MP 60.0. Occasional spruce, but mostly medium age paper birch with about 8" DBH and with scattered alder/paper birch understory. From MP 52.3 to at least MP 61.0 mostly gravel substrate. If ROW is widened, mostly medium age paper birch trees would need to be cleared. ROW about 50' from edge of road in this area. Pipeline could be put on either side. Crosses a larger t-line ROW at MP 61.5. No bogs to cross through MP 66.0. Railroad crossing, either side of road O.K. at MP 66.5. Also Nancy Lake turnoffs at MP 66.6 and MP 67.3.
MP 67.3 - 74.7	About MP 69.0, cleared ROW has narrowed to about 50' from edge of the road on either side. City of Willow at MP 69.0. In general, right side of road is better as there is more development on the left side. Recent hydroaxing at Willow Creek has pushed the cleared ROW back to about 100' on each side of the road. Crossing at Willow Creek (MP 71.4) either should be made upstream of the riprap or on the left side of the road. Starting at MP 72.0 hydroax clearing within ROW to about 60 ft. from the road. About 20' of trees separate the ROW clearing and a small t-line ROW paralleling the road on the right side. Widening the ROW would make the t-line more visible from the road. There are more private drives on the right side of the road in this area.
MP 74.7 - 83.2	At Little Willow Creek (MP 74.7) the crossing should be made upstream (right side) of the riprap (about 300' upstream) or immediately downstream (left side) of the bridge. T-line ROW still on the right side of the road. Starting to enter more mature mixed forest (MP 76.0) with more spruce, trees 40-50' tall. Starting to encounter a few damp bogs. Obvious sign of moose browsing at MP 77.0, stems broken off on right side of road. Frequent hydroaxing of shrubs is necessary to discourage attraction of moose to the road and pipeline ROW. Mostly mature paper birch forest, scattered white spruce, trees about 60' tall. Pipeline could be on either side in this section. T-line ROW still on right side, with a 70-80' forested strip between it and the road ROW. Several streams and small bog areas at MP 81.0-82.0 near 196 Mile Creek and 197 Mile Creek.

HWY MP	Description
MP 83.2 - 88.6	Kashwitna River (MP 83.2) should be crossed on left about 100-200' downstream or upstream of riprap several hundred feet if crossed on the right. Crossing on the left is preferable. A bog on the right could be avoided by crossing on the left Small stream at MP 85.0, 6' wide willow bottomland. MP 86.0-87.0 t-line ROW still on right with screening forest mostly intact.
MP 88.6 - 96.6	Sheep Creek (MP 88.6) is riprapped quite a distance upstream, plus ponds on right side, plus t-line ROW on right side. Recommend crossing on left side (downstream). Railroad crossing at MP 91.7 can be crossed on either side. At MP 92.0 there is a small bog and possibly a small stream to cross. Goose Creek at MP 93.5 can be crossed on either side.
MP 96.6 - 104.3	Montana Creek (MP 96.6) has a high (30') riprap berm and ponds on the right (upstream side). Recommend crossing on left (downstream) side. North of Montana Creek the pipeline could be run on either side. The ROW on right is wider because of the paralleling t-line ROW with screening forest. Road ROW cleared is about 50' wide from the ditch line. Left side of the road would avoid the Talkeetna turnoff plus the private gas-stops on the right side. Small stream just north of the Talkeetna turnoff would need to be crossed. Railroad crossing at MP 100.4 could be made on either side, but left side is less congested with wires. Bog area and stream to cross at MP 101.2.
MP 104.3 - 132.8	Cross Susitna River on left (downstream) side of road. A slough/stream to cross at point "D" at toe of road. Recommend being on the left side of the road on approach, make the river crossing, and then stay on the left side of the road rather than crossing back and forth. After Big Bend get into mature mixed spruce-paper birch forest. Several small streams at MP 106.0, each about 4' wide. Gravel substrate predominant. Cleared ROW 50-70' wide. T-line ROW on right side behind screen of trees. Recommend pipeline on left side. Very few bog areas through about MP 110.0. Small stream at MP 111.5 about 2' wide. Need to minimize attraction of moose to a widened ROW; hydroax every 5-8 years. MP 113.0 has birch and poplar saplings in ROW, t-line (2 conductors) ROW continuing on the right side behind a 30-40' screen of trees. Recommend crossing Petersville Road (MP 114.9) on left side, away from buildings. Trapper Creek (MP

HWY MP	Description
	115.6) can be crossed on either side. Recommend left side at MP 117.0. T-line stopped at Petersville Road. MP 117.0-118.0 ROW cleared to about 80' each side. At MP 118.0 crews were installing a culvert for a small stream. MP 119.5 ponded area. Logging on right side at MP 120.0. Overly mature mixed paper birch-spruce forest, 70' tall spruce, holes in canopy. ROW grown up to 25-30' tall. Small stream at MP 120.0. Pipeline on either side of road O.K. in this area. Solid, dry ground. Alder and poplar in understory. Small stream 6' wide at MP 124.5. Small stream at MP 126.0. Pipeline on either side O.K. Stream 10-15' wide at MP 128.5, either side O.K. Petersville Road north to Chulitna River may require very little clearing.
MP 132.8 - 163.2	Chulitna River should be crossed on the right (downstream) side of the road, where banks are more suitable plus less scour potential. Small airstrip just north of Chulitna River on the left side of road, indicating private property. Now in more undulating terrain, rising to the northeast. Mature paper birch-spruce mixed forest to MP 136.0. Troublesome Creek (MP 137.3) is small and has a campground on left side of road. Could be crossed on either side, however, crossing on the left side (downstream) of bridge would pass through the campground parking lot. Past flooding evident. ROW about 50' wide each side from toe of road, overgrown balsam poplar and alder to 20' in height. Overly mature paper birch-spruce mixed forest adjacent to ROW. Small stream 6-7' wide at MP 140.0; could cross on either side. Gravel pit on left side road at MP 140.3. Byers Creek bridge at MP 144.0, about 30' wide. Can be crossed on either side. Overly mature mixed forest extends to Byers Lake turn-off. Cleared ROW has narrowed to about 5' beyond the toe of road, with a secondary layer extending another 40' to the forest. Alder and balsam poplar shrubs in ROW. Pipeline could be on either side of the road. Mature mixed forest from about MP 149.0 through MP 155.0, heavier on the spruce. Relatively dense balsam poplar and alder shrubs in the ROW, 12-15' in height. Substrate gravelly. About MP 155.0 as climb higher getting into some bogs surrounded by black spruce and interspersed with alder understory to 15' in height, losing some of the paper birch with a more open canopy and overall shorter trees. Pipeline O.K. on either side. Still in an open canopy mixed forest to MP 158.0 with occasional bogs with culverts. Pipeline O.K. on either side. Horseshoe Creek (MP 159.8) about 10' wide, culverted through road. Crossing either side O.K. Little Coal

HWY MP	Description
	Creek at MP 163.2 could be crossed on the right (upstream) side by angling upstream slightly and down to the creek to avoid the exposed bedrock beneath and to the left (downstream) side of the bridge.
MP 163.2-194.5	At MP 165.0 gaining a greater component of stunted white spruce and paper birch becoming less predominant and shorter in stature. The cleared ROW is not much wider than the toe of the road. Gravels predominant, shallow topsoil. Small stream at MP 167.0. At MP 168.0 in and out of mixed forest, more spruce. Railroad crossing at MP 169.0, crossing O.K. on either side. Leaving Denali State Park at MP 169.0. Alder to 6-7' in height is primary shrub in ROW at MP 170.0, ROW about 50' wide each side. Basically paper birch is no longer a component of forest. Now into woodland spruce 30-40' in height, balsam poplar also dominant, only occasional paper birch. As climb in elevation to MP 173.0 changes into primarily a tall alder shrubland with only occasional trees. Start dropping back down again after MP 173.0 and by MP 173.5 begin to pick up a few spruce again but remains a tall alder shrubland to Hurricane Gulch at MP 174.0. Bridging of Hurricane Gulch required. By MP 175.0 into a woodland spruce forest with some paper birch. ROW clearing of only occasional spruce trees and hydroax clearing of alder required in this area. Small culverted stream at MP 176.6, could be crossed on either side. Honolulu Creek at MP 178.1 could be crossed on either side, but if crossed on the right (upstream) side should move about 30' upstream of the bridge to avoid riprap. MP 179.0-183.0 woodland - open white spruce forest, trees to 35' in height, dense understory. Gravel pit on right at MP 183.0. East Fork Chulitna River (MP 185.1) could be crossed on either side. From MP 185.0 - 187.0 going up through a valley with mixed paper birch-spruce forest. By MP 188.0 back into woodland spruce forest with alder and resin birch understory. At MP 193.0 scattered trees cleared back to about 80' each side from toe of road, to 30' in height. Willows, alder, and resin birch in understory. Railroad crossing at MP 194.3 and Middle Fork Chulitna River at MP 194.5 both could be crossed on either side.
MP 194.5 - 215.7	North of MP 194.5 to MP 215.0 vegetation changes to low ericaceous shrub/scrub with willows and resin birch, only an occasional bog. Leave Mat-Su Borough about MP 202.2. Railroad crossing at MP 203.1 could

HWY MP	Description
	be crossed on either side. Pass Creek at MP 208.0 could be crossed on either side. Jack River at MP 209.5 could be crossed on either side, but the left (downstream) side is drier. Constricted area near MP 214.0 might better be crossed on the right (uphill) side if stayed adjacent to the road. Left (downstream) side crossing at Nenana Bridge No. 1 at MP 215.7.
MP 215.7 - 238.0	Recommend crossing back to right side of road just north of Nenana Bridge No. 1 (MP 215.7) and remain on right through MP 219.0 to stay out of the Nenana River. From MP 215.7 into a woodland spruce forest with alder/willow understory. From MP 220.0 into an open spruce forest with willow understory. Spruce only 10-30' in height. ROW only cleared to toe of road, but a hydroax would easily clear these trees. Carlo Creek at MP 224.0 could be crossed on either side. North of Carlo Creek is open spruce forest with increasing aspen component, all 6-8' DBH and 20-30' in height, gravel substrate. Concur with alternate crossing at Nenana Bridge No. 2 (MP 231.3). Private property in this area. From MP 231.3 north primarily woodland dwarf spruce forest. Railroad crossing at MP 235.1 could be made on either side. From MP 235.1 into an aspen/balsam poplar-spruce mixed forest to 20-25' in height with willow understory. Railroad crossing at MP 236.7. Riley Creek at MP 237.2 could easily be crossed on the right (downstream) side. This would avoid crossing both the Parks Highway and the Denali National Park turn-off road. However, the alternate route crossing on the left (downstream) side of the bridge at Nenana River Bridge No. 3 (MP 238.0) is best because of the steep north bank.
MP 238.0 - 272.0	Pipeline should be on right side of the road north of MP 238.0. Crossings of Ice Worm Gulch (MP 240.1), Hornet Creek (MP 240.2), Fox Creek (MP 241.2), and Dragonfly Creek (MP 242.4) all can be easily made on the right (upstream) side of the road; all these streams were nearly dry at this time. Concur with alternate crossing of Nenana River at Moody Bridge (MP 242.9), which appears to be outside the boundary of Denali National Park. Crossing could also be made on right by suspension bridge or by hanging from Moody Bridge. Vegetation in this area is low alder/willow with scattered stands of dwarf spruce. Bison Creek

HWY MP	Description
	(MP 243.0) had virtually no water in it, and could be crossed on either side. Bison Gulch (MP 243.6) could be crossed on the right without any problem. From MP 243.6 on north there are few trees beside the road. The ROW would need to be widened by hydroax. Gravel substrate. Antler Creek (MP 244.6) has very little running water, and could be crossed on either side equally well. Dwarf aspen and woodland spruce starting about MP 248.0. Healy Roadhouse at MP 245.5. Healy turnoff at MP 248.8, dwarf aspen, willows, balsam poplar in understory of ROW, woodland to open spruce 20-25' in height. Dry Creek No. 1 was dry. Dry Creek No. 2 was also dry. These streams can run high after rain storms. Crossings could be made almost anywhere on the right side of either creek. Panguinque Creek (MP 252.5) could be crossed on either side. Willows to 8' in ROW in this area, small aspen, woodland spruce, also large aspen. Slate Creek crossing with virtually no water at MP 257.9. From MP 258.0 is 8-10' tall willows, alders, and aspen with occasional spruce trees to 12' in height. All trees appear dense and stunted in this area, with maximum heights to about 25'. About MP 261.0 appear to be getting into silts and leaving gravels. About MP 262.0 picking up some spindly, scattered paper birch trees. Fires in the past have affected the heterogeneous distribution of forest in this area. Several private parcels on right side of road around MP 268.0. In this area black spruce with black spruce bogs. June Creek to cross at MP 269.0. Bear Creek (MP 269.3) has virtually no water and could be crossed on either side of the road.
<u>MP 272.0 - 286.5</u>	From MP 272.0 starting to get back into discontinuous stands of mature to immature paper birch, balsam, poplar, aspen and scattered spruce mixed forest. Gravel substrate. Nenana River Rex Bridge at MP 275.8 could be crossed on either side. Railroad crossing at MP 276.3 could be made on either side. Most of this area could be cleared by hydroax. Very level terrain. Pipeline leaves road at MP 286.5.
<u>MP 286.5-Fairbanks Via Cross-Country Route</u>	Mixture of taller aspen, medium spruce, low black spruce, open bogs, interspersed with low aspen, willow and paper birch. Very flat. Looks like excellent moose habitat, though sign is minimal. Less evidence of recent fires. Much of the clearing could be by

HWY MP	Description
	hydroax with the exception of the larger trees. This area would cross numerous streams, and winter construction techniques would need to be employed throughout the length. Crossing of Tanana River at Fairbanks required.
MP 286.5-Fairbanks Via Parks Highway	Primarily aspen forest with white spruce interspersed, particularly north of Nenana. Bridge over Fish Creek at MP 296.7, cross on either side. Tanana River Bridge (MP 305.1) at Nenana. Railroad crossing at MP 308.8. Bridge over Little Goldstream Creek at MP 314.8. Chena River Bridge at MP 357.5. The Nenana to Fairbanks portion of the highway follows sweeping curves over loessal hills. The cleared ROW is generally quite narrow. Divergence from the highway may be required in some areas of steeper side slopes. Highway access would be an advantage.

Table 5.4.4
Geotechnical Catalog

HWY MP	Description
Knik to MP 52.3	Glacial deposits of gravel, sand and silt overlain by alluvial outwash gravel and sand. Occasional thin loess and silty peaty deposits up to 10 feet. The water table is at or near the ground surface. This area is classified as generally free of permafrost.
MP 52.3 to MP 71.4 (Big Lake to Willow)	Glacial deposits of gravel and silty gravel. Peat deposits are very limited in extent. Several Non Frost Suceptible (NFS) material borrow sites identified. Generally free of permafrost.
MP 71.4 to MP 104.3 (Willow to Susitna R.)	As above with occasional clay lake deposits. A veneer of loess is common. Several NFS material borrow sites identified. The water table is at or near ground surface in several places. Depth of frost penetration is up to 6 feet. Generally free of permafrost.
MP 104.3 to MP 132.8 (Susitna R. to Chulitna R.)	Glacial outwash composed of gravel, sand and locally silty gravel. Thin loess deposits blanket the area. Several NFS material borrow sites available and/or developed. Shallow bedrock occurs from MP 131 to MP 132.8.
MP 132.8 to MP 174 (Chulitna R. to Hurricane Gulch)	Glacial outwash gravel, sand and silt overlain by alluvial gravel and silt. The water table is several feet below the ground surface. Loess deposits up to 3 feet thick are common. Shallow bedrock identified at MP 143, MP 156.5 and MP 164.2. Borrow sites for NFS material and riprap have been identified. This area is described as generally underlain by discontinuous permafrost.
MP 174 to MP 201.3 (Hurricane Gulch to summit)	Glacial outwash gravel and silt. Shallow bedrock identified at MP 186 to MP 187. Swampy peat deposit at MP 190. Steep terrain at Hurricane Gulch.
MP 201.3 to MP 209.9 (Summit to Cantwell)	Glacial gravel and sandy gravel with alluvial channel gravel and sand. Local peat and loess deposits. Permafrost is common at depths of 2.5 to 4 feet below ground surface from MP 203 to MP 204. Bedrock is at depths of 1.5 to 5.5 feet from MP 204 to MP 204.5
MP 209.9 to MP 232.2 (Cantwell to Nenana R.)	Glacial gravel and sandy gravel with alluvial gravel and sand. Permafrost is described as generally discontinuous. Shallow bedrock was identified at MP 218 and MP 219.

HWY MP	Description
MP 232.2 to MP 238 (Nenana R. to McKinley Park)	Glacial gravel and sand with occasional silt and alluvial gravel, sand and silty clay. Permafrost has been identified at shallow depths. The terrain is rolling to hummocky and local deposits of silt and peat up to 6 feet thick are present in low lying poorly draining areas.
MP 238 to MP 276 (McKinley Park to Nenana R. at Rex)	Glacial gravel, sand and alluvial sand gravel and silt. Bedrock outcrops from MP 238 to MP 243. The terrain is steep at the river crossings. Permafrost is generally discontinuous. At MP 252 bedrock is overlain by up to 4 feet of sandy silt.
MP 276 to MP 295 (Nenana R. at Rex to Julius)	Glacial gravel and alluvial gravel, sand and silt. Generally underlain by isolated masses of permafrost.
MP 295 Cross County to Fairbanks (Julius to Fairbanks)	Silty gravel alluvium deposits commonly overlain by up to 3 feet of peat and/or loess. Poorly drained soils in low lying areas have shallow (1 to 3 feet deep) ice-rich permafrost. Permafrost under higher well drained soil is either very deep or absent.

6.0 CONCEPTUAL ENGINEERING AND DESIGN

6.1 Mainline Design

The proposed gas transmission line between its connection point to the Beluga pipeline and its termination at a city gate station at Fairbanks is approximately 298 miles in length. System analysis (see Section 4) has identified the optimum pipeline diameter as 16 inch for the baseline case.

For 80% of the route the pipeline will be installed within the easement of the Fairbanks Highway between the communities of Willow (Hwy MP 53) and Julius (Hwy MP 295).

The initial 7 miles from the Beluga pipeline to Willow is across undulating lightly timbered country interspersed with wet open areas. The final 48 miles from Julius to Fairbanks crosses open flat country traversed by many meandering streams and small rivers creating considerable areas of open bogs. Both these sections would be best installed using winter working techniques and will require the implementation of bouyancy control measures.

The design of the pipeline would be in accordance with the provisions of the Code of Federal Regulations, 49, Transportation Part 192.

The high pressure transmission system will be constructed of API 5L-X60 carbon steel pipe. Isolation valves will be provided at each major river crossing and at selected intervals along the line according to the area classification of each section of the pipeline. A number of communities are passed by the pipeline and it is anticipated that some of these communities will be provided with gas service.

The following communities have been determined to be of sufficient size to make gas connection feasible.

City	Population	Hwy M.P.
Houston	725	57.5
Willow	494	69.0
Talkeetna	441	98.7
Cantwell	100	209.9
Healy	334	248.7
Anderson/Clear	370	283.5
Nenana	540	304.5

Significant design features of the line include the following:

- o Class of Construction
- o Supply and Terminal Facilities
  - Metering
  - Pressure Regulation
- o Scraper Stations

- River and Stream Crossings
- Highway and Railroad Crossings
- Block Valve Stations
- Special Geotechnical Considerations

6.1.1 Class of Construction

The following table provides the class definitions based on human occupancy density and the required design factor and mainline valve spacing. In addition the calculated pipewall thickness based on API-5L X60, 16" pipeline with a maximum allowable operating pressure (MAOP) of 1440 psi has been determined.

Class	Design Factor	Valve Spacing (miles)	Pipe W.T. (inch)
I	0.72	20	0.281
II	0.60	15	0.344
III	0.50	8	0.406
IV	0.40	5	0.500

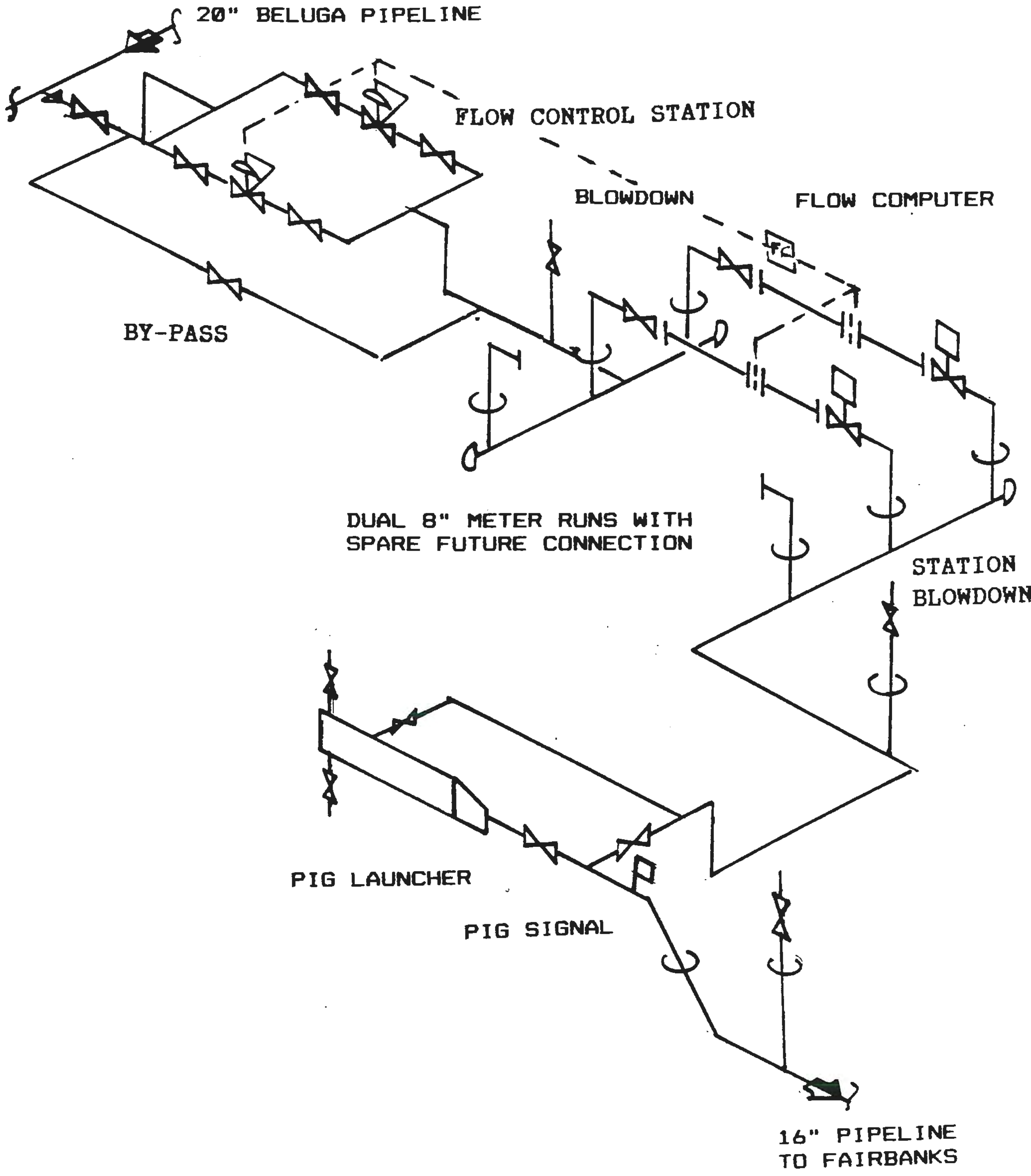
As already noted the majority of the pipeline lies adjacent to the Highway and would fall under a Class II classification (0.60 design factor) but some segments parallel to the highway and passing through small towns with a Class II density would require a 0.50 design factor. The initial and final cross country sections lie within Class I. No part of the proposed mainline route would fall within Class IV. For the purposes of the cost estimate the following quantities have been assumed.

Length (miles)	Pipe Size (inch)
63	16 x 0.281
211	16 x 0.344
24	16 x 0.406

6.1.2 Terminal Facilities

Gas supply to the Fairbanks pipeline would be obtained from the Beluga pipeline system at approximately MP 39 on that system. A metering station will be installed at this location to facilitate the custody transfer of the gas from one system to the other.

A typical meter station schematic capable of handling a flowrate of 70 mmscfd with expansion capabilities up to 95 mmscfd is shown in Figure 6.1.1.



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STONE & WEBSTER ENGINEERING CORPORATI

CUSTODY TRANSFER STATION
AT BELUGA CONNECTION

The metering and recording equipment will be housed in an insulated pre-engineered type steel building equipped with catalytic type space heaters and with space for normal operation and maintenance activities. The station would be designed for unattended operation with remote monitoring of key functions.

The metering unit can be field fabricated or supplied as a prepackaged skid complete with either mechanical and/or electronic data recording system. The gas company would have the option of manual collection of data logs or remote readout at a central dispatch center.

The meter station will consist of two 8" senior type orifice meter runs off a common header. A spare connection will be incorporated on the header for a future meter run should the system be expanded. The meter runs will be equipped with power operators on the downstream valves. The power operators will be designed with automatic run switching controls to ensure that the pressure differentials across the orifice plate operate within the 40-160 inch water column range. The meter station will also incorporate the use of a Real Time Measurement (flow computer) for instant calculations of flow for control purposes. Flow and temperature recorders with automatic chart changers will also be installed.

The equipment will be capable of providing totalized flow at standard pressure and temperature bases with input for corrections to specific gravity, thermal content, supercompressibility and changes to beta ratios. Totalized flow and pressure conditions at the station will be telemetered to the central control room.

6.1.3 Scraper Stations

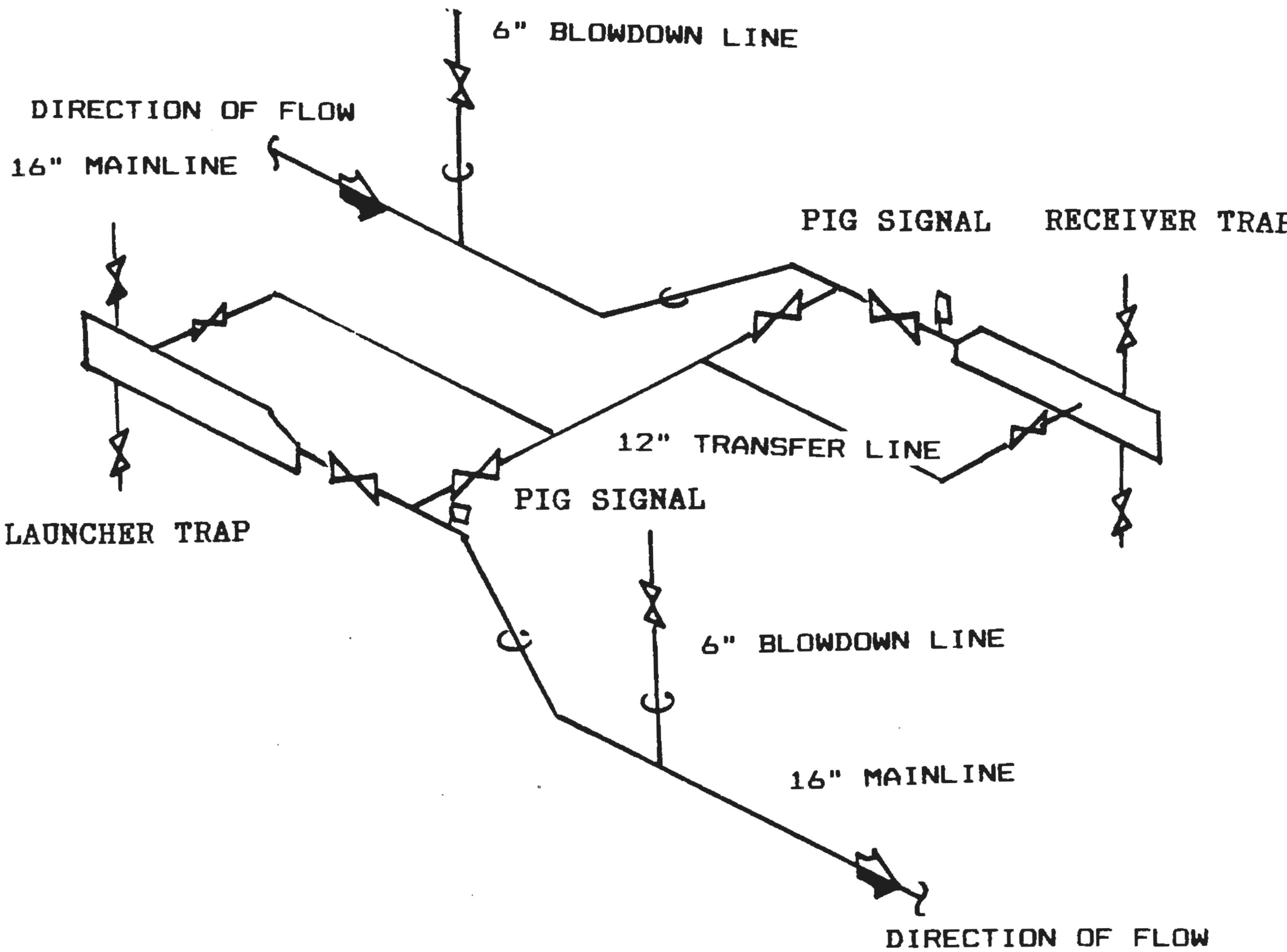
Scraper stations will be installed at regular intervals along the pipeline. These stations facilitate the pigging of the pipeline during normal maintenance of the pipeline for internal cleaning and removal of any gas liquids that have condensed in the line. It is expected that future Department of Transportation regulations will require pipelines to be capable of handling "intelligent inspection pigs" used for pipe wall thickness, deformation and corrosion surveys. The scraper traps will be designed to handle these types of inspection devices.

Scraper station spacing has been selected at approximately 80 miles which results in three full scraper stations together with a launcher scraper trap at the Beluga connection and receiving scraper trap at Fairbanks.

A typical station schematic is shown in Fig 6.1.2.

6.1.4 Road and Railroad Crossing

The pipeline route as it parallels the main highway will cross the Alaska Railroad 9 times and will cross the George Parks highway 3 times in order to avoid constricted areas or make the optimum approach to stream and river crossings.



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STONE & WEBSTER ENGINEERING CORPORATIO

TYPICAL INTERMEDIATE SCRAPE
RECEIVER & LAUNCHING
FACILITIES

All railroad crossings will be carried out by means of a large diameter steel casing sleeve first installed under the railroad embankment and through which the gas pipeline is subsequently threaded. Road crossings will be installed either cased or uncased dependent on local and state requirements. It has been assumed that all crossing of the Fairbanks-Anchorage highway will be cased.

Typcial details of a cased crossing is shown in Fig 6.1.3.

6.1.5 Mainline Valves

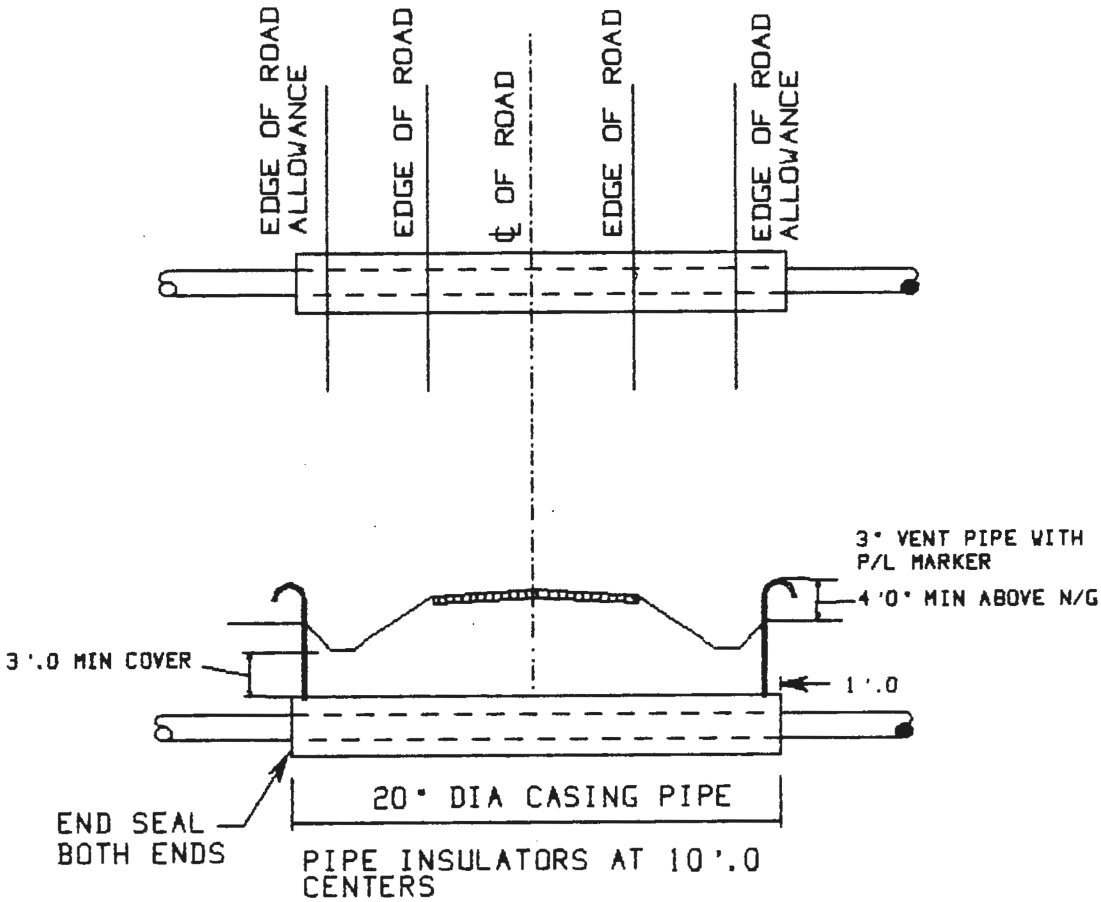
In conformance with the DOT code mainline block valves will be installed in the pipeline at the designated spacing (20 miles for Class I and 15 miles for Class II). Additionally mainline valves will be installed at the scraper stations and at any major crossings where the future ability to isolate the crossing is deemed advisable.

Valves fitted with line break monitoring and shut-in capability will be installed at several locations along the pipeline system. These line break operators will shut the pipeline down in the event of a major failure such as a line rupture.

All valves in the mainline will be 16" of the through-conduit ball type with a 1440 psig working pressure. It is estimated that 22 mainline valves would be required not including the full line size valves associated with the scraper station assemblies and terminal facilities.

Mainline block valves will be installed underground with extended valve stems and blowdown risers.

A schematic of a standard block valve station is provided in Fig. 6.1.4.



NOTES

1) CROSSING TO BE INSTALLED AT 90 DEG TO ROAD OR AS CLOSE AS POSSIBLE
2) CASING TO BE INSTALLED BY BORING METHOD
3) CASING SHALL BE DESIGNED TO WITHSTAND SUPERIMPOSED LOADS.

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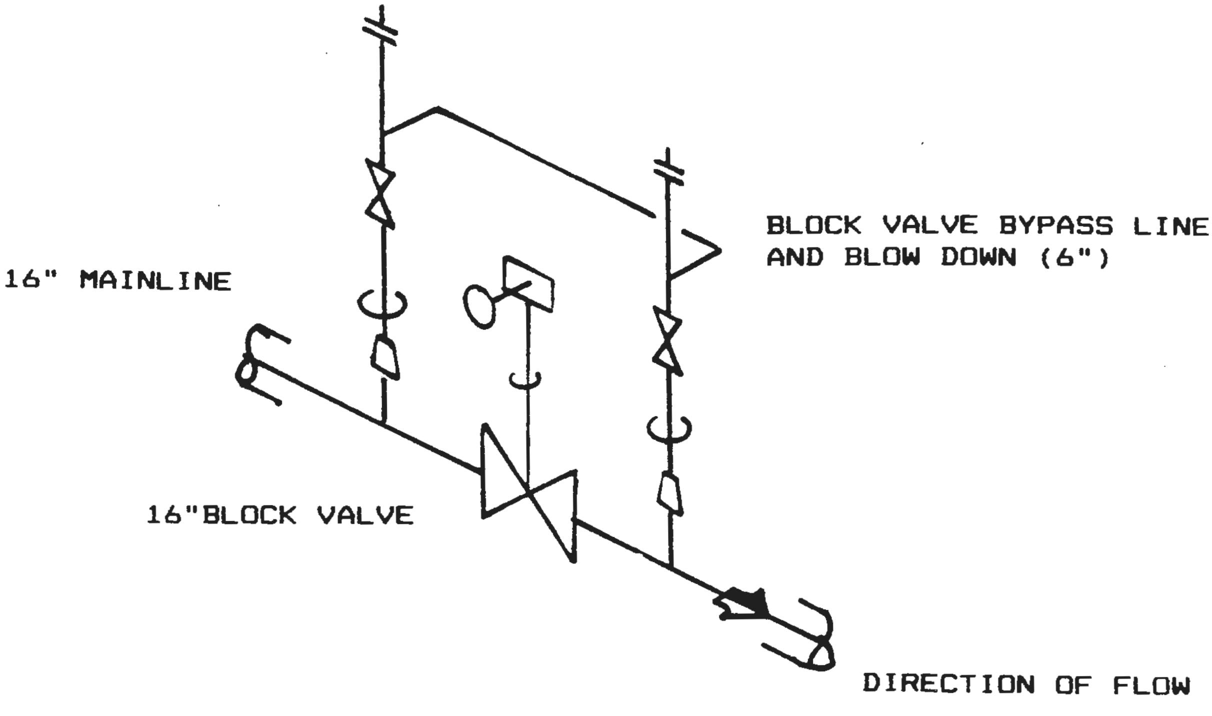
STONE & WEBSTER ENGINEERING CORPORATI

TYPICAL CASED HIGHWAY CROSSI



				SCALE	STONE & WEBSTER ENGINEERING CORPORATION
				DESIGN	TYPICAL MAINLINE BLOCK VALVE ASSEMLEY
				CHECKED	
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6.1.6 Cathodic Protection

The pipeline system will be cathodically protected using an impressed current system. The spacing of the CP system connection points will be determined following a soil resistivity survey and selection of the coating for the pipeline. Cathodic protection test points would be installed at regular intervals and where possible combined with pipeline mile markers or crossing markers. Power for the CP system will be obtained from the nearest available power source.

6.1.7 Geotechnical Considerations of Permafrost along Road Alignment

A limited amount of special treatment for permafrost conditions will be required along the portion of the pipeline alignment that parallels the Parks Highway. A study of the construction records for the highway reveals only local occurrences of permafrost.

Two types of permafrost, dry and ice-rich, may be encountered during construction. These two types of permafrost require different treatments.

Treatment for both types of permafrost will require the replacement of any fine grained or peat rich soil excavated with a nonfrost suceptible (NFS) material. Additionally, treatment of ice-rich permafrost will include over excavation to provide additional insulation of the unexcavated permafrost from the pipeline to prevent excessive settlement.

6.1.8 Permafrost along the Cross Country Portion of the Alignment

Ice-rich permafrost in poorly drained areas is common along the northern portion of the pipeline alignment. The route will be selected to minimize the amount of special treatment required. Treatment for ice-rich permafrost will include overexcavation of the trench and replacement of fine grained and peat rich soils with an NFS backfill material.

6.2 Distribution Design

The gas distribution infrastructure for Fairbanks will be composed of the following components, a town border station (TBS) which connects to the high pressure gas transmission line and meters/regulates all gas entering the system, district regulating stations (DRS) which provide the primary pressure cut from high pressure to the medium pressure distribution network of typically 4 inch and smaller pipe, and finally the individual service connections to each customer at which point the final medium pressure to low pressure regulation is performed.

The distribution system would consist of a medium pressure distribution piping which operates in the range of 30 to 100 psig depending on system requirements.

Polyethylene materials are typically used in distribution piping systems because of their capacity to undergo considerable deformation before suffering structural damage, the ability to resist corrosion, wear resistance and the ease of installation.

The design of the distribution system would be in accordance with the provisions of the Code of Federal Regulations, 49, Transportation Part 192.

Significant design features of the system include the following:

- o Town Border Stations (TBS)
- o District Regulating Stations (DRS)
  - Metering facilities
  - Pressure Limiting Devices
- o Piping Infrastructure
  - Main piping
  - Spurs and lateral piping
  - Service connections
  - Distribution line valves

6.2.1 Town Border Station

The Town Border Station (TBS) receives gas from the transmission pipeline, reduces the gas to the distribution pressure and meters the amount of gas passing through it. In the case of the Fairbanks system all pressure would be limited to 550 psig.

This gas metering system provides a cross check on the volumes taken from the pipeline system by the community takeoffs as well as providing a system balance for an overall leak detection management program. Delivery of gas to the city of Fairbanks will additionally require the installation of a pressure reduction and control facility. The pressure in the mainline would be reduced to a lower pressure (550 psi) suitable for the local distribution system. The gas will have to be preheated using an indirect heater system prior to the pressure reducing station to prevent the possibility of system freeze-up.

The pressure reducing and control system would comprise a two stage system with a parallel reducing system for safety and operating requirements. Pressure relief and a blow down system will protect the distribution system from the possibility of over pressurization. The gas would be odorized prior to delivery into the gas distribution network.

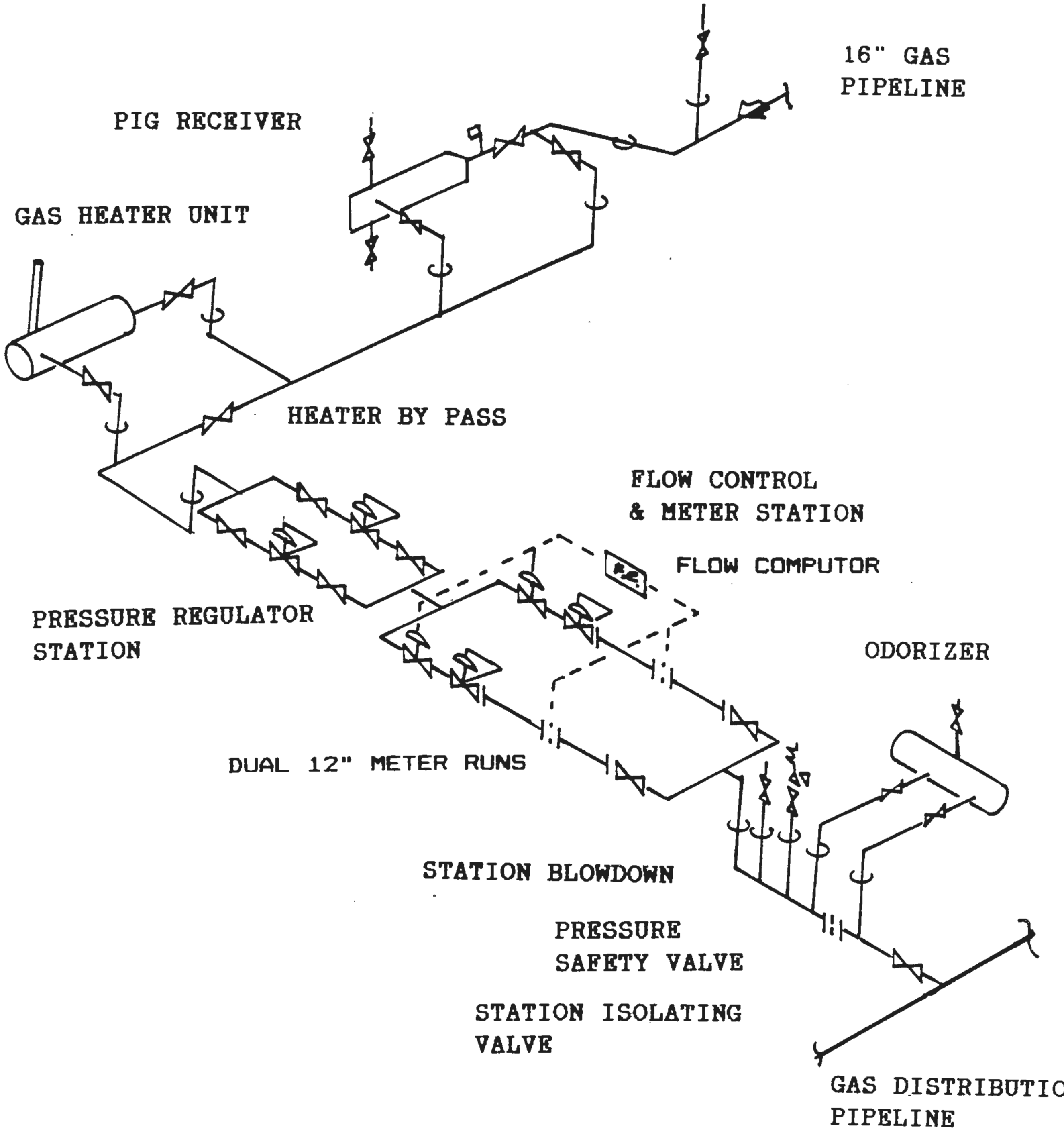
A typical layout of a city gate metering and regulation station applicable to gas supply for Fairbanks is shown in Fig. 6.2.1.

The metering, and regulation equipment will be installed within insulated pre-engineered steel building(s) adjacent to the mainline scraper trap.

For the communities along the George Parks Highway which can potentially be provided with gas service a smaller Town Border Station with an additional level of regulation could be combined in a single facility. A typically schematic of such a facility is presented in Figure 6.2.2.

6.2.2 District Regulating Station

The Distribution Regulating Station (DRS) receives gas from the 550 psig intermediate pressure distribution main and regulates the pressure to the 80 psig medium pressure system through use of a two stage pressure regulator. Depending on station gas throughput, a large station such as



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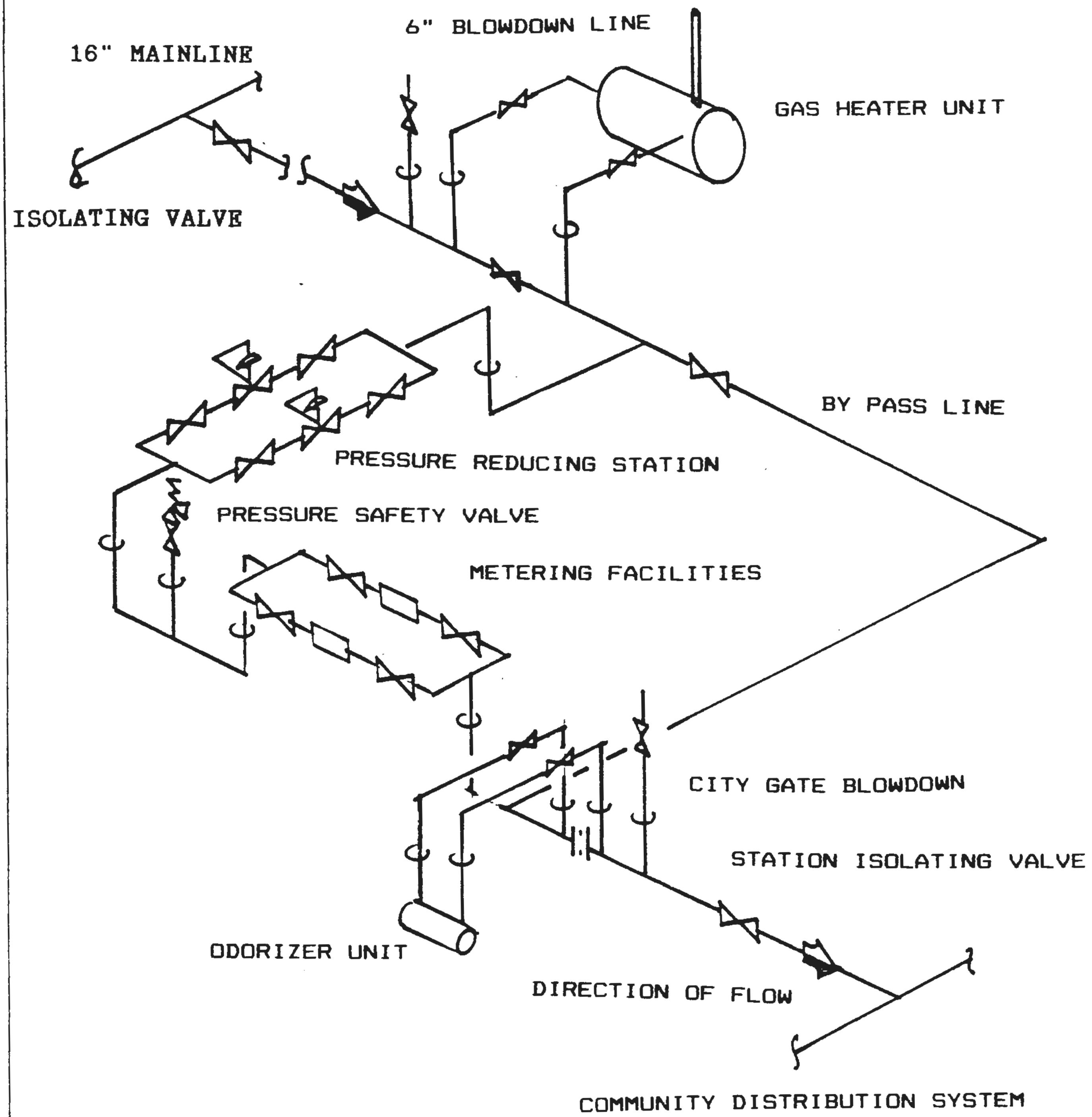
NO.	REVISION DESCRIPTION	BY	DATE	DRAWN	
CERT. FOR FAB.	CERT. FOR CONST.	APPROVED		CHECKED	



				SCALE	STONE & WEBSTER ENGINEERING CORPORATION
				DESIGN	TYPICAL COMMUNITY GATE STATION
				CHECKED	
NO	REVISION DESCRIPTION	BY	DATE	DRAWN	
CERT FOR FAB	CERT FOR CONST	APPROVED		CHECKED	

that servicing the city of Fairbanks would have two regulator runs in parallel, with one in service and one acting as standby. A typical station piping schematic is presented in Figure 6.2.3.

Downstream heat exchangers will be required to raise the temperature of the gas cooled by the Joule Thompson effect which resulted from the pressure drop through the regulator valves. For a 550 psig to 80 psig pressure cut the expected temperature drop could be as much as 26 degF.

6.2.3 Piping Infrastructure

Distribution mains in the the high pressure system would utilize carbon steel pipe and would transport gas throughout the service area with main branches to local Distribution Regulating Stations.

Downstream of the DRS, gas will be distributed through 6",4" and 2" NPS pipe to spurs and laterals in the service area. Each service area is provided with valves capable of isolating the area in the event of gas leakage, pipe repairs or service extensions of distribution pipe to previously unserved areas. To improve the reliability of gas supply, and minimize consumer disruption, pipe would be linked in an interconnected matrix such that gas supply can be rerouted around blocked off areas.

Service line size is typically 1.5" polyethylene NPS for commercial connections and 3/4" NPS for residential connections depending on consumer gas volume requirements. The gas will be metered and finally reduced to a pressure of approximately 6" of water column by an individual regulator at the building or structure where the gas will be used.

A typical polyethylene pipe commonly used for gas distribution would be Driscopipe SDR 11 polyethylene pipe ranging in size from NPS 6" down through NPS 3/4". All connections above NPS 3/4" are joined by the butt fusion method.

A conceptual arrangement for the high pressure backbone main to deliver gas to each power station is shown on Fig. 6.2.3. The lines are sized to handle Baseline Case peak day volumes and to deliver gas to the electrical generating equipment at a minimum pressure of 450 psig.

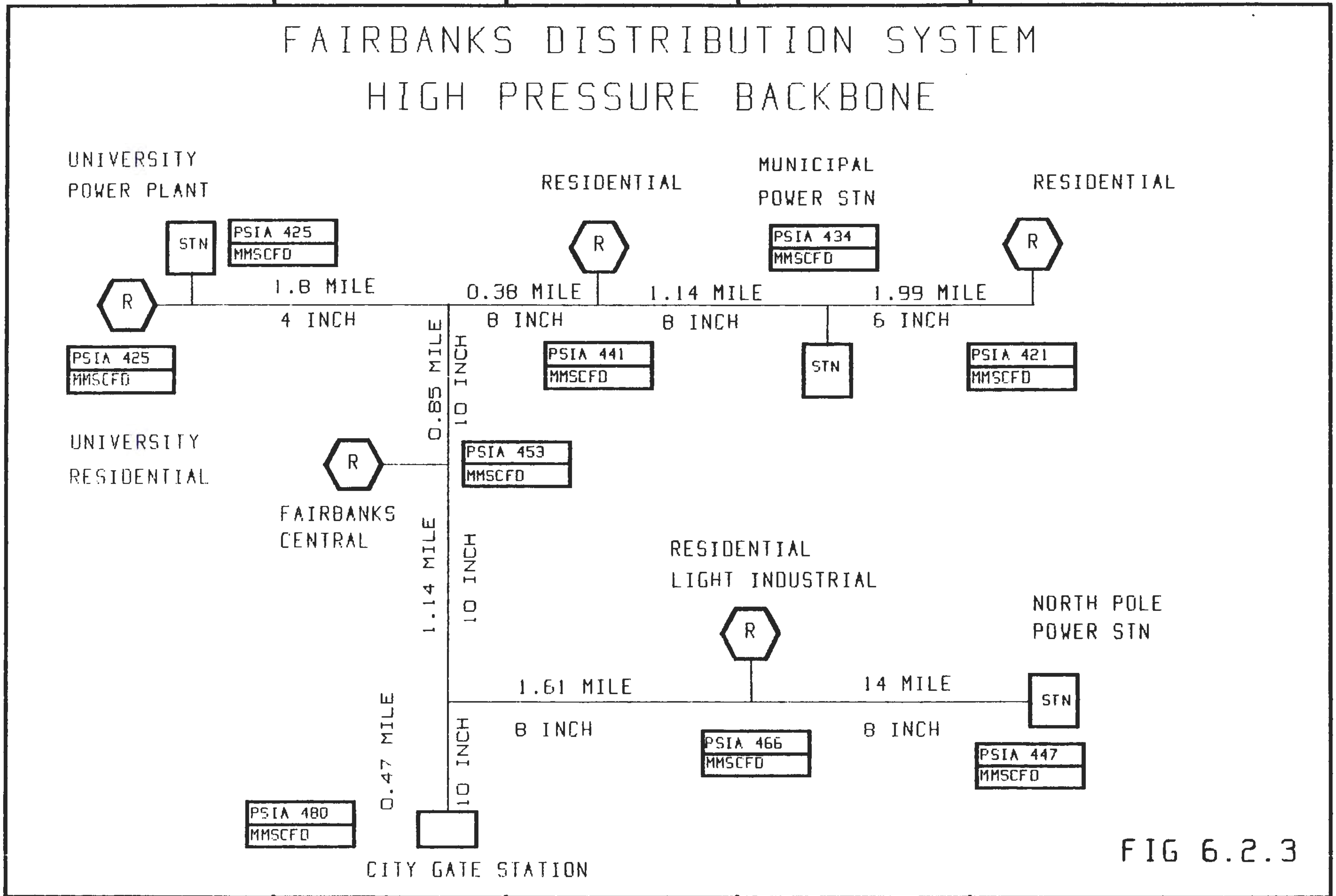

FAIRBANKS DISTRIBUTION SYSTEM
HIGH PRESSURE BACKBONE
UNIVERSITY
POWER PLANT
STN
PSIA 425
MMSCFD
R
PSIA 425
MMSCFD
1.8 MILE
4 INCH
RESIDENTIAL
R
0.38 MILE
8 INCH
PSIA 441
MMSCFD
MUNICIPAL
POWER STN
PSIA 434
MMSCFD
1.14 MILE
8 INCH
STN
RESIDENTIAL
R
1.99 MILE
6 INCH
PSIA 421
MMSCFD
0.85 MILE
10 INCH
UNIVERSITY
RESIDENTIAL
R
FAIRBANKS
CENTRAL
PSIA 453
MMSCFD
1.14 MILE
10 INCH
RESIDENTIAL
LIGHT INDUSTRIAL
R
1.61 MILE
8 INCH
PSIA 466
MMSCFD
NORTH POLE
POWER STN
14 MILE
8 INCH
STN
PSIA 447
MMSCFD
0.47 MILE
10 INCH
PSIA 480
MMSCFD
CITY GATE STATION

FIG 6.2.3

7.0 CAPITAL COST ESTIMATE

7.1 Mainline Pipe

Mainline Pipe Construction Costs are divided into three categories--Pre-Bid Expense, Pipeline Construction Costs, and Operating Facilities. Pre Bid Expense includes those items which will be under the execution responsibility of the Owner or the Contracting Agency such as right-of-way acquisition, permanent material procurement, and special work execution contracts. Owner and Design Costs are included in this section.

Pipeline Construction Costs include all activities under the responsibility of the execution contractor to include right-of-way preparation expense, actual pipeline construction, and landscape restoration along with support services such as camp construction and operation, and developing and processing of borrow materials.

In addition the Mainline Pipe Construction is divided into four construction sections to coincide with the amount of work which it is estimated can be constructed in one season by one spread. Three of these sections are summer work. The fourth, which is divided between the extreme southern end and the northern cross country section, will be winter work.

Operating Facilities include operating systems which will be used by the pipeline operator such as the SCADA system (supervisory control and data acquisition), corrosion protection system, a maintenance shop and warehouse as well as the pig launcher and receiver stations and the metering stations on each end.

An overview of the timetable required to complete the entire project is shown in the Project Summary Schedule Fig. 7.1.1.

7.1.1 Owner and Design Costs

Owner and Design Costs includes owner costs, engineering and design, material inspection, field inspection, and x-ray inspection. AFUDC (allowance for funds used during construction) is not included.

Owner costs are estimated at 2 percent of the total project costs. Engineering and design are estimated at 3.5 percent of total project costs. Material inspection is estimated at .5 percent of the permanent material costs. Field inspection is crew based and costed on a Spread working day. X-ray inspection is on a cost per foot.

7.1.2 Pre-Bid Procurement

Pre-Bid Procurement includes the purchase of most permanent materials and preliminary negotiation of pipeyard storage leases. This work will be the responsibility of the Owner or the Contracting Agency.

Permanent materials are procured directly by the Owner or its Contracting Agency as these are normally long lead time activities which would have the effect of delaying the execution of a construction contract were they the pipeline contractor's responsibility. In addition, it is important to maintain uniformity in manufacturer and quality throughout the length of the line. This is accomplished through central purchasing. Finally, the permanent materials for a pipeline are a significant portion of the cost of the project. When the owner or its contracting agency purchase the permanent materials additional fees for profit and overhead are avoided.

In this estimate Pre-Bid procurement includes the following:

- Mainline 16 Inch Pipe
- Pipe Coating
- Delivery to Rail Sidings on Project
- Mainline Valves
- Other Appurtenances including Metering
- Pipeyard Leases

Other appurtenances include concrete weights, rock shield, protective covering for joints and tie-ins, corrosion protection system, and sleeves for road crossings.

Pipeyard Leases are also included in this area to accommodate delivery of pipe, should it be necessary prior to start up by the pipeline execution contractor, and to prevent a bidding advantage by an ambitious contractor who ties up the more favorable sites.

The permanent materials will be shipped via ship directly from overseas ports to the Port of Anchorage. From the Anchorage Port most material will be loaded on rail cars and shipped via the Alaska Railroad to selected sidings along the project. Most materials produced in the U.S. or Canada will be shipped directly, via rail, to Seattle or Prince Rupert, and thence, via Hydrotrain to Whittier and the Alaska Railroad to designated sidings on the alignment.

Pipe purchase costs are for triple random lengths and are quoted as FOB trucks, Anchorage Dock, with duty paid. It is anticipated that pipe coating will be accomplished in the Anchorage Port area prior to delivery along the alignment. Preferred pipe coating is fusion bonded epoxy.

7.1.3 Other Pre-Bid Costs

Other pipeline related Pre-Bid Costs are included in the Mainline Capital Cost Estimates which are related to the actual route. These costs are:

- Temporary Right-of-Way Leases
- Permanent Right-of-Way Costs
- Permitting Costs

Temporary Right-of-Way Leases will permit adequate construction width, particularly where the alignment deviates from the State Highway right-of-way.

Permanent Right-of-Way Costs will be required wherever the alignment crosses private land as well as in the road right-of-way which abuts land owned by Regional or Village Native Corporations which were acquired under the Alaska Native Land Claims Settlement Act. This condition occurs principally in the Cantwell area as identified in Section 10 of this study.

7.1.4 Separate Contract Costs

In addition to Pre-Bid Procurement of permanent materials and right-of-ways and permits, it is anticipated that major aerial crossings will be let separately from the Main Pipeline Contract.

There are two aerial crossings planned-- Little Coal Creek and Hurricane Gulch. This specialty work is identified as a separate item from mainline pipe construction.

7.1.5 Pipeline Construction

All items of work which can affect progress of the mainline construction will be the responsibility of the Pipeline Execution Contractor. Pipeline Construction is sub-divided into four areas or phases: mobilization, logistics & support, civil construction, and pipeline construction.

7.1.6 Spread Descriptions

The pipeline has been divided into four separate geographical areas or "spreads". These are divided at natural interfaces to reflect some uniformity within the spread and include work which can be completed in a single season. Spreads one through three are anticipated to be summer work. Spread four is anticipated to be winter work. Spread four is further divided into two sub-areas to include the off-road locations at each end of the alignment.

The spread division will insure a maximum amount of competition among contractors for the work and the most competitive pricing. Each spread will be let as a separate contract. A single contractor may or may not be successful bidder on more than one spread.

Spread One begins at the intersection of the alignment with the Parks Highway at Big Lake Junction, which is Milepost (MP) 52.3 on the Parks, and extends north through the Susitna River Valley to Byers Creek at MP 144 for a distance of 91.7 miles.

Spread Two begins at Byers Creek Crossing (MP 144), heads north in the Chulitna River Valley, crosses Broad Pass to Cantwell and then follows down the Nenana River Valley to the Denali National Park Boundary at MP 231.3 for a distance of 87.3 miles.

The basic route for Spread Three will travel cross country on a sloping bench above the East Bank of the Nenana River to by-pass Denali National

Park. This route re-joins the Parks Highway at the entrance to the Nenana Canyon at approximate MP 238.5. The route then follows the highway down the canyon and along the Healy plain to the vicinity of Clear/Anderson. It leaves the highway near Julius, at approximate MP 295, for a distance of about 64.3 miles.

The Park by-pass adds approximately 3000 feet to the previous road alignment and is about 7.8 miles in length. The original alignment through the Park, followed the Parks Highway to Julius at Milepost 295. Our detailed cost sheets are based on the original alignment length of 63.7 miles. The revised basic alignment length for Spread Three is 64.3 miles. Our cost estimate for Spread Three makes an adjustment of the per mile cost determined on the detail sheets to relect this longer length. The cost of the more difficult overland route is offset by the elimination of one major stream crossing of the Nenana and two railroad crossings.

Spread Four has two sections--Spread 4A from the intersection of the Beluga line at Knik to Big Lake, and Spread 4B from Julius Creek on the Park Highway overland to Fairbanks.

Spread 4A takes off near Knik in a northerly direction to the intersection of the Parks Highway with the Big Lake Road, a distance of approximately 7.4 miles overland.

Spread 4B leaves the Parks Highway near Anderson, at Milepost 295, heading overland towards the Tanana River upstream from Nenana. It enters the Blair Lake/Ft. Wainwright Military Reservation at the crossing of the Wood River. From this point the alignment parallels the meander of the Tanana on the western edge of the Military Reservation. It crosses the Tanana River on an alignment which extends Peger Road and terminates at the Citygate Station in Fairbanks near the sewage treatment plant. Total distance of Spread 4B, as presently planned, is 48 miles.

Alternate 4B follows the Parks Highway from Julius through Nenana and on into Fairbanks, terminating in the vicinity of the University of Alaska heating plant. Costs for 4B are estimated on the basis of the per mile cost developed for Section 3 with some additional quantity of rock ditching added to the base case. Total length of Alternate 4B is about 62 miles--14 miles longer than the cross country base. The individual construction schedules for each spread are provided in Figs. 7.1.2A-D.

7.1.7 Labor Rates

The labor rates used in the estimate are based upon the Alaksa Department of Labor 1988 Wage Rate Schedule for state funded construction work. These rates, sometimes known as the "Little Davis Bacon Rates", reflect those rates currently in place in the statewide master labor agreements with the various construction trade unions. A 60 hour work week with time and one half for over forty hours is used. The workers compensation rate used is the 1987 rate for pipeline construction since the 1988 rate, which is higher, is expected to be reduced as a result of recent legislation. Labor rates are fully burdened with payroll taxes and insurance, including payroll based liability insurance. The Labor Use Rate Calculation Work Sheet, found in Appendix C, after Tab 6, provides the detailed rates used.

7.1.8 Equipment Rates

The equipment rates used are based upon the rates calculated in The Construction Equipment Ownership and Operating Expense Schedule for Region IX (Alaska) published by the U.S. Army Corps of Engineers. Rates for pipeline construction equipment not included in the Corps schedule are extrapolated on a similar basis from "lower 48" pipeline construction equipment rates. The equipment rates consist of two parts-- equipment operation and equipment ownership. Equipment operation includes repair and service labor, fuel and lube, tires, and repair parts. It does not include the labor to operate the equipment or equipment repair support equipment such as mechanic trucks, grease trucks, and fuel trucks. Equipment ownership expense includes depreciation and cost of facilities capital expense.

Winter rates for equipment are factored up by 30% to reflect the higher cost of equipment operation during the winter season when most equipment generally runs 24 hours a day at sub-zero temperatures.

7.1.9 Mobilization

Pipeline equipment in the cost estimate is mobilized from a midwestern point, the closest location of major pipeline contractors. Most of the equipment is mobilized via rail to Seattle, via Alaska Hydrotrain to Whittier, and via the Alaska Railroad directly to the project. Some of the light rubber tired vehicles are driven directly to the project. Larger rubber tired equipment is driven to Seattle and shipped Tote to Anchorage and then driven to the project when this routing is more economical than rail.

Demobilization includes return of equipment to the Midwest.

Equipment for civil construction is mobilized from within Alaska as are most camp facilities. It is anticipated that the civil work will be largely sub-contracted to local contractors.

7.1.10 Logistics and Support

Logistics and Support costs include campsite and contractor's yard lease and sitework costs, camp and shop installation costs, camp operations costs and pipe storage yard sitework costs. Pipe unloading and storage costs at the project are also included in this sub-section.

Each spread will have at least one camp site and contractor's yard. The campsite for Spread One will be in the vicinity of Sunshine, which is just past the Talkeetna Spur road on the Parks Highway (MP 99). Spread Two's campsite will either be in the vicinity of the abandoned FAA installation at Broad Pass (MP 201) or in the Cantwell area (MP 210). It is anticipated that Spread Three will use two campsites-- The first will be at Healy (MP 247) and probably use commercial dining facilities at that site for feeding the crew. The second will be in the Clear/Anderson area. This same campsite will be expanded to service Section 4B during the winter. Section 4A will not use a dedicated campsite since adequate housing is available in the area and work here will be of short duration.

The camps will be constructed of ATCO type modules of which there is a more than adequate supply presently in Alaska. The typical housing unit will be the 56 man unit which consists of 7 eight man bunk trailers and one utility trailer with an enclosed central walkway. Warehouse and shop buildings will be ATCO foldaways. Floors, if any, will probably be precast slabs. The camp units serving the summer spreads will not be interconnected with covered walkways. The camp for Spread 4B will have covered walkways.

All of the camps except Broad Pass will be serviced with commercial electricity which is readily available. Commercial telephone service should also be available, although Broad Pass may need a radio or microwave link.

Soil conditions and the temporary nature of the installations should facilitate the use of septic tank/absorption field system for sanitary wastes. Solid wastes will be incinerated for the combustibles and use locally available landfills for the remainder. Water will be supplied from wells with minimal chlorination.

Unskilled labor will be largely local hire and will not require camp accommodations. In addition, a percentage of the crew will provide their own mobile housing which will use available commercial camper parks or, if a shortage exists, camper parks provided by the contractor.

7.1.11 Civil Construction

Civil Construction consists of reclamation, revegetation and landscape restoration of all sections, production of select backfill in areas of rock excavation, excavation of borrow and construction of work pads over short areas where winter construction is not desirable and removal of those pads upon completion, and snow road construction and maintenance in Spreads 4A and 4B.

In addition to areas of rock excavation, some select backfill is estimated to be required in areas of large boulders and at some stream crossings.

Snow road construction and maintenance will be a major item in Spread 4B. Snow road construction will be two phased. In Phase one, the traffic way is cleared to encourage frost penetration. The cleared snow is placed over the pipeline ditch alignment to retard frost penetration in the ditch area. During Phase two snow is compacted in the traffic areas and water is applied to provide a durable riding surface and protect the tundra.

Phase one construction is conducted with low ground pressure equipment for minimum tundra or ground cover damage. The numerous streams along this route will prohibit an early start on phase one since the ice will not be thick enough for crossing or the ambient air cold enough for ice bridge construction.

Phase two construction requires the compaction of the existing snow and the importation or manufacture of additional snow so that a minimum compacted thickness of 15 to 18 inches is achieved in the travel lanes.

Ice bridges will undoubtedly have to be constructed for many of the stream crossings by drilling and flooding the ice. A few of the streams in this area tend to run warm until late in the winter season. Temporary bridges across the deeper channels will be required under these circumstances. Recycled flat cars and pre-fabricated modular work bridges are available in Alaska for this purpose.

7.1.12 Pipeline Construction

Pipeline construction activities are, for the most part, conventional. These activities are outlined on the cost summary sheets for each Spread. In our estimate dewatering equipment is included in appropriate work items. It is not anticipated that well point or area well type dewatering will be required.

Short sections of Spreads 1-4A will be in permafrost which will require frost excavation techniques with special frost penetrating teeth or drilling and shooting of the ditch. Much of the ditch excavation in Spread 4B will be frozen material.

Stream crossing of anadromous and resident fish streams will require schedule coordination and special measures to protect the fish.

7.1.13 Operating Facilities

Costs for operating facilities are based upon estimates for like work and include a custody transfer metering station at Knik and a city gate station at Fairbanks. The costs for SCADA facilities are rapidly declining due to new computer operating system technology. We have modified a recent quote for this system. The corrosion protection system will be by means of impressed current cathodic protection system. We are anticipating that the Cantwell Shop and Warehouse facilities for maintenance will be provided by converting similar facilities used during construction.

7.1.14 Escalation

In Alaska construction costs in almost all categories have been declining over the past few years due to a drastic reduction in construction volume in the State. That decline is probably over. Labor costs have remained steady for several years, reflecting an oversupply of Union labor and pressure from an Open Shop labor force. We believe that labor costs will continue to remain steady.

While nationally construction equipment costs have increased, in Alaska overcapacity has held those costs steady. Increasing costs for repair parts and tires have been offset by decreasing fuel costs and decreasing ownership costs.

Costs of steel pipe from Japan have increased dramatically in the past few years due to the change in the value of the Yen, escalating costs in Japan, and import quotas on foreign steel. We have used Japanese pipe prices for our cost estimate. We are unable to predict future pipe prices but note that world demand is not presently escalating so we believe that our present quote may be near peak prices.

As a result of these factors we have not used any escalation factors. Should this project move forward, consideration of current market conditions in relation to the expected construction schedule can be made to determine what, if any, escalation factor is appropriate.

7.1.15 Contingency

This estimate has been prepared by construction estimators familiar with local conditions along the route and Alaska construction costs and logistics problems. No detailed design was available but detailed soils information was available from the Parks Highway construction documents. It is doubtful that major unexpected conditions or changes will be encountered. In normal construction cost estimating for bidding the "unknowns," risks of the project are reflected in three places -- the production rate, the crew configuration, and the fee. This estimate follows that procedure. The production rates are conservative as is the estimate of quantities and the crew sizes.

Nevertheless, in recognition of possible unknown conditions or unanticipated price escalation, a 5% Contingency Factor has been used on the total cost.

7.1.16 Cost Summary

A summary of the estimated Mainline Pipe Capital Cost is as follows:

Table 7.1.1
Mainline Pipe
Capital Cost Summary
1988$

Spread	Miles	Design Inspection Materials	Construction	Total	Cost/Mile
1	91.7	$17,626,551	$33,172,742	$50,799,293	$553,973
2	87.3	$17,818,910	$30,273,084	$48,091,994	$550,882
3	64.3	$12,658,962	$26,360,577	$39,019,539	$606,836
4A	7.4	$1,935,785	$5,266,283	$7,202,068	$973,252
4B	48.0	$12,939,665	$29,359,065	$42,298,730	$881,224
SUBTOTAL	298.7	$62,979,873	$124,431,751	$187,411,624	$627,424
OpFac		$1,937,825	$634,112	$2,571,937	$8,610
TOTAL*	298.7	$64,917,698	$125,065,863	$189,983,561	$636,035
3 (alt)	63.7	$12,546,222	$26,178,655	$38,724,877	$607,926
4B (alt)	61.7	$12,915,048	$26,893,843	$39,808,891	$645,201

* TOTAL includes an appropriate apportionment of contingency cost.

Spread 3 alternate is a route following the Parks Highway right-of-way through Denali National Park. Spread 4B alternate is a route following the Parks Highway right-of-way from Julius Creek near Clear to Fairbanks.

Summary and detail costs sheets for each spread may be found in Appendix C. Detailed crew sheets for each item of work may be found following tab 3 of Appendix C.

SUMMARY PROJECT SCHEDULE
COOK INLET - FAIRBANKS PIPELINE

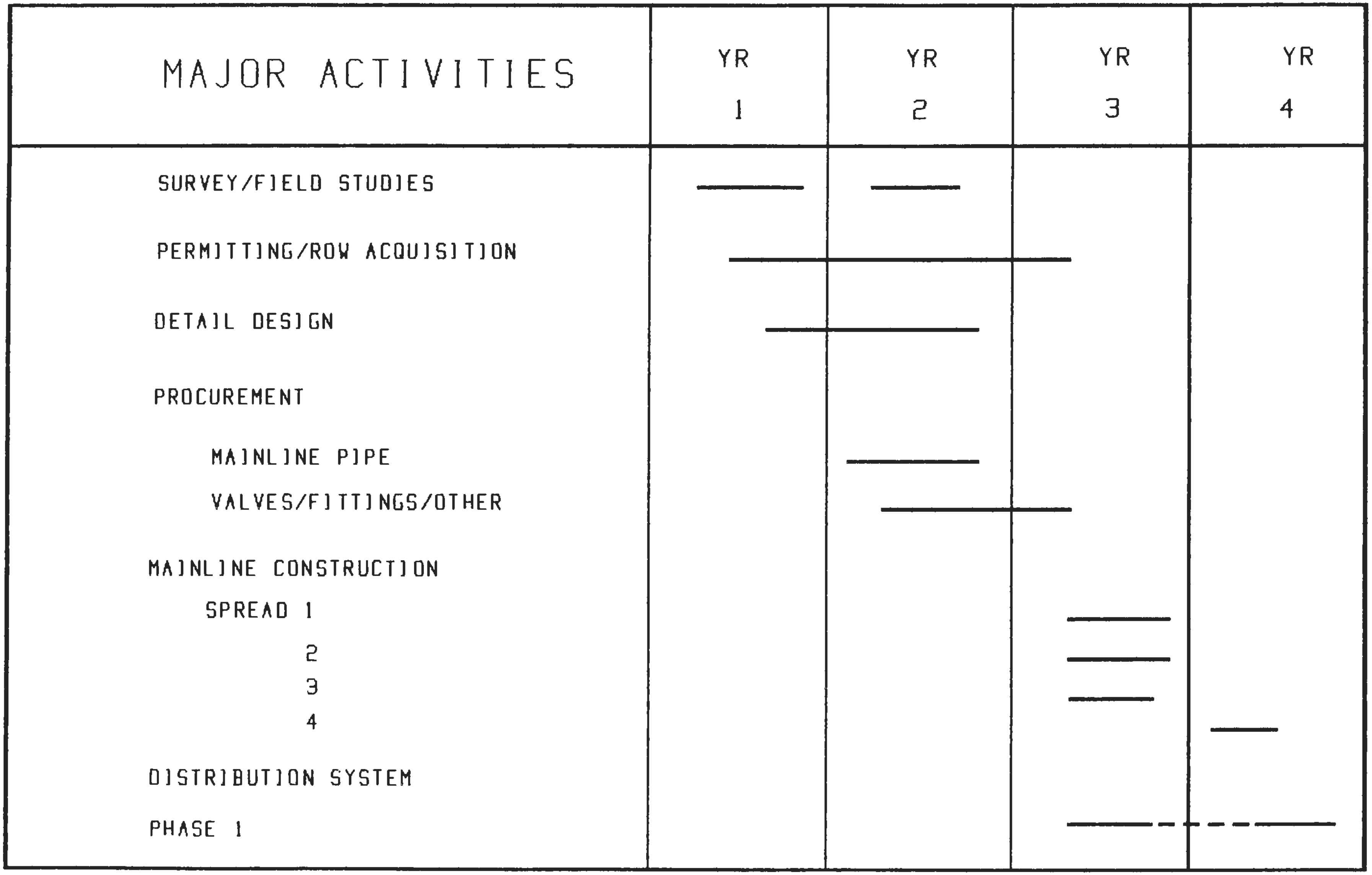
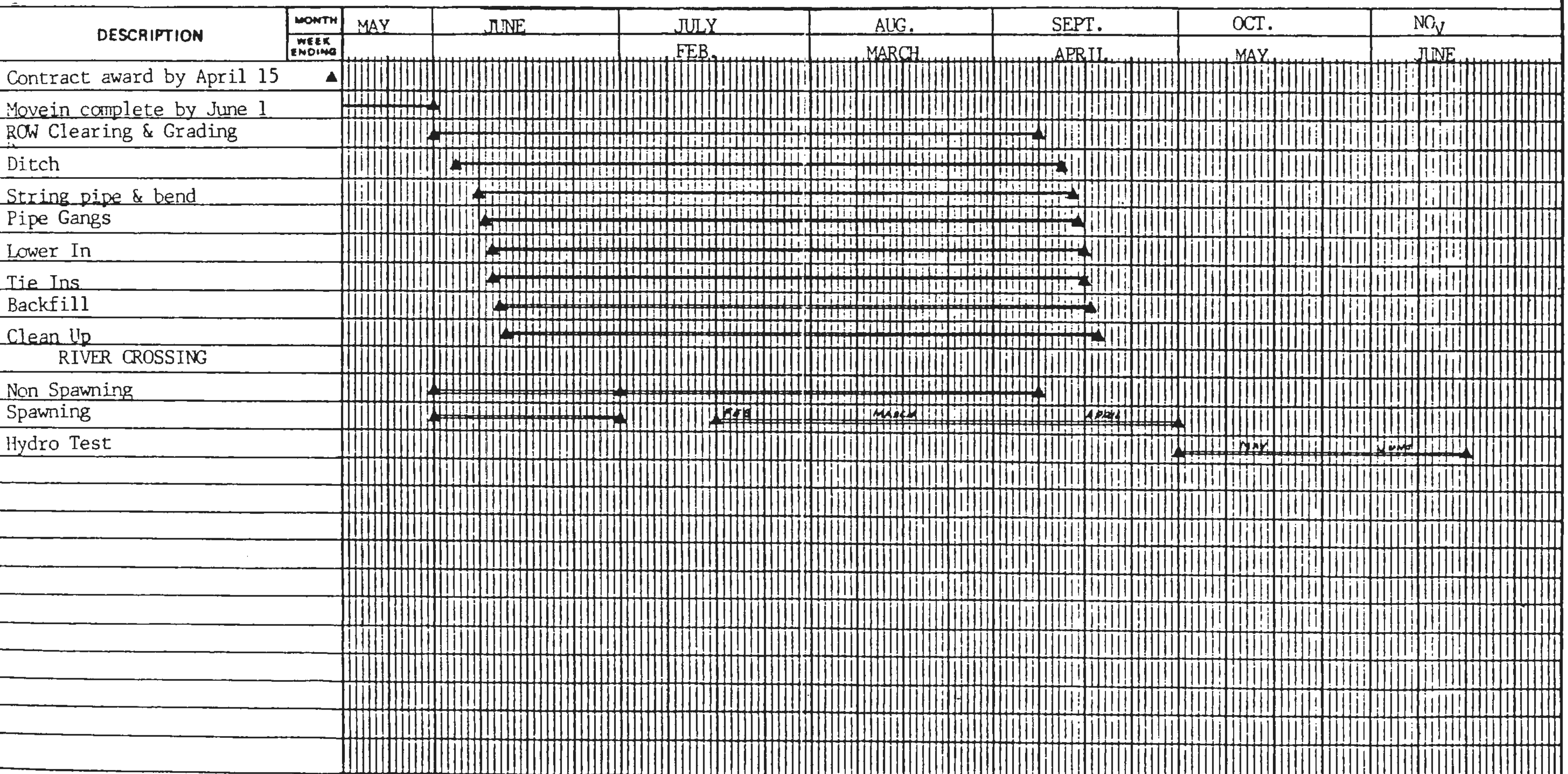


FIG 7.1.1

ANCHORAGE - FAIRBANKS - PIPELINE
CONSTRUCTION SCHEDULE

PROJECT **SPREAD NO. 1**

PERIOD ______ SHEET 1 OF 4
DATA DATE ______
ACTIVITY ______



ANCHORAGE - FAIRBANKS - PIPELINE
CONSTRUCTION SCHEDULE

PROJECT **SPREAD NO. 2**

PERIOD ________ SHEET 2 OF 4
DATA DATE ________
ACTIVITY ________

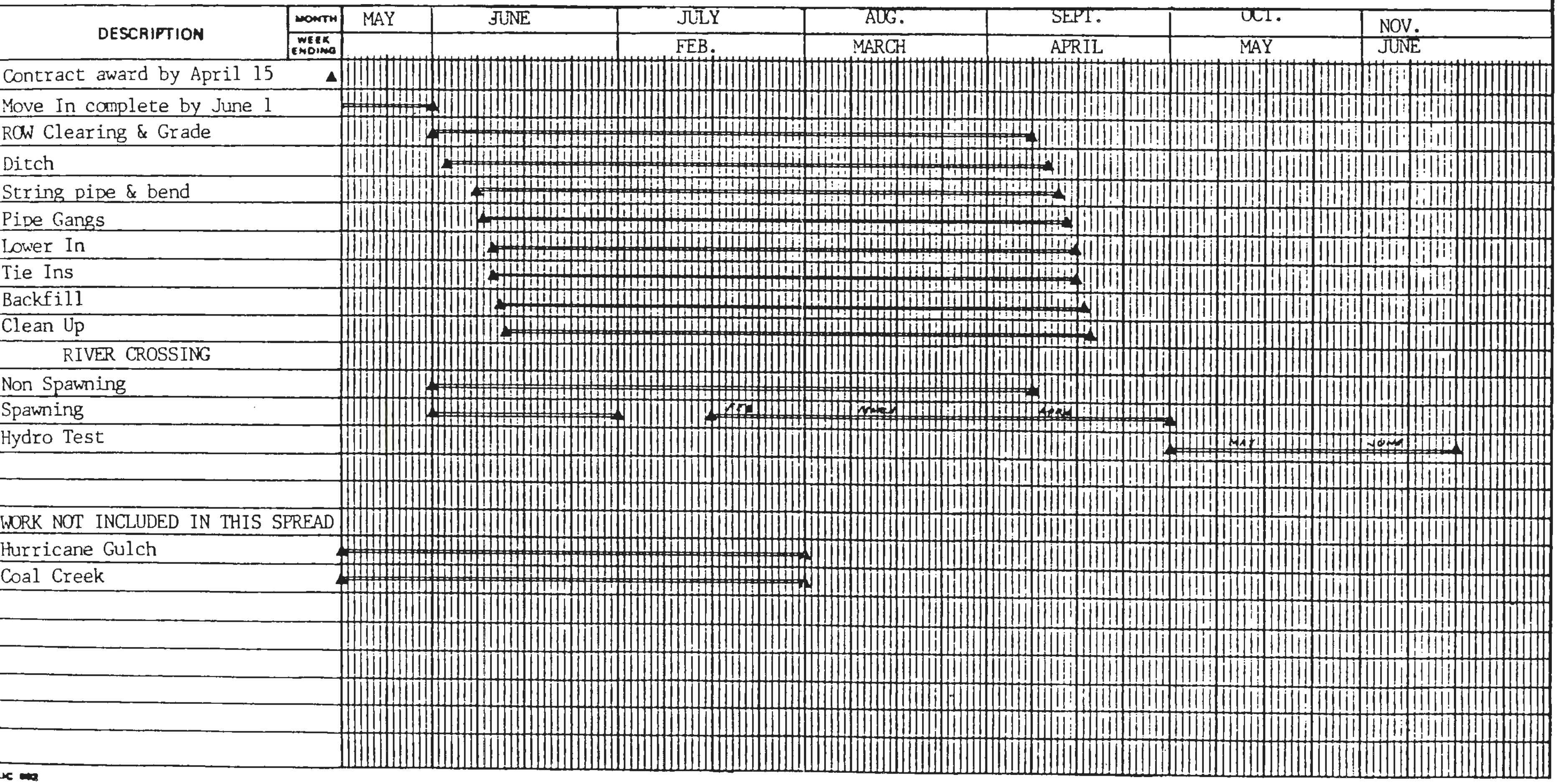


FIG. 7.1.2B

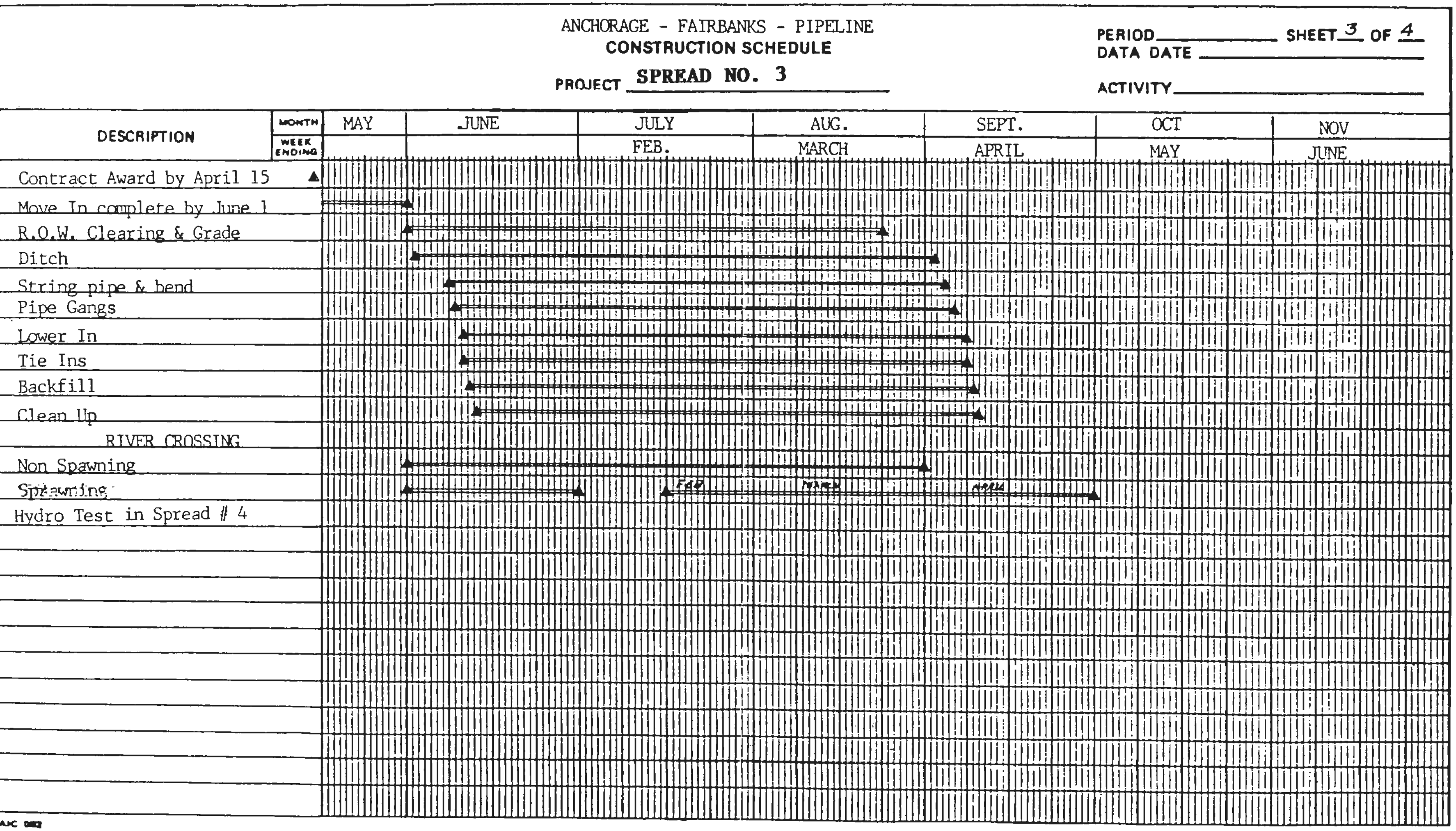

ANCHORAGE - FAIRBANKS - PIPELINE
CONSTRUCTION SCHEDULE
PROJECT SPREAD NO. 3
PERIOD
SHEET 3 OF 4
DATA DATE
ACTIVITY
DESCRIPTION
MONTH
WEEK ENDING
MAY
JUNE
JULY
AUG.
SEPT.
OCT
NOV
FEB.
MARCH
APRIL
MAY
JUNE
Contract Award by April 15
Move In complete by June 1
R.O.W. Clearing & Grade
Ditch
String pipe & bend
Pipe Gangs
Lower In
Tie Ins
Backfill
Clean Up
RIVER CROSSING
Non Spawning
Spawning
Hydro Test in Spread # 4
AJC 0802

FIG. 7.1.2C

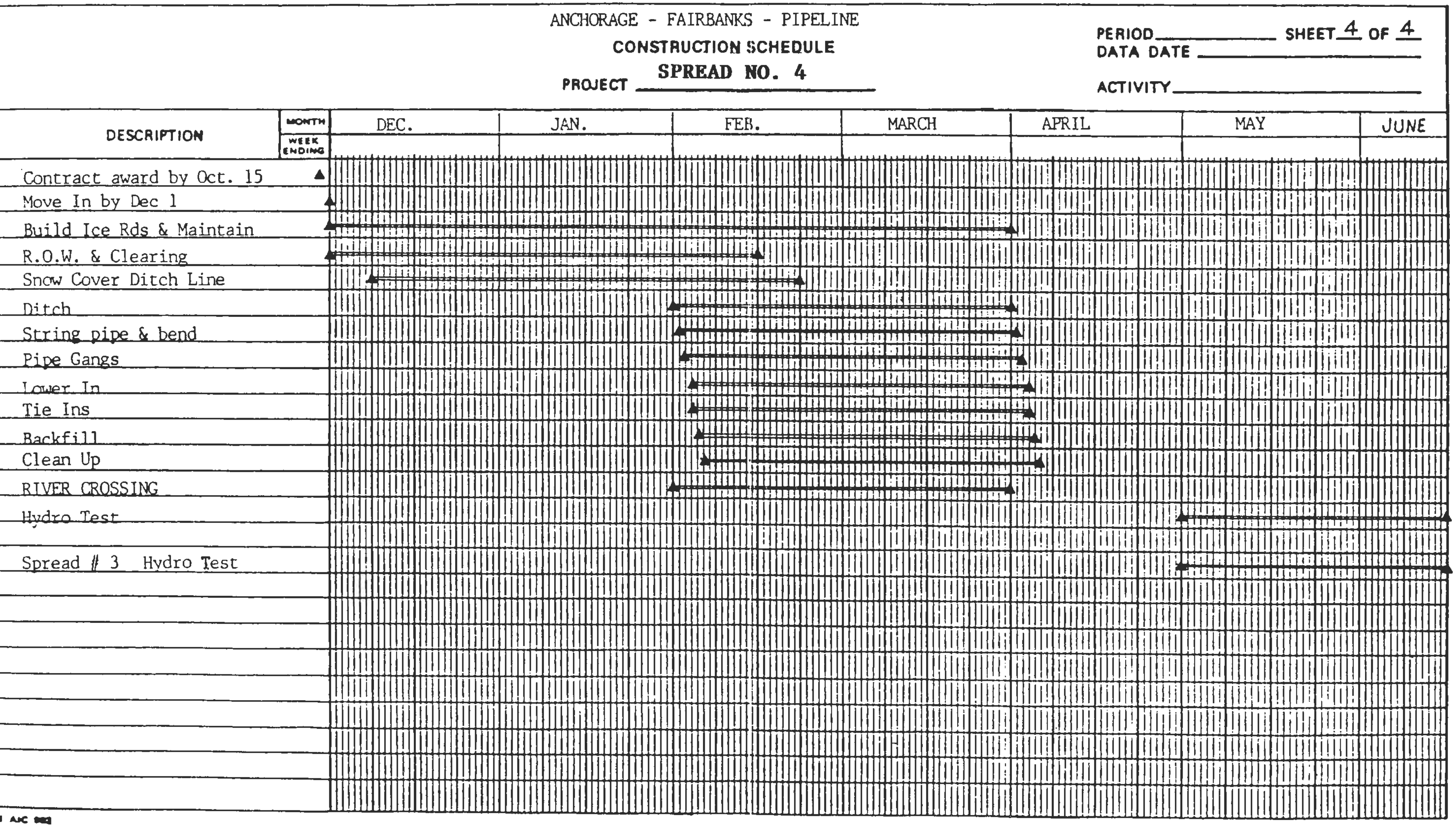

ANCHORAGE - FAIRBANKS - PIPELINE
CONSTRUCTION SCHEDULE
PROJECT SPREAD NO. 4
PERIOD
SHEET 4 OF 4
DATA DATE
ACTIVITY
DESCRIPTION
MONTH
WEEK ENDING
DEC.
JAN.
FEB.
MARCH
APRIL
MAY
JUNE
Contract award by Oct. 15
Move In by Dec 1
Build Ice Rds & Maintain
R.O.W. & Clearing
Snow Cover Ditch Line
Ditch
String pipe & bend
Pipe Gangs
Lower In
Tie Ins
Backfill
Clean Up
RIVER CROSSING
Hydro Test
Spread # 3 Hydro Test

FIG. 7.1.3D

7.2 Distribution System

Distribution system costs have been estimated on the basis of required infrastructure necessary to support the distribution loads that could be economically served upon completion of the pipeline from Anchorage.

Gas for electric power will be consumed at three defined power stations, Fairbanks Municipal, University and North Pole (GVEA). The approximately 12,000 customer units that could be provided with a gas supply during the initial distribution construction phase is based on a street-by-street survey of Fairbanks carried out be ENSTAR in the summer of 1986. Subsequent additions would be handled by normal system expansion on an incremental basis as customer density increases.

A detailed network development of the future distribution system for these forecast customers has not been carried out. However a conceptual arrangement for supplying gas to the three electric power locations and to the community take off points has been developed (See Section 6 - Fig. 6.2.4).

The take-off community points are located and sized on a prorated basis of future load and current population distribution not including the downtown core which is expected to continue to use steam heating.

The distribution system costs have been evaluated on the conceptual infrastructure, industry unit factors and typical costs experienced by ENSTAR for its gas distribution system in Anchorage.

A summary of the distribution system costs is provided in Table 7.2.1.

Table 7.2.1
Fairbanks Distribution System
Cost Summary
1988, $1000

Backbone 'T' Main	(7.8 miles)	$ 1,800
North Pole Spur	(15.6 miles)	3,600
Plastic Mains	(150 miles)	6,340
Service Lines		6,000
Meter Sets		4,600
District Regulator Stations	(5 each)	450
Subtotal Distribution System		$22,790
Fairbanks Differential Allowance	(20 percent)	4,560
Engineering & Supervision		2,460
General Plant		1,780
Administration Expenses		1,500
Contingent Items		750
Total System Cost		$33,840

8.0 OPERATIONS AND MAINTENANCE COSTS

Stone & Webster has estimated the Operations and Maintenance (O&M) costs for the proposed Fairbanks natural gas pipeline. These costs are estimated to total $4.0 million per year, with the greater portion ($2.4 million) attributable to the distribution systems in Fairbanks and the smaller communities, and the remainder ($1.6 million) attributable to the transmission pipeline.

Both distribution and transmission O&M costs were obtained through averaging three separate estimates of each. Distribution costs were estimated from 1988 factors representing:

1) cost per customer
2) cost per total cubic feet of gas
3) cost per mile of mains and services

Transmission costs were estimated from factors representing:

1) cost per total cubic feet of gas
2) cost per mile of pipeline
3) total pipeline capital cost

The first two transmission O&M cost estimates were adjusted to constant 1988 dollars from 1985 dollars. Next, all three estimates were averaged. Finally, both distribution and transmission cost averages were adjusted for northern climate and conditions. Results are shown in Table 8.1.

FILE: ALATOT PR2

TABLE 8.1

ALASKA POWER AUTHORITY
NATURAL GAS PIPELINE FEASIBILITY STUDY
OPERATIONS & MAINTENANCE COST
ESTIMATES FOR DISTRIBUTION & TRANSMISSION

($000)/YEAR, $1988

A) DISTRIBUTION			LOWER STATES	FAIRBANKS AREA
METHOD 1	12120 CUSTOMERS *	$182 /CUSTOMER	$2,206	
METHOD 2	5624 MMCF/YEAR *	$416 /MMCF	$2,340	
METHOD 3	175 MI MN&SVC *	$8.32 /MI	$1,456	
AVERAGE			$2,000	$2,401

B) TRANSMISSION				
METHOD 1	12000 MMCF/YEAR *	$84 /MMCF	$1,011	
METHOD 2	298 MI TRANS *	$3,614 /MI	$1,077	
METHOD 3	190 $MM CAP CST *	1.0%	$1,900	
AVERAGE			$1,329	$1,595

C) DISTRIBUTION & TRANSMISSION				
AVERAGE			$3,330	$3,996

FAIRBANKS CLIMATE FACTOR = 20%

8.1 Distribution System

Distribution O&M cost factors were developed through an analysis of O&M costs at eight U.S. gas distribution companies, as reported in their 1987 Uniform Statistical Reports provided to the American Gas Association. These eight companies were selected to provide a wide variation in customer counts, gas sales, main and service pipe mileage, urban/rural settings, and degree-day climates. Total O&M costs were developed from a disaggregated analysis of five O&M accounts:

1) Administration & General
2) Distribution
3) Customer Accounts
4) Customer Service
5) Sales

Other accounts referring to production, storage, or transmission were disregarded. Total O&M costs, representing the sum of the above five accounts, were used to form cost factors (ratios of O&M costs to number of customers, cubic feet of gas, and miles of pipe), as detailed in Table 8.2. These factors were then applied to the Fairbanks distribution system as shown in Table 8.3.

8.2 Transmission System

Two transmission O&M cost factors were obtained from summaries published in the Oil & Gas Journal (November 23, 1987). These data were obtained from Form 2's or Form 2A's for 1985 filed with the FERC by U.S. interstate pipelines. Total O&M costs were developed from a disaggregated analysis of accounts. Operation accounts were comprised of:

1) Gas for Compressor Station Fuel
2) Compressor Station Labor and Expense
3) Mains
4) Supervision and Engineering
5) Measuring and Regulating Station Expenses
6) Other Fuel and Power for Compressor Stations
7) Other Transmission Expenses
8) System Control and Load Dispatching
9) Communication System Expenses
10) Rents

Another operations account, referring to Transmission and Compression of Gas by Others, was disregarded.

Maintenance accounts were comprised of:

1) Compressor Station Equipment
2) Mains
3) Supervision and Engineering
4) Structures and Improvements
5) Measuring and Regulating Station Equipment
6) Communication Equipment
7) Other Equipment

FILE:ALOO&M

TABLE 8.2

ALASKA POWER AUTHORITY
NATURAL GAS PIPELINE FEASIBILITY STUDY
OPERATIONS & MAINTENANCE COST
EIGHT SELECTED U.S. DISTRIBUTION COS
RANKED BY NUMBER OF CUSTOMERS

($000)/YEAR, $1987

	COMPANY A			COMPANY B			COMPANY C			COMPANY D		
	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS
O&M COST ELEMENTS (SCHD IV - EX. PROD.,STG., & TRANSM.)												
A&G			$243,184	$42,420	$3,634	$46,054	$23,604	$315	$23,919	$16,330	$2,372	$18,702
DISTRIBUTION			$112,111	$34,943	$17,209	$52,152	$12,728	$5,764	$18,492	$8,238	$4,404	$12,642
CUST. ACCOUNTS			$76,940	$30,615		$30,615	$28,511		$28,511	$7,238		$7,238
CUST. SERVICE			$16,931	$7,431		$7,431	$8,915		$8,915	$2,428		$2,428
SALES			$3,152	$5,204		$5,204	$1,329		$1,329	$4,435		$4,435
TOTAL	N/A	N/A	$452,318	$120,613	$20,843	$141,456	$75,087	$6,079	$81,166	$38,669	$6,776	$45,445
KEY STATISTICS												
TOT. DISPOSITION MMCF (SCHD XIV)			1,275,757			238,860			100,694			74,454
NO. OF CUSTOMERS (SCHD XX)			1,747,449			1,049,670			425,301			273,166
ANNUAL DEG DAYS (SCHD XXIII)			5,521			2,934			7,334			4,451
MILES OF DISTR MAINS (SCHD XXVI)			28,059			18,200			6,285			8,084
MILES OF DISTR SVCS (SCHD XXVI)						18,488						4,938
TOTAL MILES			28,059			36,688			6,285			13,022
ADDITIONAL STATISTICS												
TOT PLANT IN SVC. (SCHD VI)			$6,047,895			$1,036,411			$474,441			$501,356
GROSS ANN. ADDITIONS (SCHD X)			$298,774			$138,627			$23,821			$31,627
O&M SAL. & WAGES (SCHD XIII)			$303,322			$75,572			$39,545			$25,039
O&M PENSIONS & BENS. (SCHD XIII)			$44,456			$6,787			$5,597			$4,978
NO. OF EMPLOYEES (SCHD XIII)			9,262			2,809			1,352			801
ESTIMATING FACTORS												
TOTAL O&M / THOUS. CUSTOMERS			$259			$135			$191			$166
TOTAL O&M / MMCF			$355			$592			$806			$610
TOTAL O&M / MI OF DISTR. MAIN & SVCS			$16.12			$3.86			$12.91			$3.49
OTHER FACTORS												
TOTAL CUSTOMERS / O&M EMPLOYEE			189			374			315			341
O&M SAL,WAGES,PENSIONS,& BEN/EMPLOYEE			$37.5			$29.3			$33.4			$37.5

COMPANY E			COMPANY F			COMPANY G			COMPANY H						
OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	OPERATIONS COSTS	MAINTENANCE COSTS	TOTAL COSTS	EIGHT COMPANY AVERAGE	% OF TOTAL		
$7,700	$401	$8,101	$7,462		$7,462	$7,991	$327	$8,318	$1,020	$24	$1,044	$44,538	45.7%		
$5,210	$3,622	$8,832	$2,911	$1,725	$4,636	$4,729	$1,017	$5,746	$633	$260	$893	$26,938	27.6%		
$4,626		$4,626	$3,001		$3,001	$3,904		$3,904	$627		$627	$19,433	19.9%		
$0		$0	$426		$426	$1,479		$1,479	$2		$2	$4,702	4.8%		
$813		$813	$569		$569	$72		$72	$37		$37	$1,951	2.0%		
$18,349	$4,023	$22,372	$14,369	$1,725	$16,094	$18,175	$1,344	$19,519	$2,319	$284	$2,603	$97,622	100.0%		
		36,561			32,451			48,381			5,584	226,593			
		117,482			113,556			87,404			18,578	479,076			
		6,330			6,574			5,620			4,957	5,465			
		1,994			2,063			2,895			546	8,516			
					1,958			1,586				3,371			
		1,994			4,021			4,481			546	11,887			
		$174,224			$138,032			$195,543			$19,163	$1,073,383			
		$11,546			$6,089			$10,869			$1,081	$65,304			
		$12,104			$8,320			$10,388			$1,262	$59,444			
		$0			$1,297			$1,436			$313	$8,108			
		538			258			352			40	1,927			
														$1987 EST. FOR SMALL DISTR CO.	$1988 EST. FOR SMALL DISTR CO.
		$190			$142			$223			$140	$181		$175.00	$182.00
		$612			$496			$403			$466	$543		$400.00	$416.00
		$11.22			$4.00			$4.36			$4.77	$7.59		$8.00	$8.32
		218			440			248			464	324		$325.00	$338.00
		$22.5			$37.3			$33.6			$39.4	$33.8		$40.00	$41.60

$1988=$1987*1.04

FILE: ALATOT PRINT RANGES= PR1, PR2, PR3

TABLE 8.3

ALASKA POWER AUTHORITY
NATURAL GAS PIPELINE FEASIBILITY STUDY
OPERATIONS & MAINTENANCE COST
FAIRBANKS DISTRIBUTION COST PROFILE

($000)/YEAR, $1988

SYSTEM PROFILE - KEY COST & OPERATING STATISTICS

	FAIRBANKS & NEARBY TOWNS	
	TOTAL COSTS	CALCULATION FORMULA
DISTRIBUTION SYSTEM		
DISTRIBUTION SYSTEM O & M COST ESTIMATE BY ACCOUNT		
A&G	$1,097	45.7% O&M
DISTRIBUTION	$663	27.6% O&M
CUST. ACCOUNTS	$478	19.9% O&M
CUST. SERVICE	$115	4.8% O&M
SALES	$48	2.0% O&M
TOTAL DISTR. O&M	$2,401	AVG. OF 3 METHODS
DISTRIBUTION SYSTEM KEY STATISTICS		
TOT. DISPOSITION CAPACITY MMCF	5,624	11,466-5,842 ELEC
NO. OF CUSTOMERS	12,120	
ANNUAL DEG DAYS	14,274	
MILES OF DISTR SVCS (2"-6")	169	
MILES OF DISTR MAINS (10"+)	6	
COMPARISON O&M ESTIMATING FACTORS FOR FAIRBANKS		
TOTAL O&M / CUSTOMER	$198	
TOTAL O&M / MMCF	$427	
TOTAL O&M / MI OF DISTR. MAIN & SVCS	$13.72	
OTHER DERIVED STATISTICS		
TOTAL CUSTOMERS / O&M EMPLOYEE	325	
O&M SAL, WAGES, PENSIONS, &BEN/EMPLOYEE	$40.0	
DISTR. O&M SAL. & WAGES, PENS & BENS	$1,492	$40 $/EMPLOYEE
NO. OF EMPLOYEES	37	#CUSTS/325

These two statements of transmission O&M costs were inflated to constant 1988 dollars from their stated 1985 dollars through use of an assumed inflation index of 4% per year, as shown in Table 8.4.

A third estimate of transmission line O&M costs was made as an aggregated straight percentage (1.0%) of estimated pipeline capital costs based on historical estimation rules of thumb.

FILE: ALATOT PR3

TABLE 8.4

ALASKA POWER AUTHORITY
NATURAL GAS PIPELINE FEASIBILITY STUDY
OPERATIONS & MAINTENANCE COST
ESTIMATES FOR TRANSMISSION FROM DGL REPORT 11-23-87

	$1985		$1988	
	COST/MILE	COST/MMCF	COST/MILE	COST/MMCF
TOTAL OPERATION EXPENSES	$11,537	$269	$12,479	$291
LESS COMPRESSION EXPENSES	$9,558	$223	$10,338	$241
NET OPERATION EXPENSES	$1,980	$46	$2,141	$50
TOTAL MAINTENANCE EXPENSES	$1,362	$32	$1,473	$34
TOTAL O&M EXPENSE /MI & /MMCF	$3,341	$78	$3,614	$84

COST INFLATION ASSUMPTION= 4.0% /YR

9.0 ENVIRONMENTAL IMPACTS AND MITIGATION

The preferred pipeline route begins at its junction with the Beluga Gas Pipeline adjacent to Knik Road about 12 miles southwest of Wasilla and travels cross-country due north for about 7 miles to the intersection of the Big Lake Junction and the George Parks Highway at MP 52.3. The pipeline route then generally follows the Parks Highway corridor north for 243 miles to Julius, about 10 miles south of Nenana, before turning northeast and traveling about 46 miles cross-country to Fairbanks. The total pipeline route length is approximately 298 miles, of which about 235 miles are adjacent to the Parks Highway corridor and 63 miles occur in roadless areas. The pipeline would require a cleared right-of-way 80 feet wide along the Parks Highway corridor and 100 feet wide in roadless areas. The 16 inch diameter pipe would be buried in a 30 inch wide ditch with an average fill cover of 3 feet.

This section discusses potential environmental impacts of construction and operation of the natural gas pipeline along the preferred route, and addresses possible mitigation to avoid, minimize, rectify, reduce, or compensate losses to natural resources. Particular attention has been given to those potential impacts considered significant in terms of cumulative environmental disturbance or public sensitivity.

9.1 Vegetation and Wetlands

Clearing of vegetation for the pipeline right-of-way would disturb approximately 3,043 acres (Table 9.1.1). Clearing for related construction and permanent facilities would disturb an additional approximate 100 acres. (Table 9.1.1). The pipeline would cross a variety of vegetation types along its route. Generally, south of Little Coal Creek the dominant overstory vegetation is mature paper birch - white spruce mixed forest. Muskeg bogs occur, occasionally in the cross-country section between the Knik Road and the Big Lake Junction. North of Little Coal Creek to Julius the vegetation alternates among paper birch - white spruce mixed forest, white/black spruce forest, alder shrubland, ericaceous shrub scrub, and aspen - spruce mixed forest. Elevation and aspect appear to influence the dominant communities in this segment of the route. From Julius to Fairbanks via the cross-country route the dominant vegetation communities are aspen forest, white spruce forest, black spruce bogs, muskeg bog wetlands, and low shrublands. Refer to Section 5.2 and Table 5.4.3 for more detailed vegetation type descriptions of specific sections of the pipeline route.

Nearly 80 percent of the pipeline route would parallel the Parks Highway and share a portion of the highway right-of-way. The width of cleared right-of-way for the highway varies along its length, and also varies depending upon which side of the highway the pipeline is to be buried. To accommodate an 80 foot wide pipeline construction right-of-way, an additional 30 to 70 feet would need to be cleared of trees and shrubs in most areas. Larger trees would need to be felled and limbed by hand methods. Smaller trees (e.g., less than 6 inches in diameter) and shrubs could be cleared by hydroaxing. Most of this clearing could be conducted at any time of year, with the exception of the scattered muskeg bogs which would need to be cleared by hand methods or using equipment during the winter.

Table 9.1.1

Approximate Acreages of Disturbance For Gas Pipeline Right-of-Way and Related Facilities

Facility Type	Approximate Acreage
Right-of-Way	
Adjacent to Parks Highway (235 miles)	2,279
Roadless Areas (63 miles)	764
Pipe Stockpile Yards	30
Temporary Camps, Equipment and Maintenance Yards	60
Weight Casting Yards	4
Permanent Structures	
Metering Stations	1
Valve Stations	5
Scraper Stations	1
Total	3,144

About 21 percent of the pipeline route would cross areas generally without existing road access. Several roads intersect the proposed route south of the Big Lake Junction, but the preponderance of muskeg bogs in this segment of the route limit access by equipment except during frozen ground conditions. With the exception of hand clearing of larger trees, the roadless areas south of the Big Lake Junction and northeast of Julius would be cleared primarily during winter.

No specific impediments to widening the clearing adjacent to the Parks Highway or creating a new right-of-way in the roadless areas to accommodate construction of the gas pipeline would be anticipated. The forest and shrubland types which would be removed are common to southcentral and interior Alaska.

In forested areas removal of the overstory would create the primary impact because of the direct loss of vegetation. The microclimate would also change due to the increased amounts of light and changes in other parameters. For example, wind velocities may increase in the cleared highway right-of-way, which would result in increased snow drifting and evapotranspiration rates from the surface vegetation.

Proper disposal of cleared trees would be required. Spruce is susceptible to infestation by spruce bark beetles, and complete removal or treatment by methods such as cutting into short segments, burning, or chipping will be important to minimize the potential for problems. Trees cleared from the Parks Highway right-of-way could be sold to commercial enterprises or provided to the public for firewood or houselogs. Trees cleared from private property would likely remain the property of the landowner. Trees cleared from roadless areas would be moved to the side of the right-of-way for proper in-place disposal.

Natural revegetation would be allowed to proceed unhindered in much of the construction right-of-way. However, maintenance clearing of natural regrowth of balsam poplar, willow, paper birch, and other species would be required for access of maintenance vehicles and equipment along the portion of the right-of-way paralleling the Parks Highway and between the Knik Road and Big Lake Junction. Maintenance clearing in the roadless area north of Julius may not be required. Maintenance clearing by hydroaxing of the full right-of-way width may be necessary and advisable in certain sections along the Parks Highway where moose wintering concentrations are known to occur (e.g., Willow to Susitna River segment).

At higher elevations shrublands are dominant. Since hydroax clearing does not disturb the integrity of the root mass, regrowth of many shrub species and sprouts from intact stumps should occur the following spring.

No threatened or endangered plant species would be expected to occur along the proposed pipeline route. If any were discovered, efforts to minimize surface disturbance in those areas or re-route of the pipeline would be undertaken.

Minimizing equipment passes over sensitive soils and vegetation communities, and restriction of overland travel to frozen ground conditions in muskeg bog areas, would minimize direct soil disturbance not associated with the trenching and pipe burial process itself.

Wetlands crossed by the pipeline route occur primarily in the cross-country segments south of the Big Lake Junction and north of Julius. Up to 40 percent of the 7 mile segment south of the Big Lake Junction is muskeg and black spruce bogs. From 60-80 percent of the 46 mile cross-country segment from Julius to Fairbanks could potentially be classified as wetlands. Winter construction techniques on frozen soils would be required in these areas. Compaction of backfill in the trench to a level at or below the adjacent ground level would be necessary to prevent interception of surface runoff and subsequent ponding. Excess fill would need to be transported from wetlands to adjacent upland areas for disposal to satisfy CORPS permitting requirements. Ice or snow roads may be required to cross wetland areas to protect the sensitive underlying vegetation, particularly if insufficient snow cover is present for the construction activities intended.

9.2 Wildlife

There are certain inherent impacts associated with the clearing of a right-of-way and burying of a pipeline in almost any location. These include primary impacts such as alteration of existing wildlife habitats and the subsequent disruption of the wildlife species utilizing those habitats. The buried pipeline itself would have no impact on wildlife. Most impacts associated with the pipeline would be directed toward individuals of a population rather than toward entire populations of a species. Secondary impacts include increased human access to previously roadless areas and potential animal-vehicle conflicts near the Parks Highway right-of-way.

Removal of trees and shrubs during right-of-way clearing would be the initial potential disturbance. This will be followed by trenching, welding, and burying of the pipe. Wildlife species, particularly mammals, will temporarily avoid the areas of activity and noise associated with clearing and construction.

Moose, which utilizes many different habitats and whose range includes the entire pipeline route, would probably be the species which encounters construction activity most frequently. However, because it is a generalist herbivore and is a species which seems to readily acclimate to noise (e.g., moose are frequently observed to feed along the major highways in Alaska), these types of disturbance impacts are not anticipated to be significant. Moose would actually benefit during the first 15-20 years from the clearing of forest vegetation and the resulting regrowth of the subclimax community. Maintenance clearing of certain areas of pipeline right-of-way along the Parks Highway may be necessary every 3-5 years if concentrations of wintering moose unacceptably increase the incidence of moose-vehicle collisions.

The distribution of caribou along the pipeline route is somewhat limited, being more common in the Cantwell area than either the north or south end of the route. Caribou typically utilize cover types which will require little if any clearing. Alteration of caribou habitat is not expected to be significant.

Both grizzly and black bears, which utilize the area surrounding the entire pipeline route, would relocate to avoid human activity along the right-of-way. This behavior would occur most frequently along the cross-country route between Julius and Fairbanks. However, since this segment would be constructed during winter while the bears are in hibernation, no disturbance impacts on bears would be anticipated. Bears probably only infrequently utilize the Parks Highway corridor because of the traffic noise and volume, thus construction along the highway should not negatively affect bears. Measures for containment and control of refuse and worker orientation training would be necessary to minimize human-bear interactions.

Small mammals and furbearers such as marten, fox, and ermine will be somewhat affected by clearing and construction activities, but would reinvade disturbed areas after human activities cease. In addition, right-of-way clearing in heavily forested areas may provide habitat improvement for most of the small mammal species which utilize subclimax communities. All told, there would be no measurable impact to the regional populations of any of the small mammal species.

Unless specific nesting trees or cliff nests of raptors are disturbed or removed during clearing, the pipeline should have no impact on endangered or threatened species. Once a specific route had been identified, surveys would be undertaken to identify raptor nesting trees in the vicinity of the pipeline route.

9.3 Fish

The proposed pipeline route is situated in the drainage basins of three large river systems. Approximately 53 percent (156 miles) of the route lies within the Susitna River Basin (which includes the Susitna River and Chulitna River) on the south. North of Broad Pass, which divides the Susitna River and Nenana River basins, about 32 percent (96 miles) of the route lies within the Nenana River Basin. Approximately 15 percent (44 miles) of the route occurs in areas which drain directly to the Tanana River.

The Susitna River Basin, and portions of the Nenana River Basin and Tanana River Basin, are important spawning grounds for the anadromous Pacific salmon as well as several resident riverine species. In the Susitna River Basin, large rivers such as the Susitna River and Chulitna River serve as major migration corridors for anadromous salmon. Generally, Pacific salmon spawning runs begin in May and June and continue into September of each year. The adults return to their natal tributary streams where they spawn and complete their life cycle. The proximity to the ocean and favorable spawning and rearing habitat and winter water flow makes the Susitna River Basin a prime system for spawning and rearing of anadromous fish. As shown in Table 9.3.1, all of the major rivers and tributaries and many of the smaller streams are listed by the Alaska Department of Fish and Game (ADF&G) as being important for anadromous fish.

The Nenana River flows into the Tanana River at the city of Nenana, about 10 miles north of Julius. Remoteness from the ocean limits these drainage basins as anadromous fish habitat. The Nenana and Tanana rivers both serve as migration corridors for anadromous fish, but spawning is primarily limited to major tributary streams with sufficient water and suitable substrate and to sloughs of rivers where the channels are braided. Table 9.3.1 shows that only the major rivers and a few larger tributary streams are currently listed by ADF&G as important to anadromous fish.

Waterways containing anadromous and resident fish are protected by ADF&G through Alaska Statutes 16.05.870 and 16.05.840. A fish habitat permit is required from ADF&G for activities which affect those waterways. Activities requiring a permit include constructing a hydraulic project, use, diversion, obstruction, pollution, or changing of the natural flow or bed of river, lake, or stream, or use of a wheeled, tracked, or excavation or log-dragging equipment in the bed of a river, lake, or stream. To acquire a fish habitat permit, an application is made to ADF&G which includes the following information:

1. plans and specifications of the proposed construction or work;
2. plans and specifications for the proper protection of fish and game in connection with the construction or work, or in connection with the use; and
3. the approximate date the construction, work, or use will begin.

The aforementioned plans and specifications would be required for crossing each stream which harbors anadromous or resident fish.

Table 9.3.1

Watercourses Crossed by Natural Gas Pipeline

Watercourse[1]	Parks Highway Milepost	Crossing Type[2]	Status[3]
Knik Road to Big Lake Junction Segment			
Lucile Creek	--	U	L
Big Lake Junction to Julius Segment			
Little Meadow Creek	52.3	U	L
Little Susitna River	57.1	U	L
Unnamed stream	58.0	U	NL
Unnamed stream	59.8	U	L
Unnamed stream	60.9	U	L
Unnamed stream	62.4	U	L
Unnamed stream	64.9	U	L
Lilly Creek	66.4	U	L
Willow Creek	71.4	U	L
Little Willow Creek	74.7	U	L
196 Mile Creek	80.9	U	NL
197 1/2 Mile Creek	81.0	U	NL
Kashwitna River	83.2	U	L
Caswell Creek	85.0	U	L
Sheep Creek	86.6	U	L
Unnamed stream	92.0	U	NL
Goose Creek	93.5	U	L
Montana Creek	96.6	U	L
Unnamed stream	99.3	U	L
Unnamed stream	101.2	U	NL
Susitna River	104.3	U	L
Rabideux Creek	106.0	U	L
Unnamed stream	108.0	U	NL
Sawmill Creek	110.0	U	L
Rabideux Creek	113.0	U	L
Trapper Creek	115.6	U	L
Unnamed stream	116.5	U	NL
Unnamed stream	117.5	U	NL
Unnamed stream	120.5	U	NL
Unnamed stream	121.9	U	NL
Unnamed stream	124.5	U	L
Unnamed stream	126.0	U	NL
Unnamed stream	126.9	U	NL
Unnamed stream	127.4	U	NL
Unnamed stream	128.4	U	L
Chulitna River	132.8	U	L
Unnamed stream	133.1	U	NL
Unnamed stream	135.4	U	NL
Unnamed stream	135.8	U	NL
Unnamed stream	136.5	U	NL
Unnamed stream	137.0	U	NL
Troublesome Creek (branch)	137.1	U	NL

Table 9.3.1 (continued)

Watercourses Crossed by Natural Gas Pipeline

Watercourse[1]	Parks Highway Milepost	Crossing Type[2]	Status[3]
Troublesome Creek	137.3	U	L
Unnamed stream	139.5	U	NL
Byers Creek	144.0	U	L
Horseshoe Creek	159.8	U	L
Unnamed stream	161.2	U	NL
Little Coal Creek	163.2	A	NL
Pass Creek	165.4	U	NL
Division Creek	167.6	U	NL
Granite Creek	170.9	U	NL
Hurricane Gulch	174.0	A	NL
Little Honolulu Creek	176.6	U	L
Unnamed stream	177.6	U	NL
Honolulu Creek	178.1	U	L
Antimony Creek	181.5	U	NL
Unnamed stream	183.6	U	NL
Unnamed stream	184.0	U	NL
East Fork Chulitna River	185.1	U	L
Fourth of July Creek	190.3	U	NL
Middle Fork Chulitna River	194.5	U	L
Unnamed stream	194.6	U	NL
Pass Creek	208.0	U	NL
Jack River	209.5	U	NL
Unnamed stream	211.5	U	NL
Unnamed stream	214.6	U	NL
Unnamed stream	214.8	U	NL
Unnamed stream	215.1	U	NL
Nenana River (bridge No. 1)	215.7	U	L
Unnamed stream	216.1	U	NL
Slime Creek	219.2	U	NL
Unnamed stream	221.5	U	NL
Carlo Creek	224.0	U	NL
Nenana River (bridge No. 2)	231.3	U	L
Riley Creek	237.2	U	NL
Nenana River (bridge No. 3)	238.0	U	L
Kingfisher Creek	238.3	U	NL
Junco Creek	238.9	U	NL
Iceworm Gulch	240.1	U	NL
Hornet Creek	240.2	U	NL
Grizzly Creek	240.6	U	NL
Fox Creek	241.2	U	NL
Eagle Creek	241.7	U	NL
Dragonfly Creek	242.1	U	NL
Coyote Creek	242.5	U	NL
Nenana River (Moody Bridge)	242.9	U	L
Bison Gulch	243.6	U	NL
Antler Creek	244.6	U	NL
Dry Creek (bridge No. 1)	249.3	U	NL

Table 9.3.1 (continued)

Watercourses Crossed by Natural Gas Pipeline

Watercourse[1]	Parks Highway Milepost	Crossing Type[2]	Status[3]
Dry Creek (bridge No. 2)	249.8	U	NL
Panguingue Creek	252.5	U	L
Little Panguingue Creek	254.0	U	NL
Slate Creek	257.9	U	NL
Rock Creek	261.2	U	NL
Unnamed stream	266.2	U	NL
June Creek	269.0	U	NL
Bear Creek	269.3	U	NL
Birch Creek	272.5	U	NL
Unnamed stream	274.2	U	NL
Unnamed stream	274.9	U	NL
Nenana River (Rex bridge)	275.8	U	L
Julius Creek	285.7	U	NL
Unnamed stream	288.5	U	NL
Unnamed stream	293.9	U	NL
Unnamed stream	294.1	U	NL
Unnamed stream	294.5	U	NL
<u>Julius to Fairbanks Segment</u>			
Fish Creek	--	U	NL
9 unnamed streams	--	U	NL
Totatlanika River	--	U	NL
Totatlanika River	--	U	NL
5 unnamed streams	--	U	NL
Tatlanika River	--	U	NL
3 unnamed streams	--	U	NL
Wood River	--	U	NL
3 unnamed streams	--	U	NL
Crooked Creek	--	U	NL
Unnamed stream	--	U	NL
Willow Creek	--	U	NL
4 unnamed streams	--	U	NL
Salchaket Slough	--	U	L
Unnamed stream	--	U	NL
Salchaket Slough	--	U	L
Unnamed stream	--	U	L
Tanana River	--	U	L

1 Names of watercourses were obtained from 1:63,360 scale U.S.G.S. quadrangle maps and highway markers.
2 U = Underground; A = Aerial stream crossings;
3 Refers to the status of protection provided the watercourse for anadromous fishes.
L: The watercourse is afforded protection under A.S. 16.05.870 as listed in "An Atlas to the Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes" as revised April 1, 1988.
NL: The watercourse is not presently afforded protection under Alaska Statutes 16.05.870 and 16.05.840 due to either the absence, or lack of documentation, of anadromous fishes.

The preferred pipeline route would cross a minimum of 144 streams and rivers, as shown in Table 9.3.1. One stream would be crossed between Knik Road and the Big Lake Junction. Between the Big Lake Junction and Julius at least 106 streams and rivers would be crossed. The greatest density of streams and rivers, crossed per linear distance occurs along the cross-country route between Julius and Fairbanks, where a minimum of 37 streams and rivers would be crossed over a distance of about 46 miles (an average of 0.8 watercourses crossed per linear mile of pipeline).

With the exception of the two aerial crossings at Little Coal Creek and Hurricane Gulch, all river and stream crossings are proposed to be placed beneath the bed of the watercourses (Table 9.3.1). Forty of the rivers and streams to be crossed by burying the pipe beneath the bed are currently listed by ADF&G as protected anadromous fish streams. This number could increase if fisheries studies in support of the pipeline project documented anadromous fish use of some of the currently unlisted streams crossed by the pipeline route.

The sheer number of anadromous fish streams crossed by the pipeline route, plus the numerous non-anadromous streams to be crossed which likely harbor resident fish, suggests that the cumulative impact on the fisheries resource may be considered significant. The primary issues of concern at stream crossings will be timing, downstream siltation, stream bank stabilization, and stream bank revegetation.

During early spring salmon and subadults undertake their seaward migration. Most spawning by returning adult salmon has not commenced until later in the summer. For these reasons, the typical window preferred by ADF&G for construction in anadromous fish streams is the period May 15 through July 15. Open water crossings of resident fish streams will have different construction windows, depending on the fish species involved. It can be assumed that ADF&G would prefer to limit all construction requiring open-water stream crossings to this time period. However, if the construction schedule would be severely impacted or other physical constraints prevent the utilization of this 2 month window, ADF&G could be expected to work with the permit applicant to arrive at a mutually agreeable solution. For example, winter construction would be required in the Julius to Fairbanks segment of the route, and authorization to conduct low-water winter crossings of the affected streams would be required.

To avoid or minimize downstream siltation impacts, specific construction techniques will be stipulated by ADF&G. These stipulations will be specific to each stream crossings and will dictate construction methods to be used in effecting the crossing. These methods may include fluming, stream channel diversion, use of filter fabric and temporary dams, replacement of stream bed and bank materials, and removal of all man-made diversion materials from the natural and diversion channels. Stream banks may also require revegetation in certain situations when erosion may prevent natural revegetation or when visibility is a problem. Appendix A contains typical ADF&G approved fish habitat protection and enhancement strategies for fluming, diversion, and revegetation.

Erosion control measures will also be required on steep slopes and other disturbed areas subject to surface erosion. Measures such as ditch plugs, water bars, and revegetation will be implemented on an as-needed basis to control surface erosion and downslope flow of erodible soils.

The actual timing and methods used in accomplishing the numerous stream crossings will probably be the major environmental issue of pipeline construction. Well developed construction plans and specifications and coordination with ADF&G, beginning with the early project planning stages, will serve to minimize potentially adverse impacts on both the fisheries resource and the project schedule.

9.4 Land Use

Since the natural gas pipeline will be buried along its entire length, it should have little or no impact on present or anticipated future land use. In granting a utility right-of-way for the pipeline, landowners would agree to not construct any buildings, structures, or obstructions which would interfere with construction, maintenance, and repair of the pipeline. The pipeline would be buried at sufficient depth to not interfere with cultivation of the soil.

Temporary disruptions in traffic could be expected at road crossings of the Parks Highway, but these would be of short duration and only minor inconveniences to the public. Similar temporary disruptions of rail traffic could be anticipated at railroad crossings, but these crossings could be timed to correspond to the intervals between trains.

Crossing of Denali National Park and Preserve along the Parks Highway right-of-way presents a potentially important land use conflict. The Code of Federal Regulations (CFR) Title 43 was amended in September 1986 to add a new Part 36 which governs, among other applications, access of natural gas pipeline transportation or utility systems within Denali National Park and Preserve. The National Park Service (NPS), which administers Denali National Park and Preserve, does not have the jurisdiction to issue a right-of-way permit for a natural gas pipeline within the park boundaries. Application to cross Denali National Park and Preserve would necessitate preparation of an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS) by the NPS or other lead federal agency. In addition to the EA and EIS requirements, authorization for a right-of-way permit would be predicated upon the assumption that the following two conditions would be met:

1. the pipeline system would be compatible with the purposes for which Denali National Park and Preserve was established; and
2. there is no economically feasible and prudent alternate route for the pipeline outside the park boundary.

Aside from the actual disturbance and visual impacts of equipment and exposed ditch and pipe during construction, the pipeline would be entirely buried and out of site during operation. Within 1-2 years, shrubs would rapidly reinvade the disturbed soils above the pipeline. Invader forb species such as fireweed would dominate the site in the interim during regrowth of the shrubs. Thus, the short-term nature of any visual disturbance impacts should be negligible.

To construct the pipeline following an alternate cross-country route around the park boundary on the east side of the Nenana River could be substantially more expensive than the route through the park, and would also result in a potentially long-term visual impact. The alternate cross-country route would require clearing trees from a 100 foot wide right-of-way. Though the pipe itself would not be visible, portions of the cleared right-of-way would be visible from higher elevations near the park entrance and from the Parks Highway. Two instream crossings of the Nenana River and one crossing of Riley Creek would be avoided by the alternate route, but the Yanert Fork would need to be crossed.

If the arguments mentioned above provided sufficient justification during the EIS process for routing the pipeline through the park, pursuant to Section 1106 (b) of ANILCA, the Secretary of the Interior would then make a recommendation to the President of the United States with a statement of reasons and a finding in support of granting a right-of-way across the park. The President then would make a determination and provide a recommendation to Congress. Congressional approval of the right-of-way through a joint resolution of Congress would be required prior to granting of the right-of-way. Resolution of this potential land use conflict could require two or more years before a right-of-way was granted.

9.5 Visual Resources

The right-of-way cleared for the Knik Road to Big Lake Junction and Julius to Fairbanks segments of the route would be viewable primarily only from the air; as such the visual impacts of this clearing would be negligible.

The pipeline route paralleling the Parks Highway would traverse 11 distinct and transitional landscape character types, as described by ADNR (1981). These landscape character types are shown in Table 9-5. Refer to ADNR (1981) for detailed descriptions and management recommendations proposed by ADNR to manage visual resources along the Parks Highway. In general, ADNR (1981) recommended designating portions of the Parks Highway with high scenic resource value as a scenic highway corridor. For portions of the Parks Highway with lower scenic resource values but high visual absorption capability, greenbelts of 100-200 feet in width beyond the edge of the highway right-of-way were recommended to protect sensitive foreground scenic resource values. Many areas bordering the Parks Highway, especially in the Susitna River Lowlands landscape character type, were of fairly low visual quality and did not warrant special scenic consideration (ADNR 1981).

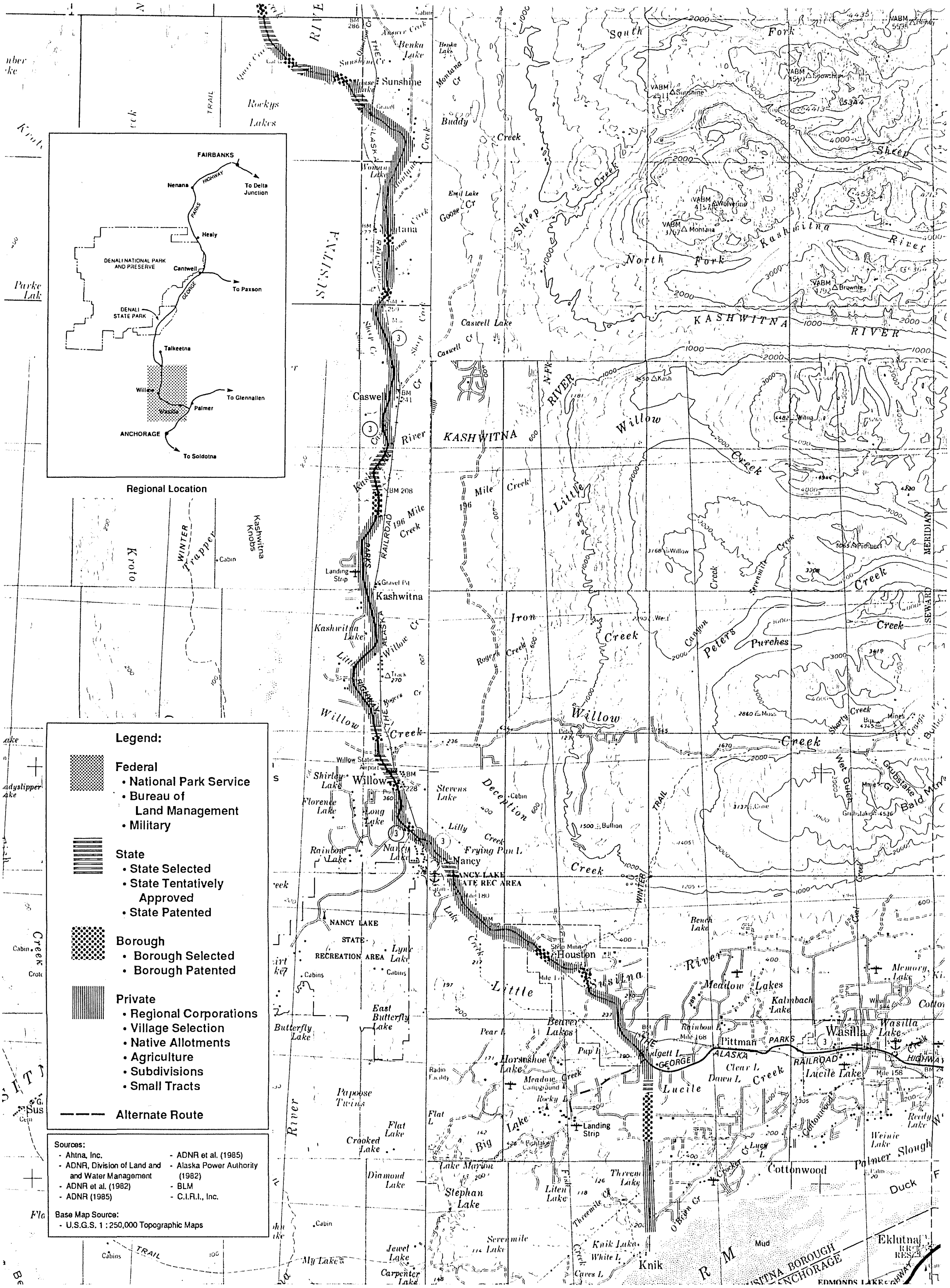
The pipeline route would lie in the immediate foreground of views from the Parks Highway. The visual impression would be one of a re-clearing of the highway right-of-way on the side of the road occupied by the pipeline. In many instances, particularly north of Willow, the highway right-of-way clearing would need to be widened to accommodate pipeline construction equipment. In all cases, except around valve stations and permanent facilities, the vegetation would be allowed to regrow. Thus the visual impact would be reduced over time as new growth covered soil exposed during construction. The viewing public expects a highway right-of-way to be cleared back some distance from the edge of the road -- if only for safety purposes to avoid collisions with moose. A widened or re-cleared highway right-of-way would not be expected to elicit negative responses from most travelers using the Parks Highway. In addition, in some instances clearing of some trees along the highway right-of-way would enhance the visual quality by opening views to background landforms.

Table 9.5

Landscape Character Types Along George Parks Highway

Landscape Character Type	Location
Little Susitna River-Susitna Lowlands	Big Lake Junction to MP 68.0 (1 mile south of Willow)
Susitna River Lowlands	MP 68.0 to Denali State Park Entrance (MP 132.7)
Chulitna River	MP 132.7 to MP 182.0 (1 mile north of Antimony Creek)
Chulitna River-Broad Pass	MP 182.0 to MP 188.0
Broad Pass	MP 188.0 to MP 194.0
Broad Pass-Alaska Range	MP 194.0 to MP 217.5 (8.5 miles north of Cantwell)
Alaska Range	MP 217.5 to MP 237.9 (Denali National Park and Preserve entrance road)
Nenana Gorge	MP 237.9 to 243.4
Nenana Uplands	MP 243.4 to MP 271.6 (2.6 miles north of June Creek)
Nenana Uplands-Nenana River Lowlands	MP 271.6 to MP 276.2
Nenana River Lowlands	MP 276.2 to MP 296.8 (Julius)

Source: ADNR (1981)



COOK INLET - FAIRBANKS NATURAL GAS PIPELINE
Alaska Power Authority

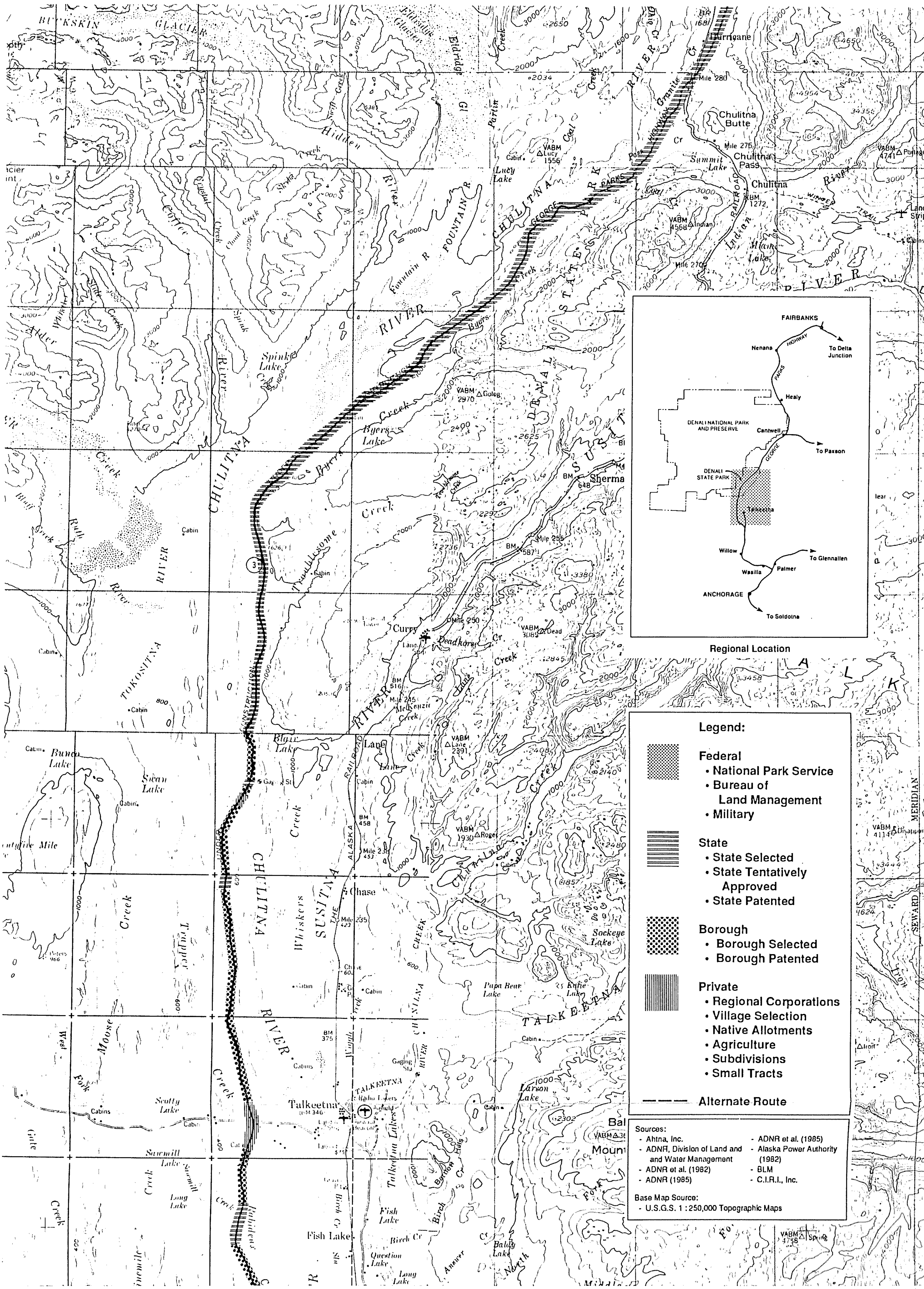
5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
0 5 10 15 Nautical Miles

North

Stone & Webster Engineering Corporation

Land Ownership

FIGURE 10-1 Sheet 1 of 5



COOK INLET - FAIRBANKS NATURAL GAS PIPELINE
Alaska Power Authority

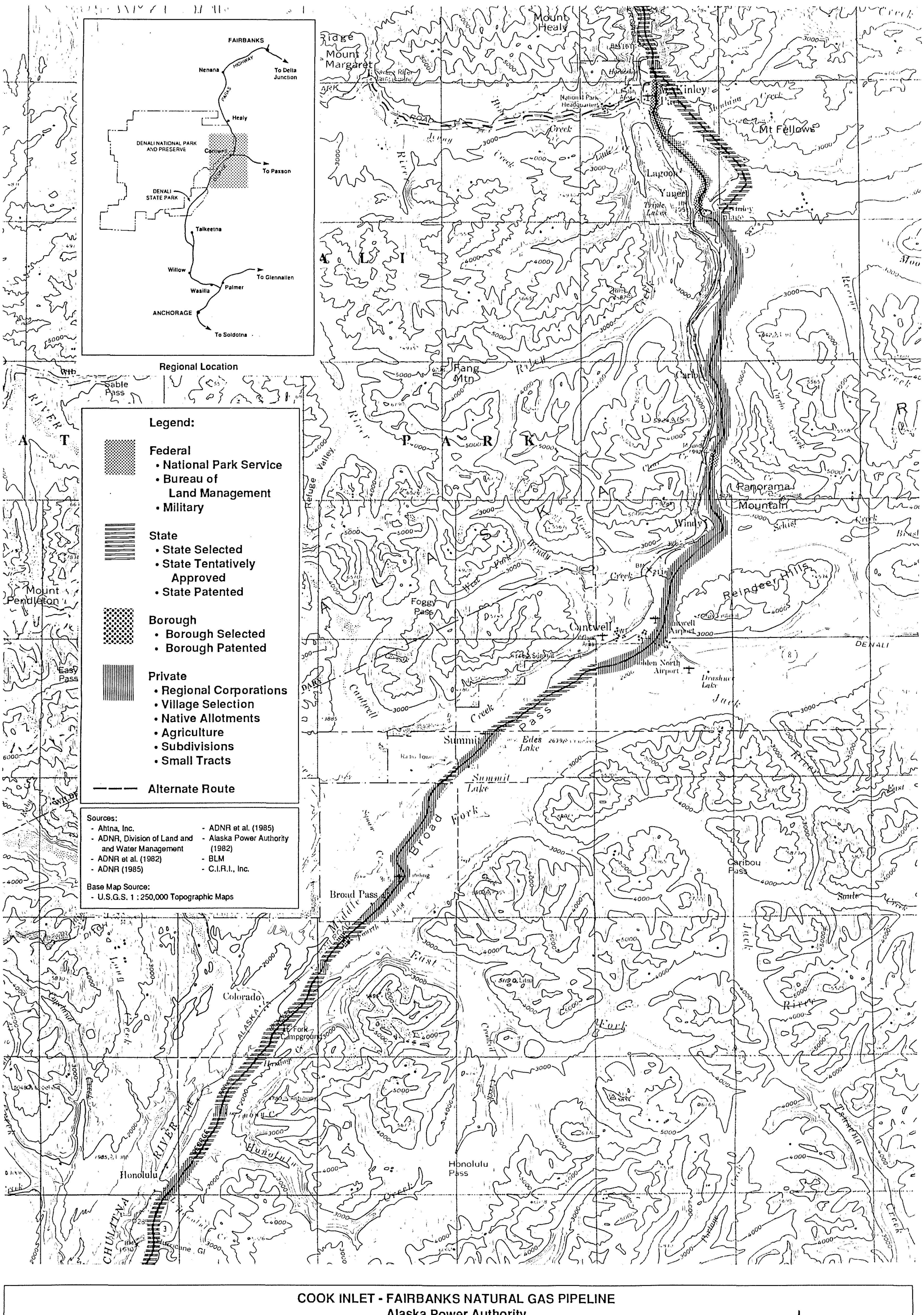
5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

North

Land Ownership

Stone & Webster Engineering Corporation

FIGURE 10-1 Sheet 2 of 5



COOK INLET - FAIRBANKS NATURAL GAS PIPELINE
Alaska Power Authority

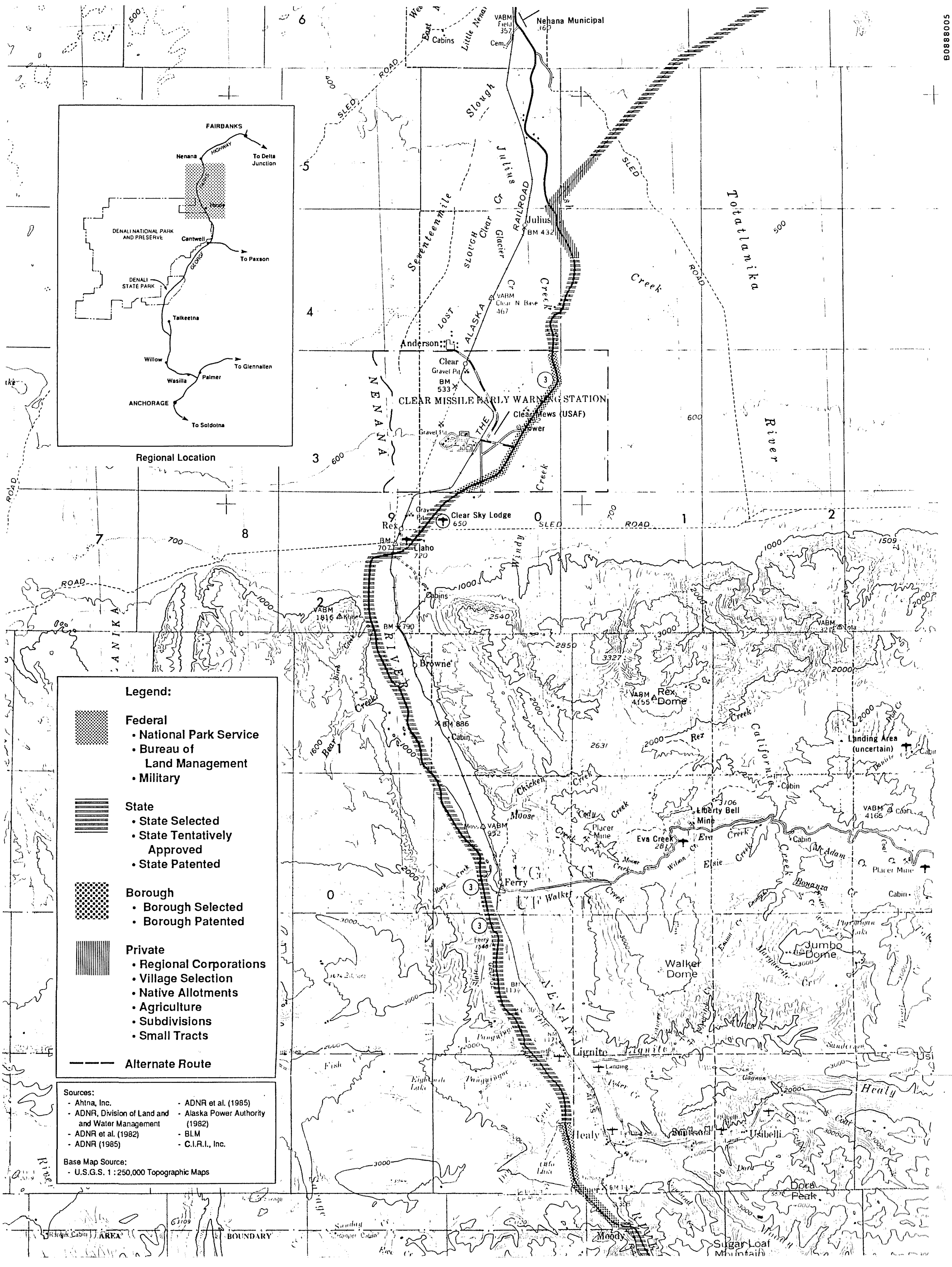
5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
0 5 10 15 Nautical Miles

North

Stone & Webster Engineering Corporation

Land Ownership

FIGURE 10-1 Sheet 3 of 5



COOK INLET - FAIRBANKS NATURAL GAS PIPELINE
Alaska Power Authority

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
0 5 10 15 Nautical Miles

North

Land Ownership

Stone & Webster Engineering Corporation

FIGURE 10-1 Sheet 4 of 5

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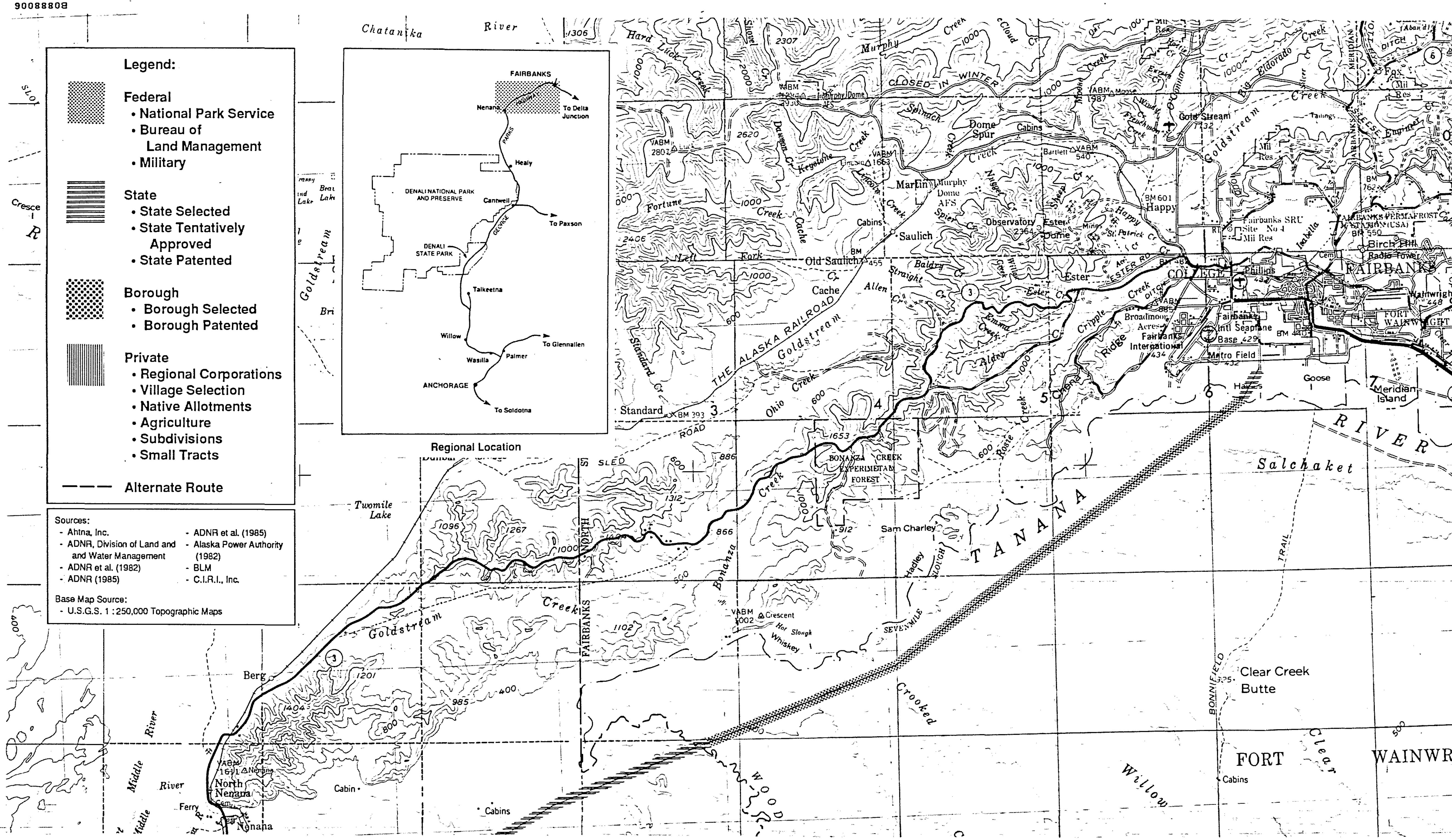


North

20 Statute Miles
30 Kilometers
15 Nautical Miles

COOK INLET - FAIRBANKS NATURAL GAS PIPELINE
Alaska Power Authority

Land Ownership
FIGURE 10-1 Sheet 5 of 5

Stone & Webster Engineering Corporation

9.6 Air Quality

A preliminary assessment was made of potential effects of construction and operation of the proposed gas pipeline on ambient air quality. Considered were: pollutant emissions associated with pipeline construction activities; emissions reductions that could be achieved at existing utility and/or industrial facilities by switching from coal and/or oil to gas; and the increased incidence of ice fog associated with firing natural gas.

9.6.1 Pipeline Construction

Use of heavy-duty construction equipment for construction of the proposed pipeline will result in temporary increases in emissions of the following regulated pollutants along the pipeline route: carbon monoxide (CO), hydrocarbons (HC), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and particulate matter (PM). The extent of these emissions will depend on the number and types of heavy duty vehicles in use at a given time, and the time required to construct a unit length of pipeline. No definitive information is currently available on the distribution of the types of vehicles which would be used for routine pipeline construction, or the approximate number of hours each would be used on a daily basis.

Effects of the above described emissions on ambient air quality are expected to be minimal because they are temporary and will affect any given location only a short period of time.

In addition to the pollutants discussed above, additional amounts of particulate matter will become airborne due to routine movement of construction vehicles on off-road locations, particularly when soils are disturbed for pipeline construction and the weather conditions are dry and windy. When feasible, water will be applied to control these types of particulates, particularly when construction is occurring near inhabitated areas.

One additional new emissions source considered for the proposed gas pipeline is a gas compressor station to power compressors used for pipeline transportation and other possible uses. However, since existing facilities are capable of providing gas in quantities that will satisfy demand over the next several years, a new compressor station will not be constructed to support the proposed pipeline.

9.6.2 Emissions Reductions Achievable by using Natural Gas at Existing Large Sources currently using Coal or Oil

The Alaska Department of Environmental Conservation (ADEC) provided Stone & Webster with a copy of its most recent summary of emissions from large pollutant sources located along the Anchorage to Fairbanks railbelt. A large source was defined by ADEC to be one which emitted more than 100 tons per year of at least one pollutant in one or more years.

The emissions data provided by ADEC identified emission rates in tons per year for PM, SO_2, NO_x and CO, and the fuel (gas, coal, oil, or coal and oil) being used at each source. Most of the emissions data provided were for the years 1973, 1975 and 1976. However, emissions data for most large sources located in the northern region were also given for the year 1978. These emissions data are considered by ADEC to be reasonably representative of existing conditions. The data did not include impacts from recent changes or predict changes for planned upgrades. The emissions data did not include any information on unit size or average plant capacity factor.

The emissions rate data described above were averaged for each source and pollutant using the data available for the years 1973, 1975, 1976 and 1978. These data were then summed for those sources using the same fuel, i.e., natural gas, oil, coal, or coal and oil. The results are given in Table 9.6. Also given in this table is the number of sources included in each fuel category.

Table 9.6
Estimates of Pollutant Emissions (Tons/Yr) Resulting Annually from Operation of Large Power Generating Sources Located Along the Railbelt Between Anchorage and Fairbanks

	Pollutants				
Fuel	PM	SO_2	NOx	CO	No. Sources
Natural Gas	132	29	3311	698	6
Oil	103	385	1399	317	2
Coal & Oil	76	738	374	63	1
Coal	5829	2830	4826	561	5
Totals	6140	3982	9910	1639	14

A fuel analysis of the natural gas identified for use in the proposed pipeline is as follows:

Constituent	Percent by Weight
Carbon Dioxide	0.2705
Ethane	0.0260
Nitrogen	0.6380
Particulates	0.0000
Sulfur	0.0000
Methane	99.0655
All	100.00

Assuming use of the above described natural gas in large sources along the railbelt, it is expected that essentially all of the particulate and sulfur dioxide emissions identified in Table 9.6 resulting from coal and oil combustion could be eliminated. Accordingly, particulate and sulfur dioxide emissions would be reduced by about 6008 and 3953 tons/year respectively. No reduction in the particulate and sulfur dioxide emissions given in Table 9.6 for gas firing is assumed, since the high quality gas previously identified is currently being used in large sources along the railbelt.

Nitrogen oxide emissions can also be reduced by using natural gas in sources currently firing coal or oil. To achieve a significant reduction at existing coal fired sources, however, the boiler would have to be modified to include low NO_x burners. Implementation of such burners could result in a factor of 2 or 3 reduction in current NO_x emissions from existing coal sources.

The amount of NOx reduction that can be achieved by using natural gas at oil-fired gas turbines depends primarily on firing temperature (Ref. 1). At low firing temperatures (800-1000°F), the reduction that can be achieved is small (0-12 ppmv). At high temperatures (about 2000°F), NOx reduction on the order of 45 to 60 ppmv can be expected.

Carbon monoxide emissions can be reduced if natural gas is substituted for oil or coal as the fuel. CO reduction at sources firing oil in gas turbines depends on firing temperature. For example, little or no reduction will occur at temperatures of 1800-2000°F. At temperatures in the range of 800-1200°F, CO emissions would be reduced by about 17 to 20 ppmvd (General Electric Company 1982).

CO emissions would be significantly reduced at a coal-fired facility if natural gas were used as the fuel. The amount of the reduction is estimated to be on the order of 70 to 80 percent. CO emissions would be reduced because more complete combustion occurs with natural gas than with coal.

Review of Table 9.6 and the information presented in this section suggests that modification of existing coal-fired facilities to burn natural gas would result in a reduction of pollutant emissions, including PM, SO_2, NOx and CO. All coal-fired units currently operating along the Anchorage to Fairbanks railbelt are located in the northern sector.

The overall effects of these potential emissions reductions on ambient air quality cannot be quantified within the scope of the present study. However, the following observations can be made.

1) Ambient air quality in the vicinity of each large source would be improved.

2) The reduced emissions of SO_2 and NOx would decrease the potential for acid rain formation and/or acid deposition in surrounding areas.

3) Decreased emissions of CO from coal-fired sources in the Fairbanks area may improve ambient CO concentrations there. However, the major CO sources most likely are automobiles, trucks and other vehicles powered by gasoline or diesel fuels.

4) Switching from wood burning stoves to natural gas furnaces could significantly reduce particulate levels in communities where wood is primarily used for home heating.

9.6.3 Increased Incidence of Ice Fog Associated with Firing Natural Gas

The firing of natural gas in power generating units in place of coal or oil will result in the formation of additional moisture during the combustion process. This additional moisture may contribute to the formation of ice fog during cold weather conditions. The potential for ice fog occurrence is greatest when ambient temperatures reach about -10°F and lower. Moreover, ice fog is a major contributor to visibility problems along roadways in some parts of Alaska during the winter season.

As part of a previous study for ENSTAR Natural Gas Company (ENSTAR), Stone & Webster estimated the amount of moisture that would be included in the flue gas from power generating units that fired coal, oil, and natural gas. The estimates are as follows:

Fuel	Moisture in Flue Gas, lb/Mbtu
Coal	77.1
Oil	63.5
Natural Gas	94.8

This shows that the moisture content of flue gas is significantly greater for natural gas firing than for firing of coal or oil.

The study for ENSTAR also reviewed the potential for gas firing to contribute to visibility reduction problems in the Fairbanks, Alaska area. University of Alaska staff consulted during this study included Dr. Carl Benson and Dr. Sue Ann Bowling, who are familiar with the ice fog problem in Fairbanks. Drs. Benson and Bowling stated that ice fog in the area occurs primarily from automobile emissions and power plant water discharges to the Chena River, resulting in visibility reduction along roadways. Visibility reduction along roadways is the most prevalent ice fog problem in Fairbanks and is most severe when ambient temperatures reach about -35° to -40°F.

During the winter season when ambient temperatures are cold, the Fairbanks area frequently experiences strong surface inversions, i.e., a temperature increase with height of about 30°C per 100 meters. Under these conditions, emissions from firing natural gas in utility or industrial boilers located near roadways will contribute to the formation of roadway ice fog since both plume rise from the stack and plume dispersion will be limited. According to Dr. Benson, however, the contribution of these sources to roadway ice fog are minor compared with those from vehicle emissions and power plant discharges to the Chena River.

Plumes from the firing of natural gas in utility or industrial boilers during winter will likely increase the frequency with which ice fog forms and affects air travel. Incremental effects over existing operations, however, are expected to be minimal. Similarily, the conversion of home heating units from wood or oil to gas is not expected to result in a noticable change in the incidence of ice fog.

9.7 Archaeological and Cultural Resources

Alaska Power Authority (1982) provided a summary of recorded archaeological or historical cultural resources along the Anchorage - Fairbanks transmission intertie extending from Willow to Healy. A portion of this route paralleled the Parks Highway, and some of the areas surveyed overlapped the pipeline corridor. Those investigations discovered several prehistoric and historic sites along the transmission line route. The pipeline route would be in the vicinity of several of those sites.

Contact with the State Historical Preservation Office (SHPO) confirmed that a significant amount of survey work has been undertaken in the railbelt area, although the entire length of the Parks Highway right-of-way itself has not been fully surveyed. The SHPO office maintains current records of surveys in the state. No significant cultural resources have been discovered in this region to date (Dixon, G., SHPO, personal communication, August 15, 1988).

On-site investigations for cultural resources would likely be required for portions of the final pipeline route not previously surveyed. Preconstruction survey and testing would identify specific resources so they can be avoided during final siting. Should impact to any specific resource be unavoidable, data recovery would be a possible mitigative measure. However, unavoidable impact to a site is unlikely given the findings of past surveys along the Parks Highway right-of-way.

9.8 Socioeconomic

An overview of the population status, settlement patterns, employment, and general economy of the railbelt area between Willow and Healy was provided by Alaska Power Authority (1982). The pipeline route spans two regional governmental borough jurisdiction which are separated by an unincorporated borough. The route occurs in the Matanuska-Susitna Borough on the south end and the Fairbanks North Star Borough on the north end.

The population of the general railbelt area is small in numbers and scattered in distribution. Population clusters occur at the settlements of Houston, Willow, Kashwitna, Talkeetna, Peters Creek, Cantwell, Healy, and Nenana. The remaining population is scattered within a narrow band of accessible land along the Parks Highway or the Alaska Railroad.

The resident labor force is small and the variety of industrial and commercial services provided by the local economy is limited. The Matanuska-Susitna Borough workforce experiences high chronic umemployment rates. Unemployment in the borough is also subject to wide seasonal swings, reaching a summertime peak when construction labor and recreation-oriented trade and services are in demand, and declining during the off-season to a wintertime low.

Available housing in the railbelt is primarily single-family in type. Few multi-family units exist north of Wasilla. The currently depressed Alaskan economy has made a large number of primarily single-family homes available in the Palmer - Wasilla area, but in general these homes would not meet the needs of a construction workforce for a linear project such as a pipeline. A few small-scale commercial lodging facilities occur along the Parks Highway, but these are often filled by summertime travelers and could not serve a large, mobile workforce.

The construction program would span about 12-18 months, with the effort being fairly evenly spread over that time period. Installation of the gas pipeline would require a total field construction workforce of about 900 workers to accomplish the work in that short time frame. The workers would be segregated into four groups, one group for each of the four spreads of pipeline. The workforce would be drawn from a variety of occupational categories, including equipment operators, pipefitters, welders, and inspectors.

In view of the lack of housing and community and commercial services available along the route, the construction workers would be housed in three temporary construction camp sites located along the pipeline route. Based on the current economic conditions in southcentral Alaska, the influx of capital in the form of spendable wages would no doubt have a favorable short-term effect on the local economy of the area. Skilled workers brought to the area for the pipeline work may elect to take up residence, though the probabilities of continued employment may discourage that effect. The provision of temporary construction camp quarters and the substantial share of non-local workers which would be expected to immigrate to the area seeking employment would tend to depress the volume of purchases of local goods and services made by the project workforce. Similarly, due to the specialized nature of the project, it would be expected that local purchase of materials, equipment, and supplies for the project would be minimal. These circumstances would minimize the stimulus to the local economy, but the primary economic impacts of direct employment of local residents and the purchasing power of wages paid to all workers would be a positive short-term benefit to the local economy.

9.9 Summary of Significant Impacts

The single major impact of overall concern would be the potential cumulative effect on fisheries resources of the numerous instream crossings proposed for the gas pipeline. The short construction schedule will dictate that not all streams can be effectively forded during the optimum May 15 through July 15 period. Winter construction techniques necessary in roadless areas away from the Parks Highway right-of-way would necessitate winter crossings of the affected streams. For the larger streams and rivers in the Susitna River drainage which harbor large runs of anadromous fish, such as the Little Susitna River, Willow Creek, Kashwitna River, and Montana Creek, fluming the stream to install the pipe may be impractical. However, in consultation with ADF&G, effective and efficient methods of crossing each stream would be developed. Specific erosion control techniques to minimize or prevent downstream siltation would be employed. ADF&G will closely monitor instream construction techniques to ensure strict compliance with permit stipulations. In addition, it is anticipated that the Quality Assurance/Quality Control (QA/QC) inspectors assigned to monitor construction of each spread and the Environmental Field Officer will assure compliance with permit stipulations. This close monitoring of the contractor's work activities should result in no significant impact to fisheries or other resources.

Key issues related to environmental protection will be addressed during the detailed design phase of the project. These issues are anticipated to include the following:

- Specific erosion control measures
- Wetland crossing measures
- Construction timing
- Stream crossing locations
- Raptor mitigation measures
- Refuse disposal
- Vegetation disposal
- Right-of-way maintenance
- QA/QC

Details of these and other issues will be completed and presented to the resource agencies for their approval prior to their implementation.

9.10 References

Alaska Department of Natural Resources. Scenic Resource Along the Parks Highway, Inventory and Management Recommendations. Susitna Basin Planning Background Report. 1981.

Alaska Power Authority. Environmental Assessment Report, Anchorage - Fairbanks Transmission Intertie. Prepared by Commonwealth Associated. March, 1982.

General Electric Company. Emission Performance and Control Techniques for Industrial Gas Turbines. 1982.

10.0 LAND OWNERSHIP

10.1 Ownership Types

Land ownership along the major portion of the pipeline route is currently under resolution among federal, state, and private interests. The Alaska Statehood Act and the Alaskan Native Claims Settlement Act provide the means for land disposition. The Statehood Act makes federal lands available to the state and the Settlement Act permits conveyance of acreage to Alaskan natives. Additionally, the Alaska Municipal Code permits the borough to select for municipal purposes ten percent of the vacant unreserved state land located within its boundaries.

The following definitions pertain to those land ownership classifications present along the pipeline route and used to delineate land ownership in Figure 10-1.

Federal: those lands under jurisdiction of the National Park Service, Bureau of Land Management, or the Military.

State: The state receives land or has received land from the federal government in a three-step process.

Federal State Selected: the state first applies for land which is classified as State Selections Applications or Federal State Selected.

State Selection Tentatively Approved: those selected lands are then approved by the federal government for transfer to the state.

State Selections Patented: federal lands are finally conveyed to the state.

Borough: boroughs receive land primarily from the state.

Borough Approved or Patented: if state patented land is not reserved for a particular use, a borough can select the land through a process similar to that used by the state in selecting federal lands.

Private: private lands are of several types.

Regional Corporation Selections: those lands selected by the regional corporations under provisions of the Alaska Native Claims Settlement Act. The project area lies within the Cook Inlet (CIRI), Doyon, and Ahtna regional corporations.

Village Selections: those lands selected by Alaskan natives, under provisions of the Alaska Native Claims Settlement Act, which have been traditionally used by them, for their commercial resource value, subsistence hunting, and fishing. The village receives the surface right, and the regional corporation retains the subsurface rights.

Native Allotments: at the start of the century (1906), natives were allowed to file for allotments of up to 160 acres on unoccupied federal lands. These are private holdings.

Agricultural Land: those lands classified by the state as having agricultural potential. The state either owns these lands or has sold them to private ownership.

Unpatented Mining Claims: mining claims by an individual(s) on federal lands. The federal government has the claim patent. Patent mining claims are privately owned.

Subdivisions and Small Tracts: primarily non-native lands held in private ownership.

The land ownership patterns depicted in Figure 10-1 reflect the dominant pattern of ownership along the route, and do not purport to be a detailed land status classification. Small inholdings are not shown due to the 1:250,000 scale of the maps. In many cases land ownership was different on each side of the Parks Highway; again, the dominant ownership pattern was depicted on the maps. The status of many lands in Alaska are dynamic, particularly along the Parks Highway. In addition, some of the background sources used to determine general land ownership were several years old. As a consequence, some small parcels shown as federal or state lands may now be in borough or private ownership. If the project were to proceed to construction, an exhaustive investigation of land ownership from current federal and state records and title searches for each individual parcel would be necessary.

Federally owned lands are concentrated toward the north end of the pipeline route in contiguous parcels at the Denali National Park and Reserve, Clear Missile Early Warning Station (MEWS), and Fort Wainwright Military Reservation. About 15 percent of the pipeline's length is across federally owned lands (Table 10.1).

State owned lands occur primarily from the Denali State Park boundary at the Chulitna River crossing to the Broad Pass area, from Healy to the Clear MEWS south boundary, and from the Clear MEWS north boundary to the Fort Wainwright Military Reservation southwest boundary at the Wood River. About 45 percent of the pipeline route would be on lands owned by the State of Alaska (Table 10.1).

Matanuska - Susitna Borough lands occur primarily in the Talkeetna area between the Susitna River crossing and the Chulitna River crossing. Only about 9 percent of the length of the pipeline is on borough lands (Table 10.1).

The southern one fifth of the pipeline route from Knik Road to the Susitna River crossing is dominated by private land holdings, interspersed by small state and borough parcels. Many of these are non-native private holdings. Additional private lands, mostly native regional and village lands, occur in the area between Cantwell and the southern boundary of Denali National Park and Preserve. Approximately 31 percent of the pipeline's length is on privately owned land (Table 10.1).

Table 10.1

Land Ownership

Ownership Type		Miles	Percent
Federal		46.0	15
State		133.0	45
Borough		26.3	9
Private		92.7	31
	TOTAL	298.0	100

10.2 References

Alaska Department of Natural Resources. Tanana Basin Area Plan for State Lands. June, 1985.

Alaska Department of Natural Resources, Alaska Department of Fish and Game, and Matanuska - Susitna Borough. Susitna Area Plan. June, 1985.

Alaska Department of Natural Resources, Matanuska - Susitna Borough, and Alaska Department of Fish and Game. Willow Sub-Basin Area Plan. October, 1982.

Alaska Power Authority. Environmental Assessment Report, Anchorage - Fairbanks Transmission Intertie. Prepared by Commonwealth Associates March, 1982.

11.0 PERMIT REQUIREMENTS AND RIGHT-OF-WAY AGREEMENTS

Regulatory requirements for a new natural gas pipeline in Alaska will involve permits, approvals, and right-of-way agreements from numerous federal, state, and local agencies. Discussions of permitting requirements address construction and operation of the gas pipeline and its appurtenances which include permanent facilities and temporary construction camps.

The various types of permits and approvals required for the gas pipeline are shown in Table 11.1. Some doubt exists whether particular permits would be required. Detailed engineering and design of project features may be necessary before the agencies can make a determination of the necessity of certain permits and approvals.

The following sections briefly describe the permits and approvals outlined in Table 11.1 which are anticipated for the gas pipeline. This information was collected primarily from meetings and telephone contacts with agency representatives.

11.1 Federal

Federal permits required for the gas pipeline permits would be required from four Federal agencies.

A National Pollutant Discharge Elimination System (NPDES) permit, which evaluates the quality of water from point source discharges of wastewater into a waterway, would be needed from the U.S. Environmental Protection Agency (EPA) for any above-ground wastewater discharge from permanent facilities, temporary construction camps, or concrete batching facilities. Processing time for the NPDES permit is 180 days.

U.S. Army Corps of Engineers (CORPS) Section 10 and Section 404 permits would be required for work in navigable waters and adjacent wetlands. Section 10 permits are needed for any construction or activity below the ordinary high water line of navigable waters. The Susitna River and Tanana River are presently listed by the CORPS as navigable waters which would be crossed by the pipeline. Section 404 permits are needed for placing dredged or fill material in waters of the U.S. Waters of the U.S. also include adjacent wetlands and tributaries. Processing time for Section 10/404 permits is 90 days. A $100 fee would also be required upon granting of the permits.

The CORPS will not issue Section 10/404 permits nor will EPA issue NPDES permits until the State of Alaska Office of the Governor, Division of Governmental Coordination (OMB-DGC) has issued a Certification of Coastal Zone Consistency for the portion of the project within the coastal zone and the Alaska Department of Environmental Conservation (ADEC) has issued a Certificate of Reasonable Assurance (401 Certification).

Table 11.1
Permits and Approvals for Cook Inlet - Fairbanks Natural Gas Pipeline, Alaska

Permit/Approval
FEDERAL
U.S. Environmental Protection Agency
National Pollutant Discharge Elimination System (NPDES)[1]
U.S. Army Corps of Engineers
Section 10
Section 404
Environmental Impact Statement (EIS)
U.S. Department of the Interior, National Park Service
Right-of-Way Permit
U.S. Department of the Interior, Bureau of Land Management
Right-of-Way Grant
Clear Missle Early Warning Station (Military)
Land Use Permit
Fort Wainwright Military Reservation (Military)
Land Use Permit
STATE
Alaska Department of Natural Resources
Division of Land and Water Management
Permanent Water Rights[1]
Temporary Water Rights[1]
Material Extraction
Pipeline Right-of-Way Permit
Division of Forestry
Burning Permit
Division of Parks and Outdoor Recreation
Incompatible Use Permit
Inventory of Archaeological and Historical Sites

Table 11.1 (continued)

Permits and Approvals for Cook Inlet - Fairbanks Natural Gas Pipeline, Alaska

Permit/Approval
STATE (continued)
<u>Alaska Department of Fish and Game</u>
Fish Habitat Permit[1]
<u>Alaska Department of Environmental Conservation</u>
Air Quality Control Permit to Operate[1]
Wastewater Discharge[1]
Potable Water Plan Review, Certificates to Construct and Operate[1]
Sewage Treatment Plan Review, Certificates to Construct and Operate[1]
Open Burning Written Approval
Solid Waste Disposal[1]
Water Quality Variance
Certificate of Reasonable Assurance (401 Certification)
<u>Alaska Department of Transportation and Public Facilities</u>
Utility Permit
Driveway Permit[1]
Lane Closure Permit[1]
<u>Alaska Railroad</u>
Right-of-Way Permit
Land Use Lease
<u>Office of the Governor, Division of Governmental Coordination</u>
Coastal Zone Consistency Certification

Table 11.1 (continued)

Permits and Approvals for Cook Inlet - Fairbanks Natural Gas Pipeline, Alaska

Permit/Approval
LOCAL
Matanuska-Susitna Borough
Utility Permit[1]
Easement Across Borough Lands[1]
Roads[1]
Flood Hazard Permit
Coastal Zone Consistency
Fairbanks North Star Borough
Utility Permit[1]
Easement Across Borough Lands[1]
Roads[1]
City of Nenana
Utility Permit[1]
City of Fairbanks
Utility Permit[1]
Private Landowners

[1] More than one permit of this type may be required.

Submittal of the CORPS permit application would trigger the evaluation of the project to determine if preparation of an Environmental Impact Statement (EIS) is needed. The CORPS permit applicant would prepare an Environmental Assessment (EA) document that provided a project description, summarized environmental information within the project area, and identified anticipated significant impacts of the project for review by the CORPS and other affected federal agencies. If a finding of significant impact was tendered by the CORPS, then the CORPS would cooperate with the applicant in selecting a third party contractor to prepare the EIS. The typical arrangement is for the third party contractor to be reimbursed for services directly by the applicant.

If the CORPS' review of the EA resulted in a finding of no significant impact, then the CORPS permits would be issued for the project following appropriate public comment. Since the gas pipeline as proposed would cross numerous streams and wetlands, it is likely that an EIS would be required. The EIS process for projects of this magnitude in Alaska typically requires about 12 months to prepare the Draft EIS and an additional 6 months to review and incorporate comments into the Final EIS. Costs of printing are borne by the applicant.

A right-of-way permit approved by Congress and administered by the National Park Service (NPS) would be required for the portions of the pipeline which cross Denali National Park and Preserve, as discussed in Section 9.4, Land Use. This permit and Congressional approval would not be needed if an alternate final route around the park boundary was selected. Acquisition of the NPS right-of-way permit would not be guaranteed, and could take as long as two or more years to obtain. Though the NPS could potentially assume the role of lead agency for preparation of the EIS, the longest length of pipeline route falls under the jurisdiction of the CORPS thus making it the prime candidate as the lead agency.

A Bureau of Land Management (BLM) right-of-way grant would be needed for those portions of the pipeline crossing military lands (Clear Missle Early Warning Station and Fort Wainwright Military Reservation), native allotments, and other federal lands administered by BLM. Each military installation must issue a land use permit before BLM will issue the right-of-way grant. Actual costs incurred by BLM for processing the right-of-way application are borne by the applicant, as delineated in 43 CFR 2808.2. Approvals for military land use permits must come from Washington, D.C. A minimum of 12-18 months for military approval of land use permits should be allowed. A pro forma BLM right-of-way grant permit is shown in Appendix B.

11.2 State

Eight state agencies would participate in permitting the natural gas pipeline. The project could expect to participate in funding any required studies by the state, and perhaps the salaries of state personnel conducting those studies, to expedite permit application processing and agency response time.

Eight or more permits or approvals would be required by the Alaska Department of Natural Resources (ADNR). Four permits would be required by the ADNR, Division of Land and Water Management. Permanent water rights permit(s) would be required for permanent facilities. Temporary water rights permit(s) and a material extraction permit may be required during construction. Processing time for water rights permits ranges from 30-90 days for a non-controversial permit application to 6-18 months for a controversial application. Filing fees are $100 for permanent water rights permits and $50 for temporary water rights permits.

An ADNR noncompetitive pipeline right-of-way permit issued under Alaska Statute 38.35 would be required for that portion of the pipeline, permanent facilities, access roads, bridges, valve stations, etc. located on state lands. The detailed pipeline right-of-way application would include footage within the coastal management zone, land ownership information, clearing and disposal techniques, construction methods and timing, and machinery types, among other items. Following an affirmative Preliminary Decision, 30 day public review period, and a Final Finding by the two ADNR Regional Managers involved and the ADNR Commissioner, a right-of-way survey would be required prior to actual construction. An as-built survey of the pipeline would also be required following completion of construction. A pipeline right-of-way lease can be given for a maximum of 30 years, and is renewable in 10 year increments thereafter. The successful applicant is obligated by Alaska Statute 38.35 to reimburse the state for all reasonable costs incurred in processing a pipeline right-of-way application and in monitoring the construction of the pipeline on the state's right-of-way. Application fees of $100 would also apply. An annual $50 per acre land rental fee would be incurred during construction, followed by an annual lease fee (typically 10 percent of the appraised value of the land). A pro forma ADNR right-of-way application is shown in Appendix B.

An ADNR, Division of Forestry burning permit would be required if any open burning were contemplated for disposal of cleared vegetation during the fire season. This situation would be most likely to occur along roadless areas which are dominated by spruce trees and where removal of cleared trees by the public is not practicable because of the remote location. An ADNR, Division of Parks and Outdoor Recreation incompatible use permit would be required for that portion of the pipeline crossing Denali State Park. A permit would also be needed from the Alaska State Historical Preservation Office to conduct surveys and/or excavations for cultural resources.

ADF&G is responsible for issuing fish habitat permits for protection of anadromous and resident fish resources at stream crossings, as discussed in Section 9.3, Fish. Additional surveys of many fish streams by ADF&G would be required in areas where data is insufficient, particularly in the portion of the pipeline route between Broad Pass and Fairbanks. The permit applicant must prepare crossing plans for each waterway crossing identified as harboring anadromous and/or resident fish.

Eight or more types of permits and approvals would be required by ADEC. More than one permit of several permit types would probably be needed. An Air Quality Control Permit to Operate may be required for the Cook Inlet Compressor station. The compressor station would be burning natural gas, so the emissions should have little difficulty in meeting the state air quality requirements. As part of this permit, ADEC may require monitoring of ambient air quality during operation. Processing time for the Air Quality Permit to Operate is 6-12 months, and is renewable after 5 years.

The ADEC wastewater discharge permit, solid waste disposal permit, and plan reviews for the potable water and sewage treatment systems would be needed for temporary construction camps and permanent facilities. The EPA NPDES permit application can also serve as the ADEC wastewater discharge permit application. The plan review process requires detailed engineering and design of water processing and treatment. Processing time is 60 days for the wastewater discharge and solid waste disposal permits and 30 days for the water system plan reviews. There are no filing fees associated with these permits.

An ADEC temporary water quality variance would be required during the construction period at river and stream crossings where downstream water quality impacts which exceed the state allowable limits cannot be entirely avoided.

The ADEC Certificate of Reasonable Assurance, or 401 Certification, states that the proposed activity will comply with the requirements of Section 401 of the Federal Water Pollution Control Act Amendments of 1972, as modified by the Clean Water Act of 1977. Issuance of the 401 Certification by ADEC is required before the federal EPA NPDES and CORPS Section 10/404 permits will be granted. Processing time is 60 to 75 days and the 401 Certification can be renewed after 5 years. There is no filing fee for the 401 Certification.

The Alaska Department of Transportation and Public Facilities (ADOTPF) issues several permits to applicants seeking compatible uses of ADOTPF highway right-of-ways. ADOTPF has in the past asserted its right to issue utility permits to applicants within portions of the Parks Highway which cross state lands. ADOTPF holds a right-of-way permit from ADNR and functions as the manager for those state lands. ADOTPF also asserts the right to issue utility permits for portions of the Parks Highway right-of-way crossing federal, borough, and private lands, though additional permits would be required from federal landowners, native landowners, and some non-native landowners depending on the type of patent easements held by the non-native landowner. ADOTPF would assess a $400 permit fee plus a 25 cents per lineal foot fee up to a limit of $2,500. Thus the total ADOTPF charges for the Parks Highway utility permit would $2,900. An example ADOTPF utility permit issued to Enstar Natural Gas Company is shown in Appendix B. The ADOTPF driveway permit, applicable to constructing new access roads which attach to the Parks Highway or other state roads, has no permit fee. Similarly, the ADOTPF lane closure permit, which is utilized when one or more lanes of a state road would be temporarily blocked during construction, has no fee.

The Alaska Railroad would require a right-of-way permit at railroad crossings and land use lease if pipe stockpile sites or other project facilities were sited on Alaska Railroad managed property.

An OMB-DGC Certification of Coastal Zone Consistency showing compliance with the Alaska Coastal Zone Management Program would be required for the southern portion of the pipeline route falling within the coastal zone management area. A Coastal Zone Project Questionnaire would be submitted with the permit applications to OMB-DGC. OMB-DGC then coordinates the permit review process with federal, state, and local agencies when more than one state agency is involved in issuing permits. After receiving all permits and agency comments, OMB-DGC can issue the consistency determination within 50 days.

11.3 Local

The Matanuska-Susitna Borough and Fairbanks North Star Borough would issue utility permits for compatible uses of borough streets, alleys, and other public ways. An easement across borough lands would be needed if the pipeline or construction right-of-way were to infringe upon borough lands beyond the limits of the Parks Highway right-of-way. A pro forma application for easement across Matanuska-Susitna Borough land is shown in Appendix N. The Matanuska-Susitna Borough assesses a fee of $50 for each non-contiguous parcel requiring an easement permit. Permits for road construction on borough land and coastal zone consistency would need to be acquired for improvements on the affected lands.

City utility permits would be required where distribution lines enter incorporated cities. Right-of-way agreements with private landowners both along the main pipeline corridor and distribution feeder lines would need to be acquired, as necessary. A pro forma right-of-way easement form used by Enstar Natural Gas Company (ENSTAR) for crossing private lands is shown in Appendix N. In addition, a pro forma right-of-way agreement used by Cook Inlet Regional Corporation, Inc. (C.I.R.I.) for access across its land is also shown in Appendix B. ENSTAR typically has not compensated private landowners for right-of-way easements across their property. C.I.R.I. typically attempts to assess utilities an annual lease fee of 10 percent of the appraised fair market value of the land.

APPENDIX A

Typical Alaska Department of Fish and Game Fish Habitat Protection and Enhancement Strategies

Alaska Department of Fish and Game
Habitat Division

FISH STREAM PROTECTION AND ENHANCEMENT STRATEGIES

FLUMING PROCEDURES

The following is a typical procedure for installing flumes in fish streams. Please see the drawings for additional information.

1. Ductile iron pipe(s) are placed in the stream.

2. The entire stream flow is diverted through the pipes by means of temporary dams composed of sandbags, jersey barriers and visqueen, or any other means which does not expose erodible fill to stream flow. (Excavation and berming of native streambed material is not an acceptable technique for diverting streams.)

3. Place a temporary dam at the downstream end of the flume to prevent backflow and to totally isolate the work area.

4. Install the utility line or pipeline by digging under the flume and pulling the line under the flume.

5. Water from the trench should not be pumped directly into the stream, but rather to a settling basin or an area where it can be naturally filtered, such as a wetland, before it reenters the stream.

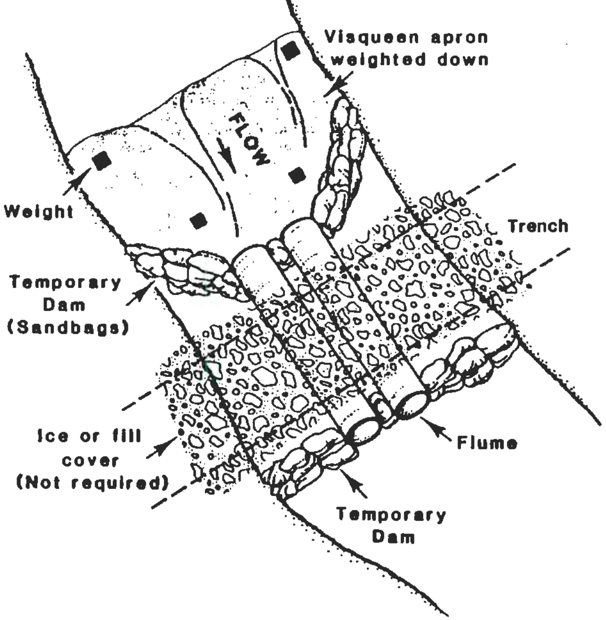
6. Sumps can also be dug adjacent to the trench to dewater the trench.

7. After the utility line or pipeline is installed, the trench should be backfilled, and the top 2 feet should be filled with clean, washed 1" to 6" rock.

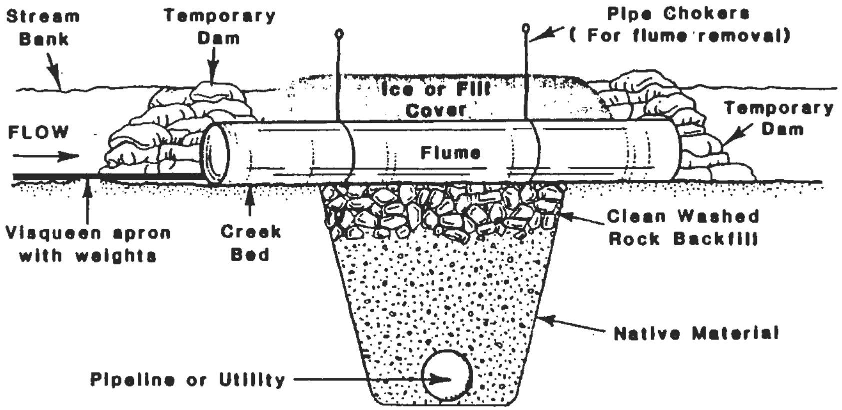
8. The flume is then removed along with all other material foreign to the stream.

9. Stream banks are restored to preproject contours, and riprapped if necessary, and stream banks are revegetated.

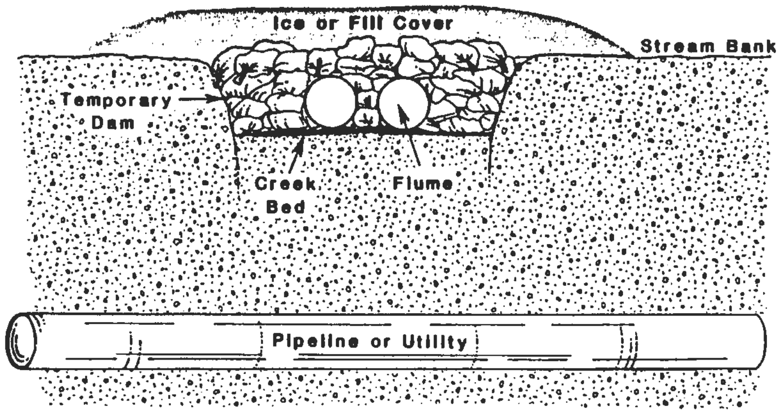
TOP VIEW



SIDE VIEW



END VIEW



NOTES

1. Fluming enables a utility or pipeline trench to be isolated from the stream flow, which reduces stream pollution. Vehicular access across a stream is also provided.

2. Flumes (temporary pipes) can be used in streams up to 100 cfs. Timing should coincide with the low flow period, unless sensitive life stages or the presence of ice are more critical.

3. Fluming procedures may vary according to site specific conditions.

4. Pipes must be large and strong enough to handle the maximum flow of the stream. Except for the smallest streams, corrugated metal pipes (cmp) must not be used because they will not support the weight of the water. Ductile iron or other heavy metal pipes must be used.

5. The length of the flume is dependent on the stability of the trench walls and the depth of the trench. The more unstable the walls or deeper the trench, the longer the pipes.

6. Flumes can be used in the winter, when ice can be placed on top, or in the summer when clean fill can be placed on top, but cover is not required.

7. For typical fluming procedure see separate handout.

FISH STREAM PROTECTION AND ENHANCEMENT STRATEGIES

FLUMING

State of Alaska
Department of Fish and Game
Habitat Division

January 1988

Alaska Department of Fish and Game
Habitat Division

FISH STREAM PROTECTION AND ENHANCEMENT STRATEGIES

TEMPORARY STREAM DIVERSION PROCEDURES

The following is a typical procedure for temporary or short duration stream channel diversions. Temporary diversions are often required for installing or replacing culverts, installing underground utility lines, or for similar reasons where a dry channel is required. Properly constructed temporary stream diversion channels allow for a project to proceed while fish passage and water quality are maintained.

1. The diversion channel must be capable of carrying anticipated streamflows during the construction period.

2. During excavation, the diversion channel must be isolated from the stream to be diverted at the upstream and downstream ends of the diversion channel.

3. The bed and banks of the diversion channel must be constructed of material that will not erode at expected flows. In most cases, the diversion channel should be completely lined with filter fabric, visqueen or some other similar material. Seams in the liner should be overlapped, with the opening facing downstream. The channel liner should be anchored with rocks or sandbags to hold it in place.

4. Diversion of flow into the temporary diversion channel must be conducted by first removing the downstream plug, then removing the upstream plug, then closing the upstream end and then the downstream end of the natural channel of the diverted stream.

5. Fish that become stranded in dewatered channels must be immediately captured and returned to the active channel without further harm.

6. If a tributary stream enters the former channel within the diversion area, connect it in a suitable manner to the new channel.

7. Fish passage in the temporary diversion channel must be maintained at all times, unless otherwise approved by the ADF&G.

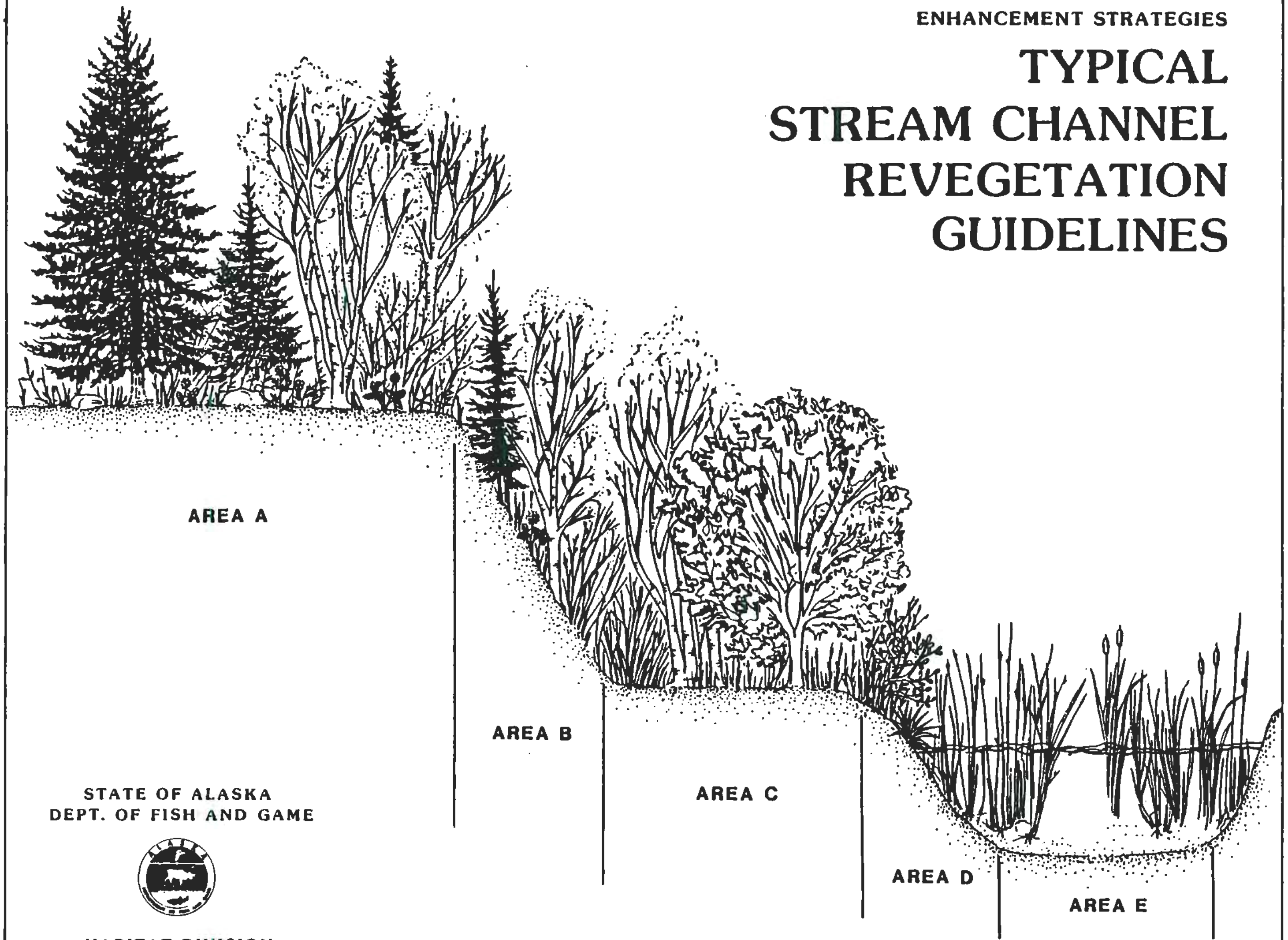
8. Rediversion of flow into the natural stream channel must be conducted by removing the downstream plug from the natural channel and then the upstream plug, then closing the upstream end and then the downstream end of the diversion channel.

(over)

9. All man-made materials shall be removed from the diversion channel, the channel shall be backfilled, and stream banks stabilized. All disturbed areas shall be revegetated with naturally occurring woody plants and grasses if appropriate.

FISH STREAM PROTECTION AND ENHANCEMENT STRATEGIES

TYPICAL STREAM CHANNEL REVEGETATION GUIDELINES



STREAM CHANNEL CROSS-SECTION

STATE OF ALASKA
DEPT. OF FISH AND GAME

HABITAT DIVISION

February 1988

Recommended plant material types suitable for each area depicted in the figure are listed below. Please note that the revegetation guidelines presented here are generally applicable to lake shorelines.

AREA A: Well drained, upland soils

Typical Plant Materials:

- Alsike Clover
- Cinquefoil
- Red Fescue
- Paper Birch
- White Spruce

AREA B: Slope-affected, subject to more extreme moisture regime, seasonal flooding and dry periods

Typical Plant Materials:

- Alsike Clover
- Prickly Rose
- Red Fescue
- Timothy
- Barclay, Bebb, and Scouler Willow
- Black Cottonwood
- Paper Birch
- White Spruce

AREA C: Floodplain zone, saturated soils

Typical Plant Materials:

- American Sloughgrass
- Bluejoint Grass
- Meadow Foxtail
- Red-osier Dogwood
- Sweetgale
- Pacific, Feltleaf, and Bebb Willow
- Black Cottonwood
- Dwarf Birch
- Paper Birch

AREA D: Active floodway zone, high moisture soils limitations

Typical Plant Materials:

- American sloughgrass
- Bulrush(Vegetative Plugs)
- Sedges(Vegetative plugs)
- Pacific Willow
- Thinleaf Alder

AREA E: Open water stream channel or lake

Typical Plant Materials:

- Bulrush
- Cattail
- Sedges

(Vegetative Plug Transplants)

Note: Revegetation of areas in peat soils or in bogs requires plant materials that are tolerant of both high moisture and acidity.

APPENDIX B

Pro Forma Right-of Way Agreements

Bureau of Land Management

Right-of-Way Grant/Temporary Use Permit

orm 2800-14
ugust 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

RIGHT-OF-WAY GRANT/TEMPORARY USE PERMIT

Issuing Office

Serial Number

A (right-of-way) (permit) is hereby granted pursuant to:

a. ☐ Title V of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2776; 43 U.S.C. 1761);

b. ☐ Section 28 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 185);

c. ☐ Other (describe) ______________________________.

Nature of Interest:

a. By this instrument, the holder ______________________________ receives a right to construct, operate, maintain, and terminate a ______________________________ on public lands (or Federal land for MLA Rights-of-Way) described as follows:

b. The right-of-way or permit area granted herein is __________ feet wide, __________ feet long and contains __________ acres, more or less. If a site type facility, the facility contains __________ acres.

c. This instrument shall terminate on ____________________ , __________ years from its effective date unless, prior thereto, it is relinquished, abandoned, terminated, or modified pursuant to the terms and conditions of this instrument or of any applicable Federal law or regulation.

d. This instrument ☐ may ☐ may not be renewed. If renewed, the right-of-way or permit shall be subject to the regulations existing at the time of renewal and any other terms and conditions that the authorized officer deems necessary to protect the public interest.

e. Notwithstanding the expiration of this instrument or any renewal thereof, early relinquishment, abandonment, or termination, the provisions of this instrument, to the extent applicable, shall continue in effect and shall be binding on the holder, its successors, or assigns, until they have fully satisfied the obligations and/or liabilities accruing herein before or on account of the expiration, or prior termination, of the grant.

Rental:

For and in consideration of the rights granted, the holder agrees to pay the Bureau of Land Management fair market value rental as determined by the authorized officer unless specifically exempted from such payment by regulation. Provided, however, that the rental may be adjusted by the authorized officer, whenever necessary, to reflect changes in the fair market rental value as determined by the application of sound business management principles, and so far as practicable and feasible, in accordance with comparable commercial practices.

Terms and Conditions:

a. This grant or permit is issued subject to the holder's compliance with all applicable regulations contained in Title 43 Code of Federal Regulations parts 2800 and 2880.

b. Upon grant termination by the authorized officer, all improvements shall be removed from the public lands within ____________ days, or otherwise disposed of as provided in paragraph (4)(d) or as directed by the authorized officer.

c. Each grant issued pursuant to the authority of paragraph (1)(a) for a term of 20 years or more shall, at a minimum, be reviewed by the authorized officer at the end of the 20th year and at regular intervals thereafter not to exceed 10 years. Provided, however, that a right-of-way or permit granted herein may be reviewed at any time deemed necessary by the authorized officer.

d. The stipulations, plans, maps, or designs set forth in Exhibit(s) ____________________________, dated ____________________________, attached hereto, are incorporated into and made a part of this grant instrument as fully and effectively as if they were set forth herein in their entirety.

e. Failure of the holder to comply with applicable law or any provision of this right-of-way grant or permit shall constitute grounds for suspension or termination thereof.

f. The holder shall perform all operations in a good and workmanlike manner so as to ensure protection of the environment and the health and safety of the public.

WITNESS WHEREOF, The undersigned agrees to the terms and conditions of this right-of-way grant or permit.

______________________________	______________________________
(Signature of Holder)	(Signature of Authorized Officer)
______________________________	______________________________
(Title)	(Title)
______________________________	______________________________
(Date)	(Effective Date of Grant)

GPO : 1985 O - 483-259

Alaska Department of Natural Resources, Division of

Land and Water Management

Application for Right-of-Way Permit

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF LAND AND WATER MANAGEMENT
P.O. BOX 107005
Anchorage, Alaska 99510-7005

APPLICATION FOR RIGHT-OF-WAY PERMIT ADL________________

$50.00 filing fee * Date:______________

The undersigned____
(please print)

Mailing address____

______________________________ Zip code: ____________ work phone: ______________

hereby applies to the Director of the Division of Lands, Department of Natural Resources, for Right-of-Way ________feet in width and ________feet in length located in:

Section__________, Township________, Range_________, Meridian__________, containing an

area of _____ acres as shown on the plat attached hereto, for the purpose of constructing

and maintaining theron a ____
FOR PRIVATE, PUBLIC, INTERMITTENT, YEARLONG USE (strike inapplicable words).

State the standards of construction of proposed improvements:____________________

____

____

____

____

Constructed____________________ Construction to begin____________________

To be completed____

If this application is approved, I agree to construct and maintain the improvements authorized in a workmanlike manner, to keep the area in a neat and sanitary condition; if said right-of-way is to be constructed across leased lands, I agree to reimburse the lessee for all damages to crops and improvements, to the extent of the fair market value thereof, which may be damaged or destroyed as the result of the construction of said right-of-way, and to comply with all the laws, rules and regulations pertaining thereto: and *provided further that upon termination of relocation of the right-of-way for which application is herein made, I agree to remove or relocate the improvements and restore the area without cost to the State and to the satisfaction of the Director.

SS #______________________________Signature of applicant______________________

(Instructions for preparation of plat: Attach triplicate copies of letter-size plat, show centerline and boundaries of right-of-way, show ties from centerline to establish monuments and section corner, show conflicts with other rights-of-way, if any, scale 4" to 8" per mile, type of survey.)

*Not applicable to State Agencies
Provision of your social security number and/or federal tax ID number is voluntary. It is used only to prevent duplication of records.

Alaska Department of Transportation and Public Facilities

Utility Permit

Permit No. 1-130000-83-180

GLENN HIGHWAY

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

UTILITY PERMIT

Approval Recommended: [signature] Date: June 9, 1983

Title: Regional Utilities Engineer Region: Central

****

THE STATE OF ALASKA, acting by and through the DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES, hereinafter called the DEPARTMENT, under provisions of AS 19.25.010 and AS 19.25.020, grants a Utility Permit to ENSTAR Natural Gas Company ______ of ______ hereinafter called the Permittee, permission to construct, install and thereafter perform routine maintenance, use and operate a natural gas pipeline ______ hereinafter called the Facility, located as follows: on the west side of the Glenn Highway from the Knik River Bridge to the A.R.R. cross

M.P. 159.38 to 163.23

across, along or under property of the Department, acquired and utilized in the operation and maintenance of a State Transportation System, at the aforementioned locations and/or positions, and in strict conformance with plans, specifications and special provisions attached hereto and made a part hereof, and not otherwise.

In accepting this Utility Permit for the Facility, the Permittee agrees to comply with the provisions of AS 19.25.010, AS 19.25.020, AS 02.15.020 and AS 35.05.040; the terms, requir ments and regulations as set forth in Title 17, Chapters 15 and 40 of the Alaska Administrative Code, as authorized under Administrative Procedures Act AS 44.62.010 - 44.62.650 and the applicable policies, directives and orders issued by the Commissioner of the Department.

The entire cost of routine maintenance operations of the Facility are to be paid for by the Permittee, and said Facility shall comply with all applicable codes.

The Permittee's construction, installation and maintenance operations of the Facility shall be accomplished in such a manner as to in no way interfere with the use, operation and maintenance of the Department's public property, and be performed with the minimum interference and interruption of the Department use upon and along the public property, or as hereinafter provided in the Department's Special Provisions, attached hereto and made a part hereof, and shall at all times in no way endanger the general public in its use of the public property.

The Department, in granting this Utility Permit, reserves the right to use, occupy and enjoy its property for a public transportation system and for public transportation purposes in such a manner and at such times as it deems necessary, the same as if this instrument had not been executed by the Department. If any such use by the Department shall at any time necessitate any change in location or manner of use of said Facility, or any part thereof, such change or alteration shall be made by the Permittee. However, the Permittee shall be reimbursed in full by the Department for all costs incurred by making such changes or alterations to the Facilities existing in the property as indicated on Exhibit "A".

On public property being utilized for right of way on highways originally established as, or converted to, controlled access highways, ingress and egress thereto is limited to the locations as designated by the Department. However, the Department shall allow the Permittee ingress and egress whenever, in the Permittee's opinion, such is necessary to affect repairs and maintenance of its existing facilities in the right of way. If such access is in conflict with the use of the controlled access highway, the Department will assume all costs to adjust or relocate the Facility.

The State of Alaska and the Department of Transportation and Public Facilities for the purpose of the Utility Permit, hereby disclaim any representation of implication to the Permittee that it retains any title in any public property other than the interest conveyed to the Department for specific purposes as described by the instrument conveying the land to the Department.

The waiver of any breach of any of the terms or conditions of this Utility Permit or provisions of the Administrative Code, by the Department shall be limited to the act or acts constituting such breach, and shall never be construed as being continuing or a permanent waiver of any such term or condition, unless expressly agreed to in writing by the parties hereto, all of which shall retain in full force and affect as to future acts or happenings, notwithstanding any such individual waiver or any breach thereof.

Only the Commissioner or delegated official of the Department shall have the authority to waive any term or condition herein contained.

The Permittee shall not assign or transfer any of the rights authorized by the Utility Permit except upon notification to and approval by the Department.

The Permittee agrees to comply with all regulations concerning present or future use of the public property acquired with, or reimbursed by Federal Aid funds.

The Permittee shall give the Department not less than ten (10) days prior written notice, unless otherwise agreed to by the parties hereto, of the Permittee's intention to enter upon the Department's property for the purpose of major maintenance or reconstruction, altering or removal of a Facility, provided, however, that normal routine maintenance is excepted from this provision, and provided further, that in any instance of sudden emergency requiring prompt and immediate action to protect the public safety, or to mitigate damage to private or public property, no notification to the Department will be required for any work, and shall notify the Department and the Alaska State Troopers of the location of the emergency and extent of work required by the most expeditious means of communication as soon as reasonably possible to do so, and the Permittee shall take such measures as are required to protect the health and safety of the public for the duration of such emergency operations.

The Permittee agrees to forever indemnify the State of Alaska and the Department, or either of them, including its agents and contractors against and save them harmless from all liability for damage to property, or injury to or death of persons, including all costs and expenses incident thereto arising wholly or in part from or in connection with the existence of construction, alteration, maintenance, repair, renewal, reconstruction, operation, use or removal of the said Facility as it pertains to the State property.

The Permittee agrees to reimburse the Department of Transportation for actual costs of inspection and testing as required during the performance of the work proposed by the Permittee. The scope of inspection and testing shall be determined by the Regional Utility Engineer. The costs billed to the Permittee will be the actual Department's costs incurred while performing the inspection and testing.

The Permittee agrees by entering on the Department's property to indemnify the Department of Transportation and its contractors of all costs tangible or intangible that would be the result of any delay in a construction project of the Department caused by work done under this permit.

The Permittee is subject to all previous easements and Utility Permits and any damage to any other utility will be the Permittee's responsibility.

The Permittee agrees to be responsible for the strict compliance of all applicable Federal, State, and local laws, regulations, codes and, ordinances.

The Permittee agrees to be responsible for obtaining all other appropriate permits or letters of non-objections needed from Federal, State, local agencies or lessees.

The Permittee may be required, within thirty (30) days after completion of any improvement placed upon or in the premises herein, deliver to the Department as-built drawings showing the location and construction specifications of said improvement.

This Utility Permit is issued under the provisions of applicable Alaska Statutes and Administrative Code effective as of the date of execution of this instruction by the Department.

The Permittee agrees that the Facility will be constructed in accordance with the attached:

a. Plans dated 5/6/83, consisting of Eleven (11) Sheets;

b. Specifications consisting of page ________ thru page ________; and

c. (Other) ________________________________,

which, by this reference, are made a part hereof.

Permit No. 1-130000-83-180

PIPE CARRIERS

TRANSMITTANT: Natural Gas

WORKING PRESSURE: 60#

NUMBER OF CONDUITS: One (1)

DIAMETER OF CONDUITS: Twenty (20) Inch

TYPE AND CLASS OF PIPE: STEEL

ENCASEMENT DIAMETER & TYPE: N/A

CROSSING ANGLE: N/A

LONGITUDINAL FACILITY LENGTH: 24,640 Feet (4.67 miles)

OFFSET FROM HIGHWAY CENTERLINE: 176 feet

DEPTH BELOW DITCH ELEVATION: 4 feet

REQUESTED METHOD OF INSTALLATION ON LONGITUDINAL FACILITY:

TRENCHING: ____ PLOWING: ____

REQUESTED METHOD INSTALLATION ON ROAD CROSSINGS:

BORING: ____ JACKING: ____ OPEN CUT: XX

CONSTRUCTION CODE(S) APPLICABLE: USNI B-31.8. D.O.T. 192

ADDITIONAL INFORMATION:

(1/82)

Permit No. 1-130000-83-180

SPECIAL PROVISIONS

BY HIS SIGNATURE ON THIS UTILITY PERMIT THE PERMITTEE PROMISES TO COMPLY WITH ALL OF THE SPECIAL PROVISIONS CHECKED BELOW. IT WILL BE THE PERMITTEE'S RESPONSIBILITY TO FAMILIARIZE HIS CONTRACTOR OR CONSTRUCTION CREW WITH THESE SPECIAL PROVISIONS AND INSIST UPON STRICT COMPLIANCE WITH THEM. A COPY OF THIS PERMIT SHALL BE ON THE JOB SITE AT ALL TIMES.

1.0 GENERAL

1.1 ____The Permittee agrees to deposit with the Department of Transportation a cash bond in the amount of ____________ to be held until all work and cleanup under this permit has been completed and approved by the Department of Transportation.

1.2 X The Permittee agrees to set and maintain permanent durable markers over, along or at an offset to the underground facility. The markers are to be placed at approximately 1,000' intervals, at all points of directional change, at points entering or leaving the right of way, and at all road crossings.

1.3 ____The Permittee shall place buried plant caution tape (example Terra Tape) one foot below the original ground directly above the facility being installed.

1.4 ____The Permittee shall discontinue the use of a machine or device which interferes with any government operated transmitter, receiver, or navigational aid until the cause of the interference is eliminated.

2.0 BACKFILL

2.1 X The Permittee shall backfill all trenches crossing road prisms, pathways, taxiways or runways in 6 inch lifts or as accepted by the Department of Transportation inspector. If no inspector is present 6 inch lifts will be required. The backfill shall be of suitable non-frost susceptible, non-organic material. All excavated non-acceptable material shall be removed from the State right of way or property by the Permittee.

2.2 X The Permittee shall compact all trenches crossing road prisms, pathways, taxiways, or runways at 95% maximum density. All compaction tests shall be at Permittee's expense and frequency will be determined by the Department of Transportation inspector, a copy of each test will be submitted to the Department of Transportation upon the inspector's request.

2.3 X The Permittee shall place the underground facility a minimum of 48" below the bottom of the ditch, when in the ditch prism.

2.4 X The Permittee shall place the underground facility a minimum of 48" below the State's roadway surface when in the road prism.

(1/82)

2.5 ____The Permittee shall complete all splicing, and all splice pits shall be backfilled by freeze up.

2.6 X The Permittee shall bore or jack the road, taxiway, or runway crossing.

2.7 ____The Permittee shall recompact and regrade any disruption made when plowing a facility across an unpaved road, taxiway or runway.

2.8 ____The Permittee shall place the facility a minimum of _____ inches below original ground when 10' outside the slope limits.

3.0 CLEANUP RESPONSIBILITY

3.1 X The Permittee or his contractor will be responsible for winter and spring maintenance of road shoulders, ditch lines, backslopes, road surfaces, taxiways, and runways that have not been left in a neat and clean condition, satisfactory to the Maintenance Section of DOT.

3.2 X Upon completion of the work within the State right of way or State property, the Permittee shall remove all equipment, dispose of all waste material and shall leave the premises in a neat and clean condition satisfactory to the Department of Transportation.

3.3 X The Permittee shall notify the Department of Transportation of drainage problems caused by work under this permit and will remedy the problem as directed by the Department of Transportation.

3.4 X The Permittee shall dispose of trees, brush or other natural growth by mechanical chipping, or hauling away.

3.5 ____The Permittee shall not blade a berm pile when plowing through tundra and small brush. If a berm pile is made during plowing operation the Permittee shall dispose of the debris by loading and hauling away.

3.6 X The Permittee shall dispose of all existing stump rows and/or berm piles if disturbed during installation of facility.

3.7 X The Permittee shall replace all culverts damaged by work under this permit with a minimum 18" C.M.P. and culverts that are found undersize or damaged shall be replaced at the expense of the Permittee. All culverts that are plugged shall be cleaned of debris or replaced at Permittees expense.

3.8 ____The Permittee shall remove all overhead lines abandoned as the result of this permit.

4.0 RE-SEEDING AND TOPSOIL

4.1 ____The Permittee shall replace any topsoil lost as a result of construction under this permit.

4.2 ____Re-seeding of all slopes disturbed by excavation shall be done at the Permittee's expense.

4.3 ____The Permittee shall re-seed as per the "Revegetative Guide for Alaska" printed by the Extension Service.

4.4 ____The Permittee shall hydroseed as follows: 20% Annual Rye Grass, 40% Kentucky Blue Grass, 40% Red fescue at 3 lbs. per 1,000 square feet. Mulch 1,500 lbs. per acre. The area should be watered twice a day for 14 days and longer if needed. Seeding shall be sown before August 15.

4.5 ____If seeding can not be done prior to August 15, then reshaping of slopes and seeding shall be completed by July 1 the following year. All erosion control and cleaning of ditches and culverts during fall and spring cleanup will be the Permittee's responsibility and expense.

4.6 X The Permittee shall re-seed as requested by the inspector for the Department of Transportation.

4.7 ____The Permittee shall stabilize all steep slopes disturbed by this permit with chain link fencing, or sodding.

4.8 ____The Permittee shall be responsible for all erosion control prior to slopes becoming stabilized.

5.0 PAVEMENT REPLACEMENT

5.1 ____The Permittee shall replace the road surface as follows: six inches (6") of hot asphalt over six inches (6") of base course (grading D-1).

5.2 ____The Permittee shall replace all paving and subbase removed in kind and to the densities existing.

5.3 ____The Permittee shall cut the pavement with a cutting wheel or other approved tool before excavation begins. Prior to paving, edges will be recut if requested by the inspector for the Department of Transportation.

5.4 ____The Permittee shall prime the edges of the pavement cut with tack coating before placing the asphalt patch.

5.5 ____The Permittee shall conduct a final grade inspection of that portion of the facility under the road before repaving.

5.6 ____The Permittee shall schedule paving to be laid within _____ (hours,days) of completion of underground installation at crossing.

5.7 X Pavement will not be affected by the work covered under this permit.

6.0 COORDINATION

6.1 X The Permittee shall notify the Department of Transportation 48 hours prior to commencing work. The number to call: (907)266-1522.

6.2 X The Permittee shall agree to the scheduling of work under this permit by the Department of Transportation and shall commence work on or about ASAP ________ and be completed by 10/1/83.

6.3 ____All work and work scheduling shall be coordinated with the Department of Transportation project engineer for ________________, Phone number:________.

6.4 ____All work and work scheduling shall be coordinated with the Department of Transportation Airport Manager, ________________, Phone number:________.

7.0 TRAFFIC CONTROL

7.1 ____The Permittee shall submit and obtain an approved traffic control plan, prior to beginning construction.

7.2 ____The Permittee shall use the attached traffic control plan during construction.

7.3 ____The Permittee shall obtain a road or lane closure permit 7 days prior to construction.

7.4 X The Permittee shall provide during the duration of construction adequate signing, barricades, and traffic control devices conforming to the last revision of the Alaska Traffic Manual as interpreted by the Department of Transportation.

7.5 X The Permittee shall maintain two-way traffic at all times.

7.6 X The Permittee shall have no parked equipment or material on the road surface at any time.

7.7 ____The Permittee shall maintain two-way traffic except for intermittent one-way traffic will be allowed with two properly equipped flagmen and proper signs.

7.8 ____The Permittee will be permitted one-way traffic with two properly equipped flagmen and proper signing.

7.9 X All signs damaged or removed shall be replaced in kind by the Permittee and/or his contractor to State standards.

8.0 LIMITATION OF OPERATION ON AIRPORTS

8.1 ____All existing runways, will remain open and operational during the period of construction. It shall be the responsibility of the Permittee to establish and maintain communication with the Air Traffic Control Tower or Flight Service Station as appropriate and to comply with their requests concerning the movements of construction equipment, men, and materials in the vicinity of the existing runways. The Permittee shall furnish a liaison radio operator and radio with each work party located within 100 feet of a runway centerline.

Vehicles, equipment, and materials shall never be parked or left standing on existing runways. All vehicles operating on airport surfaces shall be provided with a functional rotating amber light. All obstructions except stakes or hazard markers shall be removed during non-working hours.

The Permittee shall be required to remove construction equipment from and otherwise clear the runway and runway shoulders for operations of regularly scheduled airline flights. He shall cooperate with the Airport Manager and the Flight Service Station to remain continuously informed regarding flight schedule times.

8.2 ____The Permittee shall control his operations and the operations of his subcontractors and all suppliers so as to provide for the free and unobstructed movement of aircraft in the Air operations areas of the airport.

When the work requires the Permittee to conduct his operations within an air operations area of the airport, the work shall be coordinated with airport management (through the engineer) at least 48 hours prior to commencement of such work. The Permittee shall not close an air operations area until so authorized by the engineer and until the necessary temporary marking and associated lighting is in place as provided in the subsection titled Barricades, Warning Signs, and Hazard Markings of Section 7.4.

9.0 ADDITIONAL SPECIAL PROVISIONS

in consideration of the benefits accruing to the Permittee by reasons of the foregoing agreement, this said agreement is hereby accepted by the Permittee and the said Permittee hereby agrees to comply with all of the terms, provisions, conditions and stipulations therein contained.

Dated this 9th day of June, 1983

THE COMPANY OR PERMITTEE

Enstar Natural Gas Co
Name of Company

By Dave Sinclair

Title Chief Engineer

Attest Dave Bredin

Title Asst. Dist. Engr.

ACKNOWLEDGEMENT OF COMPANY OR PERMITTEE

STATE OF ALASKA
3rd JUDICIAL DISTRICT

BE IT REMEMBERED that on this 9th day of June, 1983 before me, the undersigned, a Notary Public of the State of Alaska, personally appeared Dave Sinclair and Dave Bredin both to me personally known and known to me to be the identical individuals named in and who executed the foregoing permit, and acknowledged the said instrument to be the free and voluntary act and deed of the above named company for the uses and purposes therein expressed and on oath stated that they were authorized to execute said instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Seal of my Office the day and year first above written.

My Commission Expires: 7-28-84

B. L. Heiger
A Notary Public

* *

The State of Alaska, acting by and through its Departme[nt of] Transportation and Public Facilities has caused this Utility Permit [to be] executed on the day and year herein acknowledged below.

STATE OF ALASKA

DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
DIVISION OF HIGHWAYS
CENTRAL REGION

Donald Morfield

Title Regional Design Engineer

DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

ACKNOWLEDGEMENT

STATE OF ALASKA
3rd JUDICIAL DISTRICT

BE IT REMEMBERED THAT ON THIS 10th d[ay of] June, 1983, before me, the undersign[ed, a] Notary Public of the State of Alaska, personally app[eared] DONALD MORFIELD

of the Department of Transportation and Public Facilities known [to me] to be the identical person who executed the foregoing Agreemen[t and] he acknowledged to me that he executed the same for and on beha[lf of] the State of Alaska, Department of Transportation and Public Fac[ilities] with full authority so to do, and for the uses and purposes th[erein] expressed.

IN WITNESS WHEREOF, I have hereunto set my hand and affixe[d the] Seal of my Office the day and year above written.

My Commission Expires: My Commission Expire[s] October 4, 1984

Karen E. Dalley
A Notary Public

*

When applicable or required this Utility Permit has been reviewed and approved:

Chief Utilities Engineer

Date ,19

Federal Highway Administration

Title , Date

Matanuska - Susitna Borough

Application for Easement Across Borough Lands

MATANUSKA-SUSITNA BOROUGH

APPLICATION FOR EASEMENT ACROSS BOROUGH LAND

MSB ____________

Filing Fee $50.00 - Not refundable   Date of Application: ____________

Name: ____ Age ________

Address: ____

____ Phone: ____________

Term applied for: ____

Legal Description: Township: ________ Range: ________ Section : ________

____

____

____

____

____ Acres: ________

Purpose: ____

____

____

____

____

____
Applicant

____
Applicant

Form E-1

Enstar Natual Gas Company

Right-of-Way Easement

RIGHT-OF-WAY EASEMENT

The undersigned ____, (hereinafter called Grantor, whether one or more), for good and valuable consideration receipt of which is hereby acknowledged, does hereby convey and warrant to ENSTAR Natural Gas Company, a division of Seagull Energy Corporation, its successors and assigns (hereinafter called Grantee), a right-of-way easement to construct, lay, maintain, operate, alter, repair, remove, and replace pipelines and appurtenances, including metering and regulation facilities, thereto for the transportation of natural gas under, upon, over and through lands which the undersigned owns or in which the undersigned has an interest, situated in the ___________ Recording District, Third Judicial District, State of Alaska, and more particularly described as follows:

The Grantee, its successors and assigns, is hereby expressly given and granted the right to assign said right-of-way easement herein granted and conveyed, or any part thereof or interest herein. The same shall be divisible among two or more owners as to any right or rights granted hereunder so that each assignee or owner shall have the rights and privileges herein granted, to be owned and enjoyed either in common or in severality.

This easement is given to the Grantee, its successors and assigns, with right of ingress and egress from the premises for the purposes herein granted.

The said Grantor is to fully use and enjoy said premises except for the purposes herein granted to the said Grantee and provided the said Grantor shall not construct or permit to be constructed any house, structures or obstructions on or over said easement or that will interfere with the construction, maintenance, repair or operation of pipelines or appurtenances, including metering and regulation facilities, constructed hereunder and will not change the grade of such pipelines.

Grantee hereby agrees to bury all pipes to a sufficient depth so as not to interfere with cultivation of the soil and agrees to pay for all damage to growing crops, lawns, trees, fences and other improvements which may arise from the construction, maintenance, operation of said lines, and upgrading of the original lines or that addition of new lines.

____
Grantor

____
Grantor

ACKNOWLEDGEMENT

STATE OF ALASKA)
) ss.
THIRD JUDICIAL DISTRICT)

This certifies that on this _____ day of _________,19__ , before me, the undersigned, a Notary Public in and for the State of Alaska, personally appeared ________________________ to me known and known to me to be the person(s) named as grantor(s) in the foregoing easement and acknowledged to me that _______________ executed the same freely and voluntarily for the uses and purposes therein mentioned.

WITNESS my hand and official seal the day and year in this certificate first above written.

____
Notary Public, State of Alaska
My Commission Expires: _______

Return to: ENSTAR Natural Gas Company
P.O. Box190288
Anchorage, AK 99519-0288

Cook Inlet Region, Inc.

Easement Permit

1. Permission is hereby granted to ______________________________ of ______________ whose business address is ______________________, telephone number______________, to use the following described lands:

Township	Range(s)	Section(s)	Meridian

2. For the purpose of ____ and subject to the following regulations.

3. Regulations

   a. Permittee shall include all agents, employees, contractors and assignees authorized under this permit.

   b. Permittee shall conduct all activities on the lands subject to this permit in accordance with the Plan of Operations attached hereto and by this reference made a part hereof.

   c. Permittee shall conduct all activities in such manner to ensure the least practicable temporary and permanent harm to the lands subject to this permit.

   d. This permit is issued for the period specified below. It is revocable at the discretion of CIRI at any time upon notice.

   e. Permittee shall observe all Federal, State and local laws and regulations applicable to the premises and shall keep the premises in a neat, orderly, safe and sanitary condition.

   f. Permittee shall take all reasonable precautions to prevent and suppress forest, brush and grass fire and prevent pollution of waters on or in the vicinity of the lands.

   g. Permittee shall not disturb, cut, remove or displace any materials on CIRI lands not specifically allowed by this permit without first obtaining prior written authorization from CIRI to do so. "Materials" includes, but is not limited to, gravel, rock, sand, peat, timber and all other vegetative materials.

   h. Permittee shall allow inspection of all operations as defined in item 2 above at anytime by CIRI, its agents or assigns.

   i. If requested, Permittees shall make a report to CIRI, in writing, on all matters relevant to the character, progress and results of operations as defined in item 2 above under this permit. Upon completion of operation, Permittee shall notify CIRI in writing.

   j. Permittee shall not operate any equipment outside of approved permit boundaries without prior written approval by CIRI.

   k. If Permittee fails to comply with the terms and regulations contained in this permit and, after receiving written notice, fails to remedy such failure within the time specified in the notice, CIRI may cancel this permit.

   l. Permittee shall be responsible for any problems that may arise in the future that results from Permittee's actions subject to this Permit.

   m. Permittee shall have the duty to defend and indemnify CIRI and hold it harmless against all liability for any and all claims, demands, suits, damages, costs, losses and expenses, and for any and all injury to or death of person and damage to or loss of property, resulting or arising out of, or in any way connected with, the use or occupation of CIRI lands by the Permittee or the failure of Permittee to perform fully any and all of these Stipulations.

n. Permittee shall be liable to CIRI for any liabilities, damages, injuries or expenses incurred by CIRI in any way arising from or connected with any activity, whenever such damage, cost or expenses results from any breach of the terms or stipulations associated with the Land Use Permit, or from any wrongful or negligent act of Permittee.

o. Any structure, property or land harmed or damaged by Permittee during Project construction activities shall be reconstructed, repaired, rehabilitated and restored as may be required by State and Federal Resource Agencies and CIRI, by Permittee as soon as practicable, so that the condition thereof, at the sole discretion of CIRI, is at least equal to the condition thereof immediately prior to such damage or destruction. Permittee shall immediately cease and/or eliminate any condition existing or occurring with response to Project construction activities, which may cause harm or damage to any person, structure, property, land, stream or wildlife.

p. CIRI reserves the exclusive right to grant additional permits, easements for rights-of-way or other uses to third parties for compatible uses on, or adjacent to, the land subject to this permit.

q. Permittee shall protect all survey monuments, witness corners, reference monuments, mining claims posts and bearing trees against damage, destruction or obliteration. Any damaged or obliterated marker shall be re-established by the Permittee in accordance with accepted survey practices of the State.

r. Permittee shall, at its sole expense, secure and maintain in force throughout the term of this Permit, comprehensive general liability insurance with limits of not less than $500,000 combined single limit, bodily injury and property damage per occurrence.

Such insurance shall be of a form and with companies licensed to do business with Alaska, shall name CIRI as an additional insured, shall be obtained and become effective on or prior to Permittee's exercise of any of the rights or privileges granted hereunder, and shall include, by endorsement, the following cancellation or change clause or its equivalent:

> This insurance shall not be cancelled by this Insurance Company nor shall any changes be made in the policy which will change, restrict or reduce the insurance provided, or change the name of the insured, without first giving ten (10) days notice in writing to Cook Inlet Region, Inc., P.O. Box 93330, Anchorage, Alaska 99509-3330, as evidenced by return receipt of registered or certified mail.

Either a certificate of insurance or certified copies of the policies must be filed and approved by CIRI prior to Permittee's exercise of any rights or privileges granted hereunder.

Special Conditions:

- - - - -

Permittee certifies that he/she has read and is familiar with the CIRI Land Use Regulations and that all operations shall be performed in strict compliance with said Regulations and any Special Conditions specified by CIRI in issuing this Permit.

Date ____________________ Signature ____________________

Title ____________________

Activity:

Permit issued for Period:

From:

To:

Authorized By:

COOK INLET REGION, INC.

Senior Land Management Officer

Title

Date

Permit:33

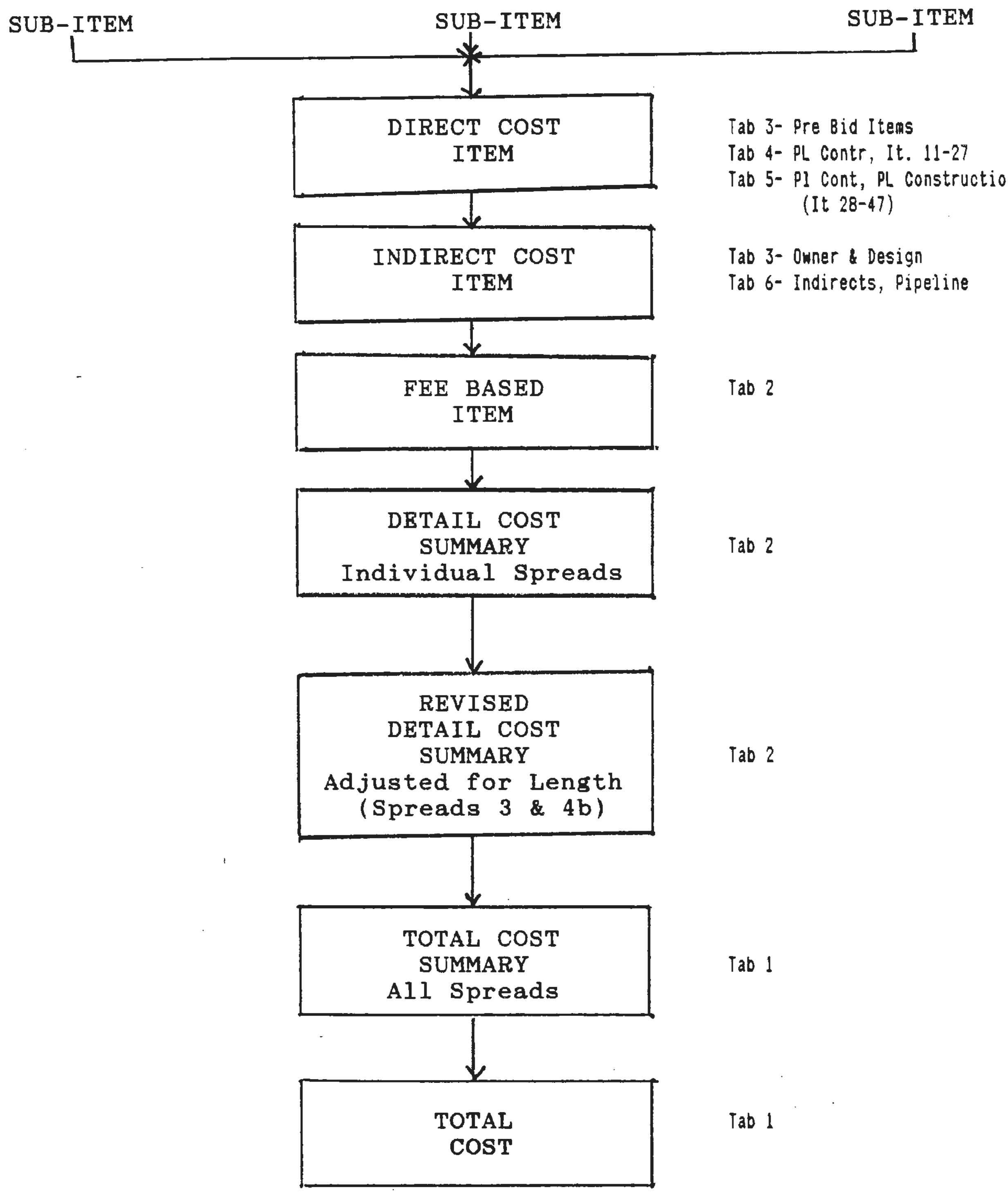
APPENDIX C

16" Mainline Capital Cost Estimate

Summaries and Detail Sheets

INDEX

ESTIMATE FLOW CHART



I

TOTAL COST SUMMARY

II

DETAIL COST SUMMARY

INDIVIDUAL SPREADS

SPREAD 1- BIG LAKE TO BYERS CR.   Fks MP52.3 to 144

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL CO
OWNER & DESIGN COSTS										
a Owner Costs	2.00	PCT						948,633		$948,6
b Engineering & Design	3.50	PCT						1,603,969		$1,603,9
c Material Inspection (Pct of Matl)	0.50	PCT						61,794		$61,7
d Field Inspection	90	WD		543,365	84,150	29,070	18,000	101,188		$775,7
e X-ray	484,176	LF						290,506		$290,5
f AFUDC	0.00	PCT						0		
TOTAL OWNR & DESIGN				$543,365	$84,150	$29,070	$18,000	$3,006,090		$3,680,6
PRE-BID PROCUREMENT										
1 Mainline 16" Pipe	484,176	LF						10,782,600	22.27	$10,782,6
2 Mainline Pipe Coating	484,176	LF						1,234,649	2.55	$1,234,6
3 Mainline Pipe Frt	13,668	TN						382,704	28.00	$382,7
4 Mainline Valves	6	EA						166,296	27,716	$166,2
5 Pipeyard Leases	7	AC					8,400		1,200	$8,4
6 Other Appurt	100	PC						166,938	1669.38	$166,9
22 Produce Weights	267	EA						77,430	290.00	$77,4
OTHER PRE-BID COSTS										
7 Temp ROW Leases	45	AC						17,800	396	$17,8
8 Perm ROW Costs	89	AC						178,000	2,000	$178,0
9 Permitting Costs	100	PC						91,700	917	$91,7
SEPARATE CONTRACT COSTS										
10 Furn & Erect Aerial Crossings	0	EA						0		
TOTAL PREBID				$0	$0	$0	$8,400	$13,098,116		$13,106,5
Contingency	5.00	PCT							1.73	$839,3
SUB TOTAL	484,176	LF		$543,365	$84,150	$29,070	$26,400	$16,104,206	36.41	$17,626,5

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

12-Jan
11:51

SPREAD 1- BIG LAKE TO BYERS CR. Pks MP52.3 to 144

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL C
PIPELINE CONTRACT										
Logistics & Support										
11 Camp & Yard Lease	6	MO					2,400		400	$2,
12 Camp & Yard Sitework	14,500	CY		32,340	18,660	12,360	0	19,500	5.71	$82.
13 Camp & Shop Set-Up & Removal	100	PC		57,342	10,127	7,349	0	54,000	1,288	$128,
14 Camp Operations	43,135	MD		603,892			1,078,379		39.00	$1,682,
15 Pipeyard Sitework	15,000	CY		22,656	16,178	11,183	0	15,000	4.33	$65,
16 Unload & Store Pipe	91.70	MI		146,715	57,474	45,929	0	0	2,728	$250.
Civil Construction										
17 Snow Road Construction	0.00	LF								
18 Snow Road Maintenance	0.00	DY								
19 Work Pad Construction	75,000	CY		131,852	103,248	73,423	0	112,500	5.61	$421,
20 Work Pad Remove	300,000	LF		76,664	61,410	43,856	0	0	0.61	$181,
21 Produce Select Backfill	15,000	CY		25,497	33,718	20,885	0	30,000	7.34	$110,
23 Reclamation & Revegetation	576	AC		20,966	11,481	7,891	0	708,480	1,300	$748,
TOTAL CIVIL & SUPPORT				1,117,924	312,296	222,876	1,080,779	939,480		3,673,
Mobilization										
24 Mobilization-Civil	100	PC		0	0	0	37,750	8,000	458	$45,
25 Demobilization-Civil	100	PC		0	0	0	37,750	8,000	458	$45,
26 Mobilization-Pipeline	100	PC		112,053	0	0	28,200	742,539	8,828	$882,
27 Demobilization-Pipeline	100	PC		112,053	0	0	28,200	620,542	7,608	$760,
TOTAL MOB-DEMOB				224,106	0	0	131,900	1,379,081		1,735,
Pipeline Construction										
28 Clearing	91.70	MI		447,052	228,911	165,282	9,170		9,274	$850,
29 Grade	91.70	MI		505,904	182,255	132,233			8,946	$820,
30 String	8110	JTS		588,948	152,615	93,397			102.95	$834,
31 Machine Ditch	484175	LF		674,921	276,393	217,433			2.41	$1,168,
32 Rock Ditch	0	LF		0	0	0				
33 Bend	91.70	MI		352,002	67,907	34,772	38,142		5,374	$492,
34 Pipe-Front End	8110	JTS		1,000,453	102,827	48,110	21,684		144.65	$1,173,
35 Pipe-Weld	484175	LF		1,393,028	149,393	51,535			3.29	$1,593,
36 Cut Out & Repair	484175	LF		385,365	69,966	33,353			1.01	$488,
38 Bottom Pad	91.70	MI		491,382	166,834	100,292			8,272	$758,
39 Lower & Backfill	91.70	MI		984,375	181,623	107,726			13,890	$1,273,
40 Top Pad	484175	LF		671,184	277,142	182,364			2.34	$1,130,
42 Road Crossing-Boring	6.00	EA		122,747	46,228	28,145			32,853	$197,
43 Tie In	74.00	EA		538,712	132,015	80,231			10,148	$750,
44 River Crossings	30.00	EA		1,876,350	587,069	453,096	124,300		101,361	$3,040,
45 Fabrication	100.00	PC		68,394	9,738	3,978	600	18,432	1,011	$101,
46 Test	91.70	MI		176,260	68,155	30,029			2,993	$274,
47 Cleanup	484175	LF		1,007,542	356,842	238,111			3.31	$1,602,
TOTAL PIPELINE DIRECT COSTS	91.70	MI	123060	11,284,619	3,055,913	2,000,087	193,896	18,432	180,512	16,552,
INDIRECTS - PIPELINE CONSTRUCTION										
Services				478,050	419,175	197,805	0			$1,095,
Supervision & Support				1,354,626	169,770	75,180	202,500			$1,802,
PL Supprt Facilities							123,000			$123,
Expendable Materials & Supplies	25.00	PCT					2,821,155			$2,821,
INDIRECTS - CIVIL & SUPPORT	25.00	PCT						918,339		$918,
Profit & Fee	10.00	PCT						2,872,099		$2,872,
Contingency	5.00	PCT							3.26	$1,579,
TOTAL PIPELINE COSTS	484176	LF	29.86	14,459,325	3,957,154	2,495,948	4,553,230	6,127,431	68.51	$33,172,
TOTAL PROJECT COSTS>>>>>>>	484176	LF							104.92	$50,799,

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline 12-Jan
Feasibility Cost Estimate 11:44

SPREAD 2- BYERS CR. TO NENANA R. NO. 2 Pks MP 144 to 231.3

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL C
OWNER & DESIGN COSTS										
a Owner Costs	2.00	PCT						891,018		$891,
b Engineering & Design	3.50	PCT						1,506,552		$1,506,
c Material Inspection (Pct of Matl)	0.50	PCT						59,130		$59,
d Field Inspection	86	WD		519,215	80,410	27,778	17,200	96,690		$741,
e X-ray	460,944	LF						276,566		$276,
f AFUDC	0.00	PCT						0		
TOTAL OWNR & DESIGN				$519,215	$80,410	$27,778	$17,200	$2,829,956		$3,474,
PRE-BID PROCUREMENT										
1 Mainline 16" Pipe	460,944	LF						10,265,223	22.27	$10,265,
2 Mainline Pipe Coating	460,944	LF						1,175,407	2.55	$1,175,
3 Mainline Pipe Frt	13,012	TN						364,336	28.00	$364,
4 Mainline Valves	6	EA						166,296	27,716	$166,
5 Pipeyard Leases	11	AC					13,200		1,200	$13,
6 Other Appurt	100	PC						205,870	2,059	$205,
22 Produce Weights	160	EA						46,400	290	$46,
OTHER PRE-BID COSTS										
7 Temp ROW Leases	246	AC						73,800	300	$73,
8 Perm ROW Costs	492	AC						738,000	1,500	$738,
9 Permitting Costs	100	PC						87,300	873	$87,
SEPARATE CONTRACT COSTS										
10 Furn & Erect Aerial Crossings	2	EA						360,000	180,000	$360,
TOTAL PREBID				$0	$0	$0	$13,200	$13,482,632		$13,495,
Contingency	5.00	PCT							1.84	$848,
SUB TOTAL	460,944	LF		$519,215	$80,410	$27,778	$30,400	$16,312,588	38.66	$17,818,

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

12-Jan-
11:44

SPREAD 2- BYERS CR. TO NENANA R. NO. 2 Pks MP 144 to 231.3

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL CO
PIPELINE CONTRACT										
Logistics & Support										
11 Camp & Yard Lease	6	MO					2,700		450	$2,7
12 Camp & Yard Sitework	17,000	CY		37,575	21,690	14,347	0	22,000	5.62	$95,6
13 Camp & Shop Set-Up & Removal	100	PC		68,163	12,197	8,629	0	67,000	1,560	$155,9
14 Camp Operations	39,085	MD		547,183			977,113		39.00	$1,524,2
15 Pipeyard Sitework	25,000	CY		37,760	26,963	18,639	0	25,000	4.33	$108,3
16 Unload & Store Pipe	87.30	MI		138,564	54,281	43,377	0	0	2,706	$236,2
Civil Construction										
17 Snow Road Construction	0	LF								
18 Snow Road Maintenance	0	DY								
19 Work Pad Construction	61,200	CY		107,719	84,350	59,984	0	61,200	5.12	$313,2
20 Work Pad Remove	250,000	LF		62,481	50,049	35,743	0	0	0.59	$148,2
21 Produce Select Backfill	22,500	CY		38,246	50,577	31,328	0	33,750	6.84	$153,9
23 Reclamation & Revegetation	552	AC		19,254	10,544	7,247	0	678,960	1,297	$716,0
TOTAL CIVIL & SUPPORT				1,056,945	310,651	219,294	979,813	887,910		3,454,6
Mobilization										
24 Mobilization-Civil	100	PC		0	0	0	75,500	8,000	835	$83,5
25 Demobilization-Civil	100	PC		0	0	0	75,500	8,000	835	$83,5
26 Mobilization-Pipeline	100	PC		112,053	0	0	56,400	742,539	9,110	$910,9
27 Demobilization-Pipeline	100	PC		112,053	0	0	56,400	620,542	7,890	$788,9
TOTAL MOB-DEMOB				224,106	0	0	263,800	1,379,081		1,866,9
Pipeline Construction										
28 Clearing	87.30	MI		424,126	217,172	156,806	0	8,730	9,242	$806,8
29 Grade	87.30	MI		479,960	172,908	125,452	0	0	8,915	$778,3
30 String	7722	JTS		558,746	144,788	88,608	0	0	102.58	$792,1
31 Machine Ditch	460950	LF		640,309	262,219	206,282	0	0	2.41	$1,108,8
32 Rock Ditch	14000	LF		109,803	39,845	26,404	1,800	35,000	15.20	$212,8
33 Bend	87.30	MI		333,951	64,424	32,989	36,186	0	5,356	$467,5
34 Pipe-Front End	7722	JTS		949,148	97,554	45,643	20,572	0	144.12	$1,112,9
35 Pipe-Weld	460950	LF		1,321,591	141,732	48,892	0	0	3.28	$1,512,2
36 Cut Out & Repair	460950	LF		365,603	66,378	31,642	0	0	1.01	$463,6
38 Bottom Pad	87.30	MI		466,183	158,279	95,149	0	0	8,243	$719,6
39 Lower & Backfill	87.30	MI		933,895	172,309	102,201	0	0	13,842	$1,208,4
40 Top Pad	460950	LF		636,765	262,929	173,012	0	0	2.33	$1,072,7
42 Road Crossing-Boring	4.00	EA		81,831	30,818	18,763	0	0	32,853	$131,4
43 Tie In	48.00	EA		511,086	125,245	76,116	0	0	14,843	$712,4
44 River Crossings	19.00	EA		1,129,131	353,280	272,660	74,800	0	96,309	$1,829,8
45 Fabrication	100.00	PC		68,394	9,738	3,978	600	18,432	1,011	$101,1
46 Test	87.30	MI		176,260	68,155	30,029	0	0	3,144	$274,4
47 Cleanup	460950	LF		955,873	338,543	225,900	0	0	3.30	$1,520,3
TOTAL PIPELINE DIRECT COSTS	87.30	MI		10,142,655	2,726,316	1,760,526	133,958	62,162	169,824	14,825,6
INDIRECTS - PIPELINE CONSTRUCTION										
Services				350,570	307,395	145,057	0	0.00		$803,0
Supervision & Support				1,309,472	164,111	72,674	195,750	0.00		$1,742,0
PL Supprt Facilities							118,900	0.00		$118,9
Expendable Materials & Supplies	25.00	PCT					2,535,664			$2,535,6
INDIRECTS - CIVIL & SUPPORT	25.00	PCT						863,653		$863,6
Profit & Fee	10.00	PCT						2,621,046		$2,621,0
Contingency	5.00	PCT							3.13	$1,441,5
TOTAL PIPELINE COSTS	460944	LF	28.38	13,083,748	3,508,473	2,197,551	4,227,884	5,813,852	65.68	$30,273,0
TOTAL PROJECT COSTS>>>>>>>	460944	LF							104.33	$48,091,9

Alaska Power Authority — ORIGINAL FOR DETAILED EST — REVISED TOTAL COST

Wasilla to Fairbanks Gas Pipeline

Feasibility Cost Estimate

SPREAD 3- NENANA NO. 2 TO JULIUS

ITEM Description	Pks MP 231.3 to MP 295 QUANT	UM	12-Jan-89 63.7 MI unit	06:16 PM 336,336 LF TOTAL COST	339,504 LF 64.30 MI QUANT	UM	unit	TOTAL COST
OWNER & DESIGN COSTS							1.009419	
a Owner Costs	2.00	PCT		$723,154	2.00	PCT		$728,656
b Engineering & Design	3.50	PCT		$1,222,724	3.50	PCT		$1,232,027
c Material Inspection (Pct of Matl)	0.50	PCT		$43,409	0.50	PCT		$43,810
d Field Inspection	70	WD		$603,379	71	WD		$609,062
e X-ray	336,336	LF		$201,802	339,504	LF		$203,702
f AFUDC	0.00	PCT		$0	0.00	PCT		$0
TOTAL OWNR & DESIGN				$2,794,467				$2,817,258
PRE-BID PROCUREMENT								
1 Mainline 16" Pipe	336,336	LF	22.27	$7,490,203	339,504	LF	22.27	$7,560,754
2 Mainline Pipe Coating	336,336	LF	2.55	$857,657	339,504	LF	2.55	$865,735
3 Mainline Pipe Frt	9,494	TN	28.00	$265,832	9,583	TN	28.00	$268,336
4 Mainline Valves	6	EA	27,716	$166,296	6	EA	27,716	$166,296
5 Pipeyard Leases	7	AC	1,200	$8,400	7	AC	1,200	$8,400
6 Other Appurt	100	PC	1593.28	$159,328	100	PC	1,608	$160,829
22 Produce Weights	140	EA	290.00	$40,600	141	EA	290	$40,982
OTHER PRE-BID COSTS								
7 Temp ROW Leases	31	AC	300	$9,300	31	AC	300	$9,388
8 Perm ROW Costs	62	AC	1,500	$93,000	63	AC	1,500	$93,876
9 Permitting Costs	100	PC	637	$63,700	100	PC	643	$64,300
SEPARATE CONTRACT COSTS								
10 Furn & Erect Aerial Crossings	0	EA		$0		EA		$0
TOTAL PREBID				$9,154,316				$9,238,896
Contingency	5.00	PCT	1.78	$597,439			1.78	$602,808
SUB TOTAL	336,325	LF	37.30	$12,546,222	339,504	LF	37.29	$12,658,962

Alaska Power Authority | ORIGINAL FOR
Wasilla to Fairbanks Gas Pipeline | DETAILED EST | 12-Jan-
Feasibility Cost Estimate | Pks MP 231.3 | 06:09
SPREAD 3- NENANA NO. 2 TO JULIUS | to MP 295

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	63.7 MI unit	336,336 TOTAL CO
OWNER & DESIGN COSTS										
a Owner Costs	2.00	PCT						723,154		$723,1
b Engineering & Design	3.50	PCT						1,222,724		$1,222,7
c Material Inspection (Pct of Matl)	0.50	PCT						43,409		$43,4
d Field Inspection	70	WD		422617	65450	22610	14000	78,702		$603,3
e X-ray	336,336	LF						201,802		$201,8
f AFUDC	0.00	PCT						0		
TOTAL OWNR & DESIGN				$422,617	$65,450	$22,610	$14,000	$2,269,790		$2,794,4
PRE-BID PROCUREMENT										
1 Mainline 16" Pipe	336,336	LF						7,490,203	22.27	$7,490,2
2 Mainline Pipe Coating	336,336	LF						857,657	2.55	$857,6
3 Mainline Pipe Frt	9,494	TN						265,832	28.00	$265,8
4 Mainline Valves	6	EA						166,296	27,716	$166,2
5 Pipeyard Leases	7	AC					8,400		1,200	$8,4
6 Other Appurt	100	PC						159,328	1593.28	$159,3
22 Produce Weights	140	EA						40,600	290.00	$40,6
OTHER PRE-BID COSTS										
7 Temp ROW Leases	31	AC						9,300	300	$9,3
8 Perm ROW Costs	62	AC						93,000	1,500	$93,0
9 Permitting Costs	100	PC						63,700	637	$63,7
SEPARATE CONTRACT COSTS										
10 Furn & Erect Aerial Crossings	0	EA						0		
TOTAL PREBID				$0	$0	$0	$8,400	$9,145,916		$9,154,3
Contingency	5.00	PCT							1.78	$597,4
SUB TOTAL	336,325	LF		$422,617	$65,450	$22,610	$22,400	$11,415,706	37.30	$12,546,2

Alaska Power Authority | ORIGINAL FOR
Wasilla to Fairbanks Gas Pipeline | DETAILED EST | 12-Jan-89 | REVISED TOTAL COST
Feasibility Cost Estimate | Pks MP 231.3 | 06:16 PM | 339,504 LF
SPREAD 3- NENANA NO. 2 TO JULIUS | to MP 295 | 63.7 MI 336,336 LF | 64.30 MI

ITEM Description	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST
PIPELINE CONTRACT								
Logistics & Support								
11 Camp & Yard Lease	5	MO	600	$3,000	5	MO	600	$3,000
12 Camp & Yard Sitework	24,500	CY	5.55	$135,890	24,500	CY	5.55	$135,890
13 Camp & Shop Set-Up & Removal	100	PC	2,359	$235,870	100	PC	2,359	$235,870
14 Camp Operations	33,063	MD	39.00	$1,289,470	33,063	MD	39.00	$1,289,470
15 Pipeyard Sitework	17,000	CY	4.33	$73,687	17,000	CY	4.33	$73,687
16 Unload & Store Pipe	63.70	MI	2,727	$173,693	64.30	MI	2,727	$175,329
Civil Construction								
17 Snow Road Construction	0	LF		$0	0	LF		$0
18 Snow Road Maintenance	0.00	DY		$0	0	DY		$0
19 Work Pad Construction	41,600	CY	5.11	$212,390	41,992	CY	5.11	$214,391
20 Work Pad Remove	170,000	LF	0.59	$100,971	171,601	LF	0.59	$101,922
21 Produce Select Backfill	18,000	CY	6.84	$123,121	18,170	CY	6.84	$124,281
23 Reclamation & Revegetation	403.00	AC	1,306	$526,148	407	AC	1,306	$531,104
TOTAL CIVIL & SUPPORT				2,874,240				2,884,943
Mobilization								
24 Mobilization-Civil	100	PC	1,099	$109,925	100	PC	1,099	$109,925
25 Demobilization-Civil	100	PC	1,099	$109,925	100	PC	1,099	$109,925
26 Mobilization-Pipeline	100	PC	9,307	$930,732	100	PC	9,307	$930,732
27 Demobilization-Pipeline	100	PC	8,087	$808,735	100	PC	8,087	$808,735
TOTAL MOB-DEMOB				1,959,317				1,959,317
Pipeline Construction								
28 Clearing	63.70	MI	9,920	$631,911	64.30	MI	9,920	$637,863
29 Grade	63.70	MI	9,577	$610,035	64.30	MI	9,577	$615,781
30 String	5632	JTS	110.24	$620,868	5,685	JTS	110.24	$626,716
31 Machine Ditch	336325	LF	2.58	$869,068	339,504	LF	2.58	$877,254
32 Rock Ditch	54000	LF	15.13	$816,766	54,509	LF	15.13	$824,459
33 Bend	63.70	MI	5,753	$366,458	64.30	MI	5,753	$369,910
34 Pipe-Front End	5632	JTS	154.88	$872,286	5,685	JTS	154.88	$880,502
35 Pipe-Weld	336325	LF	3.52	$1,185,249	339,504	LF	3.52	$1,196,413
36 Cut Out & Repair	336325	LF	1.08	$363,381	339,504	LF	1.08	$366,804
38 Bottom Pad	63.70	MI	8,854	$564,018	64.30	MI	8,854	$569,331
39 Lower & Backfill	63.70	MI	14,869	$947,128	64.30	MI	14,869	$956,049
40 Top Pad	336325	LF	2.50	$840,770	339,504	LF	2.50	$848,689
42 Road Crossing-Boring	6.00	EA	32,853	$197,120	6.00	EA	32,853	$197,120
43 Tie In	54.00	EA	10,341	$558,405	55.00	EA	10,248	$563,665
44 River Crossings	20.00	EA	80,730	$1,614,592	20	EA	80,730	$1,614,592
45 Fabrication	100.00	PC	1,011	$101,142	100	PC	1,021	$102,095
46 Test	63.70	MI	4,308	$274,444	64.30	MI	4,308	$277,029
47 Cleanup	336325	LF	3.54	$1,191,599	339,504	LF	3.54	$1,202,823
TOTAL PIPELINE DIRECT COSTS	63.70	MI	198,198	12,625,240	64.30	MI	197,933	$12,727,094
INDIRECTS - PIPELINE CONSTRUCTION								
Services				$693,520				$700,052
Supervision & Support				$1,561,800				$1,576,511
PL Supprt Facilities				$106,000				$106,998
Expendable Materials & Supplies	25.00	PCT		$2,126,826	25.00	PCT		$2,146,858
INDIRECTS - CIVIL & SUPPORT	25.00	PCT		$718,560	25.00	PCT		$721,236
Profit & Fee	10.00	PCT		$2,266,550	10.00	PCT		$2,282,301
Contingency	5.00	PCT	3.71	$1,246,603	5.00	PCT	3.70	$1,255,266
TOTAL PIPELINE COSTS	336325	LF	77.84	$26,178,655	339,504	LF	77.64	$26,360,577
TOTAL PROJECT COSTS>>>>>>>	336325	LF	115.14	$38,724,877	339,504	LF	114.93	$39,019,539

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate
SPREAD 3- NENANA NO. 2 TO JULIUS

ORIGINAL FOR
DETAILED EST
Fks MP 231.3
to MP 295

12-Jan-8
06:09 P

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	63.7 MI unit	336,336 L TOTAL COS
PIPELINE CONTRACT										
Logistics & Support										
11 Camp & Yard Lease	5	MO					3,000		600	$3,00
12 Camp & Yard Sitework	24,500	CY		54,306	31,344	20,740	0	29,500	5.55	$135,89
13 Camp & Shop Set-Up & Removal	100	PC		107,688	18,975	14,007	0	95,200	2,359	$235,87
14 Camp Operations	33,063	MD		462,887			826,583		39.00	$1,289,47
15 Pipeyard Sitework	17,000	CY		25,677	18,335	12,675	0	17,000	4.33	$73,68
16 Unload & Store Pipe	63.70	MI		101,885	39,913	31,895	0	0	2,727	$173,69
Civil Construction										
17 Snow Road Construction	0	LF								$
18 Snow Road Maintenance	0.00	DY								$
19 Work Pad Construction	41,600	CY		72,990	57,155	40,645	0	41,600	5.11	$212,39
20 Work Pad Remove	170,000	LF		42,548	34,083	24,340	0	0	0.59	$100,97
21 Produce Select Backfill	18,000	CY		30,597	40,462	25,062	0	27,000	6.84	$123,12
23 Reclamation & Revegetation	403.00	AC		15,831	8,669	5,958	0	495,690	1,306	$526,14
TOTAL CIVIL & SUPPORT				914,409	248,936	175,322	829,583	705,990		2,874,24
Mobilization										
24 Mobilization-Civil	100	PC		0	0	0	101,925	8,000	1,099	$109,92
25 Demobilization-Civil	100	PC		0	0	0	101,925	8,000	1,099	$109,92
26 Mobilization-Pipeline	100	PC		112,053	0	0	76,140	742,539	9,307	$930,73
27 Demobilization-Pipeline	100	PC		112,053	0	0	76,140	620,542	8,087	$808,73
TOTAL MOB-DEMOB				224,106	0	0	356,130	1,379,081		1,959,31
Pipeline Construction										
28 Clearing	63.70	MI		332,423	170,216	122,902	0	6,370	9,920	$631,91
29 Grade	63.70	MI		376,185	135,523	98,327	0	0	9,577	$610,03
30 String	5632	JTS		437,936	113,483	69,449	0	0	110.24	$620,86
31 Machine Ditch	336325	LF		501,864	205,523	161,681	0	0	2.58	$869,06
32 Rock Ditch	54000	LF		420,912	152,738	101,216	6,900	135,000	15.13	$816,76
33 Bend	63.70	MI		261,745	50,495	25,856	28,362	0	5,753	$366,45
34 Pipe-Front End	5632	JTS		743,927	76,461	35,774	16,124	0	154.88	$872,28
35 Pipe-Weld	336325	LF		1,035,841	111,087	38,321	0	0	3.52	$1,185,24
36 Cut Out & Repair	336325	LF		286,554	52,026	24,801	0	0	1.08	$363,38
38 Bottom Pad	63.70	MI		365,386	124,056	74,576	0	0	8,854	$564,01
39 Lower & Backfill	63.70	MI		731,971	135,053	80,104	0	0	14,869	$947,12
40 Top Pad	336325	LF		499,086	206,080	135,604	0	0	2.50	$840,77
42 Road Crossing-Boring	6.00	EA		122,747	46,228	28,145	0	0	32,853	$197,12
43 Tie In	54.00	EA		400,581	98,165	59,659	0	0	10,341	$558,40
44 River Crossings	20.00	EA		996,292	311,718	240,582	66,000	0	80,730	$1,614,59
45 Fabrication	100.00	PC		68,394	9,738	3,978	600	18,432	1,011	$101,14
46 Test	63.70	MI		176,260	68,155	30,029	0	0	4,308	$274,44
47 Cleanup	336325	LF		749,198	265,344	177,057	0	0	3.54	$1,191,59
TOTAL PIPELINE DIRECT COSTS	63.70	MI		8,507,302	2,332,089	1,508,061	117,986	159,802	198,198	12,625,24
INDIRECTS - PIPELINE CONSTRUCTION										
Services				302,765	265,478	125,277	0	0.00		$693,52
Supervision & Support				1,174,010	147,134	65,156	175,500	0.00		$1,561,80
PL Supprt Facilities							106,000			$106,00
Expendable Materials & Supplies	25.00	PCT					2,126,826			$2,126,82
INDIRECTS - CIVIL & SUPPORT	25.00	PCT								$718,56
Profit & Fee	10.00	PCT								$2,266,55
Contingency	5.00	PCT							3.71	$1,246,60
TOTAL PIPELINE COSTS	336325	LF	33.07	11,122,592	2,993,637	1,873,816	3,712,025	2,244,873	77.84	$26,178,65
TOTAL PROJECT COSTS›››››››	336325	LF							115.14	$38,724,87

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate
SPREAD 3- NENANA NO. 2 TO JULIUS

ORIGINAL FOR
DETAILED EST
Pks MP 231.3
to MP 295

12-Jan-
06:09

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	63.7 MI unit	336,336 TOTAL CO
TOTAL PROJECT COSTS>>>>>>>>	336325	LF							115.14	$38,724,8
SPREAD 4B ALT COSTS	325776	LF							115.14	$37,510,2
(61.7 Miles)										
ADD: Additional Rock Ditch	120000	LF		1,309,504	339,418	224,924	15,333	300,000	18.24	$2,189,1
Contingency	5.00	PCT								$109,4
ADJUSTED SPRD 4B ALTERNATE COST	325776	LF							122.20	$39,808,8
(Parks Highway Ridge Route)										

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

12-Jan-8
06:21 P

SPREAD 4A- BELUGA LINE TO BIG LAKE   PL MP 0 TO PL MP 7.4 = Pks MP 52.3

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL COST
OWNER & DESIGN COSTS										
a Owner Costs	2.00	PCT						134,492		$134,49
b Engineering & Design	3.50	PCT						227,403		$227,40
c Material Inspection (Pct of Matl)	0.50	PCT						5,164		$5,16
d Field Inspection	12	WD		72,449	14,586	3,876	2,400	13,492		$106,80
e X-ray	39,072	LF						23,443		$23,44
f AFUDC	0.00	PCT						0		$0
TOTAL OWNR & DESIGN				$72,449	$14,586	$3,876	$2,400	$403,994		$497,30
PRE-BID PROCUREMENT										
1 Mainline 16" Pipe	39,072	LF						870,133	22.27	$870,13
2 Mainline Pipe Coating	39,072	LF						99,634	2.55	$99,63
3 Mainline Pipe Frt	1,103	TN						30,884	28.00	$30,88
4 Mainline Valves	1	EA						27,716	27,716	$27,71
5 Pipeyard Leases	3	AC					3,600		1,200	$3,60
6 Other Appurt	100	PC						31,633	316	$31,63
22 Produce Weights	790	EA						229,100	290	$229,10
OTHER PRE-BID COSTS										
7 Temp ROW Leases	7	AC						4,200	600	$4,20
8 Perm ROW Costs	14	AC						42,000	3,000	$42,00
9 Permitting Costs	100	PC						7,400	74	$7,40
SEPARATE CONTRACT COSTS										
10 Furn & Erect Aerial Crossings	0	EA								$
TOTAL PREBID				$0	$0	$0	$3,600	$1,342,700		$1,346,30
Contingency	5.00	PCT							2.36	$92,18
SUB TOTAL	39,072	LF		$72,449	$14,586	$3,876	$6,000	$1,746,694	49.54	$1,935,78

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

12-Jan-8
05:45 P

SPREAD 4A- BELUGA LINE TO BIG LAKE   PL MP 0 TO PL MP 7.4 = Pks MP 52.3

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL COS
PIPELINE CONTRACT										
Logistics & Support										
11 Camp & Yard Lease	0	MO								$
12 Camp & Yard Sitework	0	CY								$
13 Camp & Shop Set-Up & Removal	0	PC								$
14 Per Diem	4,849	MD					72,735		15.00	$72,73
15 Pipeyard Sitework	0	CY								$
16 Unload & Store Pipe	7.40	MI		12,226	4,790	3,827	0	0	2,817	$20,84
Civil Construction										
17 Snow Road Construction	7.40	MI		112,579	85,400	44,024	0	0	32,703	$242,00
18 Snow Road Maintenance	7.40	MI		59,043	43,142	22,221	0	0	16,812	$124,40
19 Work Pad Construction	0.00	CY								$
20 Work Pad Remove	0.00	LF								$
21 Produce Select Backfill	3,000	CY		5,099	6,744	4,177	0	6,000	7.34	$22,02
23 Reclamation & Revegetation	55.00	AC		2,139	1,172	805	0	67,650	1,305	$71,76
TOTAL CIVIL & SUPPORT				191,086	141,248	75,054	72,735	73,650		$553,77
Mobilization										
24 Mobilization-Civil	0	PC								$
25 Demobilization-Civil	0	PC								$
26 Mobilization-Pipeline	100	PC		112,053	0	0	70,500	148,508	3,311	$331,06
27 Demobilization-Pipeline	100	PC		112,053	0	0	14,100	620,542	7,467	$746,69
TOTAL MOB-DEMOB				224,106	0	0	84,600	769,050		1,077,75
Pipeline Construction										
28 Clearing	7.40	MI		65,803	35,523	20,537	1,154	0	16,624	$123,01
29 Grade	0.00	MI		0	0	0	0	0		$
30 String	652	JTS		67,973	27,014	12,386	0	0	164.68	$107,37
31 Machine Ditch	39072	LF		115,839	59,155	36,778	0	0	5.42	$211,77
32 Rock Ditch	0	LF		0	0	0	0	0		$
33 Bend	7.40	MI		34,845	9,031	3,588	3,521	0	6,890	$50,98
34 Pipe-Front End	652	JTS		144,168	31,174	13,370	2,002	0	292.51	$190,71
35 Pipe-Weld	39072	LF		197,005	32,310	11,007	0	0	6.15	$240,32
36 Cut Out & Repair	39072	LF		59,985	10,235	3,640	0	0	1.89	$73,86
38 Bottom Pad	7.40	MI		25,866	12,786	5,849	0	0	6,014	$44,50
39 Lower & Backfill	7.40	MI		154,565	64,515	36,196	0	0	34,497	$255,27
40 Top Pad	39072	LF		31,456	14,772	6,730	0	0	1.36	$52,95
42 Road Crossing-Boring	0.00	EA		0	0	0	0	0		$
43 Tie In	6.00	EA		82,343	22,124	10,148	0	0	19,103	$114,61
44 River Crossings	2.00	EA		198,894	65,399	38,575	7,920	0	155,394	$310,78
45 Fabrication	100.00	PC		24,000	3,431	1,045	150	3,412	320	$32.03
46 Test	7.40	MI		39,585	18,558	7,816	0	0	8,913	$65,95
47 Cleanup	39072	LF		80,498	29,510	15,944	0	0	3.22	$125,95
TOTAL PIPELINE DIRECT COSTS	7.40	MI		1,322,825	435,537	223,609	14,747	3,412	270,288	$2,000,13
INDIRECTS - PIPELINE CONSTRUCTION										
Services				66,864	45,774	16,378	0	0.00		$129,01
Supervision & Support				132,199	21,742	7,174	24,850	0.00		$185,96
PL Supprt Facilities							11,480	0.00		$11,48
Expendable Materials & Supplies	35.00	PCT					462,989			$462,98
INDIRECTS - CIVIL & SUPPORT	25.00	PCT								$138,44
Profit & Fee	10.00	PCT								$455.95
Contingency	5.00	PCT							6.42	$250,77
TOTAL PIPELINE COSTS	39072	LF	49.58	1,937,080	644,301	322,215	671,401	846,112	134.78	$5,266,28
TOTAL PROJECT COSTS>>>>>>>	39072	LF							184.33	$7,202,06

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate
SPREAD 4B- JULIUS TO FAIRBANKS

			ORIGINAL FOR DETAILED EST		12-Jan-89 06:23 PM			REVISED TOTAL COST 253,440 LF	
				54.80 MI	289,344 LF			48.00 MI	
ITEM	Description	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST
	OWNER & DESIGN COSTS							0.875912	
a	Owner Costs	2.00	PCT		$882,903	2.00	PCT		$789,892
b	Engineering & Design	3.50	PCT		$1,492,831	3.50	PCT		$1,335,567
c	Material Inspection (Pct of Matl)	0.50	PCT		$37,965	0.50	PCT		$33,293
d	Field Inspection	65	WD		$578,513	57	WD		$506,727
e	X-ray	289,344	LF		$173,606	253,440	LF		$152,064
f	AFUDC	0.00	PCT		$0	0.00	PCT		$0
	TOTAL OWNR & DESIGN				$3,165,819				$2,817,543
	PRE-BID PROCUREMENT								
1	Mainline 16" Pipe	289,344	LF	22.27	$6,443,691	253,440	LF	22.27	$5,644,109
2	Mainline Pipe Coating	289,344	LF	2.55	$737,827	253,440	LF	2.55	$646,272
3	Mainline Pipe Frt	8,167	TN	28.00	$228,676	7154	TN	28.00	$200,300
4	Mainline Valves	2	EA	27,716	$55,432	2	EA	27,716	$55,432
5	Pipeyard Leases	7	AC	1,200	$8,400	7	AC	1,200	$8,400
6	Other Appurt	100	PC	3,476	$347,604	100	PC	3,045	$304,471
22	Produce Weights	9,930	EA	290	$2,879,700	8698	EA	290	$2,522,365
	OTHER PRE-BID COSTS								
7	Temp ROW Leases	26	AC	306	$7,950	23	AC	306	$6,964
8	Perm ROW Costs	53	AC	1,500	$79,500	46	AC	1,500	$69,635
9	Permitting Costs	100	PC	548	$54,800	100	PC	480	$48,000
	SEPARATE CONTRACT COSTS								
10	Furn & Erect Aerial Crossings	0	EA		$0	0	EA		$0
	TOTAL PREBID				$10,843,580				$9,505,947
	Contingency	5.00	PCT	2.42	$700,470			2.43	$616,175
	SUB TOTAL	289,344	LF	50.84	$14,709,869	253,440	LF	51.06	$12,939,665

Alaska Power Authority ORIGINAL FOR
Wasilla to Fairbanks Gas Pipeline DETAILED EST 12-Jan-
Feasibility Cost Estimate 06:23
SPREAD 4B- JULIUS TO FAIRBANKS

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	54.80 MI unit	289,344 TOTAL COS
OWNER & DESIGN COSTS										
a Owner Costs	2.00	PCT						882,903		$882,9
b Engineering & Design	3.50	PCT						1,492,831		$1,492,8
c Material Inspection (Pct of Matl)	0.50	PCT						37,965		$37,9
d Field Inspection	65	WD		392,430	79,008	20,995	13,000	73,080		$578,5
e X-ray	289,344	LF						173,606		$173,6
f AFUDC	0.00	PCT						0		
TOTAL OWNR & DESIGN				$392,430	$79,008	$20,995	$13,000	$2,660,386		$3,165,8
PRE-BID PROCUREMENT										
1 Mainline 16" Pipe	289,344	LF						6,443,691	22.27	$6,443,6
2 Mainline Pipe Coating	289,344	LF						737,827	2.55	$737,8
3 Mainline Pipe Frt	8,167	TN						228,676	28.00	$228,6
4 Mainline Valves	2	EA						55,432	27,716	$55,4
5 Pipeyard Leases	7	AC					8,400		1,200	$8,4
6 Other Appurt	100	PC						347,604	3,476	$347,6
22 Produce Weights	9,930	EA						2,879,700	290	$2,879,7
OTHER PRE-BID COSTS										
7 Temp ROW Leases	26	AC						7,950	306	$7,9
8 Perm ROW Costs	53	AC						79,500	1,500	$79,5
9 Permitting Costs	100	PC						54,800	548	$54,8
SEPARATE CONTRACT COSTS										
10 Furn & Erect Aerial Crossings	0	EA								
TOTAL PREBID				$0	$0	$0	$8,400	$10,835,180		$10,843,5
Contingency	5.00	PCT							2.42	$700,4
SUB TOTAL	289,344	LF		$392,430	$79,008	$20,995	$21,400	$13,495,566	50.84	$14,709,8

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate
SPREAD 4B- JULIUS TO FAIRBANKS

ORIGINAL FOR DETAILED EST — 12-Jan-89 06:23 PM

REVISED TOTAL COST 253,440 LF

ITEM Description	QUANT	UM	unit (54.80 MI)	TOTAL COST (289,344 LF)	QUANT	UM	unit (48.00 MI)	TOTAL COST
PIPELINE CONTRACT								
Logistics & Support								
11 Camp & Yard Lease	6	MO	650	$3,900	6	MO	650	$3,900
12 Camp & Yard Sitework	12,500	CY	5.82	$72,805	12,500	CY	5.82	$72,805
13 Camp & Shop Set-Up & Removal	100	PC	1,003	$100,328	100	PC	1,003	$100,328
14 Camp Operations	39,522	MD	40.00	$1,580,880	39,522	MD	40.00	$1,580,880
15 Pipeyard Sitework	15,000	CY	4.33	$65,017	15,000	CY	4.33	$65,017
16 Unload & Store Pipe	54.80	MI	2,726	$149,376	48.00	MI	2,726	$130,840
Civil Construction								
17 Snow Road Construction	54.80	MI	32,679	$1,790,816	48.00	MI	32,679	$1,568,598
18 Snow Road Maintenance	54.80	MI	14,714	$806,339	48.00	MI	14,714	$706,282
19 Work Pad Construction	3,000	CY	7.59	$22,773	2,628	CY	7.59	$19,947
20 Work Pad Remove	10,000	LF	0.73	$7,277	8,759	LF	0.73	$6,374
21 Produce Select Backfill	3,000	CY	7.34	$22,020	2,628	CY	7.34	$19,288
23 Reclamation & Revegetation	456.00	AC	1,248	$569,112	399.42	AC	1,248	$498,492
TOTAL CIVIL & SUPPORT				5,190,643				4,772,752
Mobilization								
24 Mobilization-Civil	100	PC	1,099	$109,925	100	PC	1,099	$109,925
25 Demobilization-Civil	100	PC	1,099	$109,925	100	PC	1,099	$109,925
26 Mobilization-Pipeline	100	PC	9,307	$930,732	100	PC	9,307	$930,732
27 Demobilization-Pipeline	100	PC	809	$80,873	100	PC	809	$80,873
TOTAL MOB-DEMOB				1,231,455				1,231,455
Pipeline Construction								
28 Clearing	54.80	MI	16,624	$911,000	48.00	MI	16,624	$797,956
29 Grade	0.00	MI		$0	0.00	MI		$0
30 String	4,822	JTS	163.91	$790,385	4,224	JTS	163.91	$692,308
31 Machine Ditch	289,344	LF	5.39	$1,558,885	253,440	LF	5.39	$1,365,447
32 Rock Ditch	0	LF		$0	0	LF		$0
33 Bend	54.80	MI	6,849	$375,300	48.00	MI	6,849	$328,730
34 Pipe-Front End	4,822	JTS	291.14	$1,403,867	4,224	JTS	291.14	$1,229,665
35 Pipe-Weld	289,344	LF	6.11	$1,769,038	253,440	LF	6.11	$1,549,522
36 Cut Out & Repair	289,344	LF	1.88	$543,684	253,440	LF	1.88	$476,220
38 Bottom Pad	54.80	MI	5,978	$327,574	48.00	MI	5,978	$286,926
39 Lower & Backfill	54.80	MI	34,290	$1,879,113	48.00	MI	34,290	$1,645,938
40 Top Pad	289,344	LF	1.35	$389,829	253,440	LF	1.35	$341,456
42 Road Crossing-Boring	0.00	EA		$0	0.00	EA		$0
43 Tie In	32	EA	26,366	$843,697	28	EA	26,394	$739,005
44 River Crossings	8	EA	285,968	$2,287,743	8	EA	285,968	$2,287,743
45 Fabrication	100.00	PC	632	$63,190	100.00	PC	553	$55,349
46 Test	54.80	MI	4,092	$224,263	48.00	MI	4,092	$196,435
47 Cleanup	289,344	LF	3.20	$927,155	253,440	LF	3.20	$812,107
TOTAL PIPELINE DIRECT COSTS	54.80	MI	260,853	$14,294,723	48.00	MI	266,767	$12,804,806
INDIRECTS - PIPELINE CONSTRUCTION								
Services				$949,701				$831,855
Supervision & Support				$1,368,168				$1,198,395
PL Supprt Facilities				$84,460				$73,980
Expendable Materials & Supplies	40.00	PCT		$3,781,970	40.00	PCT	40.00	$3,312,674
INDIRECTS - CIVIL & SUPPORT	25.00	PCT		$1,297,661	25.00	PCT	25.00	$1,193,188
Profit & Fee	10.00	PCT		$2,819,878	10.00	PCT	10.00	$2,541,910
Contingency	5.00	PCT	5.36	$1,550,933	5.00	PCT	5.52	$1,398,051
TOTAL PIPELINE COSTS	289,344	LF	112.56	$32,569,591	253,440	LF	115.84	$29,359,065
TOTAL PROJECT COSTS>>>>>>>	289,344	LF	163.40	$47,279,460	253,440	LF	166.90	$42,298,730

Alaska Power Authority — ORIGINAL FOR DETAILED EST
Wasilla to Fairbanks Gas Pipeline — 12-Jan-
Feasibility Cost Estimate — 06:23
SPREAD 4B- JULIUS TO FAIRBANKS

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	54.80 MI unit	289,344 TOTAL COS
PIPELINE CONTRACT										
Logistics & Support										
11 Camp & Yard Lease	6	MO					3,900		650	$3,9
12 Camp & Yard Sitework	12,500	CY		28,226	16,280	10,799	0	17,500	5.82	$72,8
13 Camp & Shop Set-Up & Removal	100	PC		64,820	11,431	8,777	0	15,300	1,003	$100,3
14 Camp Operations	39,522	MD		553,308			1,027,572		40.00	$1,580,8
15 Pipeyard Sitework	15,000	CY		22,656	16,178	11,183	0	15,000	4.33	$65,0
16 Unload & Store Pipe	54.80	MI		87,621	34,325	27,430	0	0	2,726	$149,3
Civil Construction										
17 Snow Road Construction	54.80	MI		833,083	631,959	325,774	0	0	32,679	$1,790,8
18 Snow Road Maintenance	54.80	MI		382,689	279,625	144,025	0	0	14,714	$806,3
19 Work Pad Construction	3,000	CY		5,886	4,609	3,278	0	9,000	7.59	$22,7
20 Work Pad Remove	10,000	LF		3,067	2,456	1,754	0	0	0.73	$7,2
21 Produce Select Backfill	3,000	CY		5,099	6,744	4,177	0	6,000	7.34	$22,0
23 Reclamation & Revegetation	456.00	AC		4,279	2,343	1,610	0	560,880	1,248	$569,1
TOTAL CIVIL & SUPPORT				1,990,734	1,005,950	538,807	1,031,472	623,680		5,190,6
Mobilization										
24 Mobilization-Civil	100	PC		0	0	0	101,925	8,000	1,099	$109,9
25 Demobilization-Civil	100	PC		0	0	0	101,925	8,000	1,099	$109,9
26 Mobilization-Pipeline	100	PC		112,053	0	0	76,140	742,539	9,307	$930,7
27 Demobilization-Pipeline	100	PC		11,205	0	0	7,614	62,054	809	$80,8
TOTAL MOB-DEMOB				123,258	0	0	287,604	820,593		1,231,4
Pipeline Construction										
28 Clearing	54.80	MI		487,300	263,065	152,086	8,549	0	16,624	$911,0
29 Grade	0.00	MI		0	0	0	0	0		
30 String	4,822	JTS		500,359	198,850	91,176	0	0	163.91	$790,3
31 Machine Ditch	289,344	LF		852,706	435,450	270,729	0	0	5.39	$1,558,8
32 Rock Ditch	0	LF		0	0	0	0	0		
33 Bend	54.80	MI		256,496	66,477	26,410	25,917	0	6,849	$375,3
34 Pipe-Front End	4,822	JTS		1,061,239	229,473	98,421	14,734	0	291.14	$1,403,8
35 Pipe-Weld	289,344	LF		1,450,177	237,840	81,021	0	0	6.11	$1,769,0
36 Cut Out & Repair	289,344	LF		441,555	75,337	26,792	0	0	1.88	$543,6
38 Bottom Pad	54.80	MI		190,405	94,117	43,052	0	0	5,978	$327,5
39 Lower & Backfill	54.80	MI		1,137,769	474,902	266,442	0	0	34,290	$1,879,1
40 Top Pad	289,344	LF		231,551	108,739	49,539	0	0	1.35	$389,8
42 Road Crossing-Boring	0.00	EA		0	0	0	0	0		
43 Tie In	32	EA		606,137	162,856	74,704	0	0	26,366	$843,6
44 River Crossings	8	EA		1,464,082	481,408	283,953	58,300	0	285,968	$2,287,7
45 Fabrication	100.00	PC		48,000	6,861	2,090	300	5,939	632	$63,1
46 Test	54.80	MI		134,590	63,099	26,574	0	0	4,092	$224,2
47 Cleanup	289,344	LF		592,558	217,228	117,369	0	0	3.20	$927,1
TOTAL PIPELINE DIRECT COSTS	54.80	MI		9,454,924	3,115,702	1,610,358	107,800	5,939	260,853	$14,294,7
INDIRECTS - PIPELINE CONSTRUCTION										
Services				492,194	336,945	120,562	0	0.00		$949,7
Supervision & Support				972,609	159,957	52,777	182,825	0.00		$1,368,1
PL Supprt Facilities							84,460			$84,4
Expendable Materials & Supplies	40.00	PCT					3,781,970			$3,781,9
INDIRECTS - CIVIL & SUPPORT	25.00	PCT								$1,297,6
Profit & Fee	10.00	PCT								$2,819,3
Contingency	5.00	PCT							5.36	$1,550,9
TOTAL PIPELINE COSTS	289,344	LF		10,919,727	3,612,604	1,783,697	4,157,055		112.56	$32,569,5
TOTAL PROJECT COSTS>>>>>>>	289,344	LF							163.40	$47,279,4

III

COST DETAIL SHEETS

OWNER & DESIGN COSTS

PRE BID COSTS

22-Sep-88

ITEM d. Field Inspection Plan Quantity DY

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Chief Inspector & Pic	1.00	47.00	5.50	1.90			54.40
2	Asst. Chief & Pickup	1.00	41.36	5.50	1.90			48.76
3	Director of Records &	1.00	36.76	5.50	1.90			44.16
4	Clerk	1.00	22.98	5.50	1.90			30.38
5	Asst Clerk	1.00	18.38	5.50	1.90			25.78
6	Field Inspectors/P'up	12.00	437.26	66.00	22.80			526.06
	Materials					20.00		20.00
	Fee	15.00%					112.43	112.43

		No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.	17.00	603.74	93.50	32.30	20.00	112.43	861.97
Sprd 1						0.00	$0	861.97
COST	900.00 HRS	15300.00	$543,365	$84,150	$29,070	$18,000	$101,188	$775,773
Unit	90.0 DY	170.00	6037.39	935.00	323.00	200.00	1124.31	$8,620
		MH/ DY						
Sprd 2							$0	
COST	860.00 HRS	14620.00	$519,215	$80,410	$27,778	$17,200	$96,690	$741,294
Unit	86.0 DY	170.00	6037.39	935.00	323.00	200.00	1124.31	$8,620
		MH/ DY						
Sprd 3							$0	
COST	700.00 HRS	11900.00	$422,617	$65,450	$22,610	$14,000	$78,702	$603,379
Unit	70.0 DY	170.00	6037.39	935.00	323.00	200.00	1124.31	$8,620
		MH/ DY						
Sprd 4A				+30%			$0	
COST	120.00 HRS	2040.00	$72,449	$14,586	$3,876	$2,400	$13,492	$106,802
Unit	12.0 DY	170.00	6037.39	1215.50	323.00	200.00	1124.31	$8,900
		MH/ DY						
Sprd 4B							$0	
COST	650.00 HRS	11050.00	$392,430	$79,008	$20,995	$13,000	$73,080	$578,513
Unit	65.0 DY	170.00	6037.39	1215.50	323.00	200.00	1124.31	$8,900
		MH/ DY						

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

Item 1-4 Pipeline Materials

	SPREAD:		1		2		3		4A		4B	
Description	Unit Price		Quant	$	Quant	$	Quant	$	Quant	$	Quant	$
1 Mainline 16"Pipe	22.27	LF	484176	10,782,600	460944	10,265,223	336336	7,490,203	39072	870,133	289344	6,443,69
2 Mainline Pipe Coati	2.55	LF	484176	1,234,649	460944	1,175,407	336336	857,657	39072	99,634	289344	737,82
3 Mainline Pipe Frt	28.00	TN	13668	382,704	13012	364,336	9494	265,832	1103	30,884	8167	228,67
4 Mainline Valves	27,716	EA	6	166,296	6	166,296	6	166,296	1	27,716	2	55,43
TOTAL				12,566,248		11,971,262		8,779,988		1,028,367		7,465,62

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

Description

Item 5 - Pipeyard Leases

Term:	12 Months
Cost/Acre/Mo:	$100

SECTION	Acres	Tot Cost
1	7	$8,400
2	11	$13,200
3	7	$8,400
4A	3	$3,600
4B	7	$8,400

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

Item 6 Other Appurtenances

	SPREAD:	1		2		3		4A		4B	
Description	Unit Price	Quant	$	Quant	$	Quant	$	Quant	$	Quant	$
Rock Shield	4.61	18533	$85,437	27826	$128,278	22281	$102,715	4740	$21,851	59700	$275,217
Shrink Sleeve-Summr	9.09	8966	$81,501	8536	$77,592	6228	$56,613	0	$0	0	$0
Shrink Sleeve-CW Type	13.51	0	$0	0	$0	0	$0	724	$9,781	5358	$72,387
TOTAL			$166,938		$205,870		$159,328		$31,633		$347,604

WASILLA to FAIRBANKS GASLINE

ITEM 22 Concrete Weights Plan Quantity

28-Sep-88 SUMMARY

Description	No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL	UNIT COST	MANHR
SECT 4A									
Produce Weights	790 EA	$55,785	$9,541	$5,648	$0	$75,050	$146,024	$184.84	1452.0
Haul Weights	790 EA	$29,489	$13,766	$6,731	$0	$0	$49,987	$63	740.0
Form Costs	790 EA	$0	$0	$0	$0	$9,794	$9,794	$12.40	0.0
OH & Profit	11.50%						$23,668		
Item Total	790 EA	$85,274	$23,307	$12,379	$0	$84,844	$229,472	$290.47	2192
SECT 4B									
Produce Weights	9930 EA	$699,427	$119,623	$70,817	$0	$943,350	$1,833,218	$184.61	18205.0
Haul Weights	9930 EA	$366,624	$171,148	$83,683	$0	$0	$621,454	$62.58	9200.0
Form Costs	9930 EA	$0	$0	$0	$0	$123,106	$123,106	$12.40	0.0
OH & Profit	11.50%						$296,445		
Item Total	9930 EA	$1,066,051	$290,771	$154,501	$0	$1,066,456	$2,874,223	$289.45	27405

28-Sep-88

ITEM 22 Produce Weights Plan Quantity EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Civ	1.00	45.95	7.15	1.90			55.00
2	966 Loader	1.00	42.58	38.70	22.87			104.15
3	26 Genl Lab	8.00	291.51	0.00	0.00			291.51
4	18 Tn Hydr Crane	1.00	42.58	26.43	18.02			87.03

	Total Crew/Hr.	11.00	422.61	72.28	42.79	0.00	0.00	537.68
Sprd 4A							$95	537.68
COST	132.00 HRS	1452.00	$55,785	$9,541	$5,648	$0	$75,050	$146,024
Unit	790.0 EA	1.84	70.61	12.08	7.15	0.00	95.00	$185
		MH/ EA						
Sprd 4B							$95	
COST	1655.00 HRS	18205.00	$699,427	$119,623	$70,817	$0	$943,350	$1,833,218
Unit	9930.0 EA	1.83	70.44	12.05	7.13	0.00	95.00	$185
		MH/ EA						

28-Sep-88

ITEM 22 Haul Weights Plan Quantity EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Civ	1.00	45.95	7.15	1.90			55.00
2	966 Loader w/forks	2.00	85.15	77.40	45.74			208.30
3	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
4	Tractor w/Float	3.00	121.64	101.48	43.32			266.44

			No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.		10.00	398.50	186.03	90.96	0.00	0.00	675.49
Sprd 4A								0.00	675.49
COST		74.00 HRS	740.00	$29,489	$13,766	$6,731	$0	$0	$49,987
Unit		790.0 EA	0.94	37.33	17.43	8.52	0.00	0.00	63.27
			MH/ EA						
Sprd 4B								0.00	
COST		920.00 HRS	9200.00	$366,624	$171,148	$83,683	$0	$0	$621,454
Unit		9930.0 EA	0.93	36.92	17.24	8.43	0.00	0.00	62.58
			MH/ EA						

28-Sep-88

ITEM 22 Form Costs — Plan Quantity — PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Purchase Bolt on Form	100.00					62900.00	62900.00
2	Purchase Forms for Sq	100.00					50000.00	50000.00
3	Purch Curing Blnks	100.00					20000.00	20000.00
	Total Crew/Hr.		0.00	0.00	0.00	0.00	132900	132900.00
[illegible]d 4A								132900.00
[illegible]	7.37%PC	0.00	$0	$0	$0	$0	$9,794	$9,794
Unit	790 EA	0.00	0.00	0.00	0.00	0.00	12.40	12.40
Sprd 4B								
COST	92.63%PC	0.00	$0	$0	$0	$0	$123,106	$123,106
Unit	9930 EA	0.00	0.00	0.00	0.00	0.00	12.40	12.40

PC

NG-0071

DIRECT COST ESTIMATE

PROJECT FAIRBANKS GAS LINE Est. ______ Date ______ Sheet ______ of ______

ITEM 8. ROW COSTS Bid Quantity ______ T. O. Quantity ______

NO COST IN ROAD ROW EXCEPT IN NATIVE LANDS

SECT 2 @ CANTWELL LARGELY AHTNA OWNED 42 miles MAX

407 AC @ 80'

FIGURE 10% CONTINGENCY OTHER SECTIONS, 20% SECT 4A

DESCRIPTION	QUANTITY	LABOR	EQUIPMENT OPERATION	EQUIPMENT OWNERSHIP	JOB MATERIAL	PERMANENT MATERIAL	SUB BID	TOTAL
SECT					1500		133 500	
1 10% 91.7m	89 AC				~~3000~~ 3000	267 000	~~178 000~~	
2 10% 87.3m	85 AC				1500 2000	170 000	127 500	
2 AHTNA	407 AC				1500 2000	814 000	610 500	
3 10% 63.7	62 AC				1500 2000	124 000	93 000	
4A A 20% 7.4	14 AC				3000 3000	42 000	42 000	
4A B 10% 54.8	53 AC				1500 2000	106 000	79 500	
Σ						~~1 523 000~~	~~1 130 500~~ 1086 000	
IT 7. TEMP @ 10% Perm								
IT 9 Permitting Costs @ $1000/mile								

ENG-0071

DIRECT COST ESTIMATE

PROJECT FAIRBANKS CASING Est. ______ Date ______ Sheet ______ of ______

ITEM 10- AERIAL CROSSINGS Bid Quantity ______ T. O. Quantity ______

TWO ONLY - HURRICANE GULCH
LITTLE COAL CREEK BOTH SECT 2

DESCRIPTION	QUANTITY	LABOR	EQUIPMENT OPERATION	EQUIPMENT OWNERSHIP	JOB MATERIAL	PERMANENT MATERIAL	SUB BID	TOTAL
HURRICANE GULCH						200 000		
LITTLE COAL CR						160 000		
						$360 000		

IV

COST DETAIL SHEETS

PIPELINE CONTRACT

- -Logistics & Support
- -Civil Construction
- -Mobilization - Demobilization

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

Item 11 - Camp & Yard Leases

Cost/Acre/Mo: $100

SECTION	Acres	Months	Tot Cost
1	4	6	$2,400
2	4.5	6	$2,700
3	6	5	$3,000
4A	0	0	$0
4B	6.5	6	$3,900

p

WASILLA to FAIRBANKS GASLINE

ITEM 12 Camp & Yard Sitework Plan Quantity

SUMMARY

Description	No.		Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL	UNIT COST	MANHR
SECT 1										
(1) Clearing	3 AC		$2,050	$1,132	$862	$0	$0	$4,044	1347.891	50.0
(2) Embankment	14500 PC		$30,290	$17,528	$11,498	$0	$14,500	$73,816	5.091	729.0
(3) Comm'l Power Install	1 LS					$0	$5,000	$5,000	5000.000	
0	0	0	$0	$0	$0	$0	$0	$0		0.0
0	0	0	$0	$0	$0	$0	$0	$0		0.0
Item Total			$32,340	$18,660	$12,360	$0	$19,500	$82,860		779
SECT 2										
(1) Clearing	4 AC		$2,050	$1,132	$862	$0	$0	$4,044	1010.919	50.0
(2) Embankment	17000 CY		$35,525	$20,558	$13,485	$0	$17,000	$86,569	5.092	855.0
(3) Comm'l Power Install	1 LS					$0	$5,000	$5,000	5000.000	
0	0	0.00	$0	$0	$0	$0	$0	$0		0.0
0	0	0	$0	$0	$0	$0	$0	$0		0.0
Item Total			$37,575	$21,690	$14,347	$0	$22,000	$95,612		905
SECT 3										
(1) Clearing	5 AC		$3,075	$1,698	$1,293	$0	$0	$6,066	1213.102	75.0
(2) Embankment	24500 CY		$51,231	$29,647	$19,447	$0	$24,500	$124,825	5.095	1233.0
(3) Comm'l Power Install	1 LS					$0	$5,000	$5,000	5000	
0	0	0	$0	$0	$0	$0	$0	$0		0.0
0	0	0	$0	$0	$0	$0	$0	$0		0.0
Item Total			$54,306	$31,344	$20,740	$0	$29,500	$135,891		1308
SECT 4										
(1) Clearing	3 AC		$2,050	$1,132	$862	$0	$0	$4,044	1617.470	50.0
(2) Embankment	12500 CY		$26,177	$15,148	$9,937	$0	$12,500	$63,761	5.101	630.0
(3) Comm'l Power Install	1 LS					$0	$5,000	$5,000	5000.000	
0	0	0	$0	$0	$0	$0	$0	$0		0.0
0	0	0	$0	$0	$0	$0	$0	$0		0.0
	0	0	$0	$0	$0	$0	$0	$0		0.0
Item Total			$28,226	$16,280	$10,799	$0	$17,500	$72,805		680

p

ITEM 12 Clearing Plan Quantity AC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
	1 Pickup w/Foreman	1.00	45.95	5.50	1.90			53.35
	2 Hydroaxe	1.00	42.58	52.66	40.58			135.82
	3 Chainsaw & Op	2.00	73.88	4.30	4.10			82.28
	4 D-8w/winch	1.00	42.58	50.71	39.63			132.92
	Total Crew/Hr.	5.00	204.99	113.17	86.21	0.00	0.00	404.37
Sprd 1								404.37
COST	10.00 HRS	50.00	$2,050	$1,132	$862	$0	$0	$4,044
Unit	3 AC	16.67 mh/ac	683.29	377.23	287.37	0.00	0.00	$1,348
Sprd 2								0.00
COST	10.00 HRS	50.00	$2,050	$1,132	$862	$0	$0	$4,044
Unit	4 AC	14.29 mh/ac	585.68	323.34	246.31	0.00	0.00	$1,155
Sprd 3								0.00
COST	15.00 HRS	75.00	$3,075	$1,698	$1,293	$0	$0	$6,066
Unit	5 AC	15.00 mh/ac	614.96	339.51	258.63	0.00	0.00	$1,213
Sprd 4b								0.00
COST	10.00 HRS	50.00	$2,050	$1,132	$862	$0	$0	$4,044
Unit	2.50 AC	20.00 mh/ac	819.95	452.68	344.84	0.00	0.00	$1,617

p

ITEM 12 Embankment Plan Quantity CY

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
	1 Pickup w/Foreman,Ci	1.00	45.95	5.50	1.90			53.35
	2 Bot Dump w/Tract	4.00	164.78	105.68	60.00			330.46
	3 966 Loader	1.00	42.58	29.77	22.87			95.22
	4 D-8w/winch	1.00	42.58	50.71	39.63			132.92
	5 14 Motor Grader	0.50	21.29	11.72	10.43			43.44
	6 SP56 Vib Roller	0.50	20.33	13.02	7.12			40.47
	7 26 Genl Lab	1.00	36.44	0.00	0.00			36.44
	Total Crew/Hr.	9.00	373.95	216.40	141.95	0.00	0.00	732.30
Sprd 1							1.00	732.30
COST	81.00 HRS	729.00	$30,290	$17,528	$11,498	$0	$14,500	$73,816
Unit	14500 CY	0.05	2.09	1.21	0.79	0.00	1.00	5.09
		mh/ac						
Sprd 2							1.00	
COST	95.00 HRS	855.00	$35,525	$20,558	$13,485	$0	$17,000	$86,569
Unit	17000 CY	0.05	2.09	1.21	0.79	0.00	1.00	5.09
		mh/ac						
Sprd 3							1.00	
COST	137.00 HRS	1233.00	$51,231	$29,647	$19,447	$0	$24,500	$124,825
Unit	24500 CY	0.05	2.09	1.21	0.79	0.00	1.00	5.09
		mh/ac						
Sprd 4b							1.00	
COST	70.00 HRS	630.00	$26,177	$15,148	$9,937	$0	$12,500	$63,761
Unit	12500 CY	0.05	2.09	1.21	0.79	0.00	1.00	5.10
		mh/ac						

p

WASILLA to FAIRBANKS GASLINE

ITEM 13 Camp & Shop Setup — Plan Quantity

SUMMARY

Description	No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL	UNIT COST	MANHR
SECT 1									
(1) Septic Tanks & Sewers	100 PC	$16,208	$3,194	$1,716	$0	$24,500	$45,619	456.187	400.0
(2) Water Distribution	100 PC	$1,837	$162	$92	$0	$10,000	$12,091	120.908	45.0
(3) Electrical Distributi	1 LS				$0	$7,600	$7,600	7600.000	
(4) Erect Camp Units	38 CB	$31,620	$5,816	$4,248	$0	$11,400	$53,084	1396.946	800.0
(5) Erect Shop Units	1 EA	$7,677	$955	$1,292	$0	$500	$10,424	10424.26	180.0
Item Total		$57,342	$10,127	$7,349	$0	$54,000	$128,818		1425
SECT 2									
(1) Septic Tanks & Sewers	100 PC	$22,286	$4,392	$2,360	$0	$34,000	$63,038	630.382	550.0
(2) Water Distribution	100 PC	$1,837	$162	$92	$0	$10,000	$12,091	120.908	45.0
(3) Electrical Distributi	1 LS				$0	$9,000	$9,000	9000.000	
(4) Erect Camp Units	45 CB	$36,363	$6,688	$4,885	$0	$13,500	$61,437	1365.257	920.0
(5) Erect Shop Units	1 EA	$7,677	$955	$1,292	$0	$500	$10,424	10424.26	180.0
Item Total		$68,163	$12,197	$8,629	$0	$67,000	$155,990		1695
SECT 3									
(1) Septic Tanks & Sewers	100 PC	$26,338	$5,191	$2,789	$0	$40,200	$74,518	745.179	650.0
(2) Water Distribution	100 PC	$2,755	$243	$138	$0	$15,000	$18,136	181.362	67.5
(3) Electrical Distributi	1 LS				$0	$15,600	$15,600	15600	
(4) Erect Camp Units	78 CB	$63,240	$11,632	$8,496	$0	$23,400	$106,768	1368.820	1600.0
(5) Erect Shop Units	2 EA	$15,354	$1,910	$2,585	$0	$1,000	$20,849	10424.26	360.0
Item Total		$107,688	$18,975	$14,007	$0	$95,200	$235,871		2678
SECT 4									
(1) Septic Tanks & Sewers	100 PC	$4,052	$799	$429	$0	$6,200	$11,480	114.797	100.0
(2) Water Distribution	100 PC	$918	$81	$46	$0	$1,000	$2,045	20.454	22.5
(3) Electrical Distributi	1 LS				$0	$5,200	$5,200	5200.000	
(4) Erect Camp Units	26 CB	$20,553	$3,780	$2,761	$0	$2,600	$29,695	1142.099	520.0
(5) Erect Shop Units	1 EA	$7,677	$955	$1,292	$0	$300	$10,224	10224.26	180.0
(6) Walkways	100 PC	$31,620	$5,816	$4,248	$0	$0	$41,684	416.84	800.0
Item Total		$64,820	$11,431	$8,777	$0	$15,300	$100,328		1623

p

ITEM 13 (1) Septic Tanks & Sewers Plan Quantity LS

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
	1 Pickup w/Foreman	1.00	45.95	5.50	1.90			53.35
	2 JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
	3 26 Genl Lab	2.00	72.88	0.00	0.00			72.88
	4 10 CY End Dump	1.00	41.20	23.76	12.24			77.20
	Total Crew/Hr.	5.00	202.60	39.93	21.45	0.00	0.00	263.98
Sprd 1							$24,500	263.98
COST	80.00 HRS	400.00	$16,208	$3,194	$1,716	$0	$24,500	$45,619
Unit	100 PC	4.00 mh/pc	162.08	31.94	17.16	0.00	245.00	$456
Sprd 2							$34,000	0.00
COST	110.00 HRS	550.00	$22,286	$4,392	$2,360	$0	$34,000	$63,038
Unit	100 PC	5.50 mh/pc	222.86	43.92	23.60	0.00	340.00	$630
Sprd 3							$40,200	0.00
COST	130.00 HRS	650.00	$26,338	$5,191	$2,789	$0	$40,200	$74,518
Unit	100 PC	6.50 mh/pc	263.38	51.91	27.89	0.00	402.00	$745
Sprd 4b							$6,200	0.00
COST	20.00 HRS	100.00	$4,052	$799	$429	$0	$6,200	$11,480
Unit	100 PC	1.00 mh/pc	40.52	7.99	4.29	0.00	62.00	$115

P

ITEM 13 (2) Water Distribution Plan Quantity PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Ci	1.00	45.95	5.50	1.90			53.35
2	JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
3	26 Genl Lab	2.00	72.88	0.00	0.00			72.88
4	33 Fitter Journeyman	0.50	22.29	0.00	0.00			22.29

	Total Crew/Hr.	4.50	183.70	16.17	9.21	0.00	0.00	209.08
Sprd 1							100.00	209.08
COST	10.00 HRS	45.00	$1,837	$162	$92	$0	$10,000	$12,091
Unit	100 PC	0.45 mh/pc	18.37	1.62	0.92	0.00	100.00	120.91
Sprd 2							100.00	
COST	10.00 HRS	45.00	$1,837	$162	$92	$0	$10,000	$12,091
Unit	100 PC	0.45 mh/pc	18.37	1.62	0.92	0.00	100.00	120.91
Sprd 3							150.00	
COST	15.00 HRS	67.50	$2,755	$243	$138	$0	$15,000	$18,136
Unit	100 PC	0.68 mh/pc	27.55	2.43	1.38	0.00	150.00	181.36
Sprd 4b							10.00	
COST	5.00 HRS	22.50	$918	$81	$46	$0	$1,000	$2,045
Unit	100 PC	0.23 mh/pc	9.18	0.81	0.46	0.00	10.00	20.45

ENG-0071

DIRECT COST ESTIMATE

PROJECT ______________________ Est. ________ Date ________ Sheet ______ of ______

ITEM ______________________ Bid Quantity ______________ T. O. Quantity ______________

Item 13 (3.) Elect Dill

	DESCRIPTION	QUANTITY	LABOR	EQUIPMENT OPERATION	EQUIPMENT OWNERSHIP	JOB MATERIAL	PERMANENT MATERIAL	SUB BID	TOTAL
1	20 x 38	760					60'		
						7600			
2	20 45	900							
						9000			
3	20 78	1560							
						15600			
4	20 26	520							
						5200			

p

ITEM 13 (4) Erect Camp Units Plan Quantity CUBE- CB

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,	1.00	49.01	5.50	1.90			56.41
43	988 Loader w/Forks	1.00	44.85	52.66	40.58			138.09
44	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
45	30 PL Carp	2.00	76.59	0.00	0.00			76.59
	Total Crew/Hr.	8.00	316.20	58.16	42.48	0.00	0.00	416.84
Sprd 1							300.00	416.84
COST	100.00 HRS	800.00	$31,620	$5,816	$4,248	$0	$11,400	$53,084
Unit	38 CB	21.05 mh/cb	832.10	153.05	111.79	0.00	300.00	1396.95
Sprd 2							300.00	
COST	115.00 HRS	920.00	$36,363	$6,688	$4,885	$0	$13,500	$61,437
Unit	45 CB	20.44 mh/cb	808.07	148.63	108.56	0.00	300.00	1365.26
Sprd 3							300.00	
COST	200.00 HRS	1600.00	$63,240	$11,632	$8,496	$0	$23,400	$106,768
Unit	78 CB	20.51 mh/cb	810.77	149.13	108.92	0.00	300.00	1368.82
Sprd 4b							100.00	
COST	65.00 HRS	520.00	$20,553	$3,780	$2,761	$0	$2,600	$29,695
Unit	26 CB	20.00 mh/cb	790.50	145.40	106.20	0.00	100.00	1142.10
Sprd 4b Item 6								
COST	100.00 HRS	800.00	$31,620	$5,816	$4,248	$0	$0	$41,684
Unit	100 PC	8.00 mh/pc	316.20	58.16	42.48	0.00	0.00	416.84

p

ITEM 13 (5) Erect Shop Units Plan Quantity 40x50 EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,	1.00	49.01	5.50	1.90			56.41
43	Ironworker	2.00	89.17	0.00	0.00			89.17
44	26 Genl Lab	2.00	72.88	0.00	0.00			72.88
45	70 T Crane	1.00	44.85	26.33	41.18			112.36
	Total Crew/Hr.	6.00	255.90	31.83	43.08	0.00	0.00	330.81
Sprd 1							500.00	330.81
COST	30.00 HRS	180.00	$7,677	$955	$1,292	$0	$500	$10,424
Unit	1 EA	180.00 mh/ea	7676.96	954.90	1292.40	0.00	500.00	10424.26
Sprd 2							500.00	
COST	30.00 HRS	180.00	$7,677	$955	$1,292	$0	$500	$10,424
Unit	1 EA	180.00 mh/ea	7676.96	954.90	1292.40	0.00	500.00	10424.26
Sprd 3							500.00	
COST	60.00 HRS	360.00	$15,354	$1,910	$2,585	$0	$1,000	$20,849
Unit	2 EA	180.00 mh/ea	7676.96	954.90	1292.40	0.00	500.00	10424.26
Sprd 4b							300.00	
COST	30.00 HRS	180.00	$7,677	$955	$1,292	$0	$300	$10,224
Unit	1 EA	180.00 mh/ea	7676.96	954.90	1292.40	0.00	300.00	10224.26

NG-0071

DIRECT COST ESTIMATE

PROJECT Wasilla-Fai Rd Est. ______ Date ______ Sheet ______ of ______

ITEM 14- CAMP OPERATIONS Bid Quantity ______ T. O. Quantity ______

USE MAN DAY RATE INCLUDES - CATERING
UTILITIES
HEAT
MAINTENANCE

FOR M-D COUNT ADD 1 CAT/MAINT/20 M-D

DESCRIPTION	QUANTITY	LABOR	EQUIPMENT OPERATION	EQUIPMENT OWNERSHIP	JOB MATERIAL	PERMANENT MATERIAL	SUB BID	TOTAL
FOOD					18.00			18.00
LABOR		10.00						10.00
MAINT		4.00			4.00			8
HEAT / UTILITIES					3.00			3
		14			25			39
WINTER - ADD ADDL UTIL					1.00			
					26.00			40.00

SPRING 4A - USE $15.00 /DAY AVG PER DIEM

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate
MANHOUR & CREW SUMMARY

ITEM 14 - CAMP OPS / PER DIEM

ITEM	Description	SPREAD ONE Size	SPREAD ONE Duration	SPREAD ONE Manhours	SPREAD TWO Size	SPREAD TWO Duration	SPREAD TWO Manhours	SPREAD THREE Size	SPREAD THREE Duration	SPREAD THREE Manhours	SPREAD 4A Size	SPREAD 4A Duration	SPREAD 4A Manhours	SPREAD 4B Size	SPREAD 4B Duration	SPREAD 4B Manhours
	PIPELINE CONTRACT															
	Logistics & Support															
11	Camp & Yard Lease			0			0			0			0			0
12	Camp & Yard Sitework	9	91	779	9	105	905	9	152	1308			0	9	80	680
13	Camp & Shop Set-Up & Removal	15	100	1425	15	115	1695	15	200	2678			0	15	100	1623
14	Camp Operations			0												
15	Pipeyard Sitework	12	45	540	12	75	900	12	51	612			0	12	45	540
16	Unload & Store Pipe	10	360	3600	10	340	3400	10	250	2500	10	30	300	10	215	2150
	Civil Construction															
17	Snow Road Construction			0			0			0	29	100	2900	29	740	21460
18	Snow Road Maintenance			0			0			0	13	108	1426	13	700	9240
19	Work Pad Construction	14	224	3136	14	183	2562	14	124	1736	14	0	0	14	10	140
20	Work Pad Remove	9	200	1800	9	163	1467	9	111	999	9	0	0	9	8	72
21	Produce Select Backfill	6	100	600	6	150	900	6	120	720	6	20	120	6	20	120
23	Reclamation & Revegetation	10	49	515	10	45	472	10	37	388	10	5	52	10	10	105
	Mobilization															
24	Mobilization-Civil															
25	Demobilization-Civil															
26	Mobilization-Pipeline															
27	Demobilization-Pipeline															
	Pipeline Construction															
28	Clearing	14	780	11076	14	740	10508	14	580	8236	22	74	1628	22	548	12056
29	Grade	16	780	12636	16	740	11988	16	580	9396			0			0
30	String	19	780	14976	19	740	14208	19	580	11136	24	72	1742	24	530	12826
31	Machine Ditch	22	780	17316	22	740	16428	22	580	12876	42	72	3024	42	530	22260
32	Rock Ditch	NONE			16	180	2916	16	690	11178		0			0	
33	Bend	11	780	8736	11	740	8288	11	580	6496	12	72	878	12	530	6466
34	Pipe-Front End	31	780	24180	31	740	22940	31	580	17980	49	72	3528	49	530	25970
35	Pipe-Weld	44	780	34320	44	740	32560	44	580	25520	68	72	4896	68	530	36040
36	Cut Out & Repair	12	780	9516	12	740	9028	12	580	7076	21	72	1526	21	530	11236
38	Bottom Pad	16	780	12480	16	740	11840	16	580	9280	9	72	648	9	530	4770
39	Lower & Backfill	32	780	24960	32	740	23680	32	580	18560	58	72	4140	58	530	30475
40	Top Pad	22	780	17160	22	740	16280	22	580	12760	11	72	792	11	530	5830
42	Road Crossing-Boring	17	180	3060	17	120	2040	17	180	3060		0			0	
43	Tie In	17	780	13260	17	740	12580	17	580	9860	29	72	2088	29	530	15370
44	River Crossings	42	1130	47460	42	680	28560	42	600	25200	72	72	5184	72	530	38160
46	Fabrication	21	120	2520	21	120	2520	21	120	2520	30	80	2400	30	80	2400
47	Test	18	240	4320	18	240	4320	18	240	4320	19	50	950	19	170	3230
48	Cleanup	32	780	24960	32	740	23680	32	580	18560	28	72	2016	28	530	14840
	TOTAL PIPELINE DIRECT COSTS			295,331			266,665			224,955			40,238			278,059
	INDIRECTS - PIPELINE CONSTRUCTION															
	Services	9	1500	13500	9	1100	9900	9	950	8550	16	108	1728	16	795	12720
	Supervision & Support	25	1500	37500	25	1450	36250	25	1300	32500	26	140	3640	26	1030	26780
	Repair & Serv Labor		780	23400		740	22200		580	17400		72	2880		530	21200
	INDIRECTS - CIVIL & SUPPORT			74,400			68,350			58,450			8,248			60,700
	TOTAL PIPELINE			369,731			335,015			283,405			48,486			338,759

p

ITEM 15 Pipeyard Sitework Plan Quantity CY

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman	1.00	45.95	5.50	1.90			53.35
2	988 Loader	1.00	44.85	52.66	40.58			138.09
3	D-8w/winch	1.00	42.58	50.71	39.63			132.92
4	D-9 Ripper	1.00	42.58	69.06	56.31			167.95
5	14 Motor Grader	1.00	42.58	23.44	20.86			86.88
6	30 Drillr,Grd Ckr	1.00	38.30	0.00	0.00			38.30
7	SP56 Vib Roller	1.00	40.66	26.04	14.24			80.94
8	End Dump w/Tract	5.00	205.98	132.10	75.00			413.08
	Total Crew/Hr.	12.00	503.47	359.51	248.52	0.00	0.00	1111.50
Sprd 1							$1	1111.50
COST	45.00 HRS	540.00	$22,656	$16,178	$11,183	$0	$15,000	$65,018
Unit	15000 CY	0.04	1.51	1.08	0.75	0.00	1.00	$4
		MH/ CY						
Sprd 2							$1	
COST	75.00 HRS	900.00	$37,760	$26,963	$18,639	$0	$25,000	$108,363
Unit	25000 CY	0.04	1.51	1.08	0.75	0.00	1.00	$4
		MH/ CY						
Sprd 3							$1	
COST	51.00 HRS	612.00	$25,677	$18,335	$12,675	$0	$17,000	$73,687
Unit	17000 CY	0.04	1.51	1.08	0.75	0.00	1.00	$4
		MH/ CY						
Sprd 4b							$1	
COST	45.00 HRS	540.00	$22,656	$16,178	$11,183	$0	$15,000	$65,018
Unit	15000 CY	0.04	1.51	1.08	0.75	0.00	1.00	$4
		MH/ CY						

p

ITEM 0 16 Unload & Store Pipe Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Forema	1.00	45.95	5.50	1.90			53.35
2	70 T Crane	2.00	89.70	52.66	82.36			224.72
3	34 Welder Helper	2.00	77.37	0.00	0.00			77.37
4	26 Genl Lab	2.00	72.88	0.00	0.00			72.88
5	Tractor & Float	3.00	121.64	101.49	43.32			266.45

		Total Crew/Hr.	10.00	407.54	159.65	127.58	0.00	0.00	694.77
	Sprd 1							0.00	694.77
COST		360.00 HRS	3600.00	$146,715	$57,474	$45,929	$0	$0	$250,118
	Unit	91.7 MI	39.26 MH/ MI	1599.94	626.76	500.86	0.00	0.00	2727.56
	Sprd 2							0.00	
COST		340.00 HRS	3400.00	$138,564	$54,281	$43,377	$0	$0	$236,222
	Unit	87.3 MI	38.95 MH/ MI	1587.22	621.78	496.88	0.00	0.00	2705.87
	Sprd 3							0.00	
COST		250.00 HRS	2500.00	$101,885	$39,913	$31,895	$0	$0	$173,693
	Unit	63.7 MI	39.25 MH/ MI	1599.45	626.57	500.71	0.00	0.00	2726.73
	Sprd 4b						0.00	0.00	
COST		215.00 HRS	2150.00	$87,621	$34,325	$27,430	$0	$0	$149,376
	Unit	54.8 MI	39.23 MH/ MI	1598.93	626.36	500.54	0.00	0.00	2725.84
	Sprd 4a						0.00	0.00	
COST		30.00 HRS	300.00	$12,226	$4,790	$3,827	$0	$0	$20,843
	Unit	7.4 MI	40.54 MH/ MI	1652.19	647.23	517.22	0.00	0.00	2816.64

21-Sep-88

ITEM I 17 Snow Road Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman	1.00	45.95	7.15	1.90			55.00
2	Pickup w/Strawbo	1.00	45.95	7.15	1.90			55.00
3	26 Genl Lab	5.00	182.19	0.00	0.00			182.19
4	D-8w/winch	4.00	170.31	263.69	158.52			592.52
5	988 Loader w/Snob	1.00	44.85	76.67	50.73			172.25
5	14 Motor Grader	5.00	212.89	152.36	104.30			469.55
6	Chainsaw & Op	2.00	75.06	4.55	3.50			83.11
7	Winch Truck	2.00	82.39	40.82	12.50			135.71
8	Bus, 30 Pasgr	2.00	17.83	52.78	19.40			90.01
9	Carryall 10 Passg	1.00	53.50	11.05	2.00			66.55
10	4" Pump	4.00	0.00	35.41	4.68			40.09
11	6" Pump	4.00	0.00	30.68	14.00			44.68
12	Tractor w/Water T	4.00	162.19	145.13	57.76			365.08
13	Pickup	2.00	0.00	14.30	3.80			18.10
14	Heater Van	1.00	32.67	12.25	5.25			50.17
	Total Crew/Hr.	29.00	1125.79	854.00	440.24	0.00	0.00	2420.02
Sprd 4A						0.00	$0	2420.02
COST	100.00 HRS	2900.00	$112,579	$85,400	$44,024	$0	$0	$242,002
Unit	7.4 MI	391.89	15213.34	11540.53	5949.12	0.00	0.00	$32,703
		MH/ MI						
Sprd 4B							$0	
COST	740.00 HRS	21460.00	$833,083	$631,959	$325,774	$0	$0	$1,790,816
Unit	54.8 MI	391.61	15202.24	11532.10	5944.78	0.00	0.00	$32,679
		MH/ MI						

21-Sep-88

ITEM I 18 Snow Road Maintenance Plan Quantity JTS

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Ci	1.00	45.95	7.15	1.90			55.00
2	14 Motor Grader	4.00	170.31	121.89	83.44			375.64
3	D-7w/winch	1.00	42.58	55.65	28.18			126.41
4	966 Loader	1.00	42.58	38.70	22.87			104.15
5	Tractor w/Water Trai	2.00	81.09	72.57	28.88			182.54
6	6" Pump	4.00	0.00	30.68	14.00			44.68
7	10 CY End Dump	2.00	82.39	61.78	24.48			168.65
8	26 Genl Lab	2.00	72.88	0.00	0.00			72.88
9	Carryall 10 Passgr	1.00	8.92	11.05	2.00			21.97

	Total Crew/Hr.	13.20	546.70	399.46	205.75	0.00	0.00	1151.91
Sprd 4A							0.00	1151.91
COST	108.00 HRS	1425.60	$59,043	$43,142	$22,221	$0	$0	$124,407
Unit	7.4 MI	192.65	7978.84	5830.02	3002.84	0.00	0.00	16811.69
		MH/ MI						
Sprd 4B							0.00	
COST	700.00 HRS	9240.00	$382,689	$279,625	$144,025	$0	$0	$806,339
Unit	54.8 MI	168.61	6983.37	5102.64	2628.19	0.00	0.00	14714.21
		MH/ MI						

p

ITEM C 19 Work Pad Construction Plan Quantity CY

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
	1 Pickup w/Foreman	1.00	45.95	5.50	1.90			53.35
	2 988 Loader	1.00	44.85	52.66	40.58			138.09
	3 D-8w/winch	1.00	42.58	50.71	39.63			132.92
	4 D-9 Ripper	1.00	42.58	69.06	56.31			167.95
	5 SP56 Vib Roller	1.00	40.66	26.04	14.24			80.94
	6 30 Drillr,Grd Ckr	1.00	38.30	0.00	0.00			38.30
	7 14 Motor Grader	1.00	42.58	23.44	20.86			86.88
	8 End Dump w/Tract	5.00	205.98	132.10	75.00			413.08
	9 D-8w/winch	2.00	85.15	101.42	79.26			265.83
	Total Crew/Hr.	14.00	588.63	460.93	327.78	0.00	0.00	1377.34
Sprd 1							1.50	1377.34
COST	224.00 HRS	3136.00	$131,852	$103,248	$73,423	$0	$112,500	$421,023
Unit	75000 CY	0.04	1.76	1.38	0.98	0.00	1.50	$6
		MH/ CY						
Sprd 2							$1	
COST	183.00 HRS	2562.00	$107,719	$84,350	$59,984	$0	$61,200	$313,252
Unit	61200 CY	0.04	1.76	1.38	0.98	0.00	1.00	$5
		MH/ CY						
Sprd 3							$1	
COST	124.00 HRS	1736.00	$72,990	$57,155	$40,645	$0	$41,600	$212,390
Unit	41600 CY	0.04	1.75	1.37	0.98	0.00	1.00	$5
		MH/ CY						
Sprd 4b							$3	
COST	10.00 HRS	140.00	$5,886	$4,609	$3,278	$0	$9,000	$22,773
Unit	3000 CY	0.05	1.96	1.54	1.09	0.00	3.00	$8
		MH/ CY						

p

ITEM 20 Work Pad Remove Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Forema	1.00	45.95	5.50	1.90			53.35
2	988 Loader	1.00	44.85	52.66	40.58			138.09
3	D-8w/winch	1.00	42.58	50.71	39.63			132.92
4	D-9 Ripper	1.00	42.58	69.06	56.31			167.95
5	14 Motor Grader	1.00	42.58	23.44	20.86			86.88
6	End Dump w/Tract	4.00	164.78	105.68	60.00			330.46

	Total Crew/Hr.	9.00	383.32	307.05	219.28	0.00	0.00	909.65
Sprd 1							0.00	909.65
COST	200.00 HRS	1800.00	$76,664	$61,410	$43,856	$0	$0	$181,930
Unit	300000 LF	0.01	0.26	0.20	0.15	0.00	0.00	0.61
		MH/ LF						
Sprd 2							0.00	
COST	163.00 HRS	1467.00	$62,481	$50,049	$35,743	$0	$0	$148,273
Unit	250000 LF	0.01	0.25	0.20	0.14	0.00	0.00	0.59
		MH/ LF						
Sprd 3							0.00	
COST	111.00 HRS	999.00	$42,548	$34,083	$24,340	$0	$0	$100,971
Unit	170000 LF	0.01	0.25	0.20	0.14	0.00	0.00	0.59
		MH/ LF						
Sprd 4b							0.00	
COST	8.00 HRS	72.00	$3,067	$2,456	$1,754	$0	$0	$7,277
Unit	10000 LF	0.01	0.31	0.25	0.18	0.00	0.00	0.73
		MH/ LF						

p

ITEM C 21 Produce Select Backfill Plan Quantity CY

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,	1.00	45.95	5.50	1.90			53.35
2	988 Loader	1.00	44.85	52.66	40.58			138.09
3	D-9 Ripper	2.00	85.15	138.12	112.62			335.89
4	26 Genl Lab	1.00	36.44	0.00	0.00			36.44
5	Kolman Screen	1.00	42.58	140.90	53.75			237.23

	Total Crew/Hr.	6.00	254.97	337.18	208.85	0.00	0.00	801.00
Sprd 1							2.00	801.00
COST	100.00 HRS	600.00	$25,497	$33,718	$20,885	$0	$30,000	$110,100
Unit	15000 CY	0.04	1.70	2.25	1.39	0.00	2.00	7.34
		MH/ CY						
Sprd 2							1.50	
COST	150.00 HRS	900.00	$38,246	$50,577	$31,328	$0	$33,750	$153,900
Unit	22500 CY	0.04	1.70	2.25	1.39	0.00	1.50	6.84
		MH/ CY						
Sprd 3							1.50	
COST	120.00 HRS	720.00	$30,597	$40,462	$25,062	$0	$27,000	$123,120
Unit	18000 CY	0.04	1.70	2.25	1.39	0.00	1.50	6.84
		MH/ CY						
Sprd 4b							2.00	
COST	20.00 HRS	120.00	$5,099	$6,744	$4,177	$0	$6,000	$22,020
Unit	3000 CY	0.04	1.70	2.25	1.39	0.00	2.00	7.34
		MH/ CY						
Sprd 4a							2.00	
COST	20.00 HRS	120.00	$5,099	$6,744	$4,177	$0	$6,000	$22,020
Unit	3000 CY	0.04	1.70	2.25	1.39	0.00	2.00	7.34
		MH/ CY						

p

ITEM C 23 Reclamation & Revegetation AC

Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1 Pickup w/Foreman,Ci	1.00	45.95	5.50	1.90			53.35
2 966 Loader	1.00	42.58	29.77	22.87			95.22
3 D-8w/winch	2.00	85.15	101.42	79.26			265.83
4 10 CY End Dump	3.00	123.59	71.28	36.72			231.59
5 Hydroseeder	0.50	21.29	26.33	20.29			67.91
6 26 Genl Lab	3.00	109.31	0.00	0.00			109.31

	Total Crew/Hr.	10.50	427.88	234.30	161.04	0.00	0.00	823.22
Sprd 1							1230.00	823.22
COST	49.00 HRS	514.50	$20,966	$11,481	$7,891	$0	$708,480	$748,818
Unit	576 AC	0.89	36.40	19.93	13.70	0.00	1230.00	1300.03
		MH/ AC						
Sprd 2							1230.00	
COST	45.00 HRS	472.50	$19,254	$10,544	$7,247	$0	$678,960	$716,005
Unit	552 AC	0.86	34.88	19.10	13.13	0.00	1230.00	1297.11
		MH/ AC						
Sprd 3							1230.00	
COST	37.00 HRS	388.50	$15,831	$8,669	$5,958	$0	$495,690	$526,149
Unit	403 AC	0.96	39.28	21.51	14.79	0.00	1230.00	1305.58
		MH/ AC						
Sprd 4b							1230.00	
COST	10.00 HRS	105.00	$4,279	$2,343	$1,610	$0	$560,880	$569,112
Unit	456 AC	0.23	9.38	5.14	3.53	0.00	1230.00	1248.05
		MH/ AC						
Sprd 4a							1230.00	
COST	5.00 HRS	52.50	$2,139	$1,172	$805	$0	$67,650	$71,766
Unit	55 AC	0.02	38.90	21.30	14.64	0.00	1230.00	1304.84
		MH/ AC						

p

ITEM M 24 Mobilization - Civil Plan Quantity PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Drive to Project	23.00				57.50		57.50
2	Haul to Project	40.00				320.00		320.00
3	Load Out	40.00					8000.00	0.00
								0.00
								0.00
								0.00
								0.00
								0.00
								0.00
	Total Cost/Mile	63.00	0.00	0.00	0.00	377.50		377.50
Sprd 1		PC						
COST	100.00 MI		$0	$0	$0	$37,750	$8,000	$45,750
Unit	100 PC	0.00	0.00	0.00	0.00	377.50	80.00	$458
Sprd 2								
COST	200.00 MI		$0	$0	$0	$75,500	$8,000	$83,500
Unit	100 PC	0.00	0.00	0.00	0.00	755.00	80.00	$835
Sprd 3								
COST	270.00 MI		$0	$0	$0	$101,925	$8,000	$109,925
Unit	100 PC	0.00	0.00	0.00	0.00	1019.25	80.00	$1,099
Sprd 4b								
COST	270.00 MI		$0	$0	$0	$101,925	$8,000	$109,925
Unit	100 PC	0.00	0.00	0.00	0.00	1019.25	80.00	$1,099

p

ITEM M 26 Mobilization- Pipeline Plan Quantity PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Rail to Project	41	112053				553500	112053
2	Tote to Anc	141.00					189039	189039
3	Drive to Project	141.00				282.00		282.00
	Total Crew/Hr.		112053	0.00	0.00	282.00	742539	
Sprd 1								
COST	100.00 MI	0.00	$112,053	$0	$0	$28,200	$742,539	$882,792
Unit	100 PC	0.00	1120.53	0.00	0.00	282.00	7425.39	8827.92
Sprd 2								
COST	200.00 MI	0.00	$112,053	$0	$0	$56,400	$742,539	$910,992
Unit	100 PC	0.00	1120.53	0.00	0.00	564.00	7425.39	9109.92
Sprd 3								
COST	270.00 MI	0.00	$112,053	$0	$0	$76,140	$742,539	$930,732
Unit	100 PC	0.00	1120.53	0.00	0.00	761.40	7425.39	9307.32
Sprd 4b								
COST	270.00 MI	0.00	$112,053	$0	$0	$76,140	$742,539	$930,732
Unit	100 PC	0.00	1120.53	0.00	0.00	761.40	7425.39	9307.32
Sprd 4a								
COST	250.00 MI	0.00	$112,053	$0	$0	$70,500	$148,508	$331,061
Unit	100 PC	0.00	1120.53	0.00	0.00	705.00	1485.08	3310.61

p

ITEM M 27 DeMobilization- Pipeline PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Rail Return	41	112053				485440	112053
2	Tote from Anc	141.00					135102	135102
3	Drive to Tote	141.00				282.00		282.00
	Total Crew/Hr.		112053	0.00	0.00	282.00	620542	
Sprd 1								
COST	100.00 MI	0.00	$112,053	$0	$0	$28,200	$620,542	$760,795
Unit	100 PC	0.00	1120.53	0.00	0.00	282.00	6205.42	7607.95
Sprd 2								
COST	200.00 MI	0.00	$112,053	$0	$0	$56,400	$620,542	$788,995
Unit	100 PC	0.00	1120.53	0.00	0.00	564.00	6205.42	7889.95
Sprd 3								
COST	270.00 MI	0.00	$112,053	$0	$0	$76,140	$620,542	$808,735
Unit	100 PC	0.00	1120.53	0.00	0.00	761.40	6205.42	8087.35
Sprd 4b								
COST	27.00 MI	0.00	$11,205	$0	$0	$7,614	$62,054	$80,874
Unit	100 PC	0.00	112.05	0.00	0.00	76.14	620.54	808.74
(4a Demobs to Lwr 48)								
Sprd 4a								
COST	50.00 MI	0.00	$112,053	$0	$0	$14,100	$620,542	$746,695
Unit	100 PC	0.00	1120.53	0.00	0.00	141.00	6205.42	7466.95

Fairbanks Gasline

SPREAD 1-3
EQUIPMENT MOBILIZATION LIST
EACH SPREAD

		NO.	LOC	WT	Tot Wt
r	Pickup w/Radio	65	O.S./AK	3700	240500
r	Bus, 30 Pasgr	6	O.S./AK	15000	90000
		71			330500
	Internal Pneumatic Clamps	1	O.S.	e	
	Inside Mandrel	1	O.S.	e	
	Roller Units	10	O.S.	e	
	Hydr. Auguer	0	O.S.	e	
	Bending Machine	1	O.S.	e	
	Tractor w/Auger	1	O.S.	e	
	Bending Shoe Liner	1	O.S.	e	
	Padding Machine	1	O.S.	e	
	6-20 Boring Machine	1	O.S.	e	
	TA77 Ditching Machine	1	O.S.	e	
	Brush Hog	1	O.S.	e	
	Test Pump	1	O.S.	e	
	Sauerman Bucket	1	O.S.	e	
	Fill Pumps-Hydrotest	2	O.S.	e	
		23			0
	2" Pump	0	O.S.	300	0
	4" Pump	2	O.S.	1500	3000
	6" Pump	4	O.S.	2400	9600
	Work Boat	1	O.S.	2500	2500
	175 Compressor	1	O.S.	3300	3300
	Raygo Romper	0	O.S.	4000	0
	Twin Drill or Track	2	O.S.	11000	22000
	750 Compressor	0	O.S.	13500	0
	900 Compressor	1	O.S.	14000	14000
	1200 Compressor	4	O.S.	16000	64000
	JD 510 B'hoe	3	O.S.	21000	63000
	Rock Picker	1	O.S.	23000	23000
	SP56 Vib Roller	0	O.S.	32000	0
	561 Sideboom	13	O.S.	35000	455000
	690 Backhoe	0	O.S.	38000	0
	215 Backhoe	2	O.S.	38500	77000
	D-7w/winch	6	O.S.	47000	282000
	571 Sideboom	1	O.S.	52000	52000
	D-7 Auger Backfiller	1	O.S.	52000	52000
	D-7 Hot Pass/Tack	2	O.S.	52000	104000
	225 Clam	3	O.S.	54000	162000
	572 Sideboom	6	O.S.	63000	378000
	LS78 35 T Motor Crane	1	O.S.	72000	72000
	LS98 Dragline	2	O.S.	74100	148200
	235 Backhoe	8	O.S.	91000	728000
	70 T Crane	0	O.S.	125000	0
	Parts Vans	6	O.S.	44000	264000
		70			2978600

Fairbanks Gasline

SPREAD 1-3
EQUIPMENT MOBILIZATION LIST
EACH SPREAD

		NO.	LOC	WT	Tot Wt
r	Carryall 10 Passgr	3	O.S.	4200	12600
r	1 T Flatbed	2	O.S.	4200	8400
r	4x4 Buffing Rig	1	O.S.	4200	4200
r	Welding Rig	28	O.S.	6700	187600
r	Mechanic Rig	11	O.S.	8500	93500
r	Flatbed	1	O.S.	10000	10000
r	Bus, 20 Psgr	3	O.S.	12000	36000
r	Winch Truck	5	O.S.	16500	82500
r	Test Bus	1	O.S.	16800	16800
r	Fuel Truck	2	O.S.	20000	40000
r	Pblt Skid Truck	1	O.S.	22000	22000
r	Stringing Truck	3	O.S.	27500	82500
r	Grease Truck	2	O.S.	28000	56000
r	Tractor w/Float	1	O.S.	28500	28500
r	Tractor w/Water Trailer	1	O.S.	33200	33200
r	Lowboy Truck	5	O.S.	42000	210000
		70			923800

		NO.	LOC	WT
	966 Loader	6	AK	
	D-8w/ripper	4	AK	
	D-8w/winch	7	AK	
	988 Loader	0	AK	
	D-9 Ripper	1	AK	
r	Bot Dump w/Tract	6	AK	
	Hydroaxe	2	AK	
	D-6 Dozer	2	AK	
	JD 450 Dozer	1	AK	
r	Powder Truck	1	AK	
	14 Motor Grader	2	AK	
	Crusher w/450KW	0	AK	
	Powder Magazine	1	AK	
r	10 CY End Dump	13	AK	18500
		46		

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline — 4 SPREADS
Feasibility Cost Estimate — TOTAL PIPELINE — 16 " Line
298.7 MI

ITEM	Description	QUANT	UM	unit	TOTAL COST
OWNER & DESIGN COSTS					
a	Owner Costs	1.00	PCT		$3,492,69
b	Engineering & Design	3.00	PCT		$5,905,51
c	Material Inspection (Pct of Matl)	0.50	PCT		$203,19
d	Field Inspection	316	WD	8,681	$2,739,65
e	X-ray	1,577,136	LF	0.60	$946,28
f	AFUDC	0.00	PCT		$
	TOTAL OWNR & DESIGN				$13,287,33
PRE-BID PROCUREMENT					
1	Mainline 16" Pipe	1,577,136	LF	22.27	$35,122,81
2	Mainline Pipe Coating	1,577,136	LF	2.55	$4,021,69
3	Mainline Pipe Frt	44,520	TN	28.00	$1,246,56
4	Mainline Valves	21	EA	27,716	$582,03
5	Pipeyard Leases	35	AC	1,200	$42,00
6	Other Appurt	100	PC		$869,74
22	Produce Weights	10,056	EA	290	$2,916,27
OTHER PRE-BID COSTS					
7	Temp ROW Leases	352	AC	319	$112,15
8	Perm ROW Costs	704	AC	1,593	$1,121,51
9	Permitting Costs	100	PC		$298,70
SEPARATE CONTRACT COSTS					
10	Furn & Erect Aerial Crossings	2	EA		$360,00
	TOTAL PREBID				$46,693,49
	Contingency			$1.90	$2,999,04
	SUB TOTAL	1,577,136	LF	39.93	$62,979,87

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

4 SPREADS
TOTAL PIPELINE 298.7 MI
16 " Line

ITEM	Description	QUANT	UM	unit	TOTAL COST
	PIPELINE CONTRACT				
	Logistics & Support				
11	Camp & Yard Lease	23	MO	522	$12,00
12	Camp & Yard Sitework	68,500	CY	5.65	$387,16
13	Camp & Shop Set-Up & Removal	100	PC		$621,00
14	Camp Operations	159,654	MD	38.52	$6,149,65
15	Pipeyard Sitework	72,000	CY	4.33	$312,08
16	Unload & Store Pipe	299	MI	2,723	$813,35
	Civil Construction				
17	Snow Road Construction	55	MI	32,682	$1,810,60
18	Snow Road Maintenance	55	MI	14,994	$830,68
19	Work Pad Construction	180,820	CY	5.36	$968,61
20	Work Pad Remove	730,360	LF	0.60	$438,49
21	Produce Select Backfill	61,297	CY	7.01	$429,58
23	Reclamation & Revegetation	1,989	AC	1,290	$2,566,18
	TOTAL CIVIL & SUPPORT				$15,339,43
	Mobilization				
24	Mobilization-Civil	100	PC		$349,10
25	Demobilization-Civil	100	PC		$349,10
26	Mobilization-Pipeline	100	PC		$3,986,30
27	Demobilization-Pipeline	100	PC		$3,186,09
	TOTAL MOB-DEMOB				$7,870,60
	Pipeline Construction				
28	Clearing	299	MI	10,767	$3,216,08
29	Grade	243	MI	9,102	$2,214,49
30	String	26,393	JTS	115.69	$3,053,49
31	Machine Ditch	1,577,141	LF	3.00	$4,732,03
32	Rock Ditch	68,509	LF	15.14	$1,037,31
33	Bend	299	MI	5,725	$1,709,99
34	Pipe-Front End	26,393	JTS	173.79	$4,586,87
35	Pipe-Weld	1,577,141	LF	3.86	$6,092,42
36	Cut Out & Repair	1,577,141	LF	1.19	$1,869,19
38	Bottom Pad	299	MI	7,964	$2,378,87
39	Lower & Backfill	299	MI	17,875	$5,339,39
40	Top Pad	1,577,141	LF	2.19	$3,446,49
42	Road Crossing-Boring	16	EA	32,853	$525,65
43	Tie In	211	EA	13,653	$2,880,68
44	River Crossings	79	EA	114,985	$9,083,80
45	Fabrication	100	PC		$391,76
46	Test	299	MI	3,643	$1,088,31
47	Cleanup	1,577,141	LF	3.34	$5,263,69
	TOTAL PIPELINE DIRECT COSTS	299	MI	197,223	$58,910,59
	INDIRECTS - PIPELINE CONSTRUCTION				
	Services				$3,558,97
	Supervision & Support				$6,504,95
	PL Supprt Facilities				$434,35
	Expendable Materials & Supplies	30	PCT		$11,279,34
	INDIRECTS - CIVIL & SUPPORT	25	PCT		$3,834,85
	Profit & Fee	10	PCT		$10,773,31
	Contingency			$3.76	$5,925,32
	TOTAL PIPELINE COSTS	1,577,136	LF	$78.90	$124,431,75
	TOTAL PROJECT COSTS>>>>>>>	1,577,136	LF	$118.83	$187,411,62
	OPERATING FACILITIES COST				$2,571,93

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

	SPREAD 1				SPREAD 2				SPREAD 3-				SPREAD 4A-				SPREAD 4B-				4 SPREADS	
	BIG LAKE TO BYERS CR.				BYERS CR. TO NENANA R. NO. 2				NENANA NO. 2 TO JULIUS				BELUGA LINE TO BIG LAKE				JULIUS TO FAIRBANKS				TOTAL PIPELINE	
	Pks MP52.3 to 144				Pks MP 144 to 231.3				Pks MP 231.3 to 295				PL MP 0 TO MP 7.4 = Pks MP 52.3				PKS MP295 = PL MP 250.7 TO MP 299				298.7 MI	
ITEM Description	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	unit	TOTAL COST
OWNER & DESIGN COSTS																						
a Owner Costs	2.00	PCT		$948,633	2.00	PCT		$891,018	2.00	PCT		$728,656	2.00	PCT		$134,492	2.00	PCT		$789,892		$3,492,691
b Engineering & Design	3.50	PCT		$1,603,969	3.50	PCT		$1,506,552	3.50	PCT		$1,232,027	3.50	PCT		$227,403	3.50	PCT		$1,335,567		$5,905,517
c Material Inspection(Pct of Matl)	0.50	PCT		$61,794	0.50	PCT		$59,130	0.50	PCT		$43,810	0.50	PCT		$5,164	0.50	PCT		$33,293		$203,191
d Field Inspection	90	WD		$775,773	86	WD		$741,293	71	WD		$609,062	12	WD		$106,803	57	WD		$506,727	8,681	$2,739,658
e X-ray	484,176	LF		$290,506	460,944	LF		$276,566	339,504	LF		$203,702	39,072	LF		$23,443	253,440	LF		$152,064	0.60	$946,282
f AFUDC	0.00	PCT		$0	0.00	PCT		$0	0.00	PCT		$0	0.00	PCT		$0	0.00	PCT		$0		$0
TOTAL OWNE & DESIGN				$3,680,675				$3,474,559				$2,817,258				$497,305				$2,817,543		$13,287,339
PRE-BID PROCUREMENT																						
1 Mainline 16" Pipe	484,176	LF	22.27	$10,782,600	460,944	LF	22.27	$10,265,223	339,504	LF	22.27	$7,560,754	39,072	LF	22.27	$870,133	253,440	LF	22.27	$5,644,109	22.27	$35,122,819
2 Mainline Pipe Coating	484,176	LF	2.55	$1,234,649	460,944	LF	2.55	$1,175,407	339,504	LF	2.55	$865,735	39,072	LF	2.55	$99,634	253,440	LF	2.55	$646,272	2.55	$4,021,697
3 Mainline Pipe Frt	13,668	TN	28.00	$382,704	13,012	TN	28.00	$364,336	9,583	TN	28.00	$268,336	1,103	TN	28.00	$30,884	7154	TN	28.00	$200,300	28.00	$1,246,560
4 Mainline Valves	6	EA	27,716	$166,296	6	EA	27,716	$166,296	6	EA	27,716	$166,296	1	EA	27,716	$27,716	2	EA	27,716	$55,432	27,716	$582,036
5 Pipeyard Leases	7	AC	1,200	$8,400	11	AC	1,200	$13,200	7	AC	1,200	$8,400	3	AC	1,200	$3,600	7	AC	1,200	$8,400	1,200	$42,000
6 Other Appurt	100	PC	1669.38	$166,938	100	PC	2,059	$205,870	100	PC	1,608	$160,829	100	PC	316	$31,633	100	PC	3,045	$304,471		$869,740
22 Produce Weights	267	EA	290.00	$77,430	160	EA	290	$46,400	141	EA	290	$40,982	790	EA	290	$229,100	8698	EA	290	$2,522,365	290	$2,916,277
OTHER PRE-BID COSTS																						
7 Temp ROW Leases	45	AC	396	$17,800	246	AC	300	$73,800	31	AC	300	$9,388	7	AC	600	$4,200	23	AC	306	$6,964	319	$112,151
8 Perm ROW Costs	89	AC	2,000	$178,000	492	AC	1,500	$738,000	63	AC	1,500	$93,876	14	AC	3,000	$42,000	46	AC	1,500	$69,635	1,593	$1,121,511
9 Permitting Costs	100	PC	917	$91,700	100	PC	873	$87,300	100	PC	643	$64,300	100	PC	74	$7,400	100	PC	480	$48,000		$298,700
SEPARATE CONTRACT COSTS																						
10 Furn & Erect Aerial Crossings	0	EA		$0	2	EA	180,000	$360,000		EA		$0	0	EA		$0	0	EA		$0		$360,000
TOTAL PREBID				$13,106,516				$13,495,832				$9,238,896				$1,346,300				$9,505,947		$46,693,491
Contingency	5.00	PCT	1.73	$839,360	5.00	PCT	1.84	$848,520	5.00	PCT	1.78	$602,808	5.00	PCT	2.36	$92,180	5.00	PCT	2.43	$616,175	$1.90	$2,999,042
SUB TOTAL	484,176	LF	36.41	$17,626,551	460,944	LF	38.66	$17,818,910	339,504	LF	37.29	$12,658,962	39,072	LF	49.54	$1,935,785	253,440	LF	51.06	$12,939,665	39.93	$62,979,872

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

	SPREAD 1				SPREAD 2				SPREAD 3-				SPREAD 4A-				SPREAD 4B-				4 SPREADS	
	BIG LAKE TO BYERS CR.				BYERS CR. TO NENANA R. NO. 2				NENANA NO. 2 TO JULIUS				BELUGA LINE TO BIG LAKE				JULIUS TO FAIRBANKS				TOTAL PIPELINE	
	Pks MP52.3 to 144				Pks MP 144 to 231.3				Pks MP 231.3 to 295				PL MP 0 TO MP 7.4 = Pks MP 52.3				PKS MP295 = PL MP 250.7 TO MP 299				298.7 MI	
ITEM Description	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	unit	TOTAL COST
PIPELINE CONTRACT																						
Logistics & Support																						
11 Camp & Yard Lease	6	MO	400	$2,400	6	MO	450	$2,700	5	MO	600	$3,000	0	MO		$0	6	MO	650	$3,900	522	$12,000
12 Camp & Yard Sitework	14,500	CY	5.71	$82,860	17,000	CY	5.62	$95,612	24,500	CY	5.55	$135,890	0	CY		$0	12,500	CY	5.82	$72,805	5.65	$387,167
13 Camp & Shop Set-Up & Removal	100	PC	1,288	$128,818	100	PC	1,560	$155,989	100	PC	2,359	$235,870	0	PC		$0	100	PC	1,003	$100,328		$621,005
14 Camp Operations	43,135	MD	39.00	$1,682,272	39,085	MD	39.00	$1,524,296	33,063	MD	39.00	$1,289,470	4,849	MD	15.00	$72,735	39,522	MD	40.00	$1,580,880	38.52	$6,149,652
15 Pipeyard Sitework	15,000	CY	4.33	$65,017	25,000	CY	4.33	$108,362	17,000	CY	4.33	$73,687	0	CY		$0	15,000	CY	4.33	$65,017	4.33	$312,083
16 Unload & Store Pipe	91.70	MI	2,728	$250,118	87.30	MI	2,706	$236,222	64.30	MI	2,727	$175,329	7.40	MI	2,817	$20,843	48.00	MI	2,726	$130,840	2,723	$813,352
Civil Construction																						
17 Snow Road Construction	0.00	LF			0	LF			0	LF		$0	7.40	MI	32,703	$242,003	48.00	MI	32,679	$1,568,598	32,682	$1,810,601
18 Snow Road Maintenance	0.00	DY			0	DY			0	DY		$0	7.40	MI	16,812	$124,406	48.00	MI	14,714	$706,282	14,994	$830,688
19 Work Pad Construction	75,000	CY	5.61	$421,023	61,200	CY	5.12	$313,253	41,992	CY	5.11	$214,391	0.00	CY		$0	2,628	CY	7.59	$19,947	5.36	$968,614
20 Work Pad Remove	300,000	LF	0.61	$181,930	250,000	LF	0.59	$148,273	171,601	LF	0.59	$101,922	0.00	LF		$0	8,759	LF	0.73	$6,374	0.60	$438,499
21 Produce Select Backfill	15,000	CY	7.34	$110,100	22,500	CY	6.84	$153,901	18,170	CY	6.84	$124,281	3,000	CY	7.34	$22,020	2,628	CY	7.34	$19,288	7.01	$429,589
23 Reclamation & Revegetation	576	AC	1,300	$748,818	552	AC	1,297	$716,005	407	AC	1,306	$531,104	55.00	AC	1,305	$71,766	399.42	AC	1,248	$498,492	1,290	$2,566,185
TOTAL CIVIL & SUPPORT				3,673,356				3,454,613				2,884,943				$553,773				4,772,752		$15,339,436
Mobilization																						
24 Mobilization-Civil	100	PC	458	$45,750	100	PC	835	$83,500	100	PC	1,099	$109,925	0	PC		$0	100	PC	1,099	$109,925		$349,100
25 Demobilization-Civil	100	PC	458	$45,750	100	PC	835	$83,500	100	PC	1,099	$109,925	0	PC		$0	100	PC	1,099	$109,925		$349,100
26 Mobilization-Pipeline	100	PC	8,828	$882,792	100	PC	9,110	$910,992	100	PC	9,307	$930,732	100	PC	3,311	$331,061	100	PC	9,307	$930,732		$3,986,309
27 Demobilization-Pipeline	100	PC	7,608	$760,795	100	PC	7,890	$788,995	100	PC	8,087	$808,735	100	PC	7,467	$746,695	100	PC	809	$80,873		$3,186,093
TOTAL MOB-DEMOB				1,735,087				1,866,987				1,959,317				1,077,756				1,231,455		$7,870,602
Pipeline Construction																						
28 Clearing	91.70	MI	9,274	$850,415	87.30	MI	9,242	$806,834	64.30	MI	9,920	$637,863	7.40	MI	16,624	$123,017	48.00	MI	16,624	$797,956	10,767	$3,216,085
29 Grade	91.70	MI	8,946	$820,392	87.30	MI	8,915	$778,320	64.30	MI	9,577	$615,781	0.00	MI		$0	0.00	MI		$0	9,102	$2,214,493
30 String	8110	JTS	102.95	$834,960	7722	JTS	102.58	$792,142	5,685	JTS	110.24	$626,716	652	JTS	164.68	$107,373	4,224	JTS	163.91	$692,308	115.69	$3,053,499
31 Machine Ditch	484175	LF	2.41	$1,168,747	460950	LF	2.41	$1,108,810	339,504	LF	2.58	$877,254	39072	LF	5.42	$211,772	253,440	LF	5.39	$1,365,447	3.00	$4,732,030
32 Rock Ditch	0	LF		$0	14000	LF	15.20	$212,852	54,509	LF	15.13	$824,459	0	LF		$0	0	LF		$0	15.14	$1,037,311
33 Bend	91.70	MI	5,374	$492,823	87.30	MI	5,356	$467,550	64.30	MI	5,753	$369,910	7.40	MI	6,890	$50,985	48.00	MI	6,849	$328,730	5,725	$1,709,998
34 Pipe-Front End	8110	JTS	144.65	$1,173,074	7722	JTS	144.12	$1,112,917	5,685	JTS	154.88	$880,502	652	JTS	292.51	$190,714	4,224	JTS	291.14	$1,229,665	173.79	$4,586,872
35 Pipe-Weld	484175	LF	3.29	$1,593,956	460950	LF	3.28	$1,512,215	339,504	LF	3.52	$1,196,413	39072	LF	6.15	$240,322	253,440	LF	6.11	$1,549,522	3.86	$6,092,428
36 Cut Out & Repair	484175	LF	1.01	$488,684	460950	LF	1.01	$463,623	339,504	LF	1.08	$366,804	39072	LF	1.89	$73,860	253,440	LF	1.88	$476,220	1.19	$1,869,190
38 Bottom Pad	91.70	MI	8,272	$758,508	87.30	MI	8,243	$719,611	64.30	MI	8,854	$569,331	7.40	MI	6,014	$44,501	48.00	MI	5,978	$286,926	7,964	$2,378,877
39 Lower & Backfill	91.70	MI	13,890	$1,273,724	87.30	MI	13,842	$1,208,405	64.30	MI	14,869	$956,049	7.40	MI	34,497	$255,276	48.00	MI	34,290	$1,645,938	17,875	$5,339,393
40 Top Pad	484175	LF	2.34	$1,130,690	460950	LF	2.33	$1,072,706	339,504	LF	2.50	$848,689	39072	LF	1.36	$52,958	253,440	LF	1.35	$341,456	2.19	$3,446,499
42 Road Crossing-Boring	6.00	EA	32,853	$197,120	4.00	EA	32,853	$131,412	6.00	EA	32,853	$197,120	0.00	EA		$0	0.00	EA		$0	32,853	$525,652
43 Tie In	74.00	EA	10,148	$750,958	48.00	EA	14,843	$712,447	55.00	EA	10,248	$563,665	6.00	EA	19,103	$114,815	28	EA	26,394	$739,005	13,653	$2,880,689
44 River Crossings	30.00	EA	101,361	$3,040,815	19.00	EA	96,309	$1,829,871	20	EA	80,730	$1,614,592	2.00	EA	155,394	$310,788	8	EA	285,968	$2,287,743	114,985	$9,083,809
45 Fabrication	100.00	PC	1,011	$101,142	100.00	PC	1,011	$101,142	100	PC	1,021	$102,095	100.00	PC	320	$32,038	100.00	PC	553	$55,349		$391,766
46 Test	91.70	MI	2,993	$274,444	87.30	MI	3,144	$274,444	64.30	MI	4,308	$277,029	7.40	MI	8,913	$65,959	48.00	MI	4,092	$196,435	3,643	$1,088,311
47 Cleanup	484175	LF	3.31	$1,602,495	460950	LF	3.30	$1,520,316	339,504	LF	3.54	$1,202,823	39072	LF	3.22	$125,952	253,440	LF	3.20	$812,107	3.34	$5,263,692
TOTAL PIPELINE DIRECT COSTS	91.70	MI	180,512	16,552,947	87.30	MI	169,824	14,825,617	64.30	MI	197,933	$12,727,094	7.40	MI	270,288	$2,000,130	48.00	MI	266,767	$12,804,806	197,223	$58,910,594
INDIRECTS - PIPELINE CONSTRUCTION																						
Services				$1,095,030				$803,022				$700,052				$129,016				$831,855		$3,558,975
Supervision & Support				$1,802,076				$1,742,007				$1,576,511				$185,965				$1,198,395		$6,504,954
PL Supprt Facilities				$123,000				$118,900				$106,998				$11,480				$73,980		$434,358
Expendable Materials & Supplies	25.00	PCT		$2,821,155	25.00	PCT		$2,535,664	25.00	PCT		$2,146,858	35.00	PCT		$462,989	40.00	PCT	40.00	$3,312,674		$11,279,340
INDIRECTS - CIVIL & SUPPORT	25.00	PCT		$918,339	25.00	PCT		$863,653	26.00	PCT		$721,236	25.00	PCT		$138,443	25.00	PCT	25.00	$1,193,188		$3,834,859
Profit & Fee	10.00	PCT		$2,872,099	10.00	PCT		$2,621,046	10.00	PCT		$2,282,301	10.00	PCT		$455,955	10.00	PCT	10.00	$2,541,910		$10,773,312
Contingency	5.00	PCT	3.26	$1,579,654	5.00	PCT		$1,441,575	5.00	PCT		$1,255,266	5.00	PCT		$250,775	5.00	PCT		$1,398,051	$3.76	$5,925,322
TOTAL PIPELINE COSTS	484176	LF	68.51	$33,172,742	460944	LF	65.68	$30,273,084	339,504	LF	77.64	$26,360,577	39072	LF	134.78	$5,266,283	253,440	LF	115.84	$29,359,065	$78.90	$124,431,751
TOTAL PROJECT COSTS>>>>>>>	484,176	LF	104.92	$50,799,293	460,944	LF	104.33	$48,091,994	339,504	LF	114.93	$39,019,539	39,072	LF	184.33	$7,202,068	253,440	LF	166.90	$42,298,730	$118.83	$187,411,624
OPERATING FACILITIES COST																						$2,571,937

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

ITEM Description	SPREAD 1 BIG LAKE TO BYERS CR. Pks MP52.3 to 144				SPREAD 2 BYERS CR. TO NENANA R. NO. 2 Pks MP 144 to 231.3				SPREAD 3- NENANA NO. 2 TO JULIUS Pks MP 231.3 to 295				SPREAD 4A- BELUGA LINE TO BIG LAKE PL MP 0 TO MP 7.4 = Pks MP 52.3				SPREAD 4B- JULIUS TO FAIRBANKS PKS MP295 = PL MP 250.7 TO MP 299				4 SPREADS TOTAL PIPELINE 298.7 MI	
	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	QUANT	UM	unit	TOTAL COST	unit	TOTAL COST
TOTAL PROJECT COSTS>>>>>>>>	484,176	LF	104.92	$50,799,293	460,944	LF	104.33	$48,091,994	339,504	LF	114.93	$39,019,539	39,072	LF	184.33	$7,202,068	253,440	LF	166.90	$42,298,730	$118.83	$187,411,624
OPERATING FACILITIES COST																						$2,571,937
TOTAL COSTS>>>>																						$189,983,561
SPREAD 4B ALT COSTS (61.7 Miles)																	325,776	LF	115.14	$37,510,252		
ADD: Additional Rock Ditch																	120,000	LF	19.16	$2,298,639		
ADJUSTED SPRD 4B ALTERNATE COST (Parks Highway Ridge Route)																	325,776	LF	122.20	$39,808,891		

OPERATING FACILITIES

RECAP:

Launcher/Receivers	3	EA	$833,702
Knik Meter Station	1	LS	$426,883
Fairbanks Meter Station	1	LS	$428,407
SCADA System	1	LS	$631,510
Corrosion Protection	1	LS	$175,420
Cantwell Shop & Warehouse	1	LS	$76,015
			$2,571,937

V

COST DETAIL SHEETS

PIPELINE CONTRACT

Pipeline Construction

PG

ITEM 28 Clearing- ROW Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Own	Eq Rent	SST Matl	TOTAL	$/AC
1	Pickup w/Foreman	1.00	45.95	5.50	1.90			53.35	
2	D-8w/winch	1.00	42.58	50.71	39.63			132.92	
3	D-8w/ripper	1.00	42.58	51.98	40.90			135.46	
4	Hydroaxe	2.00	85.15	105.32	81.16			271.63	
5	Brush Hog	0.50	21.29	7.44	5.72			34.45	
6	Chainsaw & Op	4.00	150.12	7.00	7.00			164.12	
7	Tractor w/Auger	0.50	21.29	24.29	17.48			63.05	
8	1 T Flatbed	1.00	41.20	5.24	2.16			48.60	
9	Winch Truck	1.00	41.20	15.70	6.25			63.15	
10	26 Genl Lab	2.00	72.88	0.00	0.00			72.88	
11	Bus, 30 Pasgr	1.00	8.92	20.30	9.70			38.92	
	Total Crew/Hr.	14.20	573.14	293.48	211.90	0.00	0.00	1078.52	
Sprd 1							$100	1078.52	
COST	780.00 HRS	11076.00	$447,052	$228,911	$165,282	$0	$9,170	$850,414	1530.89
Unit	91.70 MI	120.79	4875.16	2496.30	1802.42	0.00	100.00	$9,274	
		MH/ MI							
Sprd 2		19.93 mh/ac					$100		
COST	740.00 HRS	10508.00	$424,126	$217,172	$156,806	$0	$8,730	$806,833	1525.64
Unit	87.30 MI	120.37	4858.26	2487.65	1796.17	0.00	100.00	$9,242	
		MH/ MI							
Sprd 3		19.86 mh/ac					$100		
COST	580.00 HRS	8236.00	$332,423	$170,216	$122,902	$0	$6,370	$631,911	1637.57
Unit	63.70 MI	129.29	5218.57	2672.14	1929.39	0.00	100.00	$9,920	
		MH/ MI							
		21.33 mh/ac							

20-Sep-88

ITEM I 28 Clearing Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,	1.00	45.95	7.15	1.90			55.00
2	Pickup w/Strawbos	1.00	45.95	7.15	1.90			55.00
3	26 Genl Lab	2.00	72.88	0.00	0.00			72.88
4	D-8w/ripper	1.00	42.58	67.57	40.90			151.05
5	D-8w/winch	1.00	42.58	65.92	39.63			148.13
6	Hydroaxe	2.00	85.15	136.92	81.16			303.23
7	Heater Van	2.00	65.34	24.50	10.50			100.34
8	Brush Hog	1.00	42.58	19.34	11.44			73.36
9	Chainsaw & Op	6.00	225.18	13.65	10.50			249.33
10	235 Backhoe w/grap	1.00	42.58	54.28	38.69			135.54
11	1 T Flatbed	1.00	41.20	6.81	2.16			50.17
12	Winch Truck	1.00	41.20	20.41	6.25			67.86
13	Bus, 30 Pasgr	1.00	53.50	26.39	9.70			89.59
14	Haglund	1.00	0.00	0.00	0.00	15.60		15.60
15	LS98 Dragline	1.00	42.58	29.95	22.80			95.33
	Total Crew/Hr.	22.00	889.23	480.05	277.53	15.60	0.00	1662.41
Sprd 4A							0.00	1662.41
COST	74.00 HRS	1628.00	$65,803	$35,523	$20,537	$1,154	$0	$123,018
Unit	7.4 MI	220.00	8892.33	4800.46	2775.30	156.00	0.00	16624.09
		MH/ MI						
Sprd 4B							0.00	
COST	548.00 HRS	12056.00	$487,300	$263,065	$152,086	$8,549	$0	$911,000
Unit	54.8 MI	220.00	8892.33	4800.46	2775.30	156.00	0.00	16624.09
		MH/ MI						

13-Sep-88

ITEM I 29 Grade ROW Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman	2.00	91.91	11.00	3.80			106.71
2	JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
3	26 Genl Lab	6.00	218.63	0.00	0.00			218.63
4	D-8w/winch	2.00	85.15	101.42	79.26			265.83
5	D-8w/ripper	1.00	42.58	51.98	40.90			135.46
6	Chainsaw & Op	2.00	75.06	3.50	3.50			82.06
7	Bus, 20 Psgr	1.00	8.92	15.95	7.65			32.52
8	Winch Truck	1.00	41.20	15.70	6.25			63.15
9	14 Motor Grader	1.00	42.58	23.44	20.86			86.88

	Total Crew/Hr.	16.20	648.60	233.66	169.53	0.00	0.00	1051.79
Sprd 1						0.00	$0	1051.79
COST	780.00 HRS	12636.00	$505,904	$182,255	$132,233	$0	$0	$820,392
Unit	91.7 MI	137.80	5516.95	1987.51	1442.02	0.00	0.00	$8,946
		MH/ MI						
Sprd 2							$0	
COST	740.00 HRS	11988.00	$479,960	$172,908	$125,452	$0	$0	$778,321
Unit	87.3 MI	137.32	5497.83	1980.62	1437.02	0.00	0.00	$8,915
		MH/ MI						
Sprd 3							$0	
COST	580.00 HRS	9396.00	$376,185	$135,523	$98,327	$0	$0	$610,035
Unit	63.7 MI	147.50	5905.58	2127.52	1543.60	0.00	0.00	$9,577
		MH/ MI						

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ITEM I 30 String Mainline Pipe Plan Quantity JTS

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Forema	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Strawb	1.00	45.95	5.50	1.90			53.35
44	571 Sideboom	1.00	42.58	35.67	23.48			101.73
45	D-6 Dozer	1.00	42.58	26.04	17.17			85.79
46	LS78 35 T Motor	1.00	42.58	20.32	26.18			89.08
47	Stringing Truck	3.00	121.64	72.09	36.93			230.66
48	Pblt Skid Truck	1.00	41.20	22.04	10.18			73.42
49	26 Genl Lab	9.00	327.94	0.00	0.00			327.94
50	Carryall 10 Pass	1.00	8.92	8.50	2.00			19.42
51	I17 Rig Oiler	1.00	32.67	0.00	0.00			32.67

	Total Crew/Hr.	19.20	755.06	195.66	119.74	0.00	0.00	1070.46
Sprd 1							0.00	1070.46
COST	780.00 HRS	14976.00	$588,948	$152,615	$93,397	$0	$0	$834,960
Unit	8110 JTS	1.85	72.62	18.82	11.52	0.00	0.00	102.95
		MH/ JTS						
Sprd 2							0.00	
COST	740.00 HRS	14208.00	$558,746	$144,788	$88,608	$0	$0	$792,142
Unit	7722 JTS	1.84	72.36	18.75	11.47	0.00	0.00	102.58
		MH/ JTS						
Sprd 3							0.00	
COST	580.00 HRS	11136.00	$437,936	$113,483	$69,449	$0	$0	$620,868
Unit	5632 JTS	1.98	77.76	20.15	12.33	0.00	0.00	110.24
		MH/ JTS						

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ITEM I 30 String Mainline Pipe Plan Quantity JTS

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Forema	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Strawb	1.00	45.95	7.15	1.90			55.00
44	571 Sideboom	1.00	42.58	46.37	23.48			112.43
45	D-6 Dozer	2.00	85.15	67.70	34.34			187.20
46	LS78 35 T Motor	1.00	42.58	26.42	26.18			95.17
47	Stringing Truck	5.00	202.74	156.20	61.55			420.48
48	Pblt Skid Truck	1.00	41.20	28.65	10.18			80.03
49	26 Genl Lab	9.00	327.94	0.00	0.00			327.94
50	Carryall 10 Pass	1.00	8.92	11.05	2.00			21.97
51	I17 Big Oiler	1.00	32.67	0.00	0.00			32.67
52	Heater Van	2.00	65.34	24.50	10.50			100.34
	Total Crew/Hr.	24.20	944.07	375.19	172.03	0.00	0.00	1491.29
Sprd 4A							0.00	1491.29
COST	72.00 HRS	1742.40	$67,973	$27,014	$12,386	$0	$0	$107,373
Unit	652.00 JTS	2.67	104.25	41.43	19.00	0.00	0.00	164.68
		MH/	JTS					
Sprd 4B							0.00	
COST	530.00 HRS	12826.00	$500,359	$198,850	$91,176	$0	$0	$790,385
Unit	4822 JTS	2.66	103.76	41.23	18.91	0.00	0.00	163.90
		MH/	JTS					

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ITEM I 31 Machine Ditch Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Strawbos	1.00	45.95	5.50	1.90			53.35
44	26 Genl Lab	5.00	182.19	0.00	0.00			182.19
45	D-8w/ripper	1.00	42.58	51.98	40.90			135.46
46	D-7w/winch	1.00	42.58	42.81	28.18			113.57
47	TA77 Ditching Mach	1.00	42.58	38.97	32.09			113.64
48	215 Backhoe	2.00	85.15	40.66	36.04			161.85
49	235 Backhoe	3.00	127.73	125.25	116.07			369.05
50	JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
51	4" Pump	1.00	0.00	6.81	1.17			7.98
52	6" Pump	1.00	0.00	5.90	3.50			9.40
53	Bus, 30 Pasgr	1.00	8.92	20.30	9.70			38.92
54	I17 Rig Oiler	6.00	196.02	0.00	0.00			196.02
	Total Crew/Hr.	22.20	865.28	354.35	278.76	0.00	0.00	1498.39
Sprd 1							0.00	1498.39
COST	780.00 HRS	17316.00	$674,921	$276,393	$217,433	$0	$0	$1,168,746
Unit	484175 LF	0.04	1.39	0.57	0.45	0.00	0.00	2.41
		MH/ LF						
Sprd 2							0.00	
COST	740.00 HRS	16428.00	$640,309	$262,219	$206,282	$0	$0	$1,108,811
Unit	460950 LF	0.04	1.39	0.57	0.45	0.00	0.00	2.41
		MH/ LF						
Sprd 3							0.00	
COST	580.00 HRS	12876.00	$501,864	$205,523	$161,681	$0	$0	$869,068
Unit	336325 LF	0.04	1.49	0.61	0.48	0.00	0.00	2.58
		MH/ LF						

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ITEM I   31 Machine Ditch   Plan Quantity   LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Strawbos	1.00	45.95	7.15	1.90			55.00
44	26 Genl Lab	10.00	364.38	0.00	0.00			364.38
45	D-8w/ripper	2.00	85.15	135.15	81.80			302.10
46	D-7w/winch	2.00	85.15	111.31	56.36			252.82
47	Heater Van	4.00	130.68	49.00	21.00			200.68
48	215 Backhoe	2.00	85.15	52.86	36.04			174.05
49	235 Backhoe	7.00	298.04	379.93	270.83			948.80
50	JD 510 B'hoe	1.00	42.58	13.87	7.31			63.76
51	4" Pump	1.00	0.00	8.85	1.17			10.02
52	6" Pump	0.00	0.00	0.00	0.00			0.00
53	Bus, 30 Pasgr	1.00	53.50	26.39	9.70			89.59
54	I17 Big Oiler	10.00	326.70	0.00	0.00			326.70
55	LS98 Dragline	1.00	42.58	29.95	22.80			95.33
	Total Crew/Hr.	42.00	1608.88	821.60	510.81	0.00	0.00	2941.29
Sprd 4A							0.00	2941.29
COST	72.00 HRS	3024.00	$115,839	$59,155	$36,778	$0	$0	$211,773
Unit	39072 LF	0.08	2.96	1.51	0.94	0.00	0.00	5.42
		MH/ LF						
Sprd 4B							0.00	
COST	530.00 HRS	22260.00	$852,706	$435,450	$270,729	$0	$0	$1,558,885
Unit	289344 LF	0.08	2.95	1.50	0.94	0.00	0.00	5.39
		MH/ LF						

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ITEM I 32 Rock Ditch Plan Quantity LF

	CREW COST			Eq Rent			
Description	No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
1 Pickup w/Foreman,	1.00	45.95	5.50	1.90			53.35
2 D-8w/ripper	1.00	42.58	51.98	40.90			135.46
3 235 Backhoe	1.00	42.58	41.75	38.69			123.02
4 900 Compressor	1.00	0.00	21.84	9.44			31.28
5 1200 Compressor	1.00	0.00	31.15	12.66			43.81
6 Twin Drill or Trac	2.00	76.59	23.54	23.00			123.13
7 Jackhammers	2.00	75.06	9.40	3.40			87.86
8 6" Pump	1.00	0.00	5.90	3.50			9.40
9 Powder Truck	1.00	41.20	8.85	3.65			53.70
10 Powder Magazine	1.00	0.00	0.00	0.00	10.00		10.00
11 Bus, 20 Psgr	1.00	8.92	15.95	7.65			32.52
12 31 Powdrman & P'up	1.00	38.74	5.50	1.90			46.14
13 28 Chktndr,Road Cr	2.00	75.06	0.00	0.00			75.06
14 I17 Rig Oiler	5.00	163.35	0.00	0.00			163.35
Total Crew/Hr.	16.20	610.02	221.36	146.69	10.00	0.00	988.07

Sprd 1							0.00	988.07
COST	0.00 HRS	0.00	$0	$0	$0	$0	$0	$0
Unit	0 LF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		MH/ LF						
Sprd 2							2.50	
COST	180.00 HRS	2916.00	$109,803	$39,845	$26,404	$1,800	$35,000	$212,852
Unit	14000 LF	0.21	7.84	2.85	1.89	0.13	2.50	15.20
		MH/ LF						
Sprd 3							2.50	
COST	690.00 HRS	11178.00	$420,912	$152,738	$101,216	$6,900	$135,000	$816,766
Unit	54000 LF	0.21	7.79	2.83	1.87	0.13	2.50	15.13
		MH/ LF						

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ITEM II   33 Bend   Plan Quantity   MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,P	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Field Eng	1.00	47.00	5.50	1.90			54.40
44	561 Sideboom	2.00	85.15	49.76	31.88			166.79
45	Bending Machine	1.00	42.58	17.80	6.90			67.28
46	Bending Shoe Liner	1.00	0.00	0.00	0.00	15.60		15.60
47	Inside Mandrel	1.00	0.00	0.00	0.00	33.30		33.30
48	Carryall 10 Passgr	1.00	8.92	8.50	2.00			19.42
49	26 Genl Lab	6.00	218.63	0.00	0.00			218.63

	Total Crew/Hr.	11.20	451.29	87.06	44.58	48.90	0.00	631.83
Sprd 1						0.00	$0	631.83
COST	780.00 HRS	8736.00	$352,002	$67,907	$34,772	$38,142	$0	$492,824
Unit	91.7 MI	95.27	3838.63	740.53	379.20	415.94	0.00	$5,374
		MH/ MI						
Sprd 2							$0	
COST	740.00 HRS	8288.00	$333,951	$64,424	$32,989	$36,186	$0	$467,551
Unit	87.3 MI	94.94	3825.33	737.97	377.88	414.50	0.00	$5,356
		MH/ MI						
Sprd 3							$0	
COST	580.00 HRS	6496.00	$261,745	$50,495	$25,856	$28,362	$0	$366,459
Unit	63.7 MI	101.98	4109.03	792.70	405.91	445.24	0.00	$5,753
		MH/ MI						

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ITEM II 33 Bend Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,P	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Field Eng	1.00	47.00	7.15	1.90			56.05
44	561 Sideboom	2.00	85.15	64.69	31.88			181.72
45	Bending Machine	1.00	42.58	23.14	6.90			72.62
46	Bending Shoe Liner	1.00	0.00	0.00	0.00	15.60		15.60
47	Inside Mandrel	1.00	0.00	0.00	0.00	33.30		33.30
48	Carryall 10 Passgr	1.00	8.92	11.05	2.00			21.97
49	26 Genl Lab	6.00	218.63	0.00	0.00			218.63
50	Heater Van	1.00	32.67	12.25	5.25			50.17

	Total Crew/Hr.	12.20	483.95	125.43	49.83	48.90	0.00	708.11
Sprd 4A						0.00	$0	708.11
COST	72.00 HRS	878.40	$34,845	$9,031	$3,588	$3,521	$0	$50,984
Unit	7.4 MI	118.70	4708.75	1220.38	484.83	475.78	0.00	$6,890
		MH/ MI						
Sprd 2							$0	
COST	530.00 HRS	6466.00	$256,496	$66,477	$26,410	$25,917	$0	$375,300
Unit	54.8 MI	117.99	4680.59	1213.08	481.93	472.94	0.00	$6,849
		MH/ MI						

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ITEM II　34 Weld Pipe- Front End　Plan Quantity　JTS

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Strawboss	1.00	45.95	5.50	1.90			53.35
44	561 Sideboom	1.00	42.58	24.88	15.94			83.40
45	D-7 Hot Pass/Tack	1.00	42.58	37.59	22.09			102.26
46	Internal Pneumatic Cl	1.00	0.00	0.00	0.00	27.80		27.80
47	4x4 Buffing Rig	1.00	36.44	7.40	2.53			46.37
48	Welding Rig	3.00	133.75	30.66	7.62			172.03
49	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
50	Pipe Buffer	1.00	36.44	0.00	0.00			36.44
51	Bus, 30 Pasgr	1.00	53.50	20.30	9.70			83.50
52	Swamper	2.00	75.06	0.00	0.00			75.06
53	Clamp Man	1.00	44.58	0.00	0.00			44.58
54	Bd Clnr,Spcr,Stabbr	6.00	267.50	0.00	0.00			267.50
55	34 Welder Helper	8.00	309.49	0.00	0.00			309.49
	Total Crew/Hr.	31.00	1282.63	131.83	61.68	27.80	0.00	1503.94
Sprd 1							0.00	1503.94
COST	780.00 HRS	24180.00	$1,000,453	$102,827	$48,110	$21,684	$0	$1,173,075
Unit	8110 JTS	2.98	123.36	12.68	5.93	2.67	0.00	144.65
		MH/ JTS						
Sprd 2							0.00	
COST	740.00 HRS	22940.00	$949,148	$97,554	$45,643	$20,572	$0	$1,112,917
Unit	7722 JTS	2.97	122.91	12.63	5.91	2.66	0.00	144.12
		MH/ JTS						
Sprd 3							0.00	
COST	580.00 HRS	17980.00	$743,927	$76,461	$35,774	$16,124	$0	$872,286
Unit	5632 JTS	3.19	132.09	13.58	6.35	2.86	0.00	154.88
		MH/ JTS						

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ITEM II 34 Weld Pipe- Front End Plan Quantity JTS

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Strawboss	1.00	45.95	7.15	1.90			55.00
44	561 Sideboom	2.00	85.15	64.69	31.88			181.72
45	D-7 Hot Pass/Tack	1.00	42.58	48.87	22.09			113.53
46	Internal Pneumatic Cl	1.00	0.00	0.00	0.00	27.80		27.80
47	4x4 Buffing Rig	1.00	36.44	9.62	2.53			48.59
48	Welding Rig	4.00	178.33	53.14	10.16			241.64
49	26 Genl Lab	8.00	291.51	0.00	0.00			291.51
50	Pipe Buffer	3.00	109.31	0.00	0.00			109.31
51	Bus, 30 Pasgr	1.00	53.50	26.39	9.70			89.59
52	Swamper	4.00	150.12	0.00	0.00			150.12
53	Clamp Man	2.00	89.17	0.00	0.00			89.17
54	Bd Clnr,Spcr,Stabbr	8.00	356.67	0.00	0.00			356.67
55	34 Welder Helper	10.00	386.86	0.00	0.00			386.86
56	D-7w/winch	3.00	127.73	166.96	84.54			379.23
57	Heater Van	4.00	0.00	49.00	21.00			70.00
	Total Crew/Hr.	49.00	2002.34	432.97	185.70	27.80	0.00	2648.81
Sprd 4A							0.00	2648.81
COST	72.00 HRS	3528.00	$144,168	$31,174	$13,370	$2,002	$0	$190,714
Unit	652 JTS	5.41	221.12	47.81	20.51	3.07	0.00	292.51
		MH/ JTS						
Sprd 4B							0.00	
COST	530.00 HRS	25970.00	$1,061,239	$229,473	$98,421	$14,734	$0	$1,403,867
Unit	4822 JTS	5.39	220.08	47.59	20.41	3.06	0.00	291.14
		MH/ JTS						

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ITEM II 35 Weld Pipe Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Strawboss	1.00	45.95	5.50	1.90			53.35
44	26 Genl Lab	13.00	473.70	0.00	0.00			473.70
45	D-7 Hot Pass/Tack	1.00	42.58	37.59	22.09			102.26
46	Welding Rig	12.00	535.00	122.64	30.48			688.12
47	Bus, 30 Pasgr	1.00	53.50	20.30	9.70			83.50
48	34 Welder Helper	14.00	541.61	0.00	0.00			541.61
49	Hot Pass Cleaner	1.00	44.58	0.00	0.00			44.58

Total Crew/Hr.		44.00	1785.93	191.53	66.07	0.00	0.00	2043.53
Sprd 1							0.00	2043.53
COST	780.00 HRS	34320.00	$1,393,028	$149,393	$51,535	$0	$0	$1,593,956
Unit	484175 LF	0.07	2.88	0.31	0.11	0.00	0.00	3.29
		MH/ LF						
Sprd 2							0.00	
COST	740.00 HRS	32560.00	$1,321,591	$141,732	$48,892	$0	$0	$1,512,215
Unit	460950 LF	0.07	2.87	0.31	0.11	0.00	0.00	3.28
		MH/ LF						
Sprd 3							0.00	
COST	580.00 HRS	25520.00	$1,035,841	$111,087	$38,321	$0	$0	$1,185,249
Unit	336325 LF	0.08	3.08	0.33	0.11	0.00	0.00	3.52
		MH/ LF						

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ITEM II 35 Weld Pipe Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Strawboss	1.00	45.95	7.15	1.90			55.00
44	26 Genl Lab	18.00	655.89	0.00	0.00			655.89
45	D-7 Hot Pass/Tack	1.00	42.58	48.87	22.09			113.53
46	Welding Rig	15.00	668.76	199.29	38.10			906.15
47	Bus, 30 Pasgr	1.00	53.50	26.39	9.70			89.59
48	34 Welder Helper	22.00	851.10	0.00	0.00			851.10
49	Hot Pass Cleaner	3.00	133.75	0.00	0.00			133.75
50	D-6 Dozer	4.00	170.31	135.41	68.68			374.40
51	Heater Van	2.00	65.34	24.50	10.50			100.34

		No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.	68.00	2736.18	448.76	152.87	0.00	0.00	3337.81
Sprd 4A							0.00	3337.81
COST	72.00 HRS	4896.00	$197,005	$32,310	$11,007	$0	$0	$240,322
Unit	39072 LF	0.13	5.04	0.83	0.28	0.00	0.00	6.15
		MH/ LF						
Sprd 4B							0.00	
COST	530.00 HRS	36040.00	$1,450,177	$237,840	$81,021	$0	$0	$1,769,038
Unit	289344 LF	0.12	5.01	0.82	0.28	0.00	0.00	6.11
		MH/ LF						

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ITEM II 36 Cut Out & Repair Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pipel	1.00	49.01	5.50	1.90			56.41
43	561 Sideboom	2.00	85.15	49.76	31.88			166.79
44	Welding Rig	2.00	89.17	20.44	5.08			114.69
45	Pickup	1.00	0.00	5.50	1.90			7.40
46	34 Welder Helper	3.00	116.06	0.00	0.00			116.06
47	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
48	Carryall 10 Passgr	1.00	8.92	8.50	2.00			19.42

	Total Crew/Hr.	12.20	494.06	89.70	42.76	0.00	0.00	626.52
Sprd 1							0.00	626.52
COST	780.00 HRS	9516.00	$385,365	$69,966	$33,353	$0	$0	$488,684
Unit	484175 LF	0.02	0.80	0.14	0.07	0.00	0.00	1.01
		MH/ LF						
Sprd 2							0.00	
COST	740.00 HRS	9028.00	$365,603	$66,378	$31,642	$0	$0	$463,623
Unit	460950 LF	0.02	0.79	0.14	0.07	0.00	0.00	1.01
		MH/ LF						
Sprd 3							0.00	
COST	580.00 HRS	7076.00	$286,554	$52,026	$24,801	$0	$0	$363,380
Unit	336325 LF	0.02	0.85	0.15	0.07	0.00	0.00	1.08
		MH/ LF						

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ITEM II 36 Cut Out & Repair Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pipel	1.00	49.01	7.15	1.90			58.06
43	561 Sideboom	2.00	85.15	64.69	31.88			181.72
44	Welding Rig	3.00	133.75	39.86	7.62			181.23
45	Pickup	1.00	0.00	7.15	1.90			9.05
46	34 Welder Helper	6.00	232.12	0.00	0.00			232.12
47	26 Genl Lab	8.00	291.51	0.00	0.00			291.51
48	Carryall 10 Passgr	1.00	8.92	11.05	2.00			21.97
49	Heater Van	1.00	32.67	12.25	5.25			50.17
	Total Crew/Hr.	21.20	833.12	142.15	50.55	0.00	0.00	1025.82
Sprd 4A							0.00	1025.82
COST	72.00 HRS	1526.40	$59,985	$10,235	$3,640	$0	$0	$73,859
Unit	39072 LF	0.04	1.54	0.26	0.09	0.00	0.00	1.89
		MH/ LF						
Sprd 4B							0.00	
COST	530.00 HRS	11236.00	$441,555	$75,337	$26,792	$0	$0	$543,684
Unit	289344 LF	0.04	1.53	0.26	0.09	0.00	0.00	1.88
		MH/ LF						

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ITEM III 38 Bottom Pad Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,C	1.00	45.95	5.50	1.90			53.35
2	D-7w/winch	1.00	42.58	42.81	28.18			113.57
3	966 Loader	2.00	85.15	59.54	45.74			190.43
4	10 CY End Dump	4.00	164.78	95.04	48.96			308.78
5	Pickup w/radio	2.00	0.00	11.00	3.80			14.80
6	26 Genl Lab	8.00	291.51	0.00	0.00			291.51

		No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
Total Crew/Hr.		16.00	629.98	213.89	128.58	0.00	0.00	972.45
Sprd 1						0.00	$0	972.45
COST	780.00 HRS	12480.00	$491,382	$166,834	$100,292	$0	$0	$758,508
Unit	91.7 MI	136.10	5358.58	1819.35	1093.70	0.00	0.00	$8,272
		MH/ MI						
Sprd 2							$0	
COST	740.00 HRS	11840.00	$466,183	$158,279	$95,149	$0	$0	$719,611
Unit	87.3 MI	135.62	5340.01	1813.04	1089.91	0.00	0.00	$8,243
		MH/ MI						
Sprd 3							$0	
COST	580.00 HRS	9280.00	$365,386	$124,056	$74,576	$0	$0	$564,019
Unit	63.7 MI	145.68	5736.05	1947.51	1170.74	0.00	0.00	$8,854
		MH/ MI						

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ITEM III 38 Bottom Pad Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,C	1.00	45.95	7.15	1.90			55.00
2	D-7w/winch	1.00	42.58	55.65	28.18			126.41
3	966 Loader	1.00	42.58	38.70	22.87			104.15
4	10 CY End Dump	2.00	82.39	61.78	24.48			168.65
5	Pickup w/radio	2.00	0.00	14.30	3.80			18.10
6	26 Genl Lab	4.00	145.75	0.00	0.00			145.75

		No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.	9.00	359.25	177.58	81.23	0.00	0.00	618.06
Sprd 4A						0.00	$0	618.06
COST	72.00 HRS	648.00	$25,866	$12,786	$5,849	$0	$0	$44,501
Unit	7.4 MI	87.57 MH/ MI	3495.44	1727.81	790.35	0.00	0.00	$6,014
Sprd 4B							$0	
COST	530.00 HRS	4770.00	$190,405	$94,117	$43,052	$0	$0	$327,574
Unit	54.8 MI	87.04 MH/ MI	3474.54	1717.47	785.62	0.00	0.00	$5,978

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ITEM III 39 Lower & Backfill Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Strawboss	1.00	45.95	5.50	1.90			53.35
44	561 Sideboom	2.00	85.15	49.76	31.88			166.79
45	572 Sideboom	2.00	85.15	76.10	50.10			211.35
46	6" Pump	1.00	0.00	5.90	3.50			9.40
47	Winch Truck	1.00	41.20	15.70	6.25			63.15
48	Welding Rig	2.00	89.17	20.44	5.08			114.69
49	26 Genl Lab	16.00	583.01	0.00	0.00			583.01
50	225 Clam	1.00	42.58	28.15	25.90			96.63
51	Bus, 30 Pasgr	1.00	53.50	20.30	9.70			83.50
52	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58
53	34 Welder Helper	2.00	77.37	0.00	0.00			77.37
54	Pickup	1.00	0.00	5.50	1.90			7.40
55	I17 Rig Oiler	2.00	65.34	0.00	0.00			65.34
	Total Crew/Hr.	32.00	1262.02	232.85	138.11	0.00	0.00	1632.98
Sprd 1							0.00	1632.98
COST	780.00 HRS	24960.00	$984,375	$181,623	$107,726	$0	$0	$1,273,724
Unit	91.7 MI	272.19	10734.74	1980.62	1174.76	0.00	0.00	13890.12
		MH/ MI						
Sprd 2							0.00	
COST	740.00 HRS	23680.00	$933,895	$172,309	$102,201	$0	$0	$1,208,405
Unit	87.3 MI	271.25	10697.53	1973.76	1170.69	0.00	0.00	13841.98
		MH/ MI						
Sprd 3							0.00	
COST	580.00 HRS	18560.00	$731,971	$135,053	$80,104	$0	$0	$947,128
Unit	63.7 MI	291.37	11490.92	2120.14	1257.52	0.00	0.00	14868.57
		MH/ MI						

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ITEM III   39 Lower & Backfill   Plan Quantity   MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Strawboss	1.00	45.95	7.15	1.90			55.00
44	D-7 Sideboom	2.00	85.15	98.93	50.10			234.18
45	572 Sideboom	4.00	170.31	197.86	100.20			468.37
46	6" Pump	1.00	0.00	7.67	3.50			11.17
47	Winch Truck	1.00	41.20	15.70	6.25			63.15
48	Welding Rig	2.00	89.17	20.44	5.08			114.69
49	26 Genl Lab	22.00	801.64	0.00	0.00			801.64
50	LS78 35 T Motor Crane	1.00	42.58	26.42	26.18			95.17
51	Bus, 30 Pasgr	1.00	53.50	20.30	9.70			83.50
52	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58
53	34 Welder Helper	5.00	193.43	0.00	0.00			193.43
54	Pickup	2.00	0.00	11.00	3.80			14.80
55	117 Rig Oiler	2.00	65.34	0.00	0.00			65.34
56	D-8w/winch	4.00	170.31	263.69	158.52			592.52
57	14 Motor Grader	4.00	170.31	121.89	83.44			375.64
58	225 Clam	1.00	42.58	36.60	25.90			105.07
59	Heater Van	5.00	81.67	61.25	26.25			169.17
	Total Crew/Hr.	54.50	2146.73	896.04	502.72	0.00	0.00	3545.49
Sprd 4A							0.00	3545.49
COST	72.00 HRS	3924.00	$154,565	$64,515	$36,196	$0	$0	$255,276
Unit	7.4 MI	530.27	20887.14	8718.24	4891.33	0.00	0.00	34496.70
		MH/ MI						
Sprd 4B							0.00	
COST	530.00 HRS	28885.00	$1,137,769	$474,902	$266,442	$0	$0	$1,879,112
Unit	54.8 MI	527.10	20762.20	8666.09	4862.07	0.00	0.00	34290.37
		MH/ MI						

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ITEM III 40 Top Padding Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Civ	1.00	45.95	5.50	1.90			53.35
2	966 Loader	2.00	85.15	59.54	45.74			190.43
3	Bot Dump w/Tract	6.00	247.18	158.52	90.00			495.70
4	Padding Machine	1.00	42.58	77.94	64.18			184.70
5	26 Genl Lab	10.00	364.38	0.00	0.00			364.38
6	Pickup	2.00	0.00	11.00	3.80			14.80
7	I17 Rig Oiler	1.00	32.67	0.00	0.00			32.67
8	D-7w/winch	1.00	42.58	42.81	28.18			113.57

	Total Crew/Hr.	22.00	860.49	355.31	233.80	0.00	0.00	1449.60
Sprd 1							0.00	1449.60
COST	780.00 HRS	17160.00	$671,184	$277,142	$182,364	$0	$0	$1,130,690
Unit	484175 LF	0.04	1.39	0.57	0.38	0.00	0.00	2.34
		MH/ LF						
Sprd 2							0.00	
COST	740.00 HRS	16280.00	$636,765	$262,929	$173,012	$0	$0	$1,072,706
Unit	460950 LF	0.04	1.38	0.57	0.38	0.00	0.00	2.33
		MH/ LF						
Sprd 3							0.00	
COST	580.00 HRS	12760.00	$499,086	$206,080	$135,604	$0	$0	$840,770
Unit	336325 LF	0.04	1.48	0.61	0.40	0.00	0.00	2.50
		MH/ LF						

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ITEM III 40 Top Padding Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Civ	1.00	45.95	7.15	1.90			55.00
2	966 Loader	1.00	42.58	38.70	22.87			104.15
3	10 CY End Dump	3.00	123.59	92.66	36.72			252.97
4	Padding Machine	0.00	0.00	0.00	0.00			0.00
5	26 Genl Lab	5.00	182.19	0.00	0.00			182.19
6	Pickup	2.00	0.00	11.00	3.80			14.80
7	I17 Rig Oiler	0.00	0.00	0.00	0.00			0.00
8	D-7w/winch	1.00	42.58	55.65	28.18			126.41

		No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.	11.00	436.89	205.17	93.47	0.00	0.00	735.53
Sprd 4A							0.00	735.53
COST	72.00 HRS	792.00	$31,456	$14,772	$6,730	$0	$0	$52,958
Unit	39072 LF	0.02 MH/ LF	0.81	0.38	0.17	0.00	0.00	1.36
Sprd 4B							0.00	
COST	530.00 HRS	5830.00	$231,551	$108,739	$49,539	$0	$0	$389,829
Unit	289344 LF	0.02 MH/ LF	0.80	0.38	0.17	0.00	0.00	1.35

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ITEM III 41 Dewater Plan Quantity LF

Description		CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42 Pickup w/Foreman,Pipel		0.00	0.00	0.00	0.00			0.00
43 561 Sideboom		0.00	0.00	0.00	0.00			0.00
44 Welding Rig		0.00	0.00	0.00	0.00			0.00
45 Pickup		0.00	0.00	0.00	0.00			0.00
46 34 Welder Helper		0.00	0.00	0.00	0.00			0.00
47 26 Genl Lab		0.00	0.00	0.00	0.00			0.00
48 Carryall 10 Passgr		0.00	0.00	0.00	0.00			0.00
Total Crew/Hr.		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sprd 1							0.00	0.00
COST	780.00 HRS	0.00	$0	$0	$0	$0	$0	$0
Unit	484175 LF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		MH/ LF						
Sprd 2							0.00	
COST	740.00 HRS	0.00	$0	$0	$0	$0	$0	$0
Unit	460950 LF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		MH/ LF						
Sprd 3							0.00	
COST	580.00 HRS	0.00	$0	$0	$0	$0	$0	$0
Unit	336325 LF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		MH/ LF						

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ITEM IV 42 Road Crossing-Boring Plan Quantity EA

Railroad Crossings

	CREW COST			Eq Rent			
Description	No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
42 Pickup w/Foreman,P	1.00	49.01	5.50	1.90			56.41
43 D-7w/winch	1.00	42.58	42.81	28.18			113.57
44 572 Sideboom	2.00	85.15	76.10	50.10			211.35
45 235 Backhoe	1.00	42.58	41.75	38.69			123.02
46 6-20 Boring Machine	1.00	40.66	24.50	13.00			78.16
47 26 Genl Lab	5.00	182.19	0.00	0.00			182.19
48 Welding Rig	2.00	89.17	20.44	5.08			114.69
49 Tractor w/Water Tra	1.00	40.55	27.91	14.44			82.90
50 4" Pump	1.00	0.00	6.81	1.17			7.98
51 Pickup	2.00	0.00	11.00	3.80			14.80
52 I17 Rig Oiler	1.00	32.67	0.00	0.00			32.67
53 34 Welder Helper	2.00	77.37	0.00	0.00			77.37

	Total Crew/Hr.	17.00	681.93	256.82	156.36	0.00	0.00	1095.11
Sprd 1						0.00	$0	1095.11
COST	180.00 HRS	3060.00	$122,747	$46,228	$28,145	$0	$0	$197,119
Unit	6.0 EA	510.00	20457.77	7704.60	4690.80	0.00	0.00	$32,853
		MH/ EA						
Sprd 2							$0	
COST	120.00 HRS	2040.00	$81,831	$30,818	$18,763	$0	$0	$131,413
Unit	4.0 EA	510.00	20457.77	7704.60	4690.80	0.00	0.00	$32,853
		MH/ EA						
Sprd 3							$0	
COST	180.00 HRS	3060.00	$122,747	$46,228	$28,145	$0	$0	$197,119
Unit	6.0 EA	510.00	20457.77	7704.60	4690.80	0.00	0.00	$32,853
		MH/ EA						

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ITEM IV 43 Tie In Plan Quantity EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	225 Clam	1.00	42.58	28.15	25.90			96.63
44	561 Sideboom	2.00	85.15	49.76	31.88			166.79
45	572 Sideboom	1.00	42.58	38.05	25.05			105.68
46	6" Pump	1.00	0.00	5.90	3.50			9.40
47	Bus, 20 Psgr	1.00	53.50	15.95	7.65			77.10
48	Welding Rig	2.00	89.17	20.44	5.08			114.69
49	26 Genl Lab	6.00	218.63	0.00	0.00			218.63
50	34 Welder Helper	2.00	77.37	0.00	0.00			77.37
51	117 Rig Oiler	1.00	32.67	0.00	0.00			32.67
1	Pickup	1.00	0.00	5.50	1.90			7.40

			No.	Labor	Equip Op	Eq Own	SST	Matl	TOTAL
		Total Crew/Hr.	17.00	690.66	169.25	102.86	0.00	0.00	962.77
	Sprd 1							0.00	962.77
COST		780.00 HRS	13260.00	$538,712	$132,015	$80,231	$0	$0	$750,958
	Unit	74.0 EA	179.19	7279.89	1783.99	1084.20	0.00	0.00	10148.08
			MH/ EA						
	Sprd 2							0.00	
COST		740.00 HRS	12580.00	$511,086	$125,245	$76,116	$0	$0	$712,447
	Unit	48.0 EA	262.08	10647.62	2609.27	1585.76	0.00	0.00	14842.65
			MH/ EA						
	Sprd 3							0.00	
COST		580.00 HRS	9860.00	$400,581	$98,165	$59,659	$0	$0	$558,404
	Unit	54.0 EA	182.59	7418.16	1817.87	1104.79	0.00	0.00	10340.82
			MH/ EA						

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ITEM IV 43 Tie In Plan Quantity EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	225 Clam	1.00	42.58	36.60	25.90			105.07
44	561 Sideboom	2.00	85.15	64.69	31.88			181.72
45	572 Sideboom	2.00	85.15	98.93	50.10			234.18
46	6" Pump	1.00	0.00	7.67	3.50			11.17
47	Bus, 20 Psgr	1.00	53.50	20.74	7.65			81.89
48	Welding Rig	3.00	133.75	39.86	7.62			181.23
49	26 Genl Lab	10.00	364.38	0.00	0.00			364.38
50	34 Welder Helper	6.00	232.12	0.00	0.00			232.12
51	I17 Rig Oiler	1.00	32.67	0.00	0.00			32.67
52	Heater Van	2.00	65.34	24.50	10.50			100.34
1	Pickup	1.00	0.00	7.15	1.90			9.05

	Total Crew/Hr.	29.00	1143.66	307.28	140.95	0.00	0.00	1591.88
Sprd 4A							0.00	1591.88
COST	72.00 HRS	2088.00	$82,343	$22,124	$10,148	$0	$0	$114,615
Unit	6.0 EA	348.00 MH/ EA	13723.86	3687.31	1691.40	0.00	0.00	19102.57
Sprd 4B							0.00	
COST	530.00 HRS	15370.00	$606,137	$162,856	$74,704	$0	$0	$843,697
Unit	32.0 EA	480.31 MH/ EA	18941.79	5089.26	2334.48	0.00	0.00	26365.53

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ITEM IV 44 River Crossings Plan Quantity EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Field Engin	1.00	47.00	5.50	1.90			54.40
44	D-8w/winch	2.00	85.15	101.42	79.26			265.83
45	LS98 Dragline	2.00	85.15	46.08	45.60			176.83
46	235 Backhoe	2.00	85.15	83.50	77.38			246.03
47	225 Clam	1.00	42.58	28.15	25.90			96.63
48	561 Sideboom	2.00	85.15	49.76	31.88			166.79
49	572 Sideboom	2.00	85.15	76.10	50.10			211.35
50	Work Boat	2.00	0.00	0.00	0.00	50.00		50.00
51	Lowboy Truck	2.00	82.39	57.08	36.02			175.49
52	Winch Truck	1.00	41.20	15.70	6.25			63.15
53	Roller Units	10.00	0.00	0.00	0.00	25.00		25.00
54	Sauerman Bucket	1.00	42.58	10.00	30.00			82.58
55	Welding Rig	2.00	89.17	20.44	5.08			114.69
56	Bus, 30 Pasgr	1.00	53.50	20.30	9.70			83.50
57	26 Genl Lab	15.00	546.57	0.00	0.00			546.57
58	34 Welder Helper	2.00	77.37	0.00	0.00			77.37
59	I17 Rig Oiler	5.00	163.35	0.00	0.00			163.35
60	Pulling Winch	1.00	0.00	0.00	0.00	35.00		35.00
	Total Crew/Hr.	42.00	1660.49	519.53	400.97	110.00	0.00	2690.99
Sprd 1							0.00	2690.99
COST	1130.00 HRS	47460.00	$1,876,350	$587,069	$453,096	$124,300	$0	$3,040,815
Unit	30 EA	1582.00	62545.01	19568.96	15103.20	4143.33	0.00	101360.51
		MH/ EA						
Sprd 2							0.00	
COST	680.00 HRS	28560.00	$1,129,131	$353,280	$272,660	$74,800	$0	$1,829,871
Unit	19 EA	1503.16	59427.95	18593.71	14350.51	3936.84	0.00	96309.01
		MH/ EA						
Sprd 3							0.00	
COST	600.00 HRS	25200.00	$996,292	$311,718	$240,582	$66,000	$0	$1,614,592
Unit	20 EA	1260.00	49814.61	15585.90	12029.10	3300.00	0.00	80729.61
		MH/ EA						

19-Sep-88

ITEM IV 44 River Crossings Plan Quantity EA

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Field Engin	1.00	47.00	7.15	1.90			56.05
44	D-8w/ripper	2.00	85.15	135.15	81.80			302.10
45	LS98 Dragline	2.00	85.15	59.90	45.60			190.66
46	235 Backhoe	2.00	85.15	108.55	77.38			271.08
47	225 Clam	1.00	42.58	36.60	25.90			105.07
48	571 Sideboom	2.00	85.15	92.74	46.96			224.86
49	572 Sideboom	2.00	85.15	98.93	50.10			234.18
50	Work Boat	2.00	0.00	0.00	0.00	50.00		50.00
51	Lowboy Truck	4.00	164.78	148.41	72.04			385.23
52	Winch Truck	1.00	41.20	20.41	6.25			67.86
53	Roller Units	10.00	0.00	0.00	0.00	25.00		25.00
54	Sauerman Bucket	1.00	42.58	13.00	30.00			85.58
55	Welding Rig	3.00	133.75	39.86	7.62			181.23
56	Bus, 30 Pasgr	1.00	53.50	26.39	9.70			89.59
57	26 Genl Lab	28.00	1020.27	0.00	0.00			1020.27
58	34 Welder Helper	6.00	232.12	0.00	0.00			232.12
59	I17 Rig Oiler	8.00	261.36	0.00	0.00			261.36
60	Pulling Winch	1.00	0.00	0.00	0.00	35.00		35.00
61	LS78 Dragline	2.00	85.15	52.83	52.36			190.35
62	Heater Van	5.00	163.35	61.25	26.25			250.85
	Total Crew/Hr.	72.00	2762.42	908.32	535.76	110.00	0.00	4316.50
Sprd 4A							0.00	4316.50
COST	72.00 HRS	5184.00	$198,894	$65,399	$38,575	$7,920	$0	$310,788
Unit	2.0 EA	2592.00	99447.06	32699.41	19287.36	3960.00	0.00	155393.84
		MH/ EA						
Sprd 4B							0.00	
COST	530.00 HRS	38160.00	$1,464,082	$481,408	$283,953	$58,300	$0	$2,287,743
Unit	8.0 EA	4770.00	183010.22	60176.00	35494.10	7287.50	0.00	285967.82
		MH/ EA						

24-Oct-88

ITEM V 45 Fabrication Valve Stations — Plan Quantity PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	561 Sideboom	1.00	42.58	24.88	15.94			83.40
44	Winch Truck	1.00	41.20	15.70	6.25			63.15
45	Welding Rig	5.00	222.92	51.10	12.70			286.72
46	175 Compressor	1.00	0.00	8.38	3.72			12.10
47	26 Genl Lab	6.00	218.63	0.00	0.00			218.63
48	JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
49	Sand Blst & Paint Eq	1.00	0.00	0.00	0.00	7.50		7.50
50	Pickup	1.00	0.00	5.50	1.90			7.40
51	34 Welder Helper	5.00	193.43	0.00	0.00			193.43
52	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58

			Labor	Equip Op	Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.	21.00	854.92	121.73	49.72	7.50	0.00	1033.87
Sprd 1						0.00	$184	1033.87
COST	80.00 HRS	1680.00	$68,394	$9,738	$3,978	$600	$18,432	$101,142
Unit	100.0 PC	16.80 MH/ PC	683.94	97.38	39.78	6.00	184.32	$1,011
Sprd 2							$184	
COST	80.00 HRS	1680.00	$68,394	$9,738	$3,978	$600	$18,432	$101,142
Unit	100.0 PC	16.80 MH/ PC	683.94	97.38	39.78	6.00	184.32	$1,011
Sprd 3							$184	
COST	80.00 HRS	1680.00	$68,394	$9,738	$3,978	$600	$18,432	$101,142
Unit	100.0 PC	16.80 MH/ PC	683.94	97.38	39.78	6.00	184.32	$1,011

24-Oct-88

ITEM V 45 Fabrication Valve Stations — Plan Quantity PC

CREW COST

	Description	No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	561 Sideboom	1.00	42.58	32.34	15.94			90.86
44	Winch Truck	1.00	41.20	20.41	6.25			67.86
45	Welding Rig	6.00	267.50	79.72	15.24			362.46
46	175 Compressor	1.00	0.00	10.89	3.72			14.61
47	26 Genl Lab	10.00	364.38	0.00	0.00			364.38
48	JD 510 B'hoe	1.00	42.58	13.87	7.31			63.76
49	Sand Blst & Paint Eq	1.00	0.00	0.00	0.00	7.50		7.50
50	Pickup	1.00	0.00	7.15	1.90			9.05
51	34 Welder Helper	9.00	348.18	0.00	0.00			348.18
52	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58

			No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
	Total Crew/Hr.		30.00	1200.00	171.54	52.26	7.50	0.00	1431.30
Sprd 4A								$34	1431.30
COST		20.00 HRS	600.00	$24,000	$3,431	$1,045	$150	$3,412	$32,038
Unit		100.0 PC	6.00	240.00	34.31	10.45	1.50	34.12	$320
			MH/ PC						
Sprd 4B								$59	
COST		40.00 HRS	1200.00	$48,000	$6,861	$2,090	$300	$5,939	$63,191
Unit		100.0 PC	12.00	480.00	68.61	20.90	3.00	59.39	$632
			MH/ PC						

14-Sep-88

ITEM V 46 Test Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43	Pickup w/Field Engin	1.00	47.00	5.50	1.90			54.40
44	561 Sideboom	1.00	42.58	24.88	15.94			83.40
45	Pickup w/Strawboss	1.00	45.95	5.50	1.90			53.35
46	215 Backhoe	1.00	42.58	20.33	18.02			80.93
47	Winch Truck	1.00	41.20	15.70	6.25			63.15
48	Welding Rig	2.00	89.17	20.44	5.08			114.69
49	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
50	Fill Pumps-Hydrotest	2.00	0.00	77.80	31.60			109.40
51	Test Pump	1.00	0.00	40.88	16.62			57.50
52	Test Bus	1.00	53.50	19.30	9.25			82.05
53	34 Welder Helper	2.00	77.37	0.00	0.00			77.37
54	Carryall 10 Passgr	2.00	55.73	17.00	4.00			76.73
55	1200 Compressor	1.00	0.00	31.15	12.66			43.81
56	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58
	Total Crew/Hr.	18.00	734.42	283.98	125.12	0.00	0.00	1143.52
Sprd 1							0.00	1143.52
COST	240.00 HRS	4320.00	$176,260	$68,155	$30,029	$0	$0	$274,444
Unit	91.7 MI	47.11	1922.14	743.24	327.47	0.00	0.00	2992.85
	4 sect	MH/ MI						
Sprd 2							0.00	
COST	240.00 HRS	4320.00	$176,260	$68,155	$30,029	$0	$0	$274,444
Unit	87.3 MI	49.48	2019.02	780.70	343.97	0.00	0.00	3143.69
		MH/ MI						
Sprd 3							0.00	
COST	240.00 HRS	4320.00	$176,260	$68,155	$30,029	$0	$0	$274,444
Unit	63.7 MI	67.82	2767.04	1069.94	471.41	0.00	0.00	4308.39
		MH/ MI						

19-Sep-88

ITEM V 46 Test Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	Pickup w/Field Engin	1.00	47.00	7.15	1.90			56.05
44	561 Sideboom	1.00	42.58	32.34	15.94			90.86
45	Pickup w/Strawboss	1.00	45.95	7.15	1.90			55.00
46	225 Backhoe	1.00	42.58	36.60	25.90			105.07
47	Winch Truck	1.00	41.20	20.41	6.25			67.86
48	Welding Rig	2.00	89.17	20.44	5.08			114.69
49	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
50	Fill Pumps-Hydrotest	2.00	85.15	77.80	31.60			194.55
51	Test Pump	1.00	0.00	40.88	16.62			57.50
52	Test Bus	1.00	53.50	19.30	9.25			82.05
53	34 Welder Helper	2.00	77.37	0.00	0.00			77.37
54	Carryall 10 Passgr	1.00	27.86	8.50	2.00			38.36
55	1200 Compressor	3.00	0.00	93.45	37.98			131.43
56	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58
	Total Crew/Hr.	19.00	791.71	371.17	156.32	0.00	0.00	1319.20
Sprd 4A							0.00	1319.20
COST	50.00 HRS	950.00	$39,585	$18,558	$7,816	$0	$0	$65,960
Unit	7.4 MI	128.38	5349.38	2507.90	1056.22	0.00	0.00	8913.50
		MH/ MI						
Sprd 4B							0.00	
COST	170.00 HRS	3230.00	$134,590	$63,099	$26,574	$0	$0	$224,264
Unit	54.8 MI	58.94	2456.03	1151.44	484.93	0.00	0.00	4092.40
		MH/ MI						

14-Sep-88

ITEM V 47 Cleanup Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Civ	1.00	45.95	5.50	1.90			53.35
2	966 Loader	2.00	85.15	59.54	45.74			190.43
3	D-8w/winch	2.00	85.15	101.42	79.26			265.83
4	D-7w/winch	1.00	42.58	42.81	28.18			113.57
5	26 Genl Lab	14.00	510.14	0.00	0.00			510.14
6	Pickup	1.00	0.00	5.50	1.90			7.40
7	14 Motor Grader	1.00	42.58	23.44	20.86			86.88
8	Tow Tractor w/Disc	1.00	42.58	48.57	34.96			126.11
9	JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
10	Rock Picker	1.00	42.58	20.46	13.49			76.53
11	10 CY End Dump	4.00	164.78	95.04	48.96			308.78
12	Flatbed	1.00	41.20	13.24	9.21			63.65
13	Bus, 30 Passgr	1.00	53.50	20.30	9.70			83.50
14	Pickup w/Strawboss	1.00	45.95	5.50	1.90			53.35
15	Pickup w/Claims Agen	1.00	47.00	5.50	1.90			54.40
	Total Crew/Hr.	32.00	1291.72	457.49	305.27	0.00	0.00	2054.48
Sprd 1							0.00	2054.48
COST	780.00 HRS	24960.00	$1,007,542	$356,842	$238,111	$0	$0	$1,602,495
Unit	484175 LF	0.05	2.08	0.74	0.49	0.00	0.00	3.31
		MH/ LF						
Sprd 2							0.00	
COST	740.00 HRS	23680.00	$955,873	$338,543	$225,900	$0	$0	$1,520,316
Unit	460950 LF	0.05	2.07	0.73	0.49	0.00	0.00	3.30
		MH/ LF						
Sprd 3							0.00	
COST	580.00 HRS	18560.00	$749,198	$265,344	$177,057	$0	$0	$1,191,599
Unit	336325 LF	0.06	2.23	0.79	0.53	0.00	0.00	3.54
		MH/ LF						

19-Sep-88

ITEM V 47 Cleanup Plan Quantity LF

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
1	Pickup w/Foreman,Civ	1.00	45.95	7.15	1.90			55.00
2	966 Loader	1.00	42.58	65.92	39.63			148.13
3	D-8w/winch	2.00	85.15	135.15	81.80			302.10
4	D-7w/winch	0.00	0.00	0.00	0.00			0.00
5	26 Genl Lab	15.00	546.57	0.00	0.00			546.57
6	Pickup	1.00	0.00	7.15	1.90			9.05
7	14 Motor Grader	2.00	85.15	60.94	41.72			187.82
8	Tow Tractor w/Disc	0.00	0.00	0.00	0.00			0.00
9	JD 510 B'hoe	1.00	42.58	13.87	7.31			63.76
10	Rock Picker	0.00	0.00	0.00	0.00			0.00
11	10 CY End Dump	2.00	82.39	61.78	24.48			168.65
12	Flatbed	1.00	41.20	17.21	9.21			67.62
13	Bus, 30 Pasgr	1.00	53.50	26.39	9.70			89.59
14	Pickup w/Strawboss	1.00	45.95	7.15	1.90			55.00
15	Pickup w/Claims Agen	1.00	47.00	7.15	1.90			56.05
	Total Crew/Hr.	28.00	1118.03	409.86	221.45	0.00	0.00	1749.35
Sprd 4A							0.00	1749.35
COST	72.00 HRS	2016.00	$80,498	$29,510	$15,944	$0	$0	$125,953
Unit	39072 LF	0.05	2.06	0.76	0.41	0.00	0.00	3.22
		MH/ LF						
Sprd 4B							0.00	
COST	530.00 HRS	14840.00	$592,558	$217,228	$117,369	$0	$0	$927,155
Unit	289344 LF	0.05	2.05	0.75	0.41	0.00	0.00	3.20
		MH/ LF						

VI

COST DETAIL SHEETS

PIPELINE CONTRACT

Indirects

Equipment Rate Sheets
Labor Rate Sheets
Quotes

OPERATING FACILITIES

14-Sep-88

ITEM VI Services Plan Quantity PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Master Mech	1.00	49.01	5.50	1.90			56.41
43	Lowboy Truck	2.00	82.39	57.08	36.02			175.49
44	Tractor w/Float	1.00	40.55	26.02	14.44			81.01
45	Welding Rig	1.00	0.00	10.22	2.54			12.76
46	175 Compressor	1.00	0.00	8.38	3.72			12.10
47	Mechanic Rig	10.00	0.00	71.50	27.60			99.10
48	Fuel Truck	2.00	0.00	37.20	18.60			55.80
49	Grease Truck	2.00	0.00	36.60	15.60			52.20
50	Pickup	2.00	0.00	11.00	3.80			14.80
51	26 Genl Lab	4.00	145.75	0.00	0.00			145.75
52	Bus, 20 Psgr	1.00	1.00	15.95	7.65			24.60

	Total Crew/Hr.	9.00	318.70	279.45	131.87	0.00	0.00	730.02
Sprd 1						0.00	$0	730.02
COST	1500.00 HRS	13500.00	$478,050	$419,175	$197,805	$0	$0	$1,095,030
Unit	100.0 PC	135.00 MH/ PC	4780.50	4191.75	1978.05	0.00	0.00	$10,950
Sprd 2							$0	
COST	1100.00 HRS	9900.00	$350,570	$307,395	$145,057	$0	$0	$803,022
Unit	100.0 PC	99.00 MH/ PC	3505.70	3073.95	1450.57	0.00	0.00	$8,030
Sprd 3							$0	
COST	950.00 HRS	8550.00	$302,765	$265,478	$125,277	$0	$0	$693,519
Unit	100.0 PC	85.50 MH/ PC	3027.65	2654.78	1252.77	0.00	0.00	$6,935

Note- Eq Repair & Service Labor in Eq Op Rate

19-Sep-88

ITEM VI Services Plan Quantity PC

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Master Mech	1.00	49.01	7.15	1.90			58.06
43	Lowboy Truck	2.00	82.39	74.20	36.02			192.62
44	Tractor w/Float	1.00	40.55	33.83	14.44			88.81
45	Welding Rig	1.00	0.00	13.29	2.54			15.83
46	175 Compressor	1.00	0.00	10.89	3.72			14.61
47	Mechanic Rig	13.00	0.00	120.84	35.88			156.72
48	Fuel Truck	2.00	0.00	48.36	18.60			66.96
49	Grease Truck	2.00	0.00	47.58	15.60			63.18
50	Pickup	2.00	0.00	14.30	3.80			18.10
51	26 Genl Lab	10.00	364.38	0.00	0.00			364.38
52	Bus, 20 Psgr	1.00	8.92	20.74	7.65			37.30
53	Winch Truck	1.00	41.20	20.41	6.25			67.86
54	Heater Van	1.00	32.67	12.25	5.25			50.17

	Total Crew/Hr.	16.00	619.11	423.83	151.65	0.00	0.00	1194.59
Sprd 4A						0.00	$0	1194.59
COST	108.00 HRS	1728.00	$66,864	$45,774	$16,378	$0	$0	$129,016
Unit	100.0 PC	17.28	668.64	457.74	163.78	0.00	0.00	$1,290
		MH/ PC						
Sprd 4B							$0	
COST	795.00 HRS	12720.00	$492,194	$336,945	$120,562	$0	$0	$949,701
Unit	100.0 PC	127.20	4921.94	3369.45	1205.62	0.00	0.00	$9,497
		MH/ PC						

14-Sep-88

ITEM VI   Supervision & Support   Plan Quantity   MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Auto w/Superintendent	1.00	52.50	5.50	1.90			59.90
43	Pickup w/Assistant S	1.00	47.00	5.50	1.90			54.40
44	Pickup w/Proj Engine	1.00	47.00	5.50	1.90			54.40
45	Pickup w/Office Mana	1.00	40.25	5.50	1.90			47.65
46	Timekeeper	2.00	45.00	0.00	0.00			45.00
47	Clerk	2.00	40.00	0.00	0.00			40.00
48	1 T Flatbed w/Expedit	2.00	82.39	10.48	4.32			97.19
49	26 Genl Lab	3.00	109.31	0.00	0.00			109.31
50	Parts Man	2.00	82.39	26.48	18.42			127.29
51	Warehose Man	3.00	123.59	15.72	6.48			145.79
52	Pickup w/ Op Steward	1.00	44.71	5.50	1.90			52.11
53	Pickup w/ Teamster S	1.00	43.26	5.50	1.90			50.66
54	Pickup w/ Labor Stewr	1.00	40.68	5.50	1.90			48.08
55	Pickup w/Security Man	3.00	105.00	16.50	5.70			127.20
56	Helicopter	1.00	0.00	5.50	1.90	135.00		142.40
	Total Crew/Hr.	25.00	903.08	113.18	50.12	135.00	0.00	1201.38
Sprd 1							0.00	1201.38
COST	1500.00 HRS	37500.00	$1,354,626	$169,770	$75,180	$202,500	$0	$1,802,076
Unit	91.7 MI	408.94	14772.37	1851.36	819.85	2208.29	0.00	19651.87
		MH/ MI						
Sprd 2							0.00	
COST	1450.00 HRS	36250.00	$1,309,472	$164,111	$72,674	$195,750	$0	$1,742,007
Unit	87.3 MI	415.23	14999.68	1879.85	832.46	2242.27	0.00	19954.26
		MH/ MI						
Sprd 3							0.00	
COST	1300.00 HRS	32500.00	$1,174,010	$147,134	$65,156	$175,500	$0	$1,561,800
Unit	63.7 MI	510.20	18430.29	2309.80	1022.86	2755.10	0.00	24518.05
		MH/ MI						

19-Sep-88

ITEM VI Supervision & Support Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Auto w/Superintendent	1.00	52.50	7.15	1.90			61.55
43	Pickup w/Assistant S	1.00	47.00	7.15	1.90			56.05
44	Pickup w/Proj Engine	1.00	47.00	7.15	1.90			56.05
45	Pickup w/Office Mana	1.00	40.25	7.15	1.90			49.30
46	Timekeeper	2.00	45.00	0.00	0.00			45.00
47	Clerk	2.00	40.00	0.00	0.00			40.00
48	1 T Flatbed w/Expedit	2.00	82.39	13.62	4.32			100.34
49	26 Genl Lab	3.00	109.31	0.00	0.00			109.31
50	Parts Man	2.00	82.39	34.42	18.42			135.24
51	Warehouse Man	3.00	123.59	21.45	5.70			150.74
52	Pickup w/ Op Steward	1.00	44.71	7.15	1.90			53.76
53	Pickup w/ Teamster S	1.00	43.26	7.15	1.90			52.31
54	Pickup w/ Labor Stewr	1.00	40.68	7.15	1.90			49.73
55	Pickup w/Security Man	3.00	105.00	21.45	5.70			132.15
56	Helicopter	1.00	0.00	7.15	1.90	135.00		144.05
57	Haglund	1.00	41.20	7.15	1.90	42.50		92.75
	Total Crew/Hr.	26.00	944.28	155.30	51.24	177.50	0.00	1328.32
Sprd 4A							0.00	1328.32
COST	140.00 HRS	3640.00	$132,199	$21,742	$7,174	$24,850	$0	$185,965
Unit	7.4 MI	491.89	17864.77	2938.07	969.41	3358.11	0.00	25130.35
		MH/ MI						
Sprd 4B							0.00	
COST	1030.00 HRS	26780.00	$972,609	$159,957	$52,777	$182,825	$0	$1,368,168
Unit	54.8 MI	488.69	17748.34	2918.92	963.09	3336.22	0.00	24966.57
		MH/ MI						

14-Sep-88

ITEM VI Support Facilities Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Own	Eq Rent SST	Matl	TOTAL
1	Office Trailer,Contractor	1.00	0.00	0.00	0.00	10.00		10.00
2	Office Trailer,Owner/Insp	1.00	0.00	0.00	0.00	10.00		10.00
3	Parts Trailer	7.00	0.00	0.00	0.00	42.00		42.00
4	Warehouse Units(Atco)	2.00	0.00	0.00	0.00	20.00		20.00

Total Crew/Hr.		0.00	0.00	0.00	0.00	82.00	0.00	82.00
Sprd 1							0.00	82.00
COST	1500.00 HRS	0.00	$0	$0	$0	$123,000	$0	$123,000
Unit	91.7 MI	0.00	0.00	0.00	0.00	1341.33	0.00	1341.33
		MH/ MI						
Sprd 2							0.00	
COST	1450.00 HRS	0.00	$0	$0	$0	$118,900	$0	$118,900
Unit	87.3 MI	0.00	0.00	0.00	0.00	1361.97	0.00	1361.97
		MH/ MI						
Sprd 3							0.00	
COST	1300.00 HRS	0.00	$0	$0	$0	$106,600	$0	$106,600
Unit	63.7 MI	0.00	0.00	0.00	0.00	1673.47	0.00	1673.47
		MH/ MI						

19-Sep-88

ITEM VI Support Facilities Plan Quantity MI

	Description	CREW COST No.	Labor	Equip Op	Eq Own	Eq Rent SST	Matl	TOTAL
1	Office Trailer,Contractor	1.00	0.00	0.00	0.00	10.00		10.00
2	Office Trailer,Owner/Insp	1.00	0.00	0.00	0.00	10.00		10.00
3	Parts Trailer	7.00	0.00	0.00	0.00	42.00		42.00
4	Warehouse Units(Atco)	2.00	0.00	0.00	0.00	20.00		20.00

	Total Crew/Hr.	0.00	0.00	0.00	0.00	82.00	0.00	82.00
Sprd 4A							0.00	82.00
COST	140.00 HRS	0.00	$0	$0	$0	$11,480	$0	$11,480
Unit	7.4 MI	0.00	0.00	0.00	0.00	1551.35	0.00	1551.35
		MH/ MI						
Sprd 4B							0.00	
COST	1030.00 HRS	0.00	$0	$0	$0	$84,460	$0	$84,460
Unit	54.8 MI	0.00	0.00	0.00	0.00	1541.24	0.00	1541.24
		MH/ MI						

LABOR USE RATE CALCULATION WORK SHEET

16-Aug-88

Project: Wasilla to Fairbanks Natural Gas Pipeline
Est Date: August, 1988

Work Shift: 6-10's   W.C. Rate 9.64
Hrs./Week: 60.00   T&I Rate: 18.11   No double time in total

	LABOR Description		Rate	Labor Tot $	W.C.	T&I	Fringes	TOTAL LABOR COST
13	I13 Dozer,966	I	24.47	28.55	2.36	5.17	6.50	42.58
14	I14 Crane, Ovr 45 T	IA	26.01	30.35	2.51	5.50	6.50	44.85
15	I15 Service Oiler	II	23.80	27.77	2.29	5.03	6.50	41.59
16	I16 Rollers	III	23.17	27.03	2.23	4.90	6.50	40.66
17	I17 Rig Oiler	IV	17.75	20.71	1.71	3.75	6.50	32.67
18	I18 Foreman		26.76	31.22	2.58	5.65	6.50	45.95
19								
20	I20 Tmstr V,Fueler	V	21.61	25.21	2.08	4.57	7.64	39.50
21	I21 Rolligon w/Trailer	I	24.51	28.60	2.36	5.18	7.64	43.78
22	I22 Redy Mix7-12	II	23.46	27.37	2.26	4.96	7.64	42.23
23	[illegible] Dump 10-20	III	22.76	26.55	2.19	4.81	7.64	41.20
24	[illegible] Boom Tk,semi	IV	22.32	26.04	2.15	4.72	7.64	40.55
25				0.00				
26	I26 Genl,Swamper	I	20.34	23.73	1.96	4.30	6.45	36.44
27	I27 Comp,Conc.	II	20.68	24.13	1.99	4.37	6.45	36.94
28	I28 Chktndr,Road Crossing	III	21.08	24.59	2.03	4.45	6.45	37.53
29	I29 Pipelayer	IV	21.34	24.90	2.06	4.51	6.45	37.91
30	I30 Drillr,Grd Ckr,PL Carp	V	21.60	25.20	2.08	4.56	6.45	38.30
31	I31 Powderman	VI	21.90	25.55	2.11	4.63	6.45	38.74
32	I32 Fitter Foreman		29.17	34.03	2.81	6.16	6.00	49.01
33	I33 Fitter Journeyman		26.17	30.53	2.52	5.53	6.00	44.58
34	I34 Welder Helper		22.17	25.87	2.14	4.68	6.00	38.69

T&I Rate	
FICA:	7.51
Liab:	5.10
SUT:	4.70
FUT:	0.80

WC Rate		pct
6217	10.28	0.0 exc,no
6003	33.26	0.0 pile d
5507	6.82	0.0 subsur
6233	9.64	100.0 pipeli
5213		
5057		
mult	1.00	

Description	No.	Labor	Equip Op	Equip Own	Eq Rent SST	TOTAL HRLY
42 Pickup w/Foreman,Pipeline	1.00	49.01	5.50	1.90		56.41
43 Pickup w/Foreman,Civil	1.00	45.95	5.50	1.90		53.35
44 Pickup w/Field Engineer	1.00	47.00	5.50	1.90		54.40
45 Carryall 10 Passgr	1.00	8.92	8.50	2.00		19.42
46 Bus, 30 Pasgr	1.00	8.92	20.30	9.70		38.92
47 Bus, 20 Psgr	1.00	8.92	15.95	7.65		32.52
48 988 Loader	1.00	44.85	52.66	40.58		138.09
49 966 Loader	1.00	42.58	29.77	22.87		95.22
50 D-8w/winch	1.00	42.58	50.71	39.63		132.92
51 D-8w/ripper	1.00	42.58	51.98	40.90		135.46
52 D-7w/winch	1.00	42.58	42.81	28.18		113.57
53 D-7 Hot Pass/Tack	1.00	42.58	37.59	22.09		102.26
54 D-7 Auger Backfiller	1.00	42.58	45.19	29.75		117.52
55 D-6 Dozer	1.00	42.58	26.04	17.17		85.79
56 D-9 Ripper	1.00	42.58	69.06	56.31		167.95
57 JD 450 Dozer	1.00	42.58	11.45	6.52		60.55
58 561 Sideboom	1.00	42.58	24.88	15.94		83.40
59 571 Sideboom	1.00	42.58	35.67	23.48		101.73
60 572 Sideboom	1.00	42.58	38.05	25.05		105.68
61 Fuel Truck	1.00	0.00	18.60	9.30		27.90
62 Grease Truck	1.00	0.00	18.30	7.80		26.10
63 Mechanic Rig	1.00	0.00	7.15	2.76		9.91
64 Padding Machine	1.00	42.58	77.94	64.18		184.70
65 TA77 Ditching Machine	1.00	42.58	38.97	32.09		113.64
66 Rock Picker	1.00	42.58	20.46	13.49		76.53
67 JD 510 B'hoe	1.00	42.58	10.67	7.31		60.56
68 215 Backhoe	1.00	42.58	20.33	18.02		80.93
69 235 Backhoe	1.00	42.58	41.75	38.69		123.02
70 225 Clam	1.00	42.58	28.15	25.90		96.63
71 LS98 Dragline	1.00	42.58	23.04	22.80		88.42
72 LS78 35 T Motor Crane	1.00	42.58	20.32	26.18		89.08
73 Sauerman Bucket	1.00	42.58	10.00	30.00		82.58
74 Tractor w/Auger	1.00	42.58	48.57	34.96		126.11
75 10 CY End Dump	1.00	41.20	23.76	12.24		77.20
76 70 T Crane	1.00	44.85	26.33	41.18		112.36
77 690 Backhoe	1.00	42.58	19.92	16.29		78.79
78 Compact & Op	1.00	36.94	2.15	2.05		41.14
79 SP56 Vib Roller	1.00	40.66	26.04	14.24		80.94
80 Raygo Romper	1.00	40.66	7.19	3.86		51.71
81 Bot Dump w/Tract	1.00	41.20	26.42	15.00		82.62
82 Stringing Truck	1.00	40.55	24.03	12.31		76.89
83 Lowboy Truck	1.00	41.20	28.54	18.01		87.75
84 Tractor w/Float	1.00	40.55	26.02	14.44		81.01
85 Tractor w/Water Trailer	1.00	40.55	27.91	14.44		82.90
86 Hydr. Auguer	1.00	0.00	2.88	3.39		6.27
87 2" Pump	1.00	0.00	0.29	0.22		0.51
88 4" Pump	1.00	0.00	6.81	1.17		7.98
89 6" Pump	1.00	0.00	5.90	3.50		9.40
90 Fill Pumps-Hydrotest	1.00	0.00	38.90	15.80		54.70
91 Test Pump	1.00	0.00	40.88	16.62		57.50
92 Test Bus	1.00	8.92	19.30	9.25		37.47
93 175 Compressor	1.00	0.00	8.38	3.72		12.10

Fairbanks Gasline EQUIPMENT OPERATING COSTS 23-Sep-88

	Description	No.	Labor	Equip Op	Equip Own	Eq Rent SST	TOTAL HRLY
94	750 Compressor	1.00	0.00	18.14	7.58		25.72
95	900 Compressor	1.00	0.00	21.84	9.44		31.28
96	1200 Compressor	1.00	0.00	31.15	12.66		43.81
97	Twin Drill or Track	1.00	38.30	11.77	11.50		61.57
98	Jackhammers	1.00	37.53	4.70	1.70		43.93
99	Powder Truck	1.00	41.20	8.85	3.65		53.70
100	Powder Magazine	1.00	0.00	0.00	0.00	10.00	10.00
101	Work Boat	1.00	0.00	0.00	0.00	25.00	25.00
102	Crusher w/450KW	1.00	42.58	281.80	107.50		431.88
103	Flatbed	1.00	41.20	13.24	9.21		63.65
104	1 T Flatbed	1.00	41.20	5.24	2.16		48.60
105	Winch Truck	1.00	41.20	15.70	6.25		63.15
106	Pblt Skid Truck	1.00	41.20	22.04	10.18		73.42
107	4x4 Buffing Rig	1.00	36.44	7.40	2.53		46.37
108	Welding Rig	1.00	44.58	10.22	2.54		57.34
109	Bending Machine	1.00	42.58	17.80	6.90		67.28
110	Bending Shoe Liner	1.00	0.00	0.00	0.00	15.60	15.60
111	Inside Mandrel	1.00	0.00	0.00	0.00	33.30	33.30
112	Internal Pneumatic Clamps	1.00	0.00	0.00	0.00	27.80	27.80
113	Roller Units	1.00	0.00	0.00	0.00	2.50	2.50
114	6-20 Boring Machine	1.00	40.66	24.50	13.00		78.16
115	26 Genl Lab	1.00	36.44	0.00	0.00		36.44
116	28 Chktndr,Road Crossing	1.00	37.53	0.00	0.00		37.53
117	29 Pipelayer	1.00	37.91	0.00	0.00		37.91
118	30 Drillr,Grd Ckr,PL Carp	1.00	38.30	0.00	0.00		38.30
119	31 Powdrman	1.00	38.74	0.00	0.00		38.74
120	32 Fitter Foreman & Pickup	1.00	49.01	5.50	1.90		56.41
121	33 Fitter Journeyman	1.00	44.58	0.00	0.00		44.58
122	34 Welder Helper	1.00	38.69	0.00	0.00		38.69
123	14 Motor Grader	1.00	42.58	23.44	20.86		86.88
124	Hydroaxe	1.00	42.58	52.66	40.58		135.82
125	Brush Hog	1.00	42.58	14.88	11.44		68.90
126	Chainsaw & Op	1.00	37.53	1.75	1.75		41.03
127	I17 Rig Oiler	1.00	32.67	0.00	0.00		32.67

Fairbanks Gasline EQUIPMENT OPERATING COSTS 19-Sep-88
WINTER RATES

	Description	No.	Labor	Equip Op	Equip Own	Eq Rent SST	TOTAL HRLY
42	Pickup w/Foreman,Pipeline	1.00	49.01	7.15	1.90		58.06
43	Pickup w/Foreman,Civil	1.00	45.95	7.15	1.90		55.00
44	Pickup w/Field Engineer	1.00	47.00	7.15	1.90		56.05
45	Carryall 10 Passgr	1.00	8.92	11.05	2.00		21.97
46	Bus, 30 Passgr	1.00	8.92	26.39	9.70		45.01
47	Bus, 20 Psgr	1.00	8.92	20.74	7.65		37.30
48	988 Loader	1.00	44.85	68.46	40.58		153.89
49	966 Loader	1.00	42.58	38.70	22.87		104.15
50	D-8w/winch	1.00	42.58	65.92	39.63		148.13
51	D-8w/ripper	1.00	42.58	67.57	40.90		151.05
52	D-7w/winch	1.00	42.58	55.65	28.18		126.41
53	D-7 Hot Pass/Tack	1.00	42.58	48.87	22.09		113.53
54	D-7 Auger Backfiller	1.00	42.58	58.75	29.75		131.07
55	D-6 Dozer	1.00	42.58	33.85	17.17		93.60
56	D-9 Ripper	1.00	42.58	89.78	56.31		188.67
57	JD 450 Dozer	1.00	42.58	14.89	6.52		63.98
58	561 Sideboom	1.00	42.58	32.34	15.94		90.86
59	571 Sideboom	1.00	42.58	46.37	23.48		112.43
60	572 Sideboom	1.00	42.58	49.47	25.05		117.09
61	Fuel Truck	1.00	0.00	24.18	9.30		33.48
62	Grease Truck	1.00	0.00	23.79	7.80		31.59
63	Mechanic Rig	1.00	0.00	9.30	2.76		12.06
64	Padding Machine	1.00	42.58	101.32	64.18		208.08
65	TA77 Ditching Machine	1.00	42.58	50.66	32.09		125.33
66	Rock Picker	1.00	42.58	26.60	13.49		82.67
67	JD 510 B'hoe	1.00	42.58	13.87	7.31		63.76
68	215 Backhoe	1.00	42.58	26.43	18.02		87.03
69	235 Backhoe	1.00	42.58	54.28	38.69		135.54
70	225 Clam	1.00	42.58	36.60	25.90		105.07
71	LS98 Dragline	1.00	42.58	29.95	22.80		95.33
72	LS78 35 T Motor Crane	1.00	42.58	26.42	26.18		95.17
73	Sauerman Bucket	1.00	42.58	13.00	30.00		85.58
74	Tractor w/Auger	1.00	42.58	63.14	34.96		140.68
75	10 CY End Dump	1.00	41.20	30.89	12.24		84.32
76	70 T Crane	1.00	44.85	34.23	41.18		120.26
77	690 Backhoe	1.00	42.58	25.90	16.29		84.76
78	Compact & Op	1.00	36.94	2.80	2.05		41.78
79	SP56 Vib Roller	1.00	40.66	33.85	14.24		88.75
80	Raygo Romper	1.00	40.66	9.35	3.86		53.87
81	Bot Dump w/Tract	1.00	41.20	34.35	15.00		90.54
82	Stringing Truck	1.00	40.55	31.24	12.31		84.10
83	Lowboy Truck	1.00	41.20	37.10	18.01		96.31
84	Tractor w/Float	1.00	40.55	33.83	14.44		88.81
85	Tractor w/Water Trailer	1.00	40.55	36.28	14.44		91.27
86	Hydr. Auguer	1.00	0.00	3.74	3.39		7.13
87	2" Pump	1.00	0.00	0.38	0.22		0.60
88	4" Pump	1.00	0.00	8.85	1.17		10.02
89	6" Pump	1.00	0.00	7.67	3.50		11.17
90	Fill Pumps-Hydrotest	1.00	0.00	50.57	15.80		66.37
91	Test Pump	1.00	0.00	53.14	16.62		69.76
92	Test Bus	1.00	8.92	25.09	9.25		43.26
93	175 Compressor	1.00	0.00	10.89	3.72		14.61

Fairbanks Gasline EQUIPMENT OPERATING COSTS 19-Sep-88

WINTER RATES

Description	No.	Labor	Equip Op	Equip Own	Eq Rent SST	TOTAL HRLY
94 750 Compressor	1.00	0.00	23.58	7.58		31.16
95 900 Compressor	1.00	0.00	28.39	9.44		37.83
96 1200 Compressor	1.00	0.00	40.50	12.66		53.16
97 Twin Drill or Track	1.00	38.30	15.30	11.50		65.10
98 Jackhammers	1.00	37.53	6.11	1.70		45.34
99 Powder Truck	1.00	41.20	11.51	3.65		56.35
100 Powder Magazine	1.00	0.00	0.00	0.00	10.00	10.00
101 Work Boat	1.00	0.00	0.00	0.00	25.00	25.00
102 Crusher w/450KW	1.00	42.58	366.34	107.50		516.42
103 Flatbed	1.00	41.20	17.21	9.21		67.62
104 1 T Flatbed	1.00	41.20	6.81	2.16		50.17
105 Winch Truck	1.00	41.20	20.41	6.25		67.86
106 Pblt Skid Truck	1.00	41.20	28.65	10.18		80.03
107 4x4 Buffing Rig	1.00	36.44	9.62	2.53		48.59
108 Welding Rig	1.00	44.58	13.29	2.54		60.41
109 Bending Machine	1.00	42.58	23.14	6.90		72.62
110 Bending Shoe Liner	1.00	0.00	0.00	0.00	15.60	15.60
111 Inside Mandrel	1.00	0.00	0.00	0.00	33.30	33.30
112 Internal Pneumatic Clamps	1.00	0.00	0.00	0.00	27.80	27.80
113 Roller Units	1.00	0.00	0.00	0.00	2.50	2.50
114 6-20 Boring Machine	1.00	40.66	31.85	13.00		85.51
115 26 Genl Lab	1.00	36.44	0.00	0.00		36.44
116 28 Chktndr,Road Crossing	1.00	37.53	0.00	0.00		37.53
117 29 Pipelayer	1.00	37.91	0.00	0.00		37.91
118 30 Drillr,Grd Ckr,PL Carp	1.00	38.30	0.00	0.00		38.30
119 31 Powdrman	1.00	38.74	0.00	0.00		38.74
120 32 Fitter Foreman & Pickup	1.00	49.01	7.15	1.90		58.06
121 33 Fitter Journeyman	1.00	44.58	0.00	0.00		44.58
122 34 Welder Helper	1.00	38.69	0.00	0.00		38.69
123 14 Motor Grader	1.00	42.58	30.47	20.86		93.91
124 Hydroaxe	1.00	42.58	68.46	40.58		151.62
125 Brush Hog	1.00	42.58	19.34	11.44		73.36
126 Chainsaw & Op	1.00	37.53	2.28	1.75		41.55
127 I17 Rig Oiler	1.00	32.67	0.00	0.00		32.67
128 Heater Van	1.00	32.67	12.25	5.25		50.17

Clear Span Engineering, Inc.
3200 WILCREST, SUITE 400 • HOUSTON, TEXAS 77042
TEL: 713/789-7808

August 26, 1988

Mr. R. W. Flood
Manager Pipelines
Stone & Webster Engineering Corporation
P. O. Box 2325
Boston, MA 02107

Ref: Alaska Power Authority Pipeline Study

Dear Mr. Flood:

In response to your letter of August 10, 1988, we have prepared preliminary cost estimates for two proposed river crossings on the subject pipeline project as follows:

Location	Span	Estimated Cost
Hurricane Gulch	400 ft.	$200,000
Little Coal Creek	300 ft.	$160,000

These estimates include all engineering, materials (except the 12 in. pipe), labor, and equipment costs required for construction and erection of the pipeline bridges. The cost of supplying the pipe, however, is not included.

We are also enclosing copies of a preliminary layout which was prepared for a similar project in Ecuador for use in your report. You may prefer to have these reduced for inclusion in the report, or if you need a reproducible, let us know.

I hope the enclosed information will be useful in your study. We look forward to the opportunity of working with you if the project should progress to the engineering phase.

Respectfully,

Michael B. Rasbury

Michael B. Rasbury, P.E.
President

MBR/heh
Enclosures

TELEPHONE
(713) 787-2680

C. ITOH PIPE & TUBE, INC.
5847 SAN FELIPE, SUITE 1120
HOUSTON, TEXAS 77057-3009

CABLE ADDRESS
CITOH HOUSTON
TELEX 775448
FAX (713) 787-2688

September 22, 1988

Arget Singer & Kulawik Inc.
203 West 15th Ave., Suite 202
Anchorage, Alaska 99501

Attn: Mr. Gene Kulawik

Ref : Wasilla-Fairbanks 300 Miles Gas Pipeline Project

Dear Gene:

We are pleased to inform you our current price indication as follows:

COMMODITY: ERW Steel Linepipe
API 5L Gr. X60
Black Plain End Bevelled, DRL (40 Ft.) or TRL (60 Ft)

Size	Quantity		DRL	TRL
16"x.281"	301,600'	7,122 ST	@$16.36($693)	@$16.54 ($701)
16"x.344"	1,176,200	33,856	19.95(693)	20.16 (701)
16"x.406"	130,900	4,431	23.45(693)	23.70 (701)

Total: 45,409 ST

PRICE: FOB Loaded onto Trucks, Duty/Wharfage Paid, Anchorage per Foot(Per S/T) as shown above.

PAYMENT: Net 30 days after our invoice.

DELIVERY (EX-JAPAN): 3 - 6 months after the order.

MILL: Kawasaki Steel Corp.

REMARKS: 1. The above price is for bare pipe. Coating cost for FBE coating will be $9.57 per foot for all 3 items.

2. Following minimum quantity will be required per each shipment:

In case of DRL (40 FT): Approx. 11,000 S/T
In case of TRL (60 FT): Approx. 8,800 S/T.

Thanking you for your patronage, we remain.

Sincerely yours,

Terry Oikawa

NUERA RECLAMATION CO., INC.

Gene Kulawik
Argetsinger & Kulawik, Inc.
203 West 15th Avenue, #202
Anchorage, AK 99501

September 15, 1988

Dear Mr. Kulawik,

Further to our recent phone conversation, here follows some estimates for seeding costs related to your project. These estimates are based on large scale seeding operations involving a minimum of 250 acres for each general area. If the scope is decreased the price per acre will increase as you lose economy of scale.

These prices are also based on Davis-Bacon labor rates, and generally follow application techniques and materials used by the Alaska DOT for revegetation on highway and airport projects.

I have divided the project into three general areas. Area 1 runs from Wasilla through the Susitna River valley to approximately 20 miles north of Talkeetna. Area 2 extends through Broad Pass, Windy Pass, to Nenana. Area 3 covers the area with no road access across the Tanana Flats to Fairbanks.

I have also included a materials breakdown. Application rates and species are those generally used by Alaska DOT, if exotic native species such as Bering Hairgrass, Tundra Bluegrass, or Iceland Poppies are used the cost will be at least twice that shown. Additionally, it would take several years leadtime to develop commercial production of these species to meet the requirements of a project of this scope. Materials costs shown here are FOB Anchorage.

Area 1 Total estimated revegetation cost per Acre: $1,150.00

Materials	Rate	Cost/Ac
Wood Fiber Mulch	1200 lbs/Ac	$300.00
Fertilizer	400 lbs/Ac	$80.00
Seed Mix	75 lbs/Ac	$210.00
Arctared Fescue		
Nugget Bluegrass		
Annual Ryegrass		

Area 2	Total estimated revegetation cost per Acre:		$550.00
Materials		Rate	Cost/Ac
Fertilizer		400 lbs/Ac	$80.00
Seed Mix		90 lbs/Ac	$144.00
Bromegrass			
Annual Ryegrass			
Clover			

Area 3	Total estimated revegetation cost per Acre:		$450.00
Materials		Rate	Cost/Ac
Fertilizer		400 lbs/Ac	$80.00
Seed Mix		90 lbs/Ac	$144.00
Bromegrass			
Annual Ryegrass			
Clover			

If you have any questions, or desire greater detail please feel free to call us.

Very Truly Yours,

NUERA RECLAMATION CO., INC.

Gregory Skoglund
Operations Manager

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline — 12-Jan
Feasibility Cost Estimate — 04:58
OPERATING FACILITIES — Pks MP 144 to 231.3

ITEM Description	QUANT	UM	unit	Labor	Equip Op	Eq Rent Eq Own	SST	Perm Matl	unit	TOTAL C
OWNER & DESIGN COSTS										
a Owner Costs	2.00	PCT						48,029		$48,
b Engineering & Design	3.50	PCT						81,208		$81,
c Material Inspection (Pct of Matl)	0.50	PCT						4,510		$4,
d Field Inspection	23	WD		37,319	5,779	1,997	1,236	6,950		$53,
e X-ray	5	ST						1,500		$1,
f AFUDC	0.00	PCT						0		
TOTAL OWNR & DESIGN				$37,319	$5,779	$1,997	$1,236	$142,196		$188,
PRE-BID PROCUREMENT										
1 Launcher/Receiver Materials	3	EA						465,732	155,244	$465,
2 Knik Meter Station Equipment	1	LS						214,033	214,033	$214,
3 Fairbanks Meter Station Equipment	1	LS						222,256	222,256	$222,
SEPARATE CONTRACT COSTS										
7 SCADA System	1	LS						540,000	540,000	$540,
8 Corrosion Protection	1	LS						150,000	150,000	$150,
9 Cantwell Shop & Warehouse	1	LS						65,000	65,000	$65,
TOTAL PREBID & SEPRTE CONTR COSTS				$0	$0	$0	$0	$1,657,021		$1,657,
Contingency	5.00	PCT								$92,
SUB TOTAL				$37,319	$5,779	$1,997	$1,236	$1,799,217		$1,937,
PIPELINE CONTRACT										
Operating Facilities										
11 Launcher/Receivers	3	EA		102,591	14,607	5,967	900	50,886	58,317	$174,
12 Knik Meter Station	1	LS		72,000	10,292	3,136	450	21,000	106,878	$106,
13 Fairbanks Meter Station	1	LS		60,000	8,577	2,613	375	30,415	101,980	$101,
TOTAL PIPELINE DIRECT COSTS				234,591	33,476	11,716	1,725	102,301		383,
INDIRECTS - PIPELINE CONSTRUCTION										
Services				14,023	12,296	5,802	0	0.00		$32,
Supervision & Support				52,379	6,564	2,907	7,830	0.00		$69,
PL Supprt Facilities							4,756	0.00		$4,
Expendable Materials & Supplies	25.00	PCT					58,648			$58,
Profit & Fee	10.00	PCT						54,901		$54,
Contingency	5.00	PCT								$30,
TOTAL PIPELINE COSTS				300,993	52,336	20,425	72,959	157,202		$634,
TOTAL PROJECT COSTS>>>>>>>										$2,571,

RECAP:

Launcher/Receivers	3	EA	$833,
Knik Meter Station	1	LS	$426,
Fairbanks Meter Station	1	LS	$428,
SCADA System	1	LS	$631,
Corrosion Protection	1	LS	$175,
Cantwell Shop & Warehouse	1	LS	$76,
			$2,571,

Alaska Power Authority
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

OWNER'S OPERATING FACILITIES- Material Costs

	SPREAD:	1		2		3		4A		4B	
Description	Unit Price	Quant	$	Quant	$	Quant	$	Quant	$	Quant	$
Launcher/Rcvr	155244	1	$155,244	1	$155,244	1	$155,244	0	$0	0	$0
Meter	1	0	$0	0	$0	0	$0	1	$214,033	$1	$222,256
TOTAL			$155,244		$155,244		$155,244		$214,033		$222,256

Total L/R	3	$465,732
Total MS	2	$436,289
TOTAL ALL		$902,021

24-Oct-88

ITEM OP FAC Fabrication Launcher/Receivers — Plan Quantity — PC

CREW COST

Description	No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42 Pickup w/Foreman,Pip	1.00	49.01	5.50	1.90			56.41
43 561 Sideboom	1.00	42.58	24.88	15.94			83.40
44 Winch Truck	1.00	41.20	15.70	6.25			63.15
45 Welding Rig	5.00	222.92	51.10	12.70			286.72
46 175 Compressor	1.00	0.00	8.38	3.72			12.10
47 26 Genl Lab	6.00	218.63	0.00	0.00			218.63
48 JD 510 B'hoe	1.00	42.58	10.67	7.31			60.56
49 Sand Blst & Paint Eq	1.00	0.00	0.00	0.00	7.50		7.50
50 Pickup	1.00	0.00	5.50	1.90			7.40
51 34 Welder Helper	5.00	193.43	0.00	0.00			193.43
52 33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58

		No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
Total Crew/Hr.		21.00	854.92	121.73	49.72	7.50	0.00	1033.87
Sprd 1						0.00	$170	1033.87
COST	40.00 HRS	840.00	$34,197	$4,869	$1,989	$300	$16,962	$58,317
Unit	100.0 PC	8.40	341.97	48.69	19.89	3.00	169.62	$583
		MH/ PC						
Sprd 2							$170	
COST	40.00 HRS	840.00	$34,197	$4,869	$1,989	$300	$16,962	$58,317
Unit	100.0 PC	8.40	341.97	48.69	19.89	3.00	169.62	$583
		MH/ PC						
Sprd 3							$170	
COST	40.00 HRS	840.00	$34,197	$4,869	$1,989	$300	$16,962	$58,317
Unit	100.0 PC	8.40	341.97	48.69	19.89	3.00	169.62	$583
		MH/ PC						

24-Oct-88

ITEM OP FAC Fabrication Meter Stations — Plan Quantity PC

CREW COST

	Description	No.	Labor	Equip Op	Eq Rent Eq Own	SST	Matl	TOTAL
42	Pickup w/Foreman,Pip	1.00	49.01	7.15	1.90			58.06
43	561 Sideboom	1.00	42.58	32.34	15.94			90.86
44	Winch Truck	1.00	41.20	20.41	6.25			67.86
45	Welding Rig	6.00	267.50	79.72	15.24			362.46
46	175 Compressor	1.00	0.00	10.89	3.72			14.61
47	26 Genl Lab	10.00	364.38	0.00	0.00			364.38
48	JD 510 B'hoe	1.00	42.58	13.87	7.31			63.76
49	Sand Blst & Paint Eq	1.00	0.00	0.00	0.00	7.50		7.50
50	Pickup	1.00	0.00	7.15	1.90			9.05
51	34 Welder Helper	9.00	348.18	0.00	0.00			348.18
52	33 Fitter Journeyman	1.00	44.58	0.00	0.00			44.58

	Total Crew/Hr.	30.00	1200.00	171.54	52.26	7.50	0.00	1431.30
Sprd 4A							$210	1431.30
COST	60.00 HRS	1800.00	$72,000	$10,292	$3,136	$450	$21,000	$106,878
Unit	100.0 PC	18.00 MH/ PC	720.00	102.92	31.36	4.50	210.00	$1,069
Sprd 4B							$304	
COST	50.00 HRS	1500.00	$60,000	$8,577	$2,613	$375	$30,415	$101,980
Unit	100.0 PC	15.00 MH/ PC	600.00	85.77	26.13	3.75	304.15	$1,020

APPENDIX D

Letter Comments to Draft Report and Responses

- State of Alaska, Department of Fish and Game
- State of Alaska, Department of Environmental Conservation
- Chugach Electric Association, Inc.
- ENSTAR Natural Gas Company
- Fairbanks North Star Borough
- Usibelli Coal Mine, Inc.

MEMORANDUM

State of Alaska

DEPARTMENT OF FISH AND GAME

TO: Richard Emerman
Senior Economist
Alaska Power Authority

DATE: November 28, 1988

FILE NO.: YPG General

TELEPHONE NO.: 465-4105

SUBJECT: Natural Gas Pipeline

FROM: Frank Rue
Director
Habitat Division
Department of Fish and Game

A-1

The Alaska Department of Fish and Game (ADF&G) appreciates the opportunity to review the draft report entitled "Estimated Costs and Environmental Impacts of a Natural Gas Pipeline System Linking Fairbanks with Cook Inlet Area" prepared by Stone & Webster Engineering Corporation for the Alaska Power Authority (APA). Our review shows that, for purposes of cost estimation, the draft generally provides an adequate summary of fish and wildlife resources likely to be affected by construction and operation of a Knik-Fairbanks gas pipeline and of basic mitigation procedures for project impacts. For your information, we are providing the attached ADF&G report prepared in response to a 1981 gas liquids pipeline feasibility study. We encourage inclusion of those concerns stated in the ADF&G report, and not already addressed by Stone & Webster, during preparation of the APA's final document. We also are providing the following general and specific comments for your consideration.

GENERAL COMMENTS

A-2

Fish Surveys

The list of specified anadromous fish streams to be affected is generally accurate. The report also identifies the need for further stream surveys or studies "north of Julius." It should be noted that other streams outside of the segment of the proposed pipeline route that are not currently known to support anadromous fish may require surveys prior to issuance of ADF&G approvals. As recently as this past year, ADF&G staff have noted resident and anadromous fish use of wetlands habitat adjacent to small Susitna River tributary streams in the Willow area (Little Willow, Rogers and 196 Mile Creeks are examples). Survey costs are modest but should be considered in the cost estimates.

A-3

Fish Habitat Permits

The draft report identified the need to obtain Fish Habitat Permits from this department for work in resident or anadromous fish streams pursuant to AS 16.05.870. The report should also refer to AS 16.05.840, which specifically addresses fish passage for resident and anadromous species. Construction activities that disrupt streambeds (e.g., excavation) or involve placement of structures or fill in resident fish streams require permits pursuant to AS 16.05.840.

Erosion Control and Slope Stability

A-4 The report fails to adequately address the need to stabilize steep slopes. The ADF&G has observed significant erosion along the ENSTAR Pipeline route where the pipeline traversed steep slopes. These sites incorporated ditch plugs to preclude subsurface downslope flow and erosion; however, inadequate surface revegetation and inadequate surface water-control structures (e.g., water bars) allowed severe erosion to occur. The ADF&G is concerned about this issue especially as it pertains to steep slopes adjacent to rivers, lakes and streams.

A-5 The ADF&G is concerned about operating an ambient temperature pipeline in frozen soils, which poses the potential for subsidence and erosion of the ditch area, potentially affecting fish resources. Our understanding is that overall surface disturbance of the adjacent right-of-way may be a larger factor than heat flow from the gas pipeline in determining whether permafrost will be thawed. We request assurance that thermal effects have been adequately examined to ensure technical feasibility of an ambient temperature line, specifically including the probability that dry permafrost or otherwise thaw-stable conditions can be followed north of the Alaska Range, the effects of construction disturbance on permafrost in summer construction areas, and the efficacy of using overexcavation and select backfill for achieving soil stability. This assurance should be based on low operational maintenance requirements, especially across the Tanana Flats, and a high degree of protection for waterbodies.

A-6 Quality Assurance/Quality Control: It appears that inspection costs have been included in the cost estimates; however, QA/QC is not adequately discussed in the text. We believe that QA/QC is crucial to project mitigation. The best plans attainable are useless without onsite inspection of contractor compliance. Agency personnel can not fill this role but should work closely with QA/QC personnel and project management to ensure compliance with permits, plans, and specifications. We believe that some discussion of the inspection function as a tool for permit compliance should appear in the report.

Timing of Stream Crossings

A-7 A variety of stream crossing methologies were identified in the report, all of which have been used on other projects or recommended by the ADF&G in the past. The ADF&G will require crossings of important salmon spawning and rearing areas to occur during the May through July window and allow construction during other periods only if construction methods are used that will eliminate impacts to the fish resources present or to their habitat. Fluming, diversions and other construction means can be costly; therefore, cost estimates should reflect this expense.

A-8 Resident fish streams crossed in the openwater period will have different "construction windows" than salmon streams, depending on the fish species occurring in specific drainages. In the case of spring spawners such as grayling, July and August is the preferable stream-crossing period. Fall crossings may also be considered for some resident fish systems.

A-9 Right-of-Way Clearing

The report does not adequately describe disposal methods for vegetative debris resulting from right-of-way clearing. The ADF&G observed significant debris piles and long berms following construction of an ENSTAR pipeline. Timber that cannot be salvaged should be chipped or burned rather than pushed into windrows or stockpiles. Spruce should definitely be burned or chipped to preclude infestation by spruce beetle.

Enclosures

cc: Al Ott, Habitat, Fairbanks
Lance Trasky, Habitat, Anchorage

SPECIFIC COMMENTS

Section 2.0

A-10 Page 2-2: Operations and maintenance activities will interact with fish and wildlife resources, in addition to the construction interaction.

Section 3.0

A-11 Page 3-5: Table 3.5 has reversed column headings.

Section 4.0

A-12 Pages 4-2 and 4-3: Is a soil temperature of 60°F at a depth of more than 3 feet appropriate for Alaska conditions, particularly north of the Alaska Range? Might not thermal transfer to the surrounding soil be considerably different in permafrost?

Section 5.0

A-13 Page 5-3: Although the terrain is generally of low relief between Knik and the Susitna River, erosion-control structures could be required to stabilize locally steep slopes.

A-14 Pages 5-5: Storage of large diameter pipe adjacent to an open pipeline ditch can impede wildlife movement, but probably isn't a problem for a 16-inch line.

A-15 See our general comment on right-of-way clearing.

A-16 Page 5-7: We recommend that further analysis be devoted to the feasibility of a buried crossing of the Nenana River in the gorge at Moody. Rapids, bedrock, and steep slopes might make this crossing difficult.

A-17 Pages 5-10 through 5-12: See our general comment on fish habitat permits. In addition, the reader should be aware that, for activities affecting anadromous streams (e.g., flow, pollution, etc.), fish habitat permits may be required even if the activity occurs on tributary streams or upstream of the designated anadromous reach.

A-18 Page 5-16: Most stream crossings should occur downstream of bridges. Flooding causes significant deposition and maintenance removal of gravels beneath Parks Highway and Alaska Railroad bridges.

Section 6.0

A-19 Page 6-9: See our general comment on erosion and slope stability. Pipeline integrity related to thawing of permafrost is only one design constraint. Environmental effects of thermal disturbances must also be considered and discussed. We request further elaboration of geotechnical considerations in relation to an ambient temperature line and surface disturbance in permafrost soils. Special design for permafrost to meet environmental constraints may influence cost estimates.

Section 7.0

A-20 Page 7-6: Select backfill for permafrost areas has not been mentioned. Some riprap and select material production can be expected for stream crossings and rehabilitation as well.

A-21 Page 7-7: Crossings of resident fish streams will also require schedule coordination and measures to ensure fish passage. Short blockages may be permitted depending upon the timing of the crossings.

Section 9.0

A-22 Page 9-1: Although a 3-foot burial depth is assumed for most of the pipeline, significantly greater depths may be required for scour protection at river crossings.

A-23 See our general comment on slash disposal. Chipping or burning is appropriate for roadless areas where timber salvage is not possible.

A-24 Page 9-2: Blowdown may occur following clearing through forested areas.

A-25 Page 9-3: Muskeg bogs and other wetlands occur in Spread 2 and Spread 3, but winter construction is not reflected in the schedules for these spreads. What construction techniques will be used for wetlands to prevent unnecessary surface disturbance if winter construction isn't used in these spreads?

A-26 In general, surface protection measures haven't been adequately described in terms of erosion control and revegetation (native species or otherwise).

A-27 Why is maintenance clearing for access necessary for portions of the right-of-way adjacent to the Parks Highway?

A-28 Ditch crowns with breaks for accommodating surface drainage may be preferable to level or depressed backfill in areas where thaw subsidence or longitudinal surface flow might occur.

A-29 Page 9-4: Construction projects frequently attract, rather than repel or displace, bears because of food attractants. Animal feeding by workers, as well as poor garbage collection and disposal at camps and along the right-of-way, can cause bear problems. The general topic of human-carnivore interaction should be addressed.

A-30 Pages 9-4 and 9-5: Construction activity, temporary or permanent facilities, and aircraft traffic potentially disturb nesting raptors. Construction-timing restrictions may be imposed for protection of raptors. Note that cliff-nesting raptors as well as tree nesters require consideration.

A-31 Page 9-5: The availability of spawning and rearing habitat and winter flow may limit salmon distribution and abundance as much as "remoteness from the ocean."

A-32 See general comment on fish habitat permits pursuant to AS 16.05.840.

A-33 Page 9-8: In Table 9.3.1, the unnamed stream between the Tanana River and Salchaket Slough is considered part of the Tanana River system and will be permitted pursuant to AS 16.05.870.

A-34 Page 9-9: We believe burial of the pipe in the Nenana River gorge may not be feasible.

A-35 It should be noted that May 15-July 15 is only the preferred construction window for anadromous streams and that other periods (July-August) may be appropriate for resident fish streams crossed during the open-water season.

A-36 ADEC variances from the Alaska Water Quality Standards may impose mitigation-requirements in addition to ADF&G permit stipulations for fish habitat protection.

A-37 Appendix "M" should be A.

A-38 Page 9-18: Only three spreads are mentioned in this discussion but four are discussed elsewhere.

A-39 The statement that "no significant impact to fisheries or other resources [will occur]" is entirely dependent upon definition of terms. It is certain that minor to moderate impacts to fish habitat will result from the large number of stream crossings necessary for the pipeline project. We agree that every effort should be taken to prevent and minimize habitat losses.

A-40 Page 11-1: Note that ADEC Section 401 certifications are required for NPDES permits, and, if in the coastal zone, coastal consistency determinations as well.

RESPONSES TO THE STATE OF ALASKA DEPARTMENT OF FISH AND GAME LETTER DATED NOVEMBER 28, 1988

A-1 ADF&G concerns applicable to the level of detail and objectives of this study have been incorporated into the final document. Many comments and concerns expressed by ADF&G would be addressed during the detailed design phase of this project should it proceed.

A-2 Your comments have been incorporated into the text.

A-3 Your comments have been incorporated into the text.

A-4 Your comments have been incorporated into the text.

A-5 Our investigations of the proposed pipeline route suggested that only scattered, discontinuous permafrost may be encountered. In areas of permafrost, select backfill will be used to stabilize the pipeline and prevent subsidence.

The inlet temperature of the gas at the take off point on the Beluga pipeline is estimated to be approximately 35°F during summer operation and below 30°F during the winter. Gas temperatures will quickly adjust to ambient soil temperatures and no degradation of existing permafrost pockets is expected.

Detail flow and heat balance calculations will be carried out during the final design stage after sub-soil surveys have been completed. The results of these evaluations will be key elements in the selection or rejection of the Tanana Flats route alternate option.

A-6 Your comments have been incorporated into the text.

A-7 The projected costs will allow the pipeline to be constructed in strict conformance with specifications for environmental protection. It is anticipated that construction methods will be used which will permit crossings of anadromous fish streams also during periods other than the preferred May through July window.

A-8 Your comments have been incorporated into the text.

A-9 Methods used for disposal of cleared vegetative debris will depend upon the location and species involved. Spruce bark beetles are not known to be a significant problem along the pipeline route, nor are they anticipated to be a problem. Specific disposal requirements will be worked out with the land owner involved with each parcel crossed by the right-of-way.

A-10 Your comments have been incorporated into the text.

A-11 Your comments have been incorporated into the text.

RESPONSES TO THE STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
LETTER DATED NOVEMBER 28, 1988

A-12 The 60°F figure was used to calculate very conservative values of gas flow volumes. The temperature does not represent actual or expected soil temperatures. Revised flow calculations utilize a 40°F soil temperature consideration. Also, see response No. 6.

A-13 Your comment is noted.

A-14 Your comment is noted.

A-15 Refer to response A-9.

A-16 Our preliminary analysis suggests that a buried crossing would be feasible. A final decision would be made during the detailed design phase.

A-17 Your comment is noted.

A-18 Nearly all crossings have been sited downstream of bridges.

A-19 Refer to response A-12.

A-20 Your comments have been incorporated into the text.

A-21 Your comments have been incorporated into the text.

A-22 Your comment is noted.

A-23 Refer to response A-9.

A-24 Your comment is noted.

A-25 There are few muskeg bogs which occur in Spreads 2 and 3, and those that do occur are small. For localized bogs or wetlands, special equipment or materials such as support pads will be used to minimize surface disturbance.

A-26 Specific surface protection measures would be developed during the detailed design phase.

A-27 Maintenance clearing along certain segments of the right-of-way which is adjacent to the Parks Highway may be advisable to minimize attraction of moose to the highway corridor where collisions with vehicles can occur.

A-28 Though ditch crowns may be preferable in certain areas, CORPS permitting requirements require impounding of surface flow to be minimized.

RESPONSES TO THE STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
LETTER DATED NOVEMBER 28, 1988

A-29 Your comments have been incorporated.

A-30 Your comment is noted.

A-31 Your comments have been incorporated into the text.

A-32 Your comments have been incorporated into the text.

A-33 Your comments have been incorporated into the text.

A-34 Refer to response A-16.

A-35 Your comments have been incorporated into the text.

A-36 Your comment is noted.

A-37 Your comments have been incorporated into the text.

A-38 Your comments have been incorporated into the text.

A-39 We concur with your assessment that minor impacts to fish habitat will occur. We believe that application of appropriate construction procedures and timing of construction can collectively minimize impacts on the fishery resources.

A-40 Your comments have been incorporated into the text.

Division of Environmental Quality

MEMORANDUM

State of Alaska

TO: Richard Emerman
Alaska Power Authority

DATE: 11-23-88

FILE NO:

TELEPHONE NO:

FROM: Dan Wilkerson
Resource Planner

SUBJECT: EIS Fairbanks - Cook Inlet Gas Pipeline

B-1 The department has completed a review of the draft report evaluating the costs and impacts associated with a natural gas transmission line between Fairbanks and Cook Inlet. Concerning environmental impacts as addressed in Sec. 9, the numerous stream crossings and land clearing activities would be the major impacts requiring environmentally sensitive construction management practices. In addition, attention will need to be given to controlling impacts of construction in permafrost areas. These impacts would be addressed via permit and right-of-way stipulations, eg. erosion/sedimentation, open burning of vegetation.

B-2 The only comment concerning Sec. 11, Permit Requirements is a point of clarification concerning the temporary water quality variance. The statement on p. 11-7 should read "An ADEC (temporary) water quality variance would be required, during the construction period, at river and stream crossings where downstream water quality impacts which exceed the state allowable limits cannot be entirely avoided."

The department has no further comments at this time and reserves further comment until a project application is initiated. Thank you for the opportunity to comment.

DW/dw

cc: Larry Dietrick
Dan Easton

RESPONSES TO THE STATE OF ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION LETTER DATED NOVEMBER 28, 1988

B-1 Your comment is noted.

B-2 Your comments have been incorporated into the text.

Chugach ELECTRIC ASSOCIATION, INC.

5601 MINNESOTA DRIVE • P.O. BOX 196300 • ANCHORAGE, ALASKA 99519-6300 • PHONE 907-563-7494
FACSIMILE:
907-562-0027

December 2, 1988

Alaska Power Authority
P.O. Box 190869
Anchorage, AK 99519-0869

Attention: Mr. Richard Emerman

Subject: Alaska Intertie Feasibility Study
Estimated Costs and Environmental Impacts of
Cook Inlet - Fairbanks Natural Gas Pipeline

Dear Dick:

Chugach Electric Association has reviewed and offers the following comments on the report detailing the cost estimates and environmental impacts of a natural gas pipeline from Cook Inlet to Fairbanks.

1. C-1 We observe that there is no reference to the proposed pipeline from the North Slope south (TAGS). The Yukon Pacific Corporation is currently investigating such a pipeline and has steadily brought the project closer to reality. While we recognize that numerous hurdles remain to be overcome, the Power Authority should recognize that TAGS is a possibility and would either eliminate the need for a pipeline north to Fairbanks or impact the sizing requirements due potential flows south to Anchorage.

2. C-2 The pipeline is apparently based on estimates of peak <u>daily</u> requirements. If hourly requirements should fluctuate significantly about the daily average, then the flow requirements may not be met with the system as designed.

3. C-3 The report acknowledges that the penetration factors for gas appliances are preliminary, and although the factors are not represented as applying to Chugach's service area, they nevertheless should not set a precedent for the Decision Focus system study or the ISER consumer sector analysis to be performed in the future. Also, we would expect that the penetration factors may be phased in over time instead of the constant levels assumed in the report.

4. The proposed pipeline crosses a minimum of 144 streams and rivers, crosses three land resource areas each with its own topographic, soil, and permafrost conditions, and traverses nearly 100 miles of private lands. In spite of this, the contractor has included only a 5 percent contingency factor in the cost estimate. The report does mention in a general fashion that "conservative" estimating and production factors have been used. Without knowing the details of this "conservative" estimating, we would caution the Power Authority in using such a low contingency factor.

C-4

5. Potential annual lease and other fees for crossing private as well as public lands should be in included in the annual operating costs.

C-5

Thank you for the opportunity to review and comment on this report. If you have any questions, please do not hesitate to call me at 564-0742.

Sincerely,

Thomas A. Lovas

TAL/MDH/ts
871.TAL

RESPONSES TO THE CHUGACH ELECTRICAL ASSOCIATION, INC.
LETTER DATED DECEMBER 2, 1988

C-1 An evaluation of the potential for North Slope gas to be delivered to Fairbanks and its impact on a pipeline from Cook Inlet is outside the scope of this study.

C-2 Should there be any significant differences between equivalent volumes calculated on peak hourly or peak daily basis then such differentials would be made up by "line pack" held in the pipeline or by implementation of "interruptible gas supply" sales contracts.

C-3 The penetration factors used in the revised forecast are based on Stone & Webster's experience in similar climates in the Yukon and Northwest Territories and are modified by ENSTAR's experience in Anchorage. We believe that these factors are appropriate at the present time.

C-4 The proposed pipeline does not follow a cross country route with many areas of unknown soil conditions and uncertain logistical support. For most of its length the pipeline is adjacent to a major highway with a good data base of soil and water crossing information fully documented. Further, logistical uncertainties are limited by the availability of close road and rail resources.

The availability of actual costs incurred on the recently installed 20 inch Beluga pipeline together with the use of conservative production rates, mainly summer construction, and multiple contractor spreads results in a detailed estimate requiring only a moderate contingency factor.

C-5 The costs for acquiring right-of-way and easements to construct are included in the pre-bid portion of the Mainline Capital Cost Estimate (Section 7.0). Annual costs for leasing are included in the operations and maintenance unit costs discussed in Section 8.0.

ENSTAR

ENSTAR Natural Gas Company
A DIVISION OF SEAGULL ENERGY CORPORATION
3000 Spenard Road
P.O. Box 190288
Anchorage, Alaska 99519-0288
(907) 277-5551

December 7, 1988

Alaska Power Authority
P. O. Box 190869
Anchorage, Alaska 99519-0869

Attention: Richard Emerman

Re: Comments on Draft Report - Cook Inlet to Fairbanks Natural Gas Pipeline: Estimated Cost and Environmental Impacts

Gentlemen:

Thank you for the opportunity to comment on the draft report. Although time constraints did not permit a thorough review of the report in detail, we have reviewed the gross conclusions as well as the assumptions which provide the foundation for those conclusions. The following are our comments:

Basic Assumptions (Load Forecasting)

E-1 The power plant load is held constant throughout the 30 year life of the project. No reasons are given in the report for this assumption. The energy use figure listed for the power plants appears to be a direct conversion of actual energy use during 1985 at each power plant adjusted for normal degree days. None of the power plants operated at full capacity during 1985. If all units at each power plant were converted to gas, significant increases in gas usage for power generation would surely occur over the 30 year evaluation period. In any case, if no load growth due to increased electric demand is forecast, an explanation of the reasoning behind that assumption would be helpful.

E-2 It can be inferred (although it is not directly stated) that average residential usage in Fairbanks is forecast at 176 MCF/year. Our historical residential usage in Anchorage is 200 MCF/year. Fairbanks homes are in general somewhat smaller and better insulated than homes in Anchorage, but there are 40% more heating degree days in Fairbanks as compared to Anchorage. Taking these figures into account, we would forecast average residential usage in Fairbanks at 240-270 MCF/year.

The market penetration figures quoted in the report are significantly lower than we have experienced in our service area. Given the even higher cost differential between competing fuels in

E-3 Fairbanks, we would expect higher market penetration. The report cites studies done by Stone and Webster for 2 Canadian cities without stating which cities, what fuel cost differentials were involved, and what actual experience (if any) yielded in the way of results. We have experienced conversion rates of 98+% for propane, 95+% for fuel oil, and 90+% for electrical. Virtually 100% of commercial buildings convert due to very rapid payback.

E-4 The .8% per year annual conservation rate does not appear to be reasonable. No explanation is given for the derivation of this figure. If the factor is justified, it likely would not continue to compound over long periods of time.

E-5 Housing unit counts and population assumptions appear to be taken directly from ISER projections of the entire North Star Borough. It is not practical to assume that a gas utility could provide service to the entire borough. The lack of density outside of the Fairbanks/North Pole/Beaver Loop/Farmers Loop area would preclude service on a reasonable basis.

E-6 Our own residential/commercial load estimate following a three year construction period was 4.7 BCF/year. Stone and Webster reports approximately the same residential and commercial load in the year 2000. Stone and Webster then forecasts a total increase in load of less than 1 BCF over the next 20 years. This amounts to less than 1% per year. This would not appear to be reasonable, especially in view of the conclusion that initial construction of the distribution system for $35 million would service this load. With ultimate construction costing $63.7 million, the inference is that you would spend 82% more for an increase in load of only 17%.

Although we have not attempted to forecast future residential and commercial loads beyond construction of the initial system, we would expect a higher load growth rate than indicated in the report.

<u>Transmission Pipeline</u>

We generally agree with the estimated cost for the 16" pipeline construction. The non-construction portion of the cost estimate appears high. Our estimate for the construction of a 16" pipeline as described would be $175-$180 million.

E-7 We agree that initial service to Fairbanks as well as a significant amount of future load growth could be accommodated through a 16" pipeline. We would, however, propose that a 20" pipeline be constructed for three reasons as follows:

1) The marginal increase in construction cost would not be significant when compared to the increase in capacity gained.

E-7 2) Operating costs would be decreased as compression would not be required until a much higher throughput threshold was reached.

3) If gas were to become available in Fairbanks from the North Slope, flow could be reversed to serve firm customers in Anchorage, and sustain the industrial complex on the Kenai.

We feel that, at the very least, a discussion on these considerations should be presented.

E-8 A statement is made in the executive summary that "specialized construction techniques must be employed at water crossings including fluming, channel diversion," etc. Although our Beluga pipeline permits called for this type of construction, following a demonstration of how quickly a stream crossing using standard construction techniques could be accomplished and the reduced impact of this type of construction, we were allowed to complete the project using standard stream crossing techniques.

E-9 Operating and maintenance costs for the pipeline are higher than we would expect. The report uses extrapolations of selected gas company statistics, without identifying the gas companies included in the calculation. We would presume that transmission system operation and maintenance would be contracted to a utility connected to the system, much the same as the arrangement for operation and maintenance of the existing electrical intertie. In this situation the costs would be incremental to the utility. In any instance, we feel the costs are at least 100% too high, based on our estimate of the costs and based on comparison to our own experience in the Cook Inlet area.

<u>Distribution System</u>

E-10 As previously discussed under the heading of "Load Forecast," we feel that the estimate is based on inaccurate information with regard to population, and we disagree with the projection of costs beyond the infrastructure to serve a reasonable service area.

The $35 million figure quoted for initial system cost would be accurate for all construction to service Fairbanks, North Pole, Farmers Loop, and Beaver Loop.

Other than the statement that $35 million would be spent initially, we substantially disagree with the estimate. The fallacy we see in the estimate is the apparent application of unit costs to faulty estimates of plant requirements based on population figures for the entire North Star Borough, rather than the population of a reasonable service area. For example our Fairbanks system design calls for 131 miles of plastic main. Stone and Webster estimates that 503 miles of main will be required. It would not be feasible or reasonable to attempt to serve the entire North Star Borough.

E-10

E-11

Again, as with the transmission system, statistics from unidentified gas companies are used to derive operating and maintenance costs for the distribution system. When these unit costs are applied to erroneous customer counts and system mileage numbers, the result is an inaccurate estimate.

We appreciate the opportunity to comment on the draft report. We would be glad to discuss our estimates with Stone and Webster and/or the APA Staff at any time.

Sincerely yours,

Ronald K. Page
Vice President, Operations

RKP/gb

RESPONSES TO THE ENSTAR NATURAL GAS COMPANY
LETTER DATED DECEMBER 7, 1988

E-1 The comment concerning constant power plant load growth is answered with the inclusion of the previously omitted sentence... "Any additional growth in electricity demand could be met from cogeneration or power plants located outside of the Fairbanks area."

E-2 Average residential gas use forecast for Fairbanks has been modified to 236 Mcf/year, based on telephone discussions with ENSTAR personnel.

E-3 Residential and commercial penetration rates have been modified to more closely reflect ENSTAR's reported experience in the Anchorage area.

E-4 The 0.8% per year conservation factor represented historical behavior for 1981-1987 as estimated by Stone & Webster. In our revised forecast, this conservation adjustment has been eliminated due to apparent experience in Anchorage and taking into consideration recently declining energy prices.

E-5 Residential unit counts have been revised to more closely match ENSTAR's estimates which were based on aerial photographs and drive-through samples.

E-6 Stone & Webster's revised forecast shows combined residential and commercial gas consumption growing at an average annual rate of 1.3 percent over the forecast period. The revised estimate for the year 2020 is 5.6 Bcf/year.

E-7 Section 1 of the report has been modified to include comment on the use of a 20 inch pipeline as opposed to 16 inch line used in the study case. The estimated cost of a 20 inch line is $235.4 million, which is approximately $45 million greater than the cost of a 16 inch line. A summary of our 20 inch line capital estimate is included at the end of this response.

E-8 Our discussions with ADF&G personnel familiar with the Beluga line revealed that substantive problems occurred during and following its construction. Though standard construction techniques may be successfully demonstrated as acceptable alternatives to the proposed methods, the current level of concern expressed by ADF&G regarding stream siltation makes us hesitant to assume that standard construction techniques would be acceptable and appropriate to this study.

E-9 The operation and maintenance costs estimated for the pipeline have been modified to better compare with ENSTAR's experience in the Cook Inlet area.

RESPONSES TO THE ENSTAR NATURAL GAS COMPANY
LETTER DATED DECEMBER 7, 1988

E-10 Cost of the distribution system has been revised to reflect changes in the residential and commercial loads that can be economically serviced at the time the pipeline is completed. The customer unit counts are now based on a street survey of Fairbanks performed by ENSTAR in 1986.

E-11 Operation and maintenance costs for the distribution system have been modified to reflect the revised customer count and system infrastructure noted above.

Alaska Power Authority | 11:48 AM 13-Jan-89

Wasilla to Fairbanks Gas Pipeline | 4 SPREADS

Feasibility Cost Estimate | TOTAL PIPELINE 298.7 MI

			16 " Line			20" Alt Line	
ITEM	Description	QUANT	UM	unit	TOTAL COST	unit	TOTAL COST
OWNER & DESIGN COSTS							
a	Owner Costs	1.00	PCT		$3,492,691		$4,191,230
b	Engineering & Design	3.00	PCT		$5,905,517		$7,086,620
c	Material Inspection (Pct of Matl)	0.50	PCT		$203,191		$243,830
d	Field Inspection	316	WD	8,681	$2,739,658		$3,287,590
e	X-ray	1,577,136	LF	0.60	$946,282	0.90	$1,419,422
f	AFUDC	0.00	PCT		$0		$0
	TOTAL OWNR & DESIGN				$13,287,339	10.29	$16,228,692
PRE-BID PROCUREMENT							
1	Mainline 16" Pipe	1,577,136	LF	22.27	$35,122,819	33.41	$52,684,228
2	Mainline Pipe Coating	1,577,136	LF	2.55	$4,021,697	3.19	$5,027,121
3	Mainline Pipe Frt	44,520	TN	28.00	$1,246,560	42.00	$1,869,840
4	Mainline Valves	21	EA	27,716	$582,036	41,574	$873,054
5	Pipeyard Leases	35	AC	1,200	$42,000	1,200	$42,000
6	Other Appurt	100	PC		$869,740		$1,304,611
22	Produce Weights	10,056	EA	290	$2,916,277	363	$3,645,347
OTHER PRE-BID COSTS							
7	Temp ROW Leases	352	AC	319	$112,151	319	$112,151
8	Perm ROW Costs	704	AC	1,593	$1,121,511	1,593	$1,121,511
9	Permitting Costs	100	PC		$298,700		$298,700
SEPARATE CONTRACT COSTS							
10	Furn & Erect Aerial Crossings	2	EA		$360,000	270,000	$540,000
	TOTAL PREBID				$46,693,491	42.81	$67,518,563
	Contingency			$1.90	$2,999,042	2.66	$4,187,363
	SUB TOTAL	1,577,136	LF	39.93	$62,979,872	55.76	$87,934,617

Alaska Power Authority 12:20 PM 13-Jan-89
Wasilla to Fairbanks Gas Pipeline
Feasibility Cost Estimate

ITEM Description	4 SPREADS TOTAL PIPELINE 298.7 MI QUANT	UM	16 " Line unit	TOTAL COST	20" Alt Line unit	TOTAL COST
PIPELINE CONTRACT						
Logistics & Support						
11 Camp & Yard Lease	23	MO	522	$12,000		$14,040
12 Camp & Yard Sitework	68,500	CY	5.65	$387,167	5.65	$387,167
13 Camp & Shop Set-Up & Removal	100	PC		$621,005		$621,005
14 Camp Operations	159,654	MD	38.52	$6,149,652		$7,195,093
15 Pipeyard Sitework	72,000	CY	4.33	$312,083		$365,137
16 Unload & Store Pipe	299	MI	2,723	$813,352	3,186	$951,622
Civil Construction						
17 Snow Road Construction	55	MI	32,682	$1,810,601	32,682	$1,810,601
18 Snow Road Maintenance	55	MI	14,994	$830,688	17,543	$971,905
19 Work Pad Construction	180,820	CY	5.36	$968,614	5.36	$968,614
20 Work Pad Remove	730,360	LF	0.60	$438,499	0.60	$438,499
21 Produce Select Backfill	61,297	CY	7.01	$429,589		$502,619
23 Reclamation & Revegetation	1,989	AC	1,290	$2,566,185	1,509	$3,002,437
TOTAL CIVIL & SUPPORT				$15,339,436		$17,228,739
Mobilization						
24 Mobilization-Civil	100	PC		$349,100		$349,100
25 Demobilization-Civil	100	PC		$349,100		$349,100
26 Mobilization-Pipeline	100	PC		$3,986,309		$4,663,982
27 Demobilization-Pipeline	100	PC		$3,186,093		$3,727,729
TOTAL MOB-DEMOB				$7,870,602		$9,089,910
Pipeline Construction						
28 Clearing	299	MI	10,767	$3,216,085	12,597	$3,762,820
29 Grade	243	MI	9,102	$2,214,493	10,649	$2,590,957
30 String	26,393	JTS	115.69	$3,053,499	135.36	$3,572,594
31 Machine Ditch	1,577,141	LF	3.00	$4,732,030	3.51	$5,536,475
32 Rock Ditch	68,509	LF	15.14	$1,037,311	17.72	$1,213,654
33 Bend	299	MI	5,725	$1,709,998	6,698	$2,000,697
34 Pipe-Front End	26,393	JTS	173.79	$4,586,872	203.34	$5,366,640
35 Pipe-Weld	1,577,141	LF	3.86	$6,092,428	4.52	$7,128,141
36 Cut Out & Repair	1,577,141	LF	1.19	$1,869,190	1.39	$2,186,953
38 Bottom Pad	299	MI	7,964	$2,378,877	9,318	$2,783,286
39 Lower & Backfill	299	MI	17,875	$5,339,393	20,914	$6,247,089
40 Top Pad	1,577,141	LF	2.19	$3,446,499	2.56	$4,032,404
42 Road Crossing-Boring	16	EA	32,853	$525,652	38,438	$615,013
43 Tie In	211	EA	13,653	$2,880,689	15,974	$3,370,407
44 River Crossings	79	EA	114,985	$9,083,809	134,532	$10,628,057
45 Fabrication	100	PC		$391,766		$458,366
46 Test	299	MI	3,643	$1,088,311	4,263	$1,273,324
47 Cleanup	1,577,141	LF	3.34	$5,263,692	3.90	$6,158,520
TOTAL PIPELINE DIRECT COSTS	299	MI	197,223	$58,910,594	230,751	$68,925,395
INDIRECTS - PIPELINE CONSTRUCTION						
Services				$3,558,975		$4,164,001
Supervision & Support				$6,504,954		$7,610,796
PL Supprt Facilities				$434,358		$508,199
Expendable Materials & Supplies	30	PCT		$11,279,340		$13,196,828
INDIRECTS - CIVIL & SUPPORT	25	PCT		$3,834,859		$4,307,185
Profit & Fee	10	PCT		$10,773,312		$12,503,105
Contingency			$3.76	$5,925,322	$4.36	$6,876,708
TOTAL PIPELINE COSTS	1,577,136	LF	$78.90	$124,431,751	$91.57	$144,410,867
TOTAL PROJECT COSTS>>>>>>>	1,577,136	LF	$118.83	$187,411,624	$147.32	$232,345,484
OPERATING FACILITIES COST				$2,571,937		$3,009,166

Fairbanks North Star Borough

Mayor: Juanita Helms

MEMORANDUM

TO: Mark Biernacki, Manager
Divisions of Advanced and Current Planning

FROM: Kelly McMullen, Acting Manager
Division of Environmental Services

DATE: November 29, 1988 KMM

SUBJECT: NATURAL GAS PIPELINE FROM COOK INLET

F-1 The environmental impacts of this project are somewhat mixed. If the local powerplants see an advantage to switch to gas generation facilities the major source pollutant emissions will be substantially reduced. However the ice fog contribution may increase whenever the inversion strength is enough to hold the plume at or near stack height. If vehicles were to convert to natural gas the ice fog contribution could be major. Also not addressed in the impact statement is the impact of residential heating units being switched to natural gas in relation to ice fog generation. Some air quality benefits are claimed for switching from wood to natural gas residential heat. This is extremely unlikely because there is little, if any, cost benefit and the majority of homes using wood heat are likely to be beyond the distribution system.

F-2 Who is going to pay for the distribution system in Fairbanks? The impact analysis does not discuss how feasible a local distribution system is for Fairbanks. Given the low density of settlement in the Borough, it would appear likely that the system would not expand much beyond the city limits like the cable TV system. Thus the pipeline does not seem to offer much benefit to Fairbanks.

P.O. Box 1267 Fairbanks, Alaska 99707 (907) 452-4761

Fairbanks North Star Borough

November 29, 1988

Alaska Power Authority
Attn: Richard Emerman
P.O. Box 190869
Anchorage, Alaska 99519-0869

Gentlemen:

Having reviewed the Draft Report of the "Estimated Costs and Environmental Impacts of a Natural Gas Pipeline System Linking Fairbanks with Cook Inlet Area," the following comments seem in order.

F-3

1. While the environmental impacts of the route are addressed, there is absolutely no consideration given to the impacts which the gas pipeline system will have on the communities along the route in general and Fairbanks in particular. There are both positive and negative impacts that have been mentioned in discussions. **The environmental, social and economic impacts of this project on the communities that will be affected need to be clearly identified and documented in order for an informed decision to be made with respect to the costs/benefits.** I respectfully request the Alaska Power Authority to provide this information in the Final Draft.

F-4

2. Consumption estimates use 1981 as the base year, reflect the new housing added between 1981-1986 and have asked ISER for demand projections through 2020. In Table 3.5 regarding the Residential Demand Forecast, I note that the Housing Units are assumed to increase at a very high rate, which I question. Specifically:

Time Period	Total Increase in Housing Units	Increase per year	Percent Change per year
1981-1987	1234	205	0.9%
1988-2000	4990	384	1.6%
2000-2010	5992	599	2.1%
2010-2020	6218	622	1.8%

What is the rational to assume annual increases of 1.6% to 2.1%? The 1981-1987 period was one of tremendous economic growth and yet there was less than a 1% increase per year. I urge you to reexamine the assumptions on which the projections are based as biased assumptions will result in biased forecasts. **The Final Draft should provide reasonable justification for the assumptions on which so much rests.**

809 Pioneer Road P.O. Box 1267 Fairbanks, Alaska 99707 907-452-1761

F-5

3. The Operations and Management (O & M) costs seem well researched and documented with respect to comparable projects elsewhere. However, there are two points which I believe require additional explanation:

   (1) Distribution costs are shown to average $182 per customer. Is it anticipated that the O & M will be borne by the customers, and if so with the additional 20% allowed for Alaska, what is the cost that the customers should anticipate?

   (2) On what is the 20% markup of costs in Alaska based?

   The Final Draft should include explanatory information about the O & M costs to clarify not only their full amount but also who will bear them.

Since the purpose of the Alaska Power Authority's Report is to provide information on the economic merits of this project so that a comparison may be made with alternative use of the funding, I urge that it consider not only the costs of building a connecting pipeline but also the costs and benefits to the impacted communities.

Sincerely,

Leslye A. Korvola

Leslye A. Korvola, Manager
Community Research Center

Fairbanks North Star Borough

December 1, 1988

Alaska Power Authority
P.O. Box 190869
Anchorage, AK 99519-0869
Attention: Richard Emerman

Gentlemen:

We have reviewed the Draft Report of the "Estimated Costs and Environmental Impacts of a Natural Gas Pipeline System Linking Fairbanks with Cook Inlet Area". We feel this report is well researched and the evaluations contained are clear, thoughtful, and show unbiased reasoning. However, the following discusses a few shortcomings that we found.

F-6 The environmental impacts of converting power generation to gas is covered fairly well, particularly recognition that natural gas can increase ice fog. However, we feel the final report should recognize the possibility of strong temperature inversion holding a plume at or near stack height rather than simply dispersing to high altitudes, thereby contributing to increased ice fog. Also the draft report does not address the impact on ice fog generation of converting home heating units to gas.

F-7 We doubt that many homes will convert from wood as a primary heat source to gas because; 1) there is little or no cost benefit for such a conversion, and 2) a majority of homes that use wood as a primary heat source will be beyond the distribution system.

F-8 The final report needs to consider the feasibility and funding of a distribution system for Fairbanks.

F-9 The socioeconomic impact section needs to provide a more detailed evaluation of impacts of construction and operation on individual communities, and Fairbanks in particular. We were disappointed that the socioeconomic impact section consisted almost solely of describing services available to construction workers in communities along the route and a discussion of the impact of construction workers on the communities in general.

F-10 The projected housing growth in table 3.5 needs justification. The increase in housing units shown for 1981-1987 equals 0.9% annual growth while the predicted annual rate for 1988-2000 was 1.6%, for 2000-2010 was 2.1% and for 2010-2020 was 1.8%. 1981-1987 was a period of high growth in Fairbanks, yet the predicted growth in housing is double that of 1981-1987. We question the accuracy of the projected growth rate and therefore of the projected demand for gas.

809 Pioneer Road P.O. Box 1267 Fairbanks, Alaska 99707

F-11 We would like clarification of a couple of points in the Operation and Maintenance section. 1) Explain the basis of the 20% markup of costs in Alaska. 2) Distribution costs are shown to average $182 per customer. Clarify if the O & M costs are to be borne by the customers, and if the 20% markup for Alaska is added, what the final costs will be.

Thank you for the opportunity to comment on this draft report. Please keep us informed of future reports and hearings concerning the proposed gas line from Cook Inlet to Fairbanks.

Sincerely,

Juanita Helms

Juanita Helms
Borough Mayor

JH/TD/bjs

RESPONSES TO THE FAIRBANKS NORTH STAR BOROUGH LETTERS DATED NOVEMBER 29, AND DECEMBER 1, 1988

F-1 We agree that the use of natural gas at power generating facilities will contribute to the ice fog problem when ambient temperatures are cold and strong temperature inversions exist. The study has been revised to more accurately address this issue. According to Dr. Carl Benson of Alaska University, power plant water vapor in stack gas contributions to ice fog during strong temperature inversions would be minor compared with those from vehicle emissions and power plant warm water discharges to the Chena River.

It is unlikely that the availability of natural gas in the Fairbanks area would result in vehicle conversion from gasoline to natural gas as conversion costs are expensive and vehicle range would be reduced.

We agree that the conversion of residential units from fuel oil and electricity to natural gas would also contribute to ice fog generation in the Fairbanks area during the winter season.

We estimate that about 10,000 customers would initially switch to natural gas if this resource were offered. By the year 2000 and 2020, we estimate that the number of customers would grow to about 12,000 and 17,000 respectively.

Gas usage equivalent to customer demand by the year 2020 is estimated to be about 3378 million ft^3 per year. This gas usage is about the same as that needed to fire a 50 megawatt power plant for one year assuming an 80 percent plant capacity factor.

It is difficult to estimate the additional amount of water vapor that would be generated in the Fairbanks area from the combustion of natural gas, and its contribution to the ice fog problem. However, since the water vapor addition would be distributed over the entire Fairbanks area, it would not likely increase the severity of the ice fog situation along any highway or any specific area.

F-2 The question as to who will fund the cost of a distribution system in Fairbanks is outside the scope of this study.

The distribution system in its early stages is expected to service the high density core of residential settlement in the city, much of the commercial development as well as three major electricity generating stations.

The main infrastructure of a back-bone T main and a spur line to North Pole will allow incremental expansion into other areas as the population grows.

F-3 The socio-economic impacts of gas availability to communities along the route of the pipeline are outside the scope of this study.

F-4 Table 3.5 has been modified to include only the residential units in the Fairbanks area which could be efficiently served by a gas distribution system. The growth in residential units is based on ISER population and housing unit forecasts through 2010 with the assumption that the same growth pattern would continue through 2020.

F-5 Operation and maintenance costs are not a direct charge to the customer. These and other costs, including the purchase of gas, will be recovered by the distributor through the tariff for gas consumed.

The 20% mark-up of costs in Alaska, above average unit costs in the lower 48 states, is an estimated judgment factor based on the increased costs associated with supply of materials, more difficult working conditions, equipment operating costs, frozen soils, and like items.

F-6 Refer to response F-1.

F-7 The study statement which identified the potential for significant particulate reductions by switching from wood burning to natural gas was not intended to infer that switching would be widespread along the proposed pipeline route. Cost is always a factor in making such decisions. We estimate that only 10 percent of the residences currently burning wood in the Fairbanks area would switch to natural gas should it become available.

F-8 Refer to response F-3.

F-9 Refer to response F-3.

F-10 Refer to response F-4.

F-11 Refer to response F-5.

USIBELLI COAL MINE, INC.
MARKETING
2173 University Avenue So.
Suite 101
Fairbanks, Alaska 99709
(907) 479-2630
FAX 479-2793

November 28, 1988

Alaska Power Authority
P.O. Box 190869
Anchorage, Alaska 99519-0869

Attn: Richard Emerman

Re: Comments to draft report Estimated Costs and Environmental Impacts of a Natural Gas Pipeline System Linking Fairbanks with Cook Inlet Area

Dear Mr. Emerman:

Thank you for the opportunity to comment on this report. Since we are very interested in the manner of comparison between gas and coal alternatives for the railbelt energy needs, many of the comments will be directed towards comparison of the draft report of the coal alternative prepared earlier.

U-1 Generally, the gas line report used a much more detailed and less conservative approach to cost estimation, which will certainly make the task of comparing the coal and gas alternatives guite difficult.

Following are specific comments referenced to the section in the report to which they apply:

U-2 Pg. 1-1 Table
The figures for electric power production seem to indicate that gas is expected to displace about 90 percent of the current coal generation capacity. If one assumes that 90 percent of the coal fired capacity is desplaced then they should probably assume 100 percent since there is no guarantee that a viable coal supply would exist if 90 percent of the demand were removed.

U-3 Pg. 3-1 Last paragraph
The mine mouth plant at Healy is assumed to remain as using coal. This must also include the assumption that adequate export markets will exist for Healy coal to make the cost of coal fuel competitive.

U-4 Pg. 3-2 Table 3.1
Reference the previous two comments. The railbelt would become a single fuel system: natural gas. The assumption of no growth in gas consumption for power generation in the Fairbanks area is inconsistent with other assumptions in the report.

U-5 Page 5-10 to 5-12
Several of the streams listed as "NL" do in fact contain significant salmon runs, if not at the crossing site, then a short distance downstream. These streams are likely to receive the same kind of scrutiny during permitting as cataloged streams.

U-6 Page 7-4 last paragraph.
Appendices 3 to 6 would seem to indicate that Davis bacon rates were used. If not, shouldn´t they be since I thought the Little Davis Bacon rates apply to residential construction only.

U-7 Page 7-15
Use of typical costs for gas distribution system in Anchorage may not be applicable to Fairbanks construction where permafrost may be frequently encountered.

The cost of the distribution system should be figured in the overall project cost since the distribution system for coal is already in place.

U-8 Page 8-2
A 20 percent factor was used for Alaskanizing this estimate, whereas double the lower 48 costs were used frequently in the coal report and factors used for operating costs were not disclosed.

U-9 Page 9-14 first paragraph
Does the statement concerning no major changes in facilities in recent years consider the bag house installed by GVEA, the retirement of old boilers by FMUS, and the system upgrades planned by the military?

U-10 Page 9-15 paragraph 6
I disagree with the statement concerning modification to burn natural gas as the method for "greatest reduction of pollutants". One of the pollution problems in the Fairbanks area is the ability of ice fog to inhibit dispersal of other pollutants such as carbon monoxide from automobile exhaust. The $250 million plus that the gas line project would cost could build a new power line to Fairbanks from Healy, build a new coal fired plant in Healy using new clean coal technology to reduce emissions levels to near natural gas levels and remove the pollution problem far from any population center.

U-11 Page 9-16 last two paragraphs.

Although it is no doubt true that roadway ice fog problems are primarily caused by cars, the operation of power plants can be a significant contributor to the problem, and would not be eliminated by conversion to natural gas. Open water caused by warm water discharge certainly contributes to ground level ice fog and when standing above the ice fog on University Hill on calm days one can often see the plumes from power plants settling right back to the ground.

U-12 Section 10, Land ownership maps.

Either the state or federal color should be changed, the background colors on the maps make it very difficult to distinguish between the two.

U-13 Page 11-1, paragraph 6

The need for CORPS permits is reversed. Section 10 permits concern alteration or obstruction of navigable waters and section 404 permits deal with dredge and fill operations.

U-14 Appendix 1

The level of detail in these cost estimates make it impossible to compare with the coal study cost estimates. One item however, camp operations cost at $38.52 per man-day, stands out at less than half of that used in the coal study.

U-15 Appendices 4,5 & 6

I did not have access to the Corps of Engineers equipment cost guide while reviewing this study. However, I did compare the equipment rates to the Blue Book published by Dataquest, Inc. and found the rates to be in the range of .75 to .95 times Lower 48 rates. This and the previous comment would seem to indicate that the gas line study in general gave little if any penalty to the cost of construction in Alaska, in sharp contrast to the methods used for the coal study.

Thank you for this opportunity to comment. If there are any questions regarding these comments, I may be reached at the phone number on the letterhead or at least at my office in Ketchikan at 247-8131.

Sincerely yours,

Steve W. Denton (P.E.M.)

Usibelli Coal Mine, Inc.
by Steve W. Denton

RESPONSES TO THE USIBELLI COAL MINE, INC.
LETTER DATED NOVEMBER 28, 1988

U-1 We believe Stone & Webster's estimating philosophy is consistent with industry practice and is appropriate to the tasks at hand. The estimating formats were designed to provide valid cost input with the greatest amount of cost information visibility that budget limitations would permit.

We acknowledge the fact that the estimate for the gas line report is prepared in greater detail than the estimates for the various coal plants, but we would refute the suggestion that one estimate may be more conservative than the other.

The following comparison tabulates the general differences in estimate content between the coal plant conceptual cost estimate concepts and the gas line detailed cost estimate concept.

Subject	Coal Plant Conceptual Concept	Gas Line Detailed Concept
• Technology(s) Used	Multiple	Single
• Locations	Multiple	Specific
• Size	Multiple	Specific
• Time	Assumed	Assumed
• Estimate Format Characteristics	General	Specific
$/KW	Yes	N/A
MH/KW	Approximate	N/A
MH/Craft	Approximate	N/A
MH/Activity	N/A	Yes
MH/Unit of Work	N/A	Yes
Support Labor	N/A (a)	Yes (b)
Material Definition	N/A	Yes
Subcontracts	N/A	Yes
Construction Plant	N/A	Yes

(a) Statistical cost component allocations based on general concept of $/KW could be made.

(b) Definitive cost component descriptions based on the specific application are estimated.

U-1 Cont'd The following comparison tabulates comparable cost elements of the two projects. For convenience of comparison, the format of Table 7-1 from the coal plant report is used.

CREW RATE BUILD-UP

Subject	Coal Plant Allocation	Coal Plant Realloted[1]	Gas Line Tabulation
Base Rate	24.00	24.00	22.62[3]
Overtime Allowance	4.00	4.00	3.77[4]
Subtotal	$28.00	$28.00	$26.39
Workmens Compensation		4.20	2.18[5]
Taxes and Insurance		1.80	
• F&S Unemployment			1.45
• Social Security			1.98
• Liability			1.35
Benefits		6.00	6.40
Subtotal	$12.00	$12.00	$13.36
Small Tools	1.40	1.40	0.52[6]
Cumulative Total	$41.40	$41.40	$40.27
Contractor's Job Overhead		5.00	13.21[7]
Contractor's H.O. Overhead		.80	*[8]
Construction Distributables		20.80	
• Construction Equipment			19.15[9]
• Mobilization			3.46
• Temporary Yard Facilities			0.29
• Temporary Services			2.19
• Demobilization			3.04
Subtotal	$26.60	$26.60	$41.34
Cumulative Total	$68.00	$68.00	$81.61
Profit	7.00	7.00	9.07
Cumulative Total	$75.00	$75.00	$90.68
Camp Cost	10.00	10.00[2]	6.24[10]
Cumulative Total	$85.00	$85.00	$96.92
Contingency		12.75	4.70[11]
Grand Total		$97.75	$101.62

U-1
Cont'd

FOOTNOTES FOR CREW RATE BUILD-UP

(1) The cost allocation presented in the coal plant report could be expanded to show allocation details as estimated at that time.

(2) As stated in the coal plant narrative, camp costs were estimated to be $87 per man-day occupancy which translates to $10 per hour worked on a 60 hour basis. This camp would be established for year around occupancy with a comfort level appropriate to retaining workers throughout the year. Current Alaskan power projects are experiencing cost of this magnitude.

(3) The composite base rate is appropriately lower due to the mix of craftsmen. Approximately one-half the workers on the gas line are oilers or laborers.

(4) Overtime allowance is for identical schedules at 6-10 hour days.

(5) The variation in Workmen's Compensation rates due to type of construction and craft mix is appropriate.

(6) Small tool allowances for skilled trades in power plant construction exceed like requirements on gas line work.

(7) Job overhead costs for the gas line are estimated higher as it is a labor intensive job. Overhead costs for the coal plant are at the usual coal plant conceptual level.

(8) Contractors home office overhead is included in profit allowance.

(9) Construction equipment, mobilization, and demobilization costs are much higher for gas line type of work.

(10) The camp costs included in the pipeline estimate are approximately $62 per man-day, which is a composite of workers living in camp and local hires or others providing their own housing at a lesser rate. Also, this camp cost is for a more mobile and seasonal type of camp.

(11) Contingency levels are estimated at approximately 5% for the gas line detailed concept and at 15% for the coal plant conceptual concept.

U-2 Based on economic and environmental considerations, Stone & Webster has assumed that some power plants would convert to gas entirely. This assumption includes GVEA's North Pole Station, FMUS's Chena Station, and University of Alaska at Fairbanks.

The static gas consumption assumed for electric power generation is only for these specific plants. Any additional electric load growth is assumed to be served by plants or cogeneration plants outside of the Fairbanks area, presumably some of these plants could be coal-fired.

Our forecast also assumes that sufficient coal supplies would be available to economically serve other plants in the Fairbanks area as well as plants or cogeneration plants outside of the area, and for export markets.

U-3 Your comment is noted.

U-4 Refer to response U-2.

U-5 Information from the latest ADF&G, Habitat Division files was used in the determination of "L" or "NL" of streams. No doubt all streams currently listed as "NL" would come under scrutiny by ADF&G were the project to proceed with permitting.

U-6 Refer to revised text 7.1.7.

U-7 Costs for the gas distribution system in Fairbanks are based on ENSTAR's experience in Anchorage plus a differential factor to allow for the more difficult ground conditions in Fairbanks.

U-8 The 20 percent factor was used only in the distribution system cost estimate and is essentially a differential above Anchorage cost experience.

The estimate for the pipeline is a 'bottom-up' detailed contractor type estimate based on actual Alaska costs and productivity.

U-9 The purpose of the paragraph in question is to document ADEC's opinion of the "most recent summary of emissions from large pollutant sources " for four years in the 1970's. The data are considered to be "reasonably representative" of existing conditions and do not include emissions data from recent changes or planned future upgrades.

U-10 We believe that pollutants would be significantly reduced by conversion to natural gas. Under certain conditions, such as severe weather, the rates of dispersal would vary. But, on a yearly cumulative basis there would be an improvement.

U-11 We concur with the commentary. In addition, we have revised the text to more appropriately describe the increased ice fog that would be incident to firing with natural gas.

U-12 The land ownership maps will be printed in black and white with ownership indicated by distinctive symbols.

U-13 Your comments have been incorporated into the text.

U-14 Please refer to U-1 for thoughts concerning the level of detail within the coal plant and gas line estimates. With regard to camp costs, additional costs must be added to line Item 14 of $38.52 per man day. Camp costs as shown in U-1 are compared at $6.24 per hour.

U-15 We have compared the equipment costs generated by the Corps of Engineers Cost Guide for Alaska with historical rates for a very large fleet of equipment in Alaska and found them comparable. The Blue Book rates tend to be higher and less consistent with actual records.