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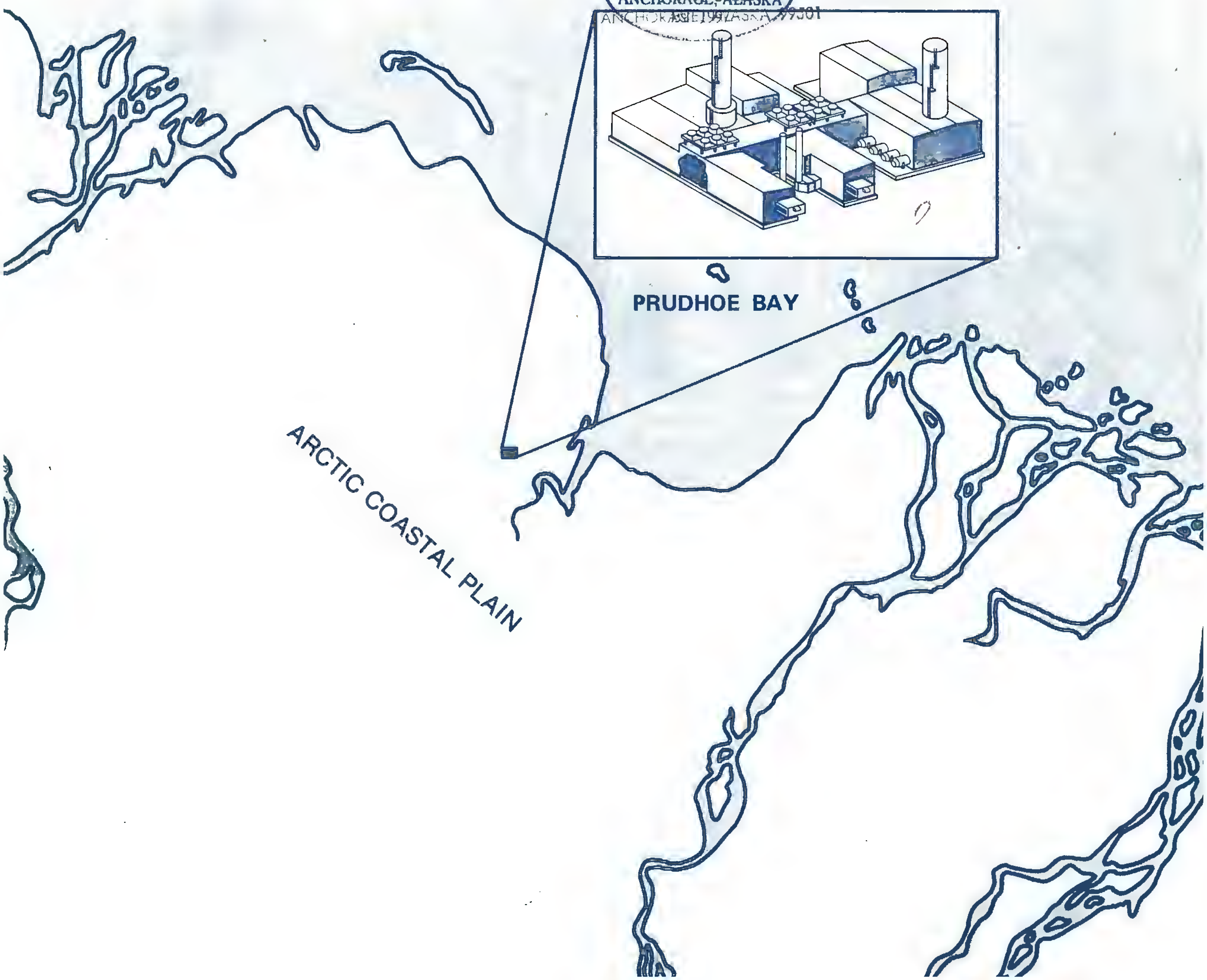
FEDERAL ENERGY REGULATORY COMMISSION
Office of Pipeline
and Producer Regulation

July 1980

Prudhoe Bay Project

Final Environmental Impact Statement



FERC/EIS-0009

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF PIPELINE AND PRODUCER REGULATION
WASHINGTON, D.C. 20426

PRUDHOE BAY PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

Construction and Operation of a Sales Gas Conditioning Facility at Prudhoe Bay, Alaska

Northwest Alaskan Natural Gas Transportation Company
Docket No. CP78-123 *et al.*

This FEIS evaluates the environmental impact of the gas conditioning and processing facilities to be constructed at Prudhoe Bay, Alaska, in association with the Alaska Natural Gas Transportation System (ANGTS), Docket No. CP78-123 *et al.* Using four processing trains, the sales gas conditioning facility (SGCF) would condition 2 billion cubic feet of gas per day with the SELEXOL process for the ANGTS to transport to the lower 48 states. The staff has also analyzed the environmental impact of an alternative site near the Yukon River and two alternative sites at Fairbanks. Alaska.

The staff concludes that the proposed Prudhoe Bay site is environmentally acceptable. The staff finds the two alternative sites in the Fairbanks area to be acceptable as well. The alternative Yukon River site is less acceptable than either the proposed Prudhoe Bay site or the two alternative sites. In addition, the staff presents 11 recommendations for the ultimate developer of an SGCF at Prudhoe Bay.

This FEIS has been circulated to Federal. state, and local agencies and to all parties to the proceedings. It has been placed in the public files of the Commission and is available for public inspection in the Commission's Office of Public Information, Room 1000, 825 North Capitol Street, N.E., Washington, D.C. 20426. Copies are available in limited quantities from the Commission's Office of Public Information.

For further information, contact Mr. Robert Arvedlund, project manager, (202) 357-9043.

FOREWORD

On July 9, 1976, Alcan Pipeline Company (Alcan), now Northwest Alaskan Pipeline Company (Northwest Alaskan), filed an application before the Federal Power Commission (predecessor to the Federal Energy Regulatory Commission) in Docket No. CP76-433 for a certificate of public convenience and necessity to construct and operate pipeline facilities to transport Alaskan natural gas to the lower 48 states. In May 1977, the Commission recommended to the President that he select an overland pipeline project to transport Alaskan natural gas to the lower contiguous 48 states. On September 22, 1977, the President recommended that a certificate be issued to construct and operate a pipeline from Prudhoe Bay, Alaska, paralleling the Trans-Alaska Pipeline System (TAPS) to Big Delta Alaska, and then following the Haines Pipeline/ Alaskan Highway into Canada. From White Horse, Yukon Territory, the pipeline would continue on through British Columbia and Alberta and reenter the United States at Eastport, Idaho. A second segment would continue on through Alberta into Saskatchewan and reenter the United States at Morgan, Montana.

The environmental impact of the pipeline was evaluated by the Commission staff in a 1976 supplement to its final environmental impact statement (FEIS), Alaska Natural Gas Transportation Systems: Alcan Pipeline Project. Under section 8(e) of the Alaska Natural Gas Transportation Act (ANGTA), the President was directed to determine the legal sufficiency of the FEIS for the transportation system which he approved. In his Decision and Report to Congress on the Alaska Natural Gas Transportation System (p. 133), the President found that the FEIS did comply with the requirements of the National Environmental Policy Act (NEPA). Under section 10(c)(3) of ANGTA, Congressional approval of the Decision is conclusive "as to the legal and factual sufficiency of the environmental impact statement submitted by the President relative to the approved transportation system and no court shall have jurisdiction to consider questions respecting the sufficiency of such statement under the National Environmental Policy Act of 1969." Congress approved the Decision by joint resolution on November 2, 1977.

Section 1(b) of the Natural Gas Act exempts from the Commission's jurisdiction " the production or gathering of natural gas." As a general rule which applies in this case, conditioning and processing facilities fall within the Natural Gas Act exemption. Accordingly, Commission certification of such facilities is not required. 1/

Nevertheless, because the processing and conditioning facilities represent a substantial construction project required for the operation of ANGTS, because of the delicate ecological balance of the North Slope, and because the environmental impact of the facilities has not been fully evaluated in any official document, the Federal Energy Regulatory Commission (FERC) has assumed the responsibility as lead agency in preparing this assessment of the environmental impact of the gas conditioning and processing facilities. 2/ The FERC has assumed this role despite the absence of FERC jurisdiction over the facilities because other Federal agencies, which might have jurisdiction over various aspects of the facilities and therefore be required to prepare environmental impact statements, do not have the expertise which the FERC has by virtue of its jurisdictional responsibilities over gas transportation facilities generally. Thus, the FERC's impact statement evaluating these facilities may expedite the ANGTS, as mandated by

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1/ Under the Natural Gas Policy Act of 1978, the Commission must determine whether a conditioning and processing allowance should be included in or added to the wellhead gas price and what this allowance should be.

2/ The staff is particularly indebted to the Environmental Protection Agency's Office of Environmental Review in Washington, D.C. and its Region X Office, Environmental Evaluation Branch, in Seattle, Washington, for their significant effort in assisting the FERC staff in preparing this EIS. Specifically, the Environmental Protection Agency, utilizing the contractual services of Wapora Inc., provided sections B.1, B.4, B.5, C.4, C.5, and H.5 and appendices D, E, and F of this EIS. In addition, they provided substantial input to sections B.3, B.8, C.3, C.8, H.3, and I of the EIS. Other Federal and state agencies which will issue permits regulating these facilities and/or which participated in preparing this impact statement include the U.S. Army Corps of Engineers, U.S. Department of Transportation, U.S. Department of the Interior, and the State of Alaska.

ANGTA. It is only the unique circumstances of ANGTS which have prompted this assessment. These unusual circumstances in no way establish a precedent for environmental analyses of similar facilities by the Commission in other actions. Since Docket No. CP78-123 et al. treats many of the overall issues associated with the ANGTS, it will be used as the lead docket for this environmental impact statement.

The project assessed in this FEIS is the project proposed in a multivolume study prepared by R. M. Parsons, Inc. in 1978 for a consortium of North Slope gas and oil producers, gas carriers, and gas purchasers. Copies of the Parsons report are available for public viewing at the Commission's Office of Public Information, Room 1000, 825 North Capitol Street, N.E., Washington, D.C. 20426 and EPA's Region X Office, 11th Floor Library, 1200 Sixth Avenue, Seattle, Washington 98101.

The Parsons analysis of site, process, and design preferences is based on a number of assumptions that may or may not be correct. Some of these issues have already been or will be determined by Commission decisions within the next few months. Two critical issues--pipeline pressure in the Alaskan segment and the maximum allowable CO_2 concentration--will determine the percentage of the heavier natural gas liquids that can be transported in the pipeline without operational problems and influence both the type of conditioning process chosen and the location of the facility. On August 6, 1979, the Commission issued its decision that the pipeline's diameter and operating pressure should be set at 48 inches and 1,260 psig, respectively.

This FEIS has been reviewed by the Alaska Gas Project Office (AGPO) prior to publication; AGPO may circulate separate comments on it.

FEDERAL ENERGY REGULATORY COMMISSION

OFFICE OF PIPELINE AND PRODUCER REGULATION

FINAL ENVIRONMENTAL IMPACT STATEMENT SUMMARY SHEET

Northwest Alaskan Natural Gas Transportation Co.
Docket No. CP78-123 et al.

1. This Final Environmental Impact Statement (FEIS), prepared by the staff of the Federal Energy Regulatory Commission, is related to an administrative action.

2. This administrative action initially arose from applications filed by Northwest Alaskan Pipeline Company (Northwest Alaskan) for a certificate of public convenience and necessity to construct and operate pipeline facilities to transport Alaskan natural gas to the lower 48 states. On September 22, 1977, the President recommended that a certificate be issued to construct and operate such a pipeline from Prudhoe Bay, Alaska, paralleling the Trans-Alaska Pipeline System (TAPS) to Big Delta, Alaska, then along the Haines Pipeline/Alaskan Highway, through Canada, and back into the United States.

The Commission staff believes that no further consideration of the pipeline route selected by the President is necessary. However, after closer review, the staff has determined that additional environmental assessment is warranted for the facilities necessary to condition and process Prudhoe Bay gas prior to pipeline transmission. While these types of facilities normally do not require Commission certification, the Commission staff believes that the uniqueness of the Alaskan Natural Gas Transportation System warrants presenting further information to the public.

Since Docket No. CP78-123 et al. treats overall issues associated with the Alaskan Natural Gas Transportation System, it will be the lead docket for this environmental impact statement.

3. The proposed site for the sales gas conditioning facility (SGCF) is at Prudhoe Bay, Alaska. The facilities would consist of four processing trains using the SELEXOL process to condition the gas and refrigeration to separate the hydrocarbons. An operations/living center and construction camp would also be constructed. The environmental impacts from construction and operation of the proposed facility would include impacts to land use, soils and permafrost, water quantity and quality, air quality, noise levels, wildlife, and social and economic aspects of the human environment.

4. The alternative sites considered for the SGCF include the Yukon River near the TAPS bridge and Fairbanks (2 sites), Alaska. Pipeline pressure and process alternatives are also considered.

5. The staff conducted local public hearings in Anchorage, Fairbanks, and Barrow, Alaska, in September 1979 to hear comments on the DEIS. Transcripts of the hearings have not been reprinted in this FEIS, but they are available for public review in (1) the Commission's Office of Public Information, Room 1000, 825 North Capitol Street, N.E., Washington, D.C. 20426, (2) the Environmental Protection Agency (EPA) Region X Office Library, 11th Floor, 1200 Sixth Avenue, Seattle, Washington 98101, and (3) at the Fairbanks North Star Borough Building, Fairbanks, Alaska 99706. The comments made at these hearings are identical to other comments specifically reprinted and considered in this FEIS, particularly pages 1-6 and 40-53 of the comments submitted by the community of Fairbanks and the North Slope Borough. The reader is therefore directed to those specific Fairbanks and North Slope Borough comments with specific staff responses in appendix M.

At the public hearings, the time limit for providing written comments on the DEIS was extended from September 14, 1979 (September 29 for comments mailed from Alaska), to October 19, 1979. At the end of this comment period, 21 letters of comment related to the DEIS had been received. They are included as appendix M of the FEIS. These comments have been carefully reviewed and analyzed by the staff. Where appropriate, the DEIS has been modified to reflect these comments. Specific staff responses to each comment are presented with the comment letters in appendix M. Comments which did not require specific staff responses are also presented alphabetically in appendix M.

6. The DEIS was published before the Commission's proposed rulemaking, "Regulations Implementing the National Environmental Policy Act of 1969," was issued on August 20, 1979. For consistency between documents, the FEIS has maintained the previous format.

7. Copies of this FEIS are being made available to the public and all parties to the proceedings on or about July 25, 1980, and to the following:

A. Federal

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army
Department of Commerce
Department of Defense
Department of Energy
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Labor
Department of State

Department of Transportation
Environmental Protection Agency
Federal Trade Commission
Honorable Mike Gravel
Honorable Ted Stevens
Honorable Don Young
Interstate Commerce Commission
Marine Mammal Commission
Nuclear Regulatory Commission

B. State of Alaska

1. State

Alaska Energy Allocation Assistance Office
Alaska State Clearinghouse
Department of Community and Regional Affairs
Department of Economic Development
Department of Environmental Conservation
Department of Fish and Game
Department of Highways
Department of Labor
Department of Law
Department of Natural Resources
Department of Public Works
Department of Social and Health Services
Federal-State Land Use Planning Commission for Alaska
Office of the Governor
State Historic Preservation Officer
University of Alaska

2. Regional and Local

Alaska Energy Corporation
Alaska Federation of Natives
Arctic Enterprises Inc.
Arctic Slope Regional Corporation
City of Anchorage
City of Barrow
City of Fairbanks
City of Haines
City of North Pole
City of Tok
City of Valdez
Fairbanks North Star Borough
Fairbanks Town and Village Association, Inc.
Greater Anchorage Area Borough
Greater Anchorage Chamber of Commerce
Greater Fairbanks Chamber of Commerce

North Slope Borough
Village of Anaktuvuk Pass
Village of Eagle
Village of Kaktovik
Village of Northway
Village of Nuiqsut
Village of Rampart
Village of Stevens

3. Conservation and Citizen Groups

Alaska Center for the Environment
Alaska Conservation Society
Alaska Wildlife Federation and Sportsmen's Council, Inc.
Alaskan Resources Science Corporation
Earth Resources Company of Alaska
Fairbanks Environmental Center
Friends of the Earth
Green Peace
League of Women Voters of Alaska
Library, University of Alaska
Prudential Insurance Company
Sierra Club
Trout Unlimited
Trustees for Alaska
Wildlife Society, Alaska Chapter

C. National Citizens Groups

American Conservation Association, Inc.
Conservation and Research Foundation, Inc.
Conservation Foundation
Environmental Action
Environmental Defense Fund
Environmental Law Institute
Friends of the Earth
Iroquois Research Institute
National Association of Conservation Districts
National Audubon Society
National Resources Council of America
National Wildlife Federation
Natural Resources Defense Council, Inc.
North American Wildlife Foundation
Sierra Club
The Wilderness Society
Wildlife Society

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ABBREVIATIONS AND ACRONYMS

AAC--Alaska Administrative Code
ACMP--Alaska Coastal Management Program
AEIDC--Arctic Environment Information Data Center
AGPO--Alaska Gas Project Office
Alcan--Alcan Pipeline Company
ANGTA--Alaska Natural Gas Transportation Act
ANGTS--Alaska Natural Gas Transportation System
API--American Petroleum Institute
AQCR--Air Quality Control Region
Arco--Atlantic Richfield Company
BaP--benzo (a) pyrene
BACT--best available control technology
BOD--biological oxygen demand
BP--British Petroleum Company
BP Alaska--BP Alaska, Inc.
bpd--barrels per day
bcfd--billion cubic feet per day
BSO--benzene soluable organics
Btu--British thermal unit
°C--degrees Celsius
C_1--methane
C_2--ethane
C_3--propane
C_4--butane
C_5--pentane
CAA--Clean Air Act
CCP--Central Compressor Plant
CEQ--Council on Environmental Quality
cfs--cubic feet per second
cfsm--cubic feet per second per square mile
cm--centimeters
cms--cubic meters per second
CO--carbon monoxide
CO_2--carbon dioxide
CPP--Central Power Plant
dBA--decibels on the A-weighted scale
DEC--Department of Environmental Conservation (Alaska)
DEW--Defense Early Warning
DOT--U.S. Department of Transportation
EED--Economic Development Division of the Greater Fairbanks Chamber of Commerce
EPA--U.S. Environmental Protection Agency
ESO--emergency shutdown system
Exxon--Exxon Company, USA
FAA--Federal Aviation Administration
FEIS--final environmental impact statement
FERC--Federal Energy Regulatory Commission
FGD--flue gas desulfurization
FWS--Fish and Wildlife Service
gpd--gallons per day
gpm--gallons per minute
HC--hydrocarbons
HEL--higher explosive limit
HHV--higher heating value
H_2S--hydrogen sulfide
km--kilometers
LEL--lower explosive limit
mcfd--thousand cubic feet per day
mg/l--milligrams per liter
msl--mean sea level
MW--megawatt
NAAQS--National Ambient Air Quality Standards
NEPA--National Environmental Policy Act
NFPA--National Fire Protection Association
NGL's--natural gas liquids
NMFS--National Marine Fisheries Service
NO_x--nitrogen oxides
NMHC--nonmethane hydrocarbons
NOAA--National Oceanic and Atmospheric Administration
Northwest Alaskan--Northwest Alaskan Pipeline Company
NPDES--National Pollution Discharge Elimination System
NSPS--New Source Performance Standards
NWS--National Weather Station
OSHA--Occupational Safety and Health Act
PSD--prevention of significant deterioration
psig--pounds per square inch, gauge
Parsons--Ralph M. Parsons Company
ppm--parts per million
PPOM--particulate polychclic
ppt--parts per thousand
SGCF--sales gas conditioning facility
SO_2--sulphur dioxide
SO_x--sulphur oxides
SOHIO--Sohio Petroleum Company
TAPS--Trans-Alaskan Pipeline System
TSP--total suspended particulates
TSS--total suspended solids
USGS--U.S. Geological Survey
WPCA--Water Pollution Control Act

A. DESCRIPTION OF THE PROPOSED ACTION[1/]

1. Purpose of the Proposed Facilities

The Prudhoe Bay field, as presently defined, is about 45 miles long and 18 miles wide and is estimated to contain 9.6 billion barrels of recoverable oil and in excess of 20 trillion cubic feet of saleable natural gas (partly in solution and partly in a free gas cap above the oil) in the sandstones of Perma-Triassic age.[2/] Currently, natural gas produced at the Prudhoe Bay field is reinjected into the oil-producing formation by compressors at the Central Compressor Plant (CCP). Before reinjection, water and a portion of the heavier hydrocarbons are removed by dehydration facilities. To meet the proposed pipeline quality specifications listed in table 1, all the natural gas will have to be conditioned before being transported into Canada and the lower 48 states. The proposed construction of a sales gas conditioning facility (SGCF) at Prudhoe Bay could accomplish this by using Allied Chemical's patented SELEXOL process to remove high concentrations of carbon dioxide (CO2) and various molecular weight hydrocarbons entrained in the 2.7 billion cubic feet per day (Bcfd) feed gas stream.

The SGCF must be an operational and economic design which will be compatible with the specifications of the Canadian segment of the pipeline, which has already been determined. Hydrocarbon dewpoint control (removal of certain hydrocarbons) is required to avoid possible hydrocarbon condensation in the pipeline. This could cause operational problems and possible pipeline shutdown. The removed hydrocarbons (ethane and heavier fractions) are called natural gas liquids (NGL's). Once gas sales commence, 50 to 60 barrels of NGL's per million cubic feet of natural gas would be extracted at the SGCF to make the gas acceptable for delivery by the pipeline system. Removal of acidic gases (sweetening) becomes essential only if the hydrogen sulfide (H_2S) content of the gas exceeds values specified in pipeline contracts. These are often as low as 1 grain of H_2S per 100 cubic feet of natural gas. However, only if H_2S content is much higher than that does it become attractive to recover elemental sulfur from the SELEXOL solvent.

1/ The project assessed in this EIS is the project proposed in the Ralph M. Parsons Inc. study conducted for the North Slope gas and oil producers.

2/ Additional information on oil reserves appears in appendix A.

TABLE 1

PIPELINE GAS COMPOSITIONS

Volume % Component	Pipeline Design Case	Plant Base Case
CO_2	1.002	0.49
N_2	0.597	0.61
C_1	85.342	92.57
C_2	8.087	4.50
C_3	4.353	1.75
iC_4	0.213	0.04
nC_4	0.331	0.03
iC_5	0.034	----
nC_5	0.031	0.01
C_{6+}	0.020	----
Total	100.00	100.00

2. Location of the Proposed Facilities

The SGCF would be located in Prudhoe Bay, Alaska (figure 1), an existing oil and gas industrial complex presently operated by Sohio Petroleum Company (SOHIO) and the Atlantic Richfield Company (Arco).

Ralph M. Parsons, Inc. (Parsons) presented two SGCF designs: a base case and an alternate case. The base case would utilize the existing inlet, separation, and dehydration facilities and the existing first stage compressors at the CCP.1/ The alternate case assumes new inlet, separation, and sales gas compression facilities.

For the base case, construction would be adjacent to the CCP. This site was chosen because of the necessity to maintain a minimum pressure drop in the interconnecting piping between the SGCF process trains and the CCP compressors. (See figure 2.) The site is also close to both gas and liquid injection wells. For the alternate case, the location of the SGCF would not be critical. However, the cost of additional gas transit and injection pipeline would be minimized by using the same location.

3. Proposed Facilities

a) Process Facilities

The process facilities recommended by Parsons include four parallel extraction trains capable of delivering about 665 million cubic feet of conditioned gas per day. Each train is composed of three units: a low temperature separator to remove entrained liquid hydrocarbons from the feed gas, a SELEXOL solvent gas treating unit to remove CO_2, and mechanical refrigeration for proper control of the hydrocarbon dewpoint. A process flow diagram is shown in figure 3.

The solvent system selected for NGL extraction and CO_2 removal is Allied Chemical's patented SELEXOL physical solvent process, which uses the capacity of the dimethyl ether of polyethylene glycol to physically and selectively absorb such compounds as CO_2, H_2S, carbonal sulfide, NGL's, and mercaptans.

1/ Additional dehydration facilities may be required to meet gas pipeline transmission specifications.

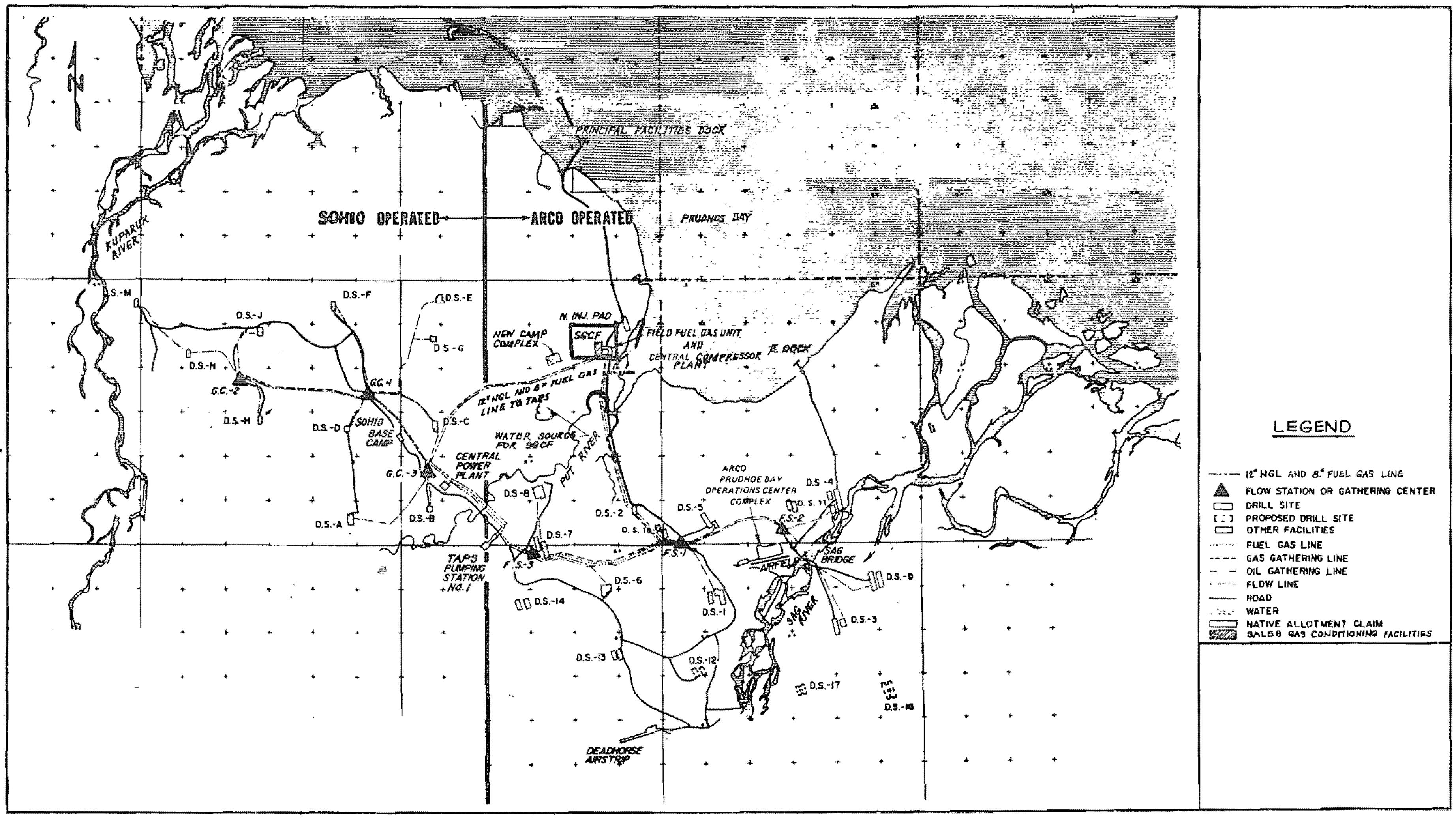


Figure 1

Site Location Map

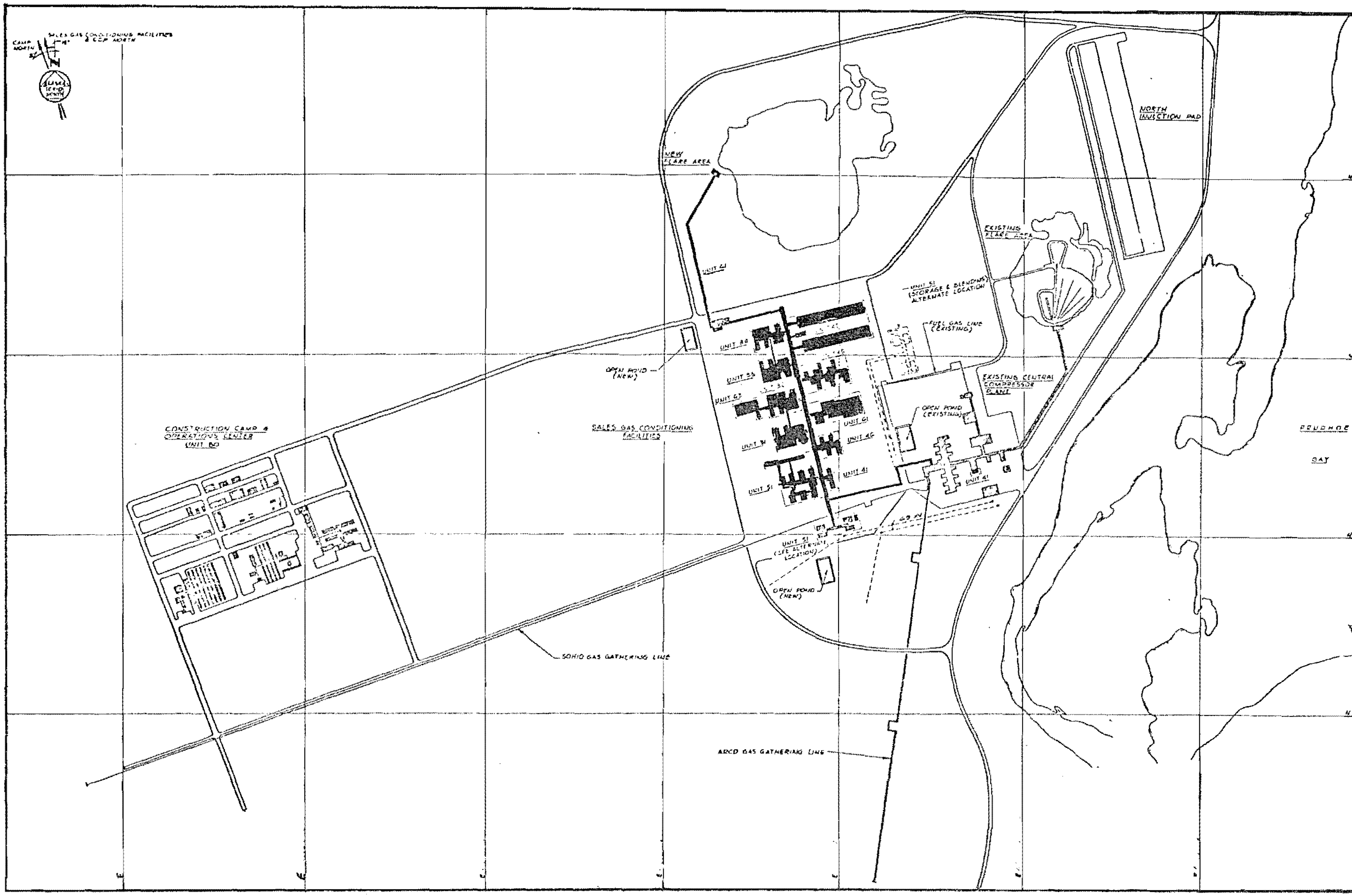


Figure 2

Plant Layout

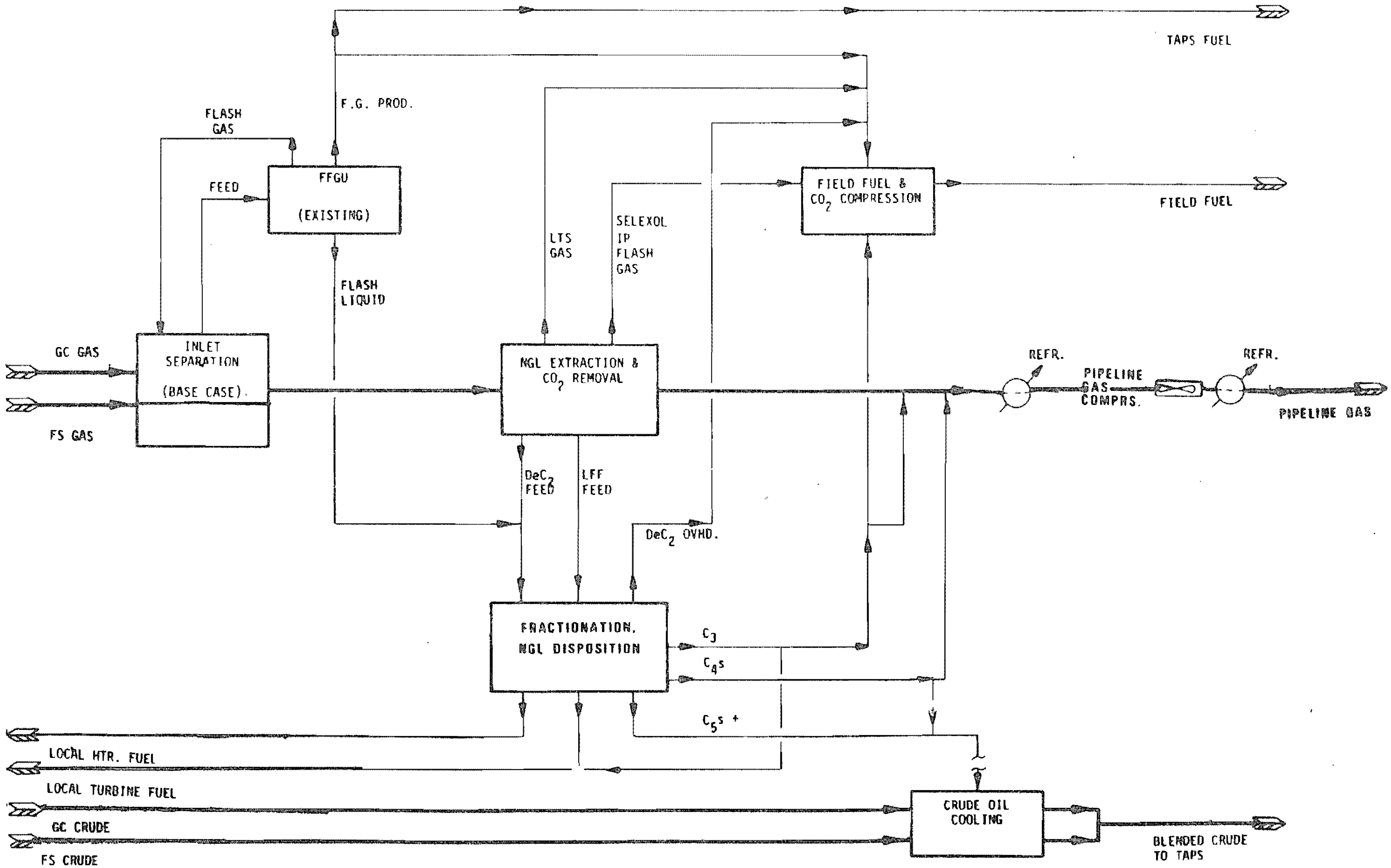


Figure 3

Process Flow Diagram

(See figure 4.) This system is a simple recirculating loop which contains a SELEXOL absorption column (using selective physical absorption procedures to remove various molecular-weight hydrocarbons and CO_2, three differential pressure flash drums (to remove CO_2 and varying quantities of hydrocarbons from the SELEXOL stripper (used to regenerate SELEXOL solvent). (See figure 5.) Also included is one single train fractionating unit, which consists of a local fuel fractionator, a deethanizer, a depropanizer, and a debutanizer.

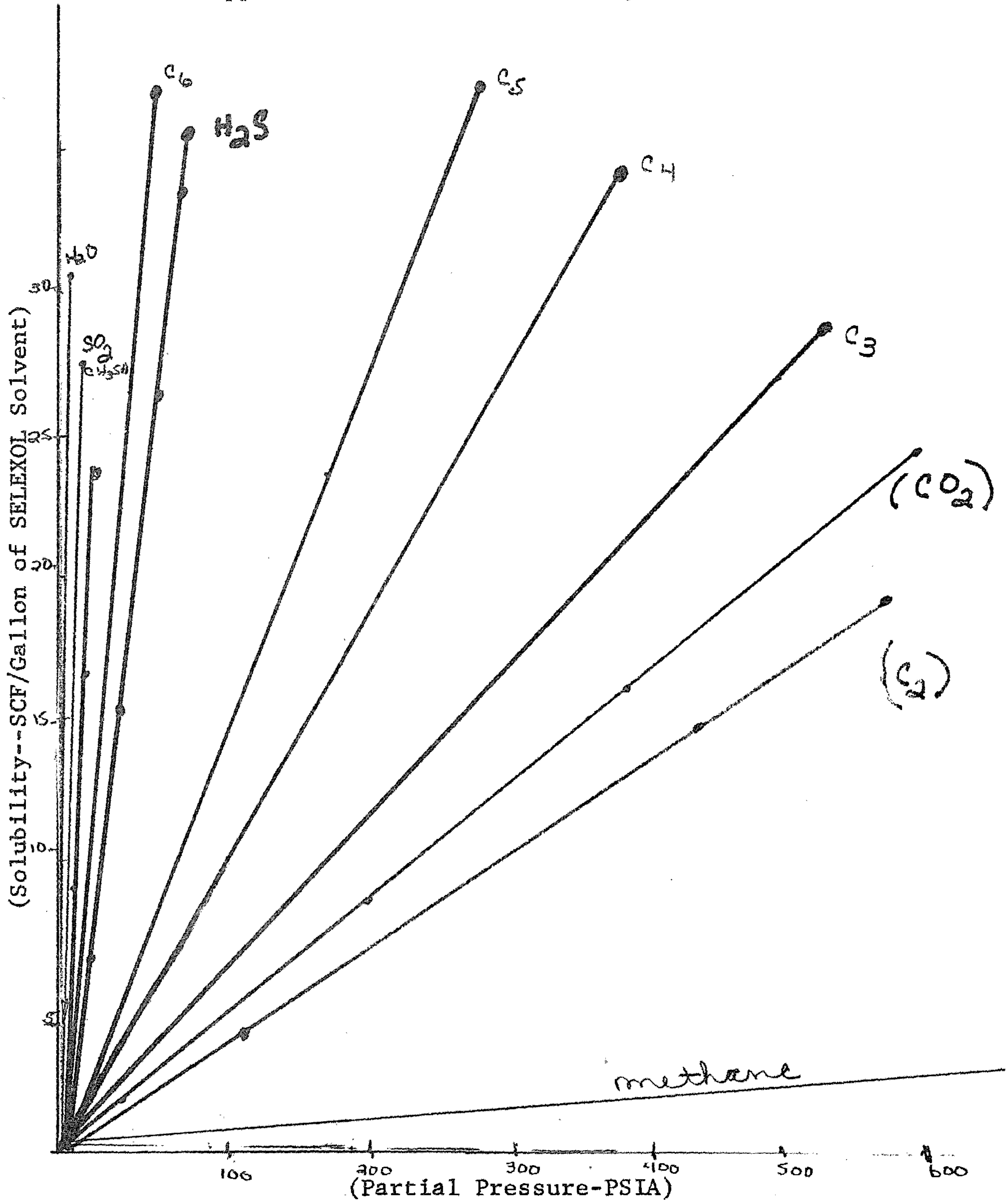
Removal of the CO_2 and NGL fractions in the feed gas takes place in a conventional countercurrent absorption column designed to accept recycled gas and semilean and lean solvents for maximum plant efficiency. The enriched SELEXOL solvent normally passes through four stages of equilibrium flashing and stripping prior to recirculation to the absorber. First, the high pressure flash produces CO_2 plus a smaller quantity of low molecular-weight hydrocarbons; this flashed gas is recycled with the feed gas to the absorber, while the solvent flows to the next flash vessel. In the intermediate flash stage, the flash gas usually has sufficient fuel value to drive some plant engines; in this stage, the liquid stream is fed to the low-pressure flash and final stripper. Next, semilean solvent from the low-pressure flash is pumped back to an intermediate tray in the absorber and flash gas is vented. Finally, the lean solvent passes from the stripper to the upper section of the absorber, and the gas is again either vented or processed to a sulfur unit. For some design conditions, the stripper and/or the intermediate flash vessel may be omitted.1/ The SELEXOL process improves efficiency as the temperature is lowered and therefore takes maximum advantage of the cooling effect from gas depressuring through hydraulic turbines. The SELEXOL system inherently provides a complete heat balance with little or no external heating or cooling required. Additional specific details of the process description are identified in appendix C.

In addition to the 2 Bcfd of pipeline gas product conditioned by the SGCF, a number of other products such as the high-CO_2 NGL would be separated. The flash gases would be used as fuel at the SGCF and the Prudhoe Bay industrial complex. The NGL's, which include separate ethane, propane, butane, and pentanes-plus streams, could be blended into the fuel streams (propane) to control heating value, into the pipeline gas to the hydrocarbon dewpoint limitation (propane or butane), or into the crude oil (butane or pentanes-plus) as limited by the vapor pressure specification.

1/ See appendix B for a discussion of plant and process economics.

Figure 4

Approximate SELEXOL Solubility Curve



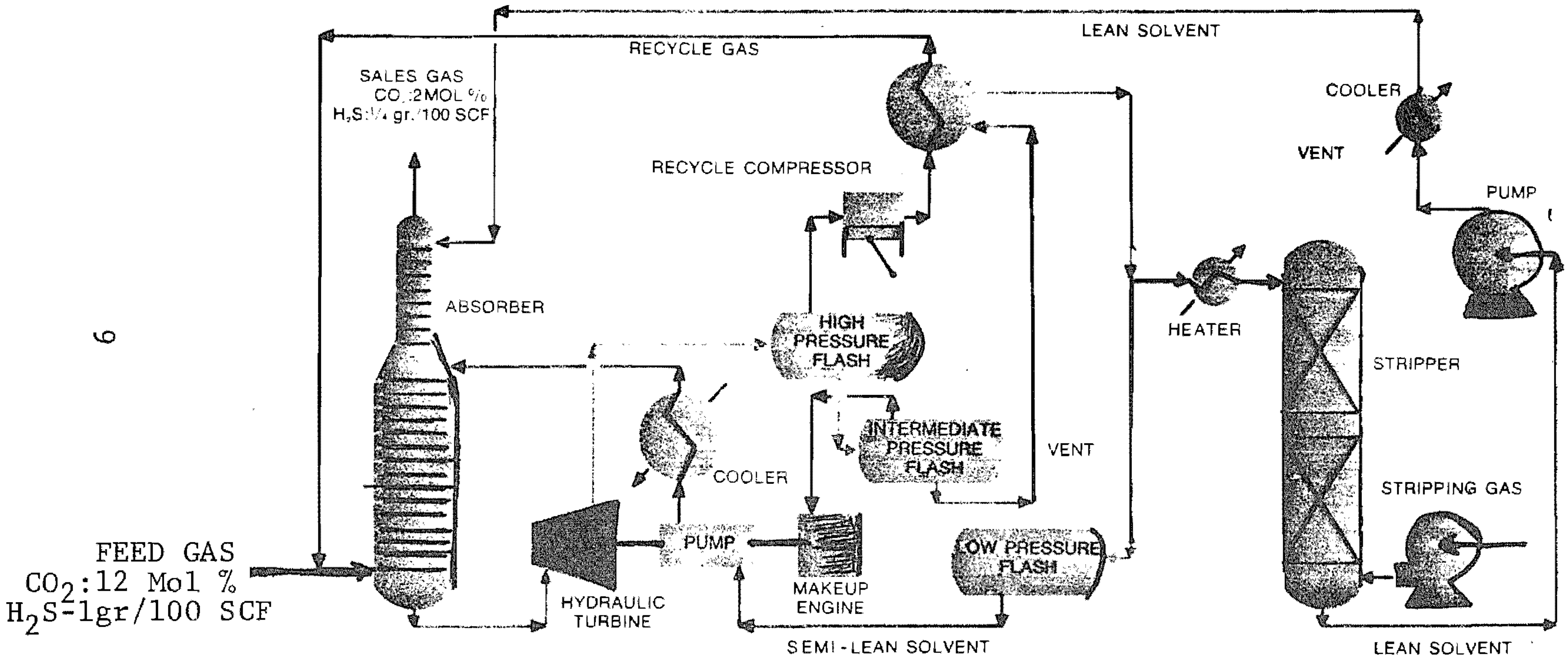


Figure 5. Typical SELEXOL Process For The Removal of CO_2 From Natural Gas

The design anticipates that there would be a significant variation in the summer and winter fuel requirements at the SGCF. The demand for fuel by the industrial complex would vary both as a function of season and time as well as oil production rates. Blending of butanes into either pipeline gas or crude is controlled by the pipeline hydrocarbon dewpoint limitation or by economics. These variations have been incorporated in the design.

The SELEXOL process was screened by Parsons along with various other processes to remove CO_2 from the natural gas being produced at Prudhoe Bay. The other processes evaluated were: Fluor's Propylene Carbonate, Shell's Sufinol, Union Oil's Sorbco-2, Latepro's Rectisol, Lurgi's Purisol, and Open-art DEA. Initially, Parsons determined that Latepro, Lurgi, and Open-art DEA were not economically feasible, given the gas composition and design considerations of the SGCF. The primary design criteria were proven reliability and capability of integration with existing facilities at low cost. The SELEXOL process was selected because of its proven commercial experience and its ability to meet hydrocarbon dewpoint specifications for the Prudhoe Bay gas. The environmental impacts of these process alternatives are addressed in section H of this EIS. The SELEXOL process has no liquid effluent or solid waste streams.

b) Support Facilities

The proposed docking facilities at Prudhoe Bay would have the capability of loading and unloading two barges simultaneously. A general cargo storage and modular staging area would be provided with appropriate lighting facilities. The proposed docking facilities considered in this EIS are the existing dock facilities owned by Arco/Exxon/SOHIO, widened to accommodate two-way modular traffic. While the Parsons report discussed the alternative of constructing a new separate causeway, ARCO has indicated in its comments on the DEIS that it does not plan a new causeway.

Process support facilities would include gas turbine-driven electric power generators, an emergency duel-fueled generator, four 1,000-barrel NGL storage tanks, a hydrocarbon waste product disposal system, a fire protection system, and a high-low pressure flare system to provide safe disposal of vapors generated during possible emergency conditions. Buildings required for plant administration and operation include an administration building, dormitory modules, an office and dining building, an elevator tower, a multistory shop complex, vehicle storage building, a warehouse, and an incinerator building. Access to the proposed SGCF and camp facilities would be provided by a new road network integrated with existing Prudhoe Bay roads.

i. Water Reservoir and Treatment Facilities

The proposed SGCF would extract water from the Putuligayuk (Put) River for immediate summer use and for storage in a proposed reservoir for use during the winter. A river intake structure, consisting of a small house on pilings from which two slotted casings would be hung, would be constructed on the main channel. The casings would have submersible pumps and discharge piping. Each pump would have a capacity of 200 gallons per minute (gpm), and they could be run simultaneously. The maximum extraction rate, therefore, would be 400 gpm, or slightly less than 1 cubic foot per second. The pump(s) would be stopped automatically during periods of low flow by a float attached to a shut-off valve. This would avoid removing all water from the river and would prevent damage to the pumping apparatus.

The water withdrawn from the river would be conveyed to a water heater that would heat the water to between 4.4°C. and 7.2°C. (40°F. to 45°F.). A 15.2 centimeter (cm.) (6-inch) diameter pipeline would convey the water directly to the operations center or to the water storage reservoir. The pipeline would be insulated by 10.1 cm. (4 inches) of polyurethane and warmed by electrical impedance heaters.

The water storage reservoir would be constructed midway between the river and the operations center. Two existing lakes averaging 0.61 meter deep would be thawed and deepened to provide a working capacity of 63 million gallons. Assuming the reservoir would have a maximum depth of 7.0 meters (23 feet), it would require a surface area of 10.4 acres. Approximately 305,824 cubic meters (400,000 cubic yards) of excavation would be necessary to provide that capacity; this includes an allowance for 1.8 meters of ice cover throughout the winter and for the possibility of annual precipitation in excess of the average of 12.7 cm. per year.1/

The intake arrangement in the reservoir would be similar to the one proposed on the Put River. Two pumps, each with a 200-gpm capacity, would lift water to the operations center. The water would then be treated and distributed to the facilities in the operations center and to the temporary construction camp.

1/ Factors for converting English units to metric units are presented in table 2.

TABLE 2

FACTORS FOR CONVERTING ENGLISH UNITS TO METRIC UNITS

Multiply English Units	By	To Obtain Metric Units
	Length	
inches (in)	25.4	millimeters (mm)
	.0254	meters (m)
feet (ft)	.3048	meters (m)
yards (yd)	.9144	meters (m)
rods	5.0292	meters (m)
miles (mi)	1.609	kilometers (km)
	Area	
acres	4047	square meters (m^2)
	.4047	hectares (ha)
	.004047	square kilometers (km^2)
square miles	2.590	square kilometers (km^2)
	Volume	
fluid ounces	29.6	milliliters (ml)
gallons (gal)	3.785	liters (l)
	3.785×10^3	cubic meters (m3)
million gallons (10^6 gal)	3785	cubic meters (m^3)
barrels (bbls)	.159	cubic meters (m3)
cubic feet (ft^3)	.02832	cubic meters (m^3)
cfs-day (ft^3/s-day)	2447	cubic meters (m^3)
acre-feet (acre-ft)	1233	cubic meters (m3)
	1.233×10^6	cubic kilometers (km^3)
	Flow	
cubic feet per second (ft^3/s)	28.32	liters per second (l/s)
	.02832	cubic meters per second (m^3/s)
gallons per minute (gpm)	.06309	liters per second (l/s)
	6.309×10^5	cubic meters per second (m^3/s)
	Weight	
grains	64.8	milligrams (mg)
ounces (oz)	28.35	grams (gr)
pounds (lb)	.4536	kilograms (kg)
tons (short)	.9072	tons (metric)

The water treatment system for the SGCF would be similar to that of the existing water treatment system in the Arco Operations Center. The design was selected because of its proven capability at the existing facilities. Water for treatment is proposed to be pumped from the Put River in the summer (late June through September) and from the water storage reservoir during the remainder of the year. The plant would contain the following equipment: flocculant feed equipment, sand filters, softeners, chlorinators, storage tanks, high-service pumps, and ancillary equipment. The usual treatment consists of sand filtration, softening, and chlorination. If the water were unusually turbid, flocculation equipment would be available. If the river were turbid, however, water generally would be taken from the reasonably clear reservoir. The water treatment facilities would have the capacity to treat 150,000 gallons per day (gpd) and to store 90,000 gallons in three equally sized tanks. Minor amounts of filter backwash and sediment, the direct byproducts of the water treatment facilities, would be conveyed to the sewage treatment facilities.

The anticipated peak daily water use is estimated to be 100 gallons per capita. Actual data for similar facilities indicate averages of 70 to 80 gallons per capita. An average camp with a population of 1,176 would use from 94,080 to 117,600 gpd during construction.1/ The permanent operations center would have a population of 200 and a daily water use of from 16,000 to 20,000 gallons. During construction, the water storage requirement for an assumed 8.5-month period would be from 23,990,000 to 29,988,000 gallons. The remaining capacity of the lake would be usurped by ice. During operation, the storage requirement would be only 5,100,000 gallons, or about 17 percent of the construction capacity.

The rate of pumping from the Put River during the 3.5 months of flow would be determined by the quantity required to replenish the reservoir and to provide the operations center and the construction camp with water. Assuming 101 pumping days (i.e., continuous pumping during June, July, August, and half of September), the daily pumping rate would be 414,500 gpd (287 gpm or 0.64 cubic feet per second (cfs)) during construction and 70,500 gpd (49 gpm or 0.1 cfs) during operation. It is more likely, however, because of low flow conditions in the Put River, that pumping would occur on 75 or fewer days during June, July, and August. Therefore, a more realistic pumping rate would be 517,400 gpd (359 gpm or 0.8 cfs) during construction and 88,000 gpd (61 gpm or 0.14 cfs) during operation.

1/ The camp population is estimated to include 1,000 craft personnel, 130 subcontractor staff, and 46 Alaskan managing contractor staff.

The wastewater treatment facilities for the proposed SGCF would be similar in design to the existing Arco wastewater treatment facilities. Wastewater from the proposed construction camp and operations center would be pumped to two 30,000-gallon surge tanks. Together the tanks would hold 50 percent of the maximum daily flow from a maximum camp population of 1,176. The flows from the conditioning plant would be stored in a holding tank in the plant and then would be trucked to the wastewater treatment plant.

The proposed treatment involves secondary wastewater treatment and sludge incineration. Wastewater would flow from the surge tanks at a controlled rate through a comminutor into a primary settling tank and then to an aerobic biological filter treatment unit. The effluent from the secondary clarification of the wastewater would be passed through a multimedia filter and would be disinfected with liquid chlorine, using a 45-minute to 60-minute contact period. The chlorinated wastewater would be discharged to a stabilization pond that would be constructed by diking a tundra lake located on the north side of the housing area. (The total size of the tundra lake is unknown.) The dike would be earthen. The effluent would be discharged into the pond through a pipe approximately 0.61 meter (2 feet) below the surface. Water from the pond then would flow over a wier to the main part of the lake or onto the tundra. The path of the treated wastewater after leaving the stabilization pond is unknown.

At the existing Arco wastewater lake, which has a surface area of about 195 acres, wastewater flows of from 33 to 55 million gallons per year are disposed of. Based on a net evaporation rate of from 12.4 to 15.1 cm. of water from June through September, from 24 to 31 million gallons could evaporate from the lake. Therefore, from 9 to 24 million gallons of water per year either flow through or across the tundra or are removed via evapotranspiration by the tundra. It is estimated that between 39 and 105 acres of tundra would be required to evaporate that quantity of water.

At the proposed SGCF wastewater pond (surface area of 19 acres), about 2.5 to 3 million gallons of water would evaporate during the summer. The net outflow to the tundra, therefore, would be about 40 million gallons. The area of tundra necessary to evaporate this water would be approximately 175 acres. Because of the saturated condition of the active layer during the summer, it is unlikely that significant volumes of wastewater would be transported for any distance through the active layer.

The sludge from the primary and secondary clarifiers would be settled, thickened, and centrifuged. About 613 pounds of sludge would require incineration daily.

The National Pollution Discharge Elimination System (NPDES) permit for the effluent discharge of waste to the existing Arco lake requires a monthly average 5-day biochemical oxygen demand (BOD_5) of 30 milligrams per liter (mg/l) or less and a monthly maximum of 45 mg/l. The permit requirements for total suspended solids (TSS) are the same as those for BOD_5. It is anticipated that the NPDES requirements would be similar at the new facility. The expected ranges of wastewater BOD_5 and TSS are 10 to 20 mg/l and 5 to 10 mg/l, respectively. Wastewater flows of up to about 120,000 gpd are anticipated, based on the assumption that 100 gallons per capita per day would be produced. The plant would have the capacity to treat flows of up to 150,000 gallons per day.

ii. Solid Waste Disposal Facilities[1/]

The solid waste disposal system would consist of an incinerator facility and a landfill to dispose of noncombustibles and ashes. The incinerator would be housed in a 9.1-by-18.3 meter building where refuse collection trucks could dump the trash without scattering it indiscriminately. The incinerator could accommodate wastes from a 1,500-person construction force that produces 8.5 pounds per capita per day of wastes requiring incineration, or an estimated total of 12,750 pounds (6.4 tons) per day. During operation, the 200-person camp is expected to produce a total of 1,700 pounds (0.85 ton) of waste per day. Sludge from the wastewater treatment plant, containing 30-percent solids, would be incinerated at the same facility. About 613 pounds of sludge would require incineration each day.

Presently, solid wastes and sludge from all of the Arco facilities and from the construction camp are incinerated at the Arco operation center. A 1979 study done for the proposed Kuparuk Field Facilities determined that the solid waste production rate for the existing facilities was from 18 to 20 pounds per capita per day, although much of the waste (10 to 11 pounds per capita per day) was noncombustible construction debris that was placed directly in the landfill. The capacity of the existing Arco incinerator is 2,000 pounds per hour, or a maximum capacity of 24 tons per day.

1/ The staff recognizes that the specific site for solid waste disposal will have to be authorized by the State of Alaska. The State and the North Slope Borough are presently addressing this issue.

The North Slope Borough has finished constructing an incinerator facility at Deadhorse that contains two units: one with a 4,000 pounds per hour capacity (48 tons per day) and the other with a 2,000 pounds per hour capacity (24 tons per day). The system consists of a refuse collection truck receiving area, a shredder, a magnetic separator, and the incinerators. An air classifier system has been proposed to remove light materials. Construction debris, large noncombustibles, and ashes would be trucked to a landfill.

4. Construction Procedures

The Parsons report estimates that approximately 4.5 years would be required for a workforce of 1,000 to complete the proposed gas conditioning facility. The general construction plan assumes that three phases of work would take place. First, a small sealift of basic equipment would be scheduled the initial year of construction and would be supplemented by truck hauling. Two major sealifts would be planned for the following 2 years.

Lower 48 fabrication site(s) for modular construction would be located adjacent to major deep-draft waterways, probably on the west coast of the United States, which provides favorable weather conditions, adequate labor force, and the shortest shipping route to Prudhoe Bay. Fabrication sites would require about 200 acres the first year and 80 acres the second year. Because of the magnitude of this project, at least two or three sites would be needed. All possible sites would require grading, compacting, and construction of module assembly pads, offices, warehouses, utility distribution system, fencing, and barge loading facilities. Docking facilities at the fabrication sites would be capable of deadloading--loading a barge that is flooded and bottomed, thus providing a stable loading platform. The difference in elevation of the dockhead and waterway bottom must match barge side shell heights; in addition, water depth must be sufficient to allow floatation of the loaded barges after deballasting. The load line draft of the largest barge is 4.3 to 4.6 meters; it is not anticipated that loaded barge drafts would exceed 3.4 meters, so that a high tide water depth of 4 meters would be sufficient for the loading/unloading operation.

Recommendations call for shipping widths of modules to be limited to 14.6 meters, allowing for side-by-side storage of modules on the 122-meter by 30.3-meter barges. Shipment of heavy, high center-of-gravity modules such as those containing the CO_2 absorber, SELEXOL strippers, and other columns would require strengthened barges.

The size and quantity of cargo barges available for the project, as well as the projected requirements, are shown in table 3. Both the phased and full startup cases would require approximately the same footage of barge space. Phased startup would require larger but fewer barges. At Prudhoe Bay, crawler transporters and transporting vehicles with pneumatic tires would be required to offload the modules from the barges. However, present crawler transporters do not have the overland speed necessary to complete extensive offloading programs. Modifications would be necessary to increase their overland speed.

Further discussion of the impact of modular construction is presented in appendix D.

Construction at Prudhoe Bay must allow for remote location, long periods of darkness, extreme ranges of temperatures, and congested packed ice conditions in the ocean access routes. The low temperatures and high winds prevalent at Prudhoe Bay dictate that all equipment be totally enclosed. By controlling the environment in which the equipment operates, it is possible to design efficient, low-maintenance process systems. Construction on the permafrost of Prudhoe Bay requires that all facilities and all accessways to facilities be on gravel pads, which provides an insulating blanket to prevent melting of the permafrost. A gravel pad thicker than the thaw depth is required to keep the permafrost under the pad frozen. Gravel pads would be laid in place before modular construction began. All equipment, interconnecting systems, and accessways would be designed for preassembly in the lower 48 states. These units would be further assembled into larger modular units in Alaska. Modular construction is designed to minimize the impact of the process plant on the permafrost, to minimize the plant's acreage layout, and to facilitate the ease of construction at the plant's construction site.

5. Operation, Maintenance and Emergency Procedures

Access to the SGCF would be limited to authorized personnel. Fire protection measures would be taken to prevent loss of life and to protect the process equipment. Fire, smoke, and gas detection alarm systems, a Halon inerting/extinguishing system, foam and dry chemical firefighting carts, fire-control water hose stations, self-contained breathing apparatus, and protective/evacuation equipment would be installed. The modular design would provide multiple exits to the outside and to other protected areas.

TABLE 3

OCEAN-GOING BARGES FOR MODULE MOVEMENT

Primary Barge Sizes (LxWxH)	Quantity Available	Estimated Quantity Required					
		Full Capacity Start			Phased Start		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
400ft X 99.5ft. X 20ft (or 25ft.)	20	--	12	13	--	17	10
400ft. X 76ft X 20ft.	10	--	8	2	--	6	--
312ft. X 68ft. X 17ft.	3	--	--	--	--	--	--
250ft. X 76ft. X 16.7ft.	10	2	4	1	2	2	1

Source: Parsons, Sales Gas Conditioning Facilities, Prudhoe Bay, Alaska: Implementation Plan and Cost Estimate Summary, September 1978.

Under normal conditions, the gas conditioning facilities would be operated by a permanent crew of 200. All operations would be controlled from a central control room. Local satellite control rooms would operate equipment in localized operational areas during startup and shutdown. The SGCF central control room would be equipped with safety alarm and control systems which would continuously monitor significant plant operations and allow the control room operators to make adjustments or notify local operators of required adjustments.

Microwaves are the primary communication between all major facilities at Prudhoe Bay. The systems would be integrated with transmitters and receivers at each location which provides both telephone and data communications with Arco, SOHIO, Alyeska, and gas pipeline compressor stations. The RCA satellite would link this system to direct dial telephone systems outside Prudhoe Bay.

The fire protection system of the proposed facility would consist of process and utility units subdivided into separate fire zones. It would comply with the provisions of the National Fire Protection Association (NFPA) Standard 70 National electric code. Fire zones are protected by two types of detection systems: a hydrocarbon gas detection system employing primary gas detectors calibrated for methane and supplemental detectors that are calibrated for propane and heavier hydrocarbon gases, and a fire detection system employing either thermal or ionization detectors. In addition, each fire zone would be protected by an independently controlled Halon 1301 (inert gas) inerting/extinguishing fire protection system. The Halon system in any one or all of these fire zones could be activated either manually or automatically by a signal from either a gas or thermal detector.

Emergency medical needs of plant personnel will be handled in the plant first aid unit, which would be equipped to handle simple emergency operations requiring local anesthetic. The proposed unit would provide 12 beds. Hazardous pollutant emergency conditions would arise if a Halon dump or a major hydrocarbon leak occurred. This would produce acute exposure to hydrocarbons but would pose no chronic toxic effect on plant personnel. General disaster procedures have not been formulated to date, but they would be included in the final plant operations manual.

The facilities and process equipment would be protected from overpressurization and be capable of depressurizing in any emergency. Venting systems would be collected by flare headers at two pressure levels. A high-pressure flare system would be designed to depressurize the SGCF to 200 psig in 10 minutes, and a low-pressure flare system would be sized to depressurize the SGCF to 5 psig in 10 minutes. All systems operating at or below 200 psig would be connected to a low-pressure flare. The emergency shutdown vent system would also be capable of relieving the entire facility within

10 minutes, with special attention given to the chilling effect caused by expansion during depressurizing in order to minimize metallurgical failure at reduced temperatures caused by thermal shock. The unenclosed flare headers would be heat traced and insulated downstream of the knownout drum to minimize condensation and possible pipeline freezeup.

6. Water Injection Facilities1/

When gas now being reinjected into the reservoir is sold, the reservoir pressure will decline rapidly. To minimize this decline and increase recovery in portions of the reservoir, water would be injected under pressure into the producing reservoir rocks via injection wells. Water injection (or waterflooding) is a commonly used secondary recovery or pressure maintenance method.

The waterflood facilities are depicted in figure 6. Water for injection would be drawn from the Beaufort Sea. The intake, designed to withdraw 75,139 gallons of seawater per minute (108.2 million gallons per day), would be an intregral part of the seawater treating plant. This plant would filter and deaerate the seawater and add heat to prevent freezing during transit in the pipeline distribution system. This heated seawater would be pumped into individual insulated low pressure pipelines to each of two injection plants on either side of the field. The injection plants would raise the pressure of the water for distribution and injection and provide additional heating to protect against freezing. The water would then be distributed through separate high pressure pipelines to well pads and injection wells.

Construction of the facilities would begin in the summer of 1981.

Directly contradicting comments ARCO made on the DEIS (see section C.3.c.), the currently proposed waterflood facilities include a 1,125-meter (3,700-foot) extension of the existing causeway on the western side of Prudhoe Bay. According to a draft environmental report prepared by Dames & Moore on the waterflood facilities, the causeway extension was substituted for buried intake pipes because of "greater costs associated with longer intake pipes as well as engineering problems. . . ."2/ Estimated gravel requirements for the waterflood project are shown in table 4. The project as currently proposed would require approximately 760,000 cubic yards more gravel than a previous proposal, which did not include a causeway extension.

1/ The waterflood project is separate from the project discussed in this volume and will be addressed in a separate EIS prepared by the U.S. Army Corps of Engineers. Consequently, the staff will not discuss in detail the impact associated with the water-injection facilities. However, we will discuss the potential cumulative impact associated with the construction and operation of these facilities.

2/ Dames and Moore, Prudhoe Bay Waterflood Project Environmental Assessment, Volume I, April 1980, p. 2-65.

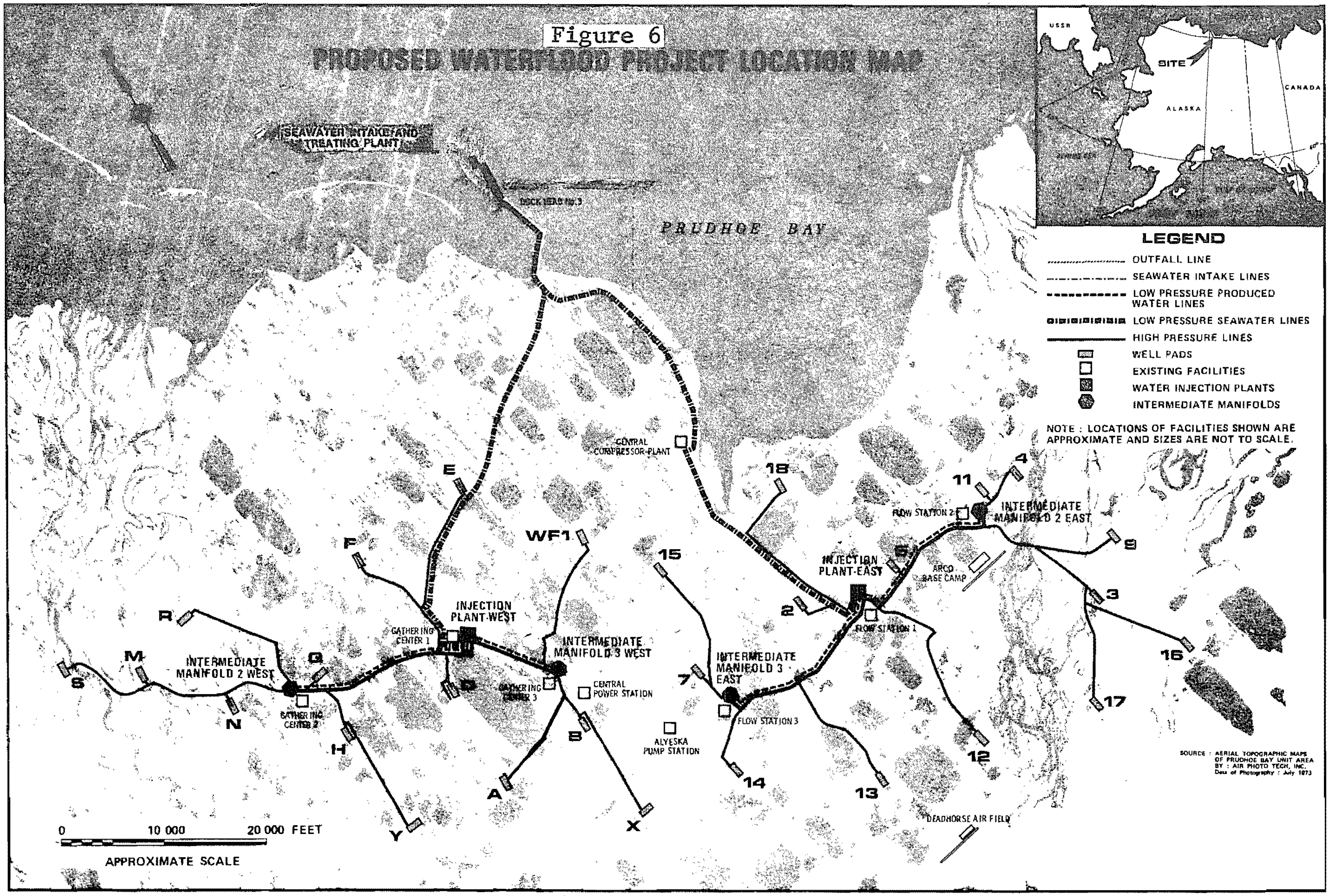


Figure 6
PROPOSED WATERFLOOD PROJECT LOCATION MAP

TABLE 4

ESTIMATED GRAVEL REQUIREMENT SUMMARY
PRUDHOE BAY UNIT WATERFLOOD PROJECT AND OTHER AREA DEVELOPMENT[a]

Year	Facility	Gravel (1000 m^3)	Gravel (1000 yd^3)
1981	Road - Staging Area to West Injection Plant	99	130
	Seawater Treating Plant	191	250
	Causeway Extension	459	600
	DH 3 and Causeway Modifications	115	150
	Total 1981	864	1130
1982	Causeway Extension	229	300
	Causeway Modification	191	250
	Pipeline Construction Pad	84	110
	Injection Plants	92	120
	Intermediate Manifolds	31	40
	Well Pad Extension and Emergency Pits	535	700
	Total 1982	1162	1520
1983	Seawater Treating Plant	229	300
	Well Pad Expansion and Emergency Pits	268	350
	Total 1983	497	650
	Waterflood Total 1980-1983	2523	3300

a/ Initial actions only; does not include maintenance, which could add another 50,000 - 100,000 m^3/yr.

The seawater treating plant would be located at the end of the causeway extension (figure 7), permitting the integral intakes to be located in a water depth of 3.7 meters (12 feet). The seawater would be strained, heated, filtered, and deaerated in the plant. As needed, a coagulant (probably a polyamine) and a biocide (probably chlorine) would be added to improve filter performance. Periodically, each of the filters would be backwashed with seawater. The backwash effluent would be returned to the sea through an outfall line. Probable water treating chemicals that would be added at three locations in the treating plant plant process flow are listed in table 5.

The 32-inch diameter main outfall pipeline would transport process effluents from the seawater treating plant to an outfall located in 3 meters (10 feet) of water approximately 760 meters (2,500 feet) north and 300 meters (1,000 feet) west of Dock Head 3. The marine life return outfall line would transport fish and other marine life screened from the inlet reservoir to an outfall approximately 150 meters (500 feet) east of the seawater treating plant.

The annual average effluent flow rate in the main outfall line would be 8.9 cubic feet per second (cfs), with a maximum flow rate of 38.8 cfs. The buried outfall pipeline would terminate in a diffuser, which would provide for dilution ranges of 10: to 15:1 within a radius of about 30 meters (100 feet) of the point of discharge. Beyond this approximately 1- acre mixing zone, the discharge would meet State of Alaska water quality criteria. Table 6, based on pilot filtration tests, characterizes the outfall pipeline effluent. The coagualated particles within the effluent would be deposited over 5 to 45 acres.

The low pressure seawater transfer lines would be buried above sea level between the extended and existing causeway and the shore. After leaving the causeway, the lines would be installed above ground and supported on pile bents.

One 40-inch diameter pipeline approximately 13 miles long and one 36-inch diameter pipeline approximately 10 miles long would be required between the seawater treating plant and the east side injection plant and between the treating plant and the west side injection plant, respectively. Three miles of the pipeline to the west side injection plant would not follow existing rights-of-way. The aboveground sections would be provided with crossings or passageways for caribou.

Gravel pads for both injection plants would occupy approximately 315,000 square feet and 267,000 square feet, respectively.

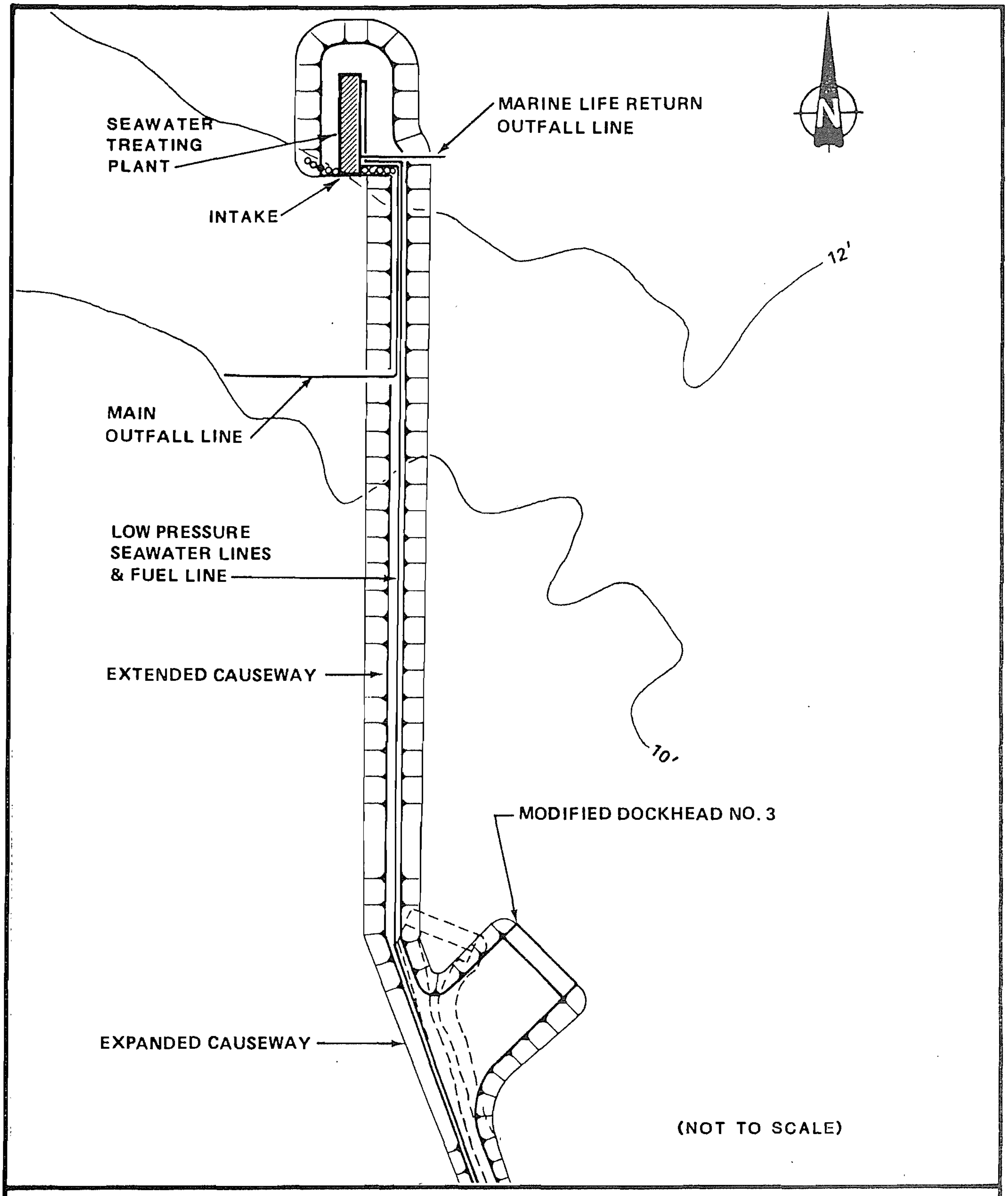


Figure 7

PROPOSED DOCK MODIFICATION & CAUSEWAY EXTENSION
LOCATION PLAN

TABLE 5

TYPICAL SYSTEM CHEMICAL USE (Estimated Average)

Where Added	Chemical Type	Effective Concentration	Use	Frequency
Upstream of filters	Sodium Hypochlorite[a]	0.1 ppm	Biocide	Continuous
	Cationic Poly-electrolyte[b]	0.85 ppm	Coagulant	Continuous
Upstream of Deaerators	Fatty Acid and Polyglycol[c]	0.25 ppm	Anti-foam	Continuous
Downstream of Deaerators	Catalyzed Sodium Bisulfite[c]	0.9 ppm	O_2 Scavenger	During Deaerator malfunction
	Filming Amine[c]	7.0 ppm	Corrosion Inhibitor	During Deaerator malfunction
	Phosphate Ester[c]	7.0 ppm	Scale Inhibitor	During Deaerator malfunction

a/ Added upstream of the filters to establish a 0.1 ppm residual concentration at the filter feed inlet. Filter backwash feed will contain no biocide.

b/ Typical brands are NALCO 3332; NALCO 3364; TFL 3910 (Tretolite).

c/ Added downstream of filters and thus will not be present in the outfall except during emergency displacement of both low pressure supply lines.

TABLE 6

CHARACTERIZATION OF MAIN OUTFALL PIPELINE EFFLUENT

	OPEN - WATER INFLUENT TSS = 150 mg/l (Maximum Case)		OPEN - WATER INFLUENT TSS = 25 mg/l (Average)		UNDER - ICE INFLUENT TSS = 3 mg/l (Average)		
	Daily Average Effluent	Effluent During Filter Backwash	Daily Average Effluent	Effluent During Filter Backwash	Daily Average Effluent	Effluent During Filter Backwash	Annual Average
COMPONENT WT%							
TSS	706 PPM	1778 PPM	525 PPM	871 PPM	72 PPM	210 PPM	185 PPM
COAGULANT[a]	6 PPM	20 PPM	20 PPM	43 PPM	18 PPM	55 PPM	18 PPM
BIOLOGICAL MATTER[b]	0.2 PPM	0.8 PPM	0.2 PPM	0.4 PPM	0.2 PPM	0.6 PPM	0.2 PPM
Cl_2[c]	0	0	0	0	0	0	0
TDS, O_2, N_2, CO_2[d]	-	-	-	-	-	-	-
TOTAL RATE m^3/s (MBD)	1.10 (594)	1.10 (594)	0.20 (110)	0.40 (214)	0.18 (96)	0.40 (214)	0.19 (100)
SOLIDS & COAGULANT DISCHARGE, TON/D							
o TSS	75.6	-	10.3	-	1.24	-	3.5
o COAGULANT	0.6	-	0.4	-	0.3	-	0.3
o BIOLOGICAL MATTER	0.02	-	0.005	-	0.005	-	0.005
FREQUENCY, CYCLES/DAY	-	48	-	40	-	24	28
DURATION PER OCCURENCE	-	9 MIN	-	9 MIN	-	9 MIN	9 MIN

NOTES:

a/ Coagulant Dosage: Open-Water Maximum: 1.5 PPM; Open-Water Average: 1.0 PPM; Under-Ice Average: 0.8 PPM.

b/ Biological Matter Cal'd from EST'D. Dry Wt. of Samples caught in net: Open-Water Maximum: 0.05 mg/l - 505 Micron Net Used; Open-Water Average: 0.01 mg/l - 505 Micron Net Used; Under-Ice Average: 0.01 mg/l - 253 Micron Net Used

c/ Biocide may normally be injected. If sodium hypochlorite is used (as assumed above), chlorine residual in the biocide treated water will be controlled to approximately 0.1 ppm max. The backwash supply for the screens, strainers, and filters would not be chlorinated.

d/ TDS, O_2, N_2, and CO_2 unchanged from ambient conditions.

e/ Annual average effluent based on 9 months under ice and 3 months open water.

Ultimately, five injection pumps would be installed at the east injection plant and four at the west injection plant. Each pump would be driven by gas turbines and would require approximately 16,000 horsepower. Field gas would be used as their fuel.

The total high pressure pipeline would be approximately 99 miles long; it would range in diameter from 6 to 24 inches. All pipelines would be installed above ground, supported on pile bent, and would follow existing (in 1984) pipeline corridors. The new pipelines would be incorporated into existing crossings for caribou.

An air emissions summary for the gas-fired heaters at the treating plant and the injection plant and the gas turbines at the injection plant appears in table 7.

7. Future Plans and Abandonment

A definite design for future expansion has not been established. However, the SGCF could increase its output by 50 percent without any major modifications to the proposed plant's process equipment. Piping, headers, and major mainfolds in the proposed facilities are designed to accommodate an eventual expansion of 50 percent. Additional process trains would of course have to be added at the site. Space adjacent to the proposed SGCF has been allotted for future additions to the facilities.

Since the Prudhoe Bay field could produce for more than 25 years and since there is a high potential for discovering other reserves in the area, the proposed SGCF should be operational for many years; therefore, exact abandonment procedures have not been formulated.

TABLE 7

PRUDHOE BAY UNIT WATERFLOOD PROJECT

ESTIMATED AIR EMISSIONS SUMMARY TABLE

Source of Emission →	SEAWATER TREATING PLANT		INJECTION PLANTS			
	Fired Heater Stack Gas		Gas Turbine Stack Gas		Fired Heater Stack Gas	
Number of Units	6		9		4	
Size per unit	100 MMBTU/hr (6)		16,000 HP		25 MMBTU/hr (6)	
Composition	Vol %	(tons/year)				
N_2	72.0		77.1		72.0	
O_2	2.5(1)		15.9		2.5(1)	
CO_2	9.8		2.7		9.8	
CO(2)	20 PPM	(8)	40 PPM	(77)	20 PPM	(2)
NO_x	80 PPM(2)	(83)	150 PPM(3)	(413)	80 PPM(2)	(21)
SO_2	0.6 PPM	(0.3)	0.1 PPM	(0.3)	0.6 PPM	(0.1)
H_2O	15.7		4.3		15.7	
Hydrocarbons(2)	5 PPM	(1.4)	10 PPM	(14)	5 PPM	(0.4)
TOTAL	100.0		100.0		100.0	
Particulates(2)	15 PPMW		N.A.		15 PPMW	
Flowrate, acfm per unit	52,000		210,000		13,000	
Temperature, °F	600(4)		300-350(5)		600(4)	
Continuous or Intermittent	C		C		I	
Frequency	-		-		Emergency backup heating	

NOTES:
1. Based on 15% excess air
2. Based on EPA emission factors, AP-42
3. Based on NSPS gas turbines
4. Heater efficiency is 85% based on fuel LHV
5. Assumes heat recovery unit installed on gas turbine
6. Heater duties are BTU inputs based on fuel LHV

B. DESCRIPTION OF THE EXISTING ENVIRONMENT

1. Climate

Climatological data for the arctic coast of Alaska are scarce. The U.S. National Weather Service (NWS) station closest to the project site is Barter Island, approximately 190 km. to the east. This station has 27 years of surface weather data taken eight times per day. In the Prudhoe Bay area, there are two non-NWS airport weather stations: at the Prudhoe Bay Airport and at the Deadhorse Airport. The Prudhoe Bay Airport weather station is operated 12 hours per day by Alaska Airlines, and the Deadhorse Airport weather station is operated 24 hours per day by the Federal Aviation Administration (FAA). At the latter station, temperature observations are taken infrequently because the FAA controller must leave the control tower to read the thermometers. Normal FAA operations prevent this most of the time. The data reported in this section are from the Barter Island station, except where otherwise noted. The data from Barter Island are similar to the data from Prudhoe Bay, except where noted.

a) Temperature

The Artic Slope of Alaska has long, cold winters and short, cool summers. At Barter Island, temperatures range between 4°C. and 24°C. during the summer months and between -29°C. and -51°C. in the winter. Annual mean temperatures range from -15.4°C. to -9°C. (See table 8.) Minimum ambient air temperatures during December, January, and February for the period of record show that at Barter Island temperatures will be -31.6°C. or lower for 15 days in December, 14 days in January, and 23 days in February.

b) Precipitation

The Prudhoe Bay area is semiarid, with annual precipitation ranging between 10.2 and 25.4 cm. Storm paths are present only during summer months and are generally infrequent. Precipitation is highest in July and August, when it generally falls as rain. Snow, however, appears in every month and usually predominates from September to May. The highest recorded 24-hour snowfall is 43.2 cm. At Barter Island, 27 years of precipitation records show that the average annual precipitation (rain) is 17.9 cm. The average annual snowfall amounts to 91.4 cm. Table 9 presents precipitation data at Barter Island, Alaska.

TABLE 8 TEMPERATURE AND RELATIVE HUMIDITY AT BARTER ISLAND, ALASKA, 1941-1970

Month	Avg. Temp. (°F.) Daily Max.	Avg. Temp. (°F.) Daily Min.	Avg. Temp. (°F.) Monthly Mean	Temperature Extremes (°F) Record highest	Temperature Extremes (°F) Record lowest	Temperatures (°F) Number of Days (Max) 90° and above	Temperatures (°F) Number of Days (Max) 32° and below	Temperatures (°F) Number of Days (Min) 32° and below	Temperatures (°F) Number of Days (Min) 0° and below	Relative Humidity (%) vs. Time 2 am	8 am	2 pm	8 pm
(a)				25	27	27	27	27	27	27	27	27	27
January	-8.5	-21.9	-15.2	39	-51	0	31	31	29	69	69	68	68
February	-13.1	-25.8	-19.5	34	-59	0	28	28	28	67	68	67	68
March	-7.5	-21.9	-14.7	36	-51	0	31	31	30	67	67	68	68
April	8.2	-8.1	0.1	43	-38	0	29	30	23	74	74	75	75
May	26.5	15.7	21.1	52	-16	0	24	31	3	87	87	85	87
June	38.2	29.9	34.1	67	13	0	4	23	0	92	90	88	90
July	45.5	34.5	40.0	78	24	<0.5	<0.5	9	0	93	89	86	89
August	43.5	34.3	38.9	72	24	<0.5	1	11	0	95	92	88	92
September	35.0	28.1	31.6	64	4	0	11	25	0	92	91	88	91
October	21.5	11.2	16.4	46	-23	0	29	31	7	84	84	84	84
November	6.3	-5.9	0.2	37	-51	0	30	30	20	75	75	75	74
December	-6.4	-18.3	-12.4	37	-51	0	31	31	29	69	69	69	69
ANNUAL AVERAGE	15.8	4.3	10.1	78	-59	<0.5	249	312	168	80	79	78	80

(a) length of record, (years) through the current year unless otherwise noted, based on January data.

NORMALS - based on records for the 1941-1970 period.

Source: NOAA, 1977

TABLE 9 PRECIPITATION DATA AT BARTER ISLAND, ALASKA, 1941-1970

Month	Precipitation in Inches: Water Equivelent: Normal	Water Equivelent: Maximum Monthly	Water Equivelent: Minimum Monthly	Water Equivelent: Maximum in 24 hr.	Snow Ice Pellets: Maximum Monthly	Snow Ice Pellets: Maximum in 24 hr.	Mean Number of Days: Precipitation 0.01 in. or more	Snow, ice pellets, 1.0 in. or more	Thunderstorms	Heavy fog, visibility 0.25 mi. or less
(a)		26	26	26	26	26	25	26	25	26
January	0.55	4.08	0.01	2.25	35.0	14.8	6	1	0	1
February	0.33	2.53	T	1.22	15.3	3.8	5	1	0	1
March	0.26	1.44	T	0.55	15.0	5.5	5	1	0	1
April	0.23	1.22	T	0.44	12.2	4.4	6	1	0	3
May	0.31	1.51	T	0.76	11.1	7.6	7	1	<0.5	8
June	0.53	2.09	0.06	1.15	9.4	6.7	6	1	<0.5	12
July	1.12	3.01	0.15	1.64	3.0	2.8	9	<0.5	<0.5	15
August	1.28	3.40	0.16	1.11	7.4	3.4	11	1	0	16
September	0.89	4.91	0.07	2.23	35.8	17.0	10	2	0	10
October	0.81	3.62	0.12	1.98	32.1	16.0	13	3	0	4
November	0.45	1.50	0.04	0.43	14.9	5.0	8	2	0	3
December	0.29	1.17	T	0.55	12.9	5.2	6	1	0	1
ANNUAL AVG.	7.05	4.91	T	2.25	35.8	17.0	91	13	<0.5	75

(a) -period of record (years) through the current year, unless otherwise noted, based on January data

T - Trace

Normal - Based on record for the 1941-1970 period.

Source: NOAA, 1977.

c) Winds

Surface winds along the arctic coast are generally constant in direction and velocity. Prevailing winds, recorded at Barter Island, are from the east most of the year, but most high winds (in excess of 17.9 meters per second) are from the west. (See table 10.) The mean annual wind speed is 21 km. per hour, though winter gusts have reached 23.8 km. per hour. Data from Barter Island and the Deadhorse Airport indicate differences in wind direction and velocity. (See table 10 and figure 8.) The prevailing winds at the Prudhoe Bay site are from the east-northeast rather than from the east, and Prudhoe Bay does not get the high winds from the west recorded at Barter Island.

d) Ice Fog

Ice fog, a phenomenon peculiar to arctic and subarctic regions, can occur any time from late November through March. It is formed when water vapor from natural or artificial sources meets a stable air mass that is cold enough (below -30°C.) to transform the vapor into tiny ice crystals. These ice crystals vary in size from 3 to 10 microns. Because of their small size, these ice crystals do not settle out like snow, but remain suspended in the stable, stratified air mass close to the ground, producing a fog-like condition. The ice fog layer has a vertical thickness of approximately 10 meters and rarely exceeds 30 meters in vertical thickness. Its thickness and density, however, increase when the temperature remains below -40°C. for extended periods.

Ice fog at the Prudhoe Bay site is reported to be minimal because of the constant wind experienced there. The major existing sources of atmospheric water vapor at the project site that contribute to ice fog include, but are not limited to, the Beaufort Sea, pickup and diesel trucks, fossil fuel space heaters, the sewage treatment plant, and human and animal respiration.

2. Topography, Geology, and Soils

The proposed SGCF would be constructed within the Arctic Coastal Plain. This relatively flat region extends north from the Arctic Foothills to the Arctic Ocean with few variations in its overall gentle slope to the sea. It is an area of very low relief; this fact, coupled with the presence of widespread shallow permafrost, has led to the formation of thousands of shallow lakes and extensive marshy or boggy areas. The skyline is sometimes flat but is commonly gently undulatory because of pingos, patterned ground, old drainage channels and other depositional, erosional, or permafrost-related features.

TABLE 10. WIND DIRECTION, WIND VELOCITY, AND OTHER METEOROLOGICAL DATA AT BARTER ISLAND, ALASKA, 1941-1970

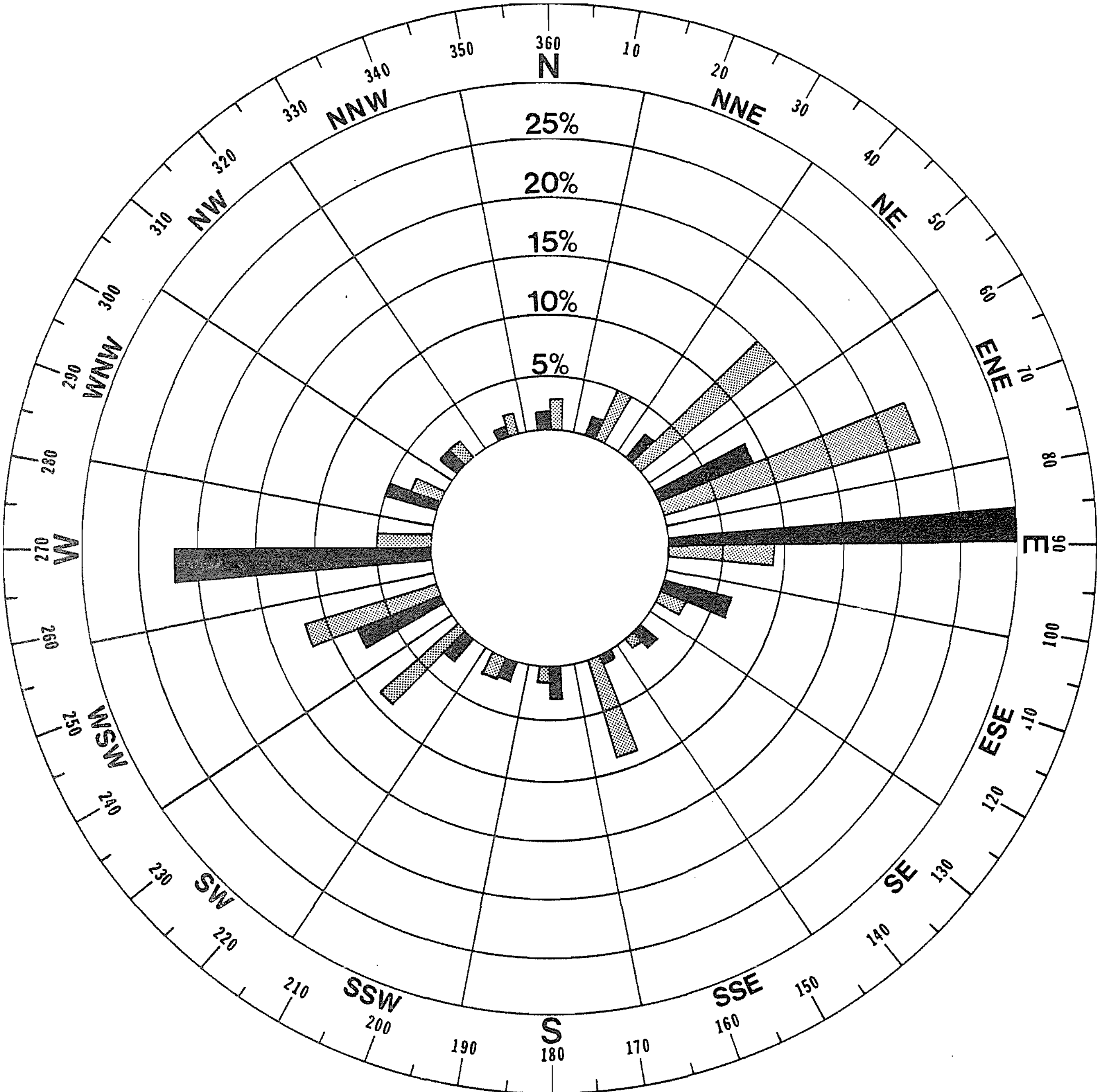
Month	Wind: Mean speed m.p.h.	Wind: Prevailing direction	Wind: Fastest Mile: Velocity m.p.h.	Wind: Fastest Mile: Direction	Wind: Fastest Mile: Year	Mean Number of Days Sunrise to Sunset: Clear	Mean Number of Days Sunrise to Sunset: Partly Cloudy	Mean Number of Days Sunrise to Sunset: Cloudy	Mean sky cover, tenths, sunrise to sunset
(a)	25	15	18	18		26	26	26	26
January	14.7	W	81	27	1974	4	2	8	#
February	14.0	W	62	27	1962	10	6	12	5.3
March	13.5	W	77	28	1969	11	8	12	5.5
April	12.0	W	52	27	1963	8	8	14	6.0
May	12.2	E	55	26	1968	3	6	22	8.2
June	11.4	ENE	38	27	1970	3	7	20	7.8
July	10.5	ENE	40	25	1963	3	9	19	7.8
August	11.6	E	44	27	1969	1	7	23	8.5
September	13.2	E	78	27	1957	2	5	23	8.5
October	14.5	E	58	27	1963	2	5	24	8.3
November	15.0	E	81	26	1970	4	4	15	#
December	13.9	E	72	27	1961	0	0	0	#
ANNUAL AVERAGE	13.0	E	81	27	JAN. 1974	51	67	192	

(a) Period of record (years) through the current year, unless otherwise noted, based on January data.

\# Sun below continuously horizon, November 24 to January 17.

Prevailing Wind Direction - Record through 1963.
Wind Direction - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
Fastest Mile Wind - Velocity is fastest observed 1-minute value when the direction is in tens of degrees.

Source: NOAA, 1977



KEY

BARTER ISLAND 1968-77, CALM 1.2%

DEADHORSE AIRPORT 1976, CALM 4.5%

Figure 8. Annual Wind Frequency Distribution

Source: Arco, 1978

Pingos are ice-cored hills, and they tend to grow because water migrates toward ice, freezes, and accumulates. They are not of substantial size in the vicinity of the site. Areas where vertical ice-wedges within the soil have connected to form ice-wedge polygons are commonly referred to as patterned ground. The polygons frequently take the shape of hexagons--six-sided figures--but four- and five-sided figures are common. The interior of the polygons may be higher or lower than the surface of the ground adjacent to the bounding wedge of ice, depending on the soil properties and whether the ice-wedges are still growing. Patterned ground indicates shallow permafrost, generally in fine-grained soils.

The shoreline of the Beaufort Sea is only infrequently marked by vertical relief in excess of 15 meters. Generally there is less than 3 meters difference between the level of the land and the adjacent sea floor as a result of the youthfulness of the coast, its depositional nature, and the lack of appreciable wave action. Immediately adjacent to the proposed plant, the shoreline of Prudhoe Bay is marked by a short broad ridge about 8 meters high.

While the elevation of the Arctic Coastal Plain may reach 180 meters at its southern edge, some 80 km. south of the project area, there is no place within 16 km. of the proposed facilities where the natural elevation is as great as 30 meters above mean sea level. The immediate vicinity of the proposed construction camp and the separate conditioning facilities ranges from about 3 to 10 meters in elevation. It includes much marshy area and several lakes and ponds.

Within the proposed project area, the bedrock is overlain by hundreds of meters of unconsolidated marine sediments and local deposits of terrestrial origin. The proposed conditioning plant and the associated construction camp would be located on upland tundra no more than 8 meters higher than the various lacustrine deposits which occupy the numerous shallow depressions on the adjacent coastal plain. The Tertiary mudstones and siltstones which form the underlying bedrock surface are generally flatlying.

The upland tundra deposits covering the proposed sites generally consist of over 400 meters of stratified sandy gravels with interbedded lenses of gravelly sand, sand, and silty sand. Individual lenses are up to 3 meters thick. Poorly stratified sandy silt 0.5 to 3.5 meters thick and often rich in organic material overlies the gravels and is in turn overlain by an organic silt-tundra mat up to 15 cm. thick.

Near shore, submarine sediments are generally poorly sorted mixtures of sand, silt, clay, and gravel. Adjacent to the proposed site are the silts of Prudhoe Bay and sands which extend eastward in a band intersecting the shoreline at Point McIntyre on the north and the mouth of Prudhoe Bay on the south.

Permafrost is, as its name implies, permanently frozen material. It may include soil, unconsolidated geologic deposits beneath the soil, and bedrock. It need not include any water, frozen or otherwise, since the definition is based only on temperature. Because of seasonal variations in the air temperature over the ground, there is generally an active layer above the permafrost which thaws during the summer and freezes in winter. Therefore, the vertical extent of the permafrost is defined by (1) the maximum depth of the active layer (top of the permafrost) and (2) the bottom of the permafrost, which is a function of the equilibrium between regional heat flow from the interior of the earth and present climatic conditions as well as those which have existed within the past 10,000 years.

Local variations in the thickness of the active layer depend on several factors including the properties of the surficial materials, the extent to which those materials are shaded from the sun, and the presence of surface water. For instance, the active layer is thinner on north-facing slopes and thicker under bodies of water. Where rivers or lakes (or the ocean) do not freeze to the bottom, the permafrost, if it exists, will be overlain by permanently thawed material or talik.

Permafrost is continuous throughout this part of Alaska and generally extends to depths on the order of 650 meters. The active layer is generally less than 0.3 meter thick. The permafrost is commonly ice-rich, containing observable free ice.

Within the onsite tundra deposits, the active layer may be as much as 2.5 meters thick, but more typically it ranges from 0.5 to 1.5 meters. Water content of the active layer, represented as a percent of the volume of solids present, may range from 50 to 200 percent in silts and sands and from 5 to 20 percent in sandy gravels. The bearing capacity of the onsite deposits, which remains moderate if only the active layer is allowed to thaw, becomes poor to very poor if the permafrost itself thaws. The deposits fail in direct proportion to the intensity and duration of loading.

Only two geologic resources are known to exist in the project area: hydrocarbons and gravel. The latter is found primarily along and within river channels, the nearest being those of the Put and Sagavanirktok (Sag) Rivers. Gravel may also be found under some larger thaw lakes. Hydrocarbons, of course, are found at depth beneath this area as natural gas and crude oil.

The project area is within Seismic Risk Zone 1 of the Uniform Building Code (UBC), and the projected maximum Modified Mercalli Intensity for this area is III.[1/] Therefore, seismicity would not be a significant hazard to the proposed facility.

Because of the low relief of the area and the lack of major fast-moving streams, hazards resulting from landslides and erosion from swift currents are nonexistent. However, other types of mass wasting phenomena--solifluction, thaw compaction, deep seated flow, and frost heave--resulting from the existence of permafrost could create hazards at this site, or lead to construction difficulties.

Soils of the coastal plain are generally nearly level and poorly drained. The only soils exhibiting good drainage are associated with floodplains near either active or abandoned stream channels, coastal deposits, or sand dunes. Well-drained soils do not appear in the immediate area of the proposed project. Those few areas of well-drained soils which occur nearby are generally subject to flooding.

A vegetation mat which is occasionally greater than 40 cm. thick but is generally 20 cm. thick or less covers most of the soils in the area. Beneath this mat may be a layer of black mucky silt loam, with a dark gray to dark gray brown frost-churned silt loam invariably underneath either the muck or the mat. In terms of Unified Group Symbols, the soils are primarily ML (silts and very fine sands-silty, clayey fine sands or clayey silts), are non-acid to calcareous, have moderate permeability, and have a high susceptibility to frost action.

These soils are too cold to allow cultivation and offer severe construction problems.

3. Hydrology

a. Arctic Coastal Plain

i General Hydrology

There are three major watersheds in the Prudhoe Bay region. The smallest watershed, the Put River basin, lies entirely within

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1/ Meyers, H. et al., An Analysis of Earthquake Intensities and Recurrence Rates in and near Alaska. NOAA Technical Memorandum, EDS NGSDC-3. Figure 7a., 1976.

the Arctic Coastal Plain. (See figure 9.) The elevation of the watershed ranges from sea level at Prudhoe Bay to 79.2 meters above mean sea level (msl) in the headwaters area. The basin is approximately 55.7 km. long and generally has very little relief, with an overall stream gradient of 1.4 meters per km. The drainage area is 473 square km.

Two larger watersheds flank the Put River basin, the Kaparuk River basin to the west and the Sag River basin to the east. Both of these watersheds extend to the divine caps of the Brooks Range. The Arctic Mountain physiographic province and the Arctic Foothills physiographic province constitute the major parts of the Kaparuk River basin and Sag River basin, respectively. In contrast to the Put River basin, limited areas of the larger basins lie within the Arctic Coastal Plain. The Sag drains 14,898 square km. and is about 272 km. long; the Kuparuk drains 9,802 square km. and is about 300 km. long.

The Arctic Coastal Plain contains hundreds of thousands of shallow lakes and ponds, a number of wide, braided rivers, and many small streams that meander extensively. Coastal lakes are near or open to the ocean. The dissolved solid concentration and composition of fresh water coastal lakes may be influenced by salt spray carried inland by storms. In some areas, coastal lakes account for 80 percent of the total surface area. These lakes generally range from 0.6 to 6 meters deep and are normally rectangular or oval. Lakes and ponds on the North Slope usually freeze over by mid to late September, remaining frozen until late June or July.

Precipitation and existing surface bodies of water are the primary sources for groundwater recharge. Water reaches aquifers at depth only through unfrozen areas that perforate the permafrost. Suprapermafrost water (groundwater which flows between the vegetative mat and the permafrost) migrates along the permafrost table until it discharges at the surface or reaches an unfrozen zone. Where drainage is impeded by slope and soil conditions during the summer, a perched water table may be created at or near the ground surface if the permafrost is close to the ground surface. This would create marshy or swampy conditions such as those found on the Arctic Coastal Plain. Along the plain, permafrost is continuous and thick, and subpermafrost water is predominantly brackish or saline. This is because the permafrost tends to be impermeable and prevents freshwater from percolating downward. Only scant information exists on the movement of soil moisture through the active layer. However, the available information suggests that water movement and the contribution of water to surface drainages are minimal. The 487 meters of permafrost below the active permafrost layer virtually eliminate deep groundwater recharge, storage, and outflow.

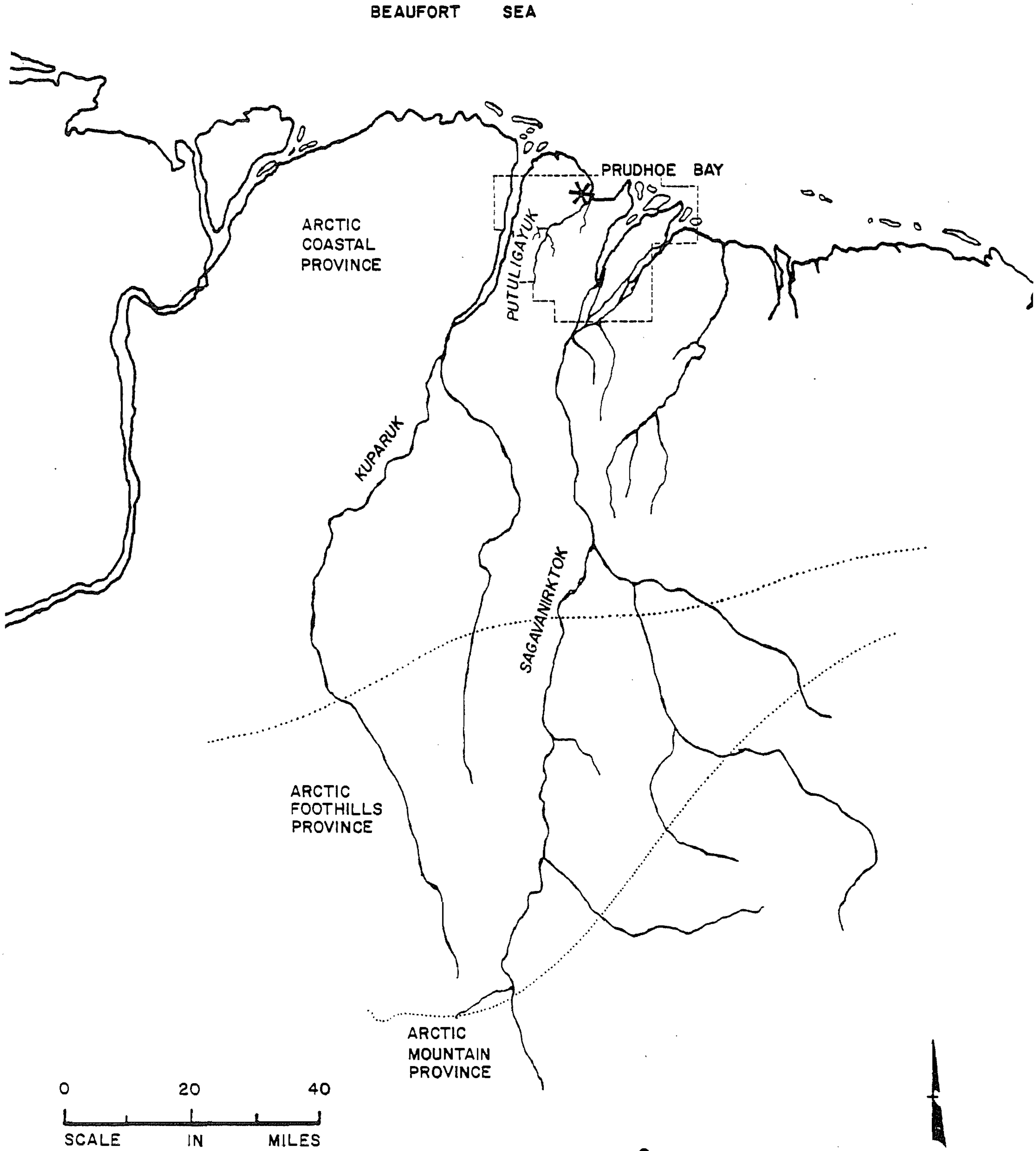


Figure 9. Prudhoe Bay Region

--------- EXISTING PRUDHOE BAY SITE BOUNDARIES

* PROPOSED SALES GAS CONDITIONING FACILITY

ii. River Systems

The Put River is classified as a tundra stream. The Sag and Kaparuk Rivers are classified as mountain streams that have spring-fed and tundra-stream tributaries. Most arctic mountain streams are wide, braided streams that deposit extensive deltas of coarse-textured material in the Beaufort Sea. By contrast, tundra streams carry much less material, tend to have more stable channels, and do not form extensive deltas. A comparison of a typical mountain and tundra stream is presented in figure 10.

The complexity of the drainage of the Put River and of the two adjacent rivers is presented in table 11. The number of tributary streams in each order was determined from U.S. Geological Survey (USGS) quadrangle sheets. The ordering of streams is based on their hydrologic characteristics. The streams in the area vary from major rivers (stream order 6) to intermittent streams (stream order 1).

TABLE 11 DISTRIBUTION OF STREAM ORDERS IN THE PUT, KAPARUK, AND SAG RIVERS

Stream Order	1	2	3	4	5	6
River Basin	(Intermittent Streams)					(Major Rivers)
Put	4	1				
Kuparuk	185	62	12	3	1	
Sag	503	103	18	5	2	1

Source: Kane and Carlson, 1973

Although the Put River has a well-defined channel in the Prudhoe Bay area, meandering of this low gradient river is evidenced by the occurrence of oxbows. The channel is about 91.4 meters wide and the channel bottom is about 6.1 meters below the prevailing ground level.

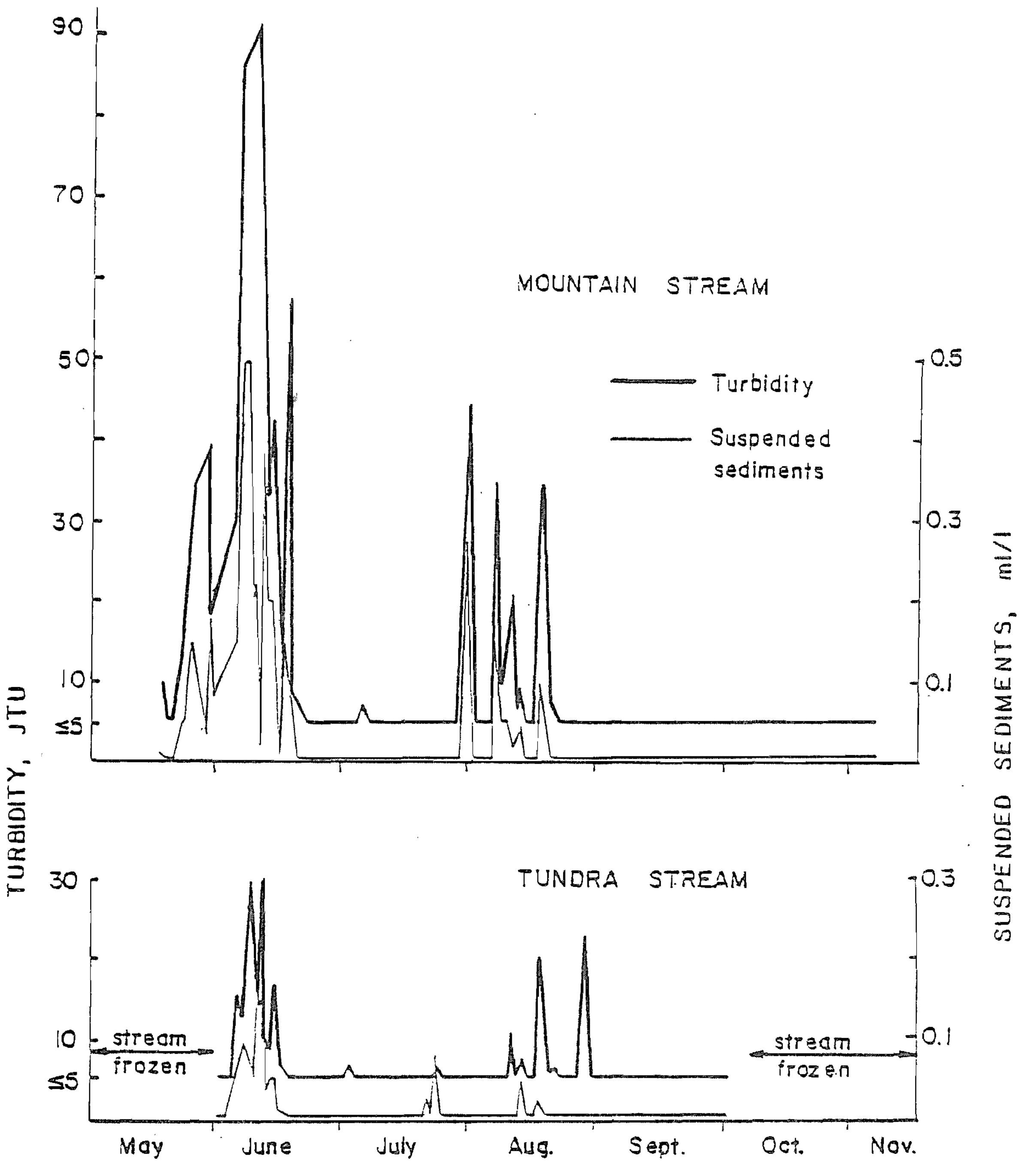


Figure 10. Comparison of Seasonal Fluctuations in Turbidity and Suspended Sediments in a Mountain Stream (Canning River) and a Tundra Stream (Wier Creek) During 1973

Source: Craig and McCart, 1975.

Two roads cross the Put River in the Prudhoe Bay area. One crossing is located near the mouth of the river in the area operated by Arco and the other is located about 11.5 km. upstream from the mouth in the area operated by the British Petroleum Company (BP). A USGS gauging station is located at mid-channel about 61 meters upstream from the BP road crossing. Both crossings are constructed of multiple corrugated metal culverts and can handle the entire anticipated flood flow. The State of Alaska allowed culvert crossings on the Put River because there were no game fish that require a natural bottom in the river. Clearspan bridges over natural bottoms are required by the state on the two adjacent rivers, the Sag and the Kuparuk, because of significant runs of Artic char and grayling. Sticklebacks have been observed in the Put River on one occasion.

Gravel removal operations are conducted by Arco and the SOHIO/BP companies along the Put River between the road crossings. The operations take place in old oxbows of the river that have been bermed to prevent inundation. Both of these oxbows have been excavated to approximately 6.1 meters below the ground surface. Arco has removed about 2.3 million cubic meters of material from the oxbow area proposed as the landfill site.

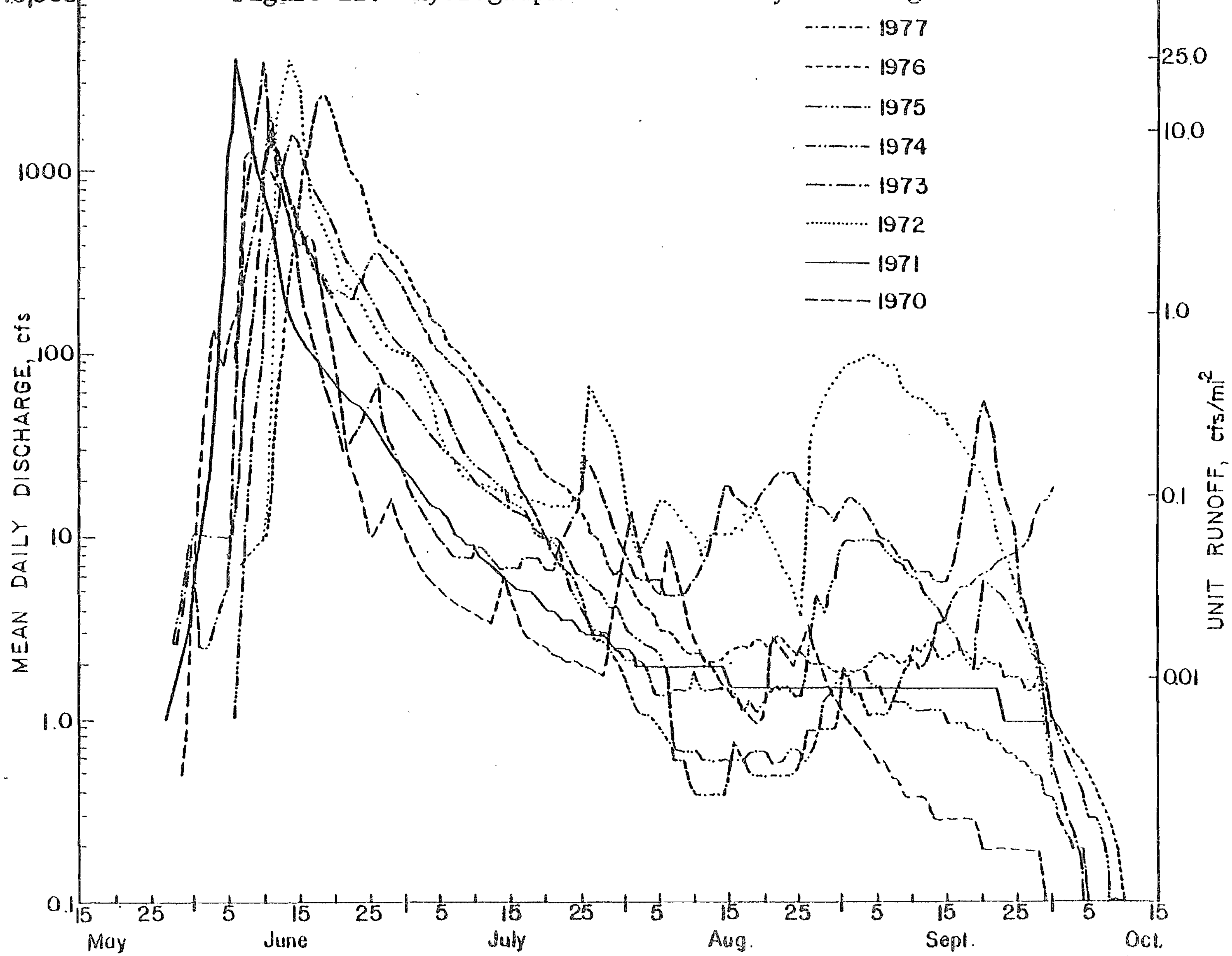
Stream Flow

The seasonal flows in the Put River depend on runoff from snowmelt and rainfall. The mean daily hydrograph for the river is shown in figure 11. The flow began between May 27 and June 9 for each of the 8 years of record. The peak flow, which results from snowmelt, usually occurs between June 6 and June 18. Subsequent peak flows resulting from rainfall were smaller. Freezing conditions ended stream flow between September 29 and October 10 during each of the 8 years of record.

The two adjacent rivers, the Sag and the Kuparuk, have minimal flows beneath thick ice covers throughout the winter. Data gathered for water year 1974 indicate that the total annual discharge of the Kuparuk River (476,400 acre-feet or 155 x 10^9 gallons) is about 25 times the discharge of the Put River (19,490 acre-feet or 6.35 x 10^9 gallons), and the Sag River (1,336,000 acre-feet or 435 x 10^9 gallons) is much larger than the Kuparuk River.

The importance of the June snowmelt runoff for peak flows is shown in the hydrograph for the Put River (figure 11.) Data for 1976 indicate that the peak discharge (2,670 cfs) from snowmelt runoff was about 30 times larger than late summer peaks caused by rainfall runoff. The snowmelt runoff is important for the peak flows in all of the rivers in the study area.

Figure 11. Hydrograph and Mean Daily Discharge



Source: U.S. Geological Survey

After snowmelt, flows in the Put River decline to very low levels. August 1976 minimum flows averaged 1.9 cubic feet per second (cfs); August 1974, 0.6 cfs. These low flows are maintained by drainage from lakes and suprapermafrost waters. The average flow for the months of July, August, and September 1974 were 17.2 cfs, 1.13 cfs, and 1.06 cfs, respectively.

Rainfall from June through September replenishes the flow in the Put River somewhat. Approximately one half of the annual precipitation--7.6 cm. of rainfall--occurs during this time. This precipitation is generally not attributable to large individual storms; rather, it is distributed evenly.

The adjacent large rivers continue to have higher flows into the summer because of the contributions from the deeper and more variable snowpacks in their drainage basins, the glaciers, and the springs in the Brooks Range. For example, mean flows in the Sag River near Sagwon for July, August, and September 1974 were 4,006 cfs, 6,731 cfs, and 1,624 cfs, respectively.

The average annual discharge for the Put River was 28,260 acre-feet (1.23×10^9 cubic feet or 9.2×10^9 gallons) for the 8 years of record. The minimum flow was 19,490 acre-feet (18.5×10^8 cubic feet or 6.35×10^9 gallons) in 1974, and the maximum was 41,170 acre feet (1.8×10^9 cubic feet or 13.4×10^9 gallons). Approximately 90 percent of the total flow occurs during June; the range was from 84 to 97 percent during the period of record. The variability of flow in June probably results from differences in the intensity of rainfall during the summer.

Water Quality in the Put River

Water quality data for the Put River are sparse. However, the USGS has published some data in its annual publication, Water Resources Data for Alaska. On the basis of these data, the water quality generally is considered good. Although the level of suspended sediment is high during snowmelt runoff, the level quickly declines to minimal amounts after the peak flow. The Put, a tundra stream, does not move large particles of sediment as do the Sag and the Kaparuk, which are mountain streams.

The USGS has measured the values of selected water quality parameters for the Put River. These values are listed in table 12. A water temperature recorder installed at the gauging station on the Put River during 1976 measured a maximum water temperature of 19°C. (66.2°F.) on August 1, 1976.

TABLE 12

SELECTED FLOW AND WATER QUALITY PARAMETERS FOR THE PUTULIGAYUK RIVER (°F=9/5 °C. + 32)

Date	Time	Discharge (cfs)	Specific Conductance (umhos)	Suspended Sediment (mg/l)	Temperature (°C.)	pH
3 June 1971	1415	58	144	46	0.5	--
6 June 1971	1445	4,700	131	46	--	--
23 June 1971	--	53	206	6	13.5	--
11 June 1975	1700	434	148	12	0.0	--
14 June 1975	1000	1,870	150	45	0.0	--
8 July 1975	2210	25	240	--	15.0	7.7
31 July 1975	800	2.2	--	--	5.0	8.0
13 Aug 1975	1600	14	--	--	13.0	--
20 Sept 1975	800	6.3	290	--	0.0	--
10 June 1976	1130	15	--	1	--	--
23 Aug 1976	1400	2.6	250	--	9.5	7.9

Source: USGS, 1971, 1975, 1976

Water Use

The present water supply in Prudhoe Bay is derived from four major sources. These sources, and the major user for each source, are:

Kaparuk River - SOHIO/BP construction camp

Big Lake - SOHIO/BP operations center

Colleen Lake - North Slope Borough distribution to service companies

Sag River - Arco operations center and construction camp

Arco presently has the water rights (permits) to pump 294,000 gpd from the Sag River and 300,000 gpd from the Put River. (Arco does not currently withdraw water from the Put River.) An excavated reservoir (Webster Lake) with an 80 million gallon winter capacity provides a winter water supply for the Arco facilities. SOHIO/BP has two reservoirs on the Kaparuk River with a combined storage capacity of 42 million gallons and a small reservoir on Big Lake with a 3 million gallon capacity. The reservoir on Big Lake is capped with 6 inches of styrofoam following the formation of ice in the autumn to limit the ice cover to 0.61 to 0.91 meter.

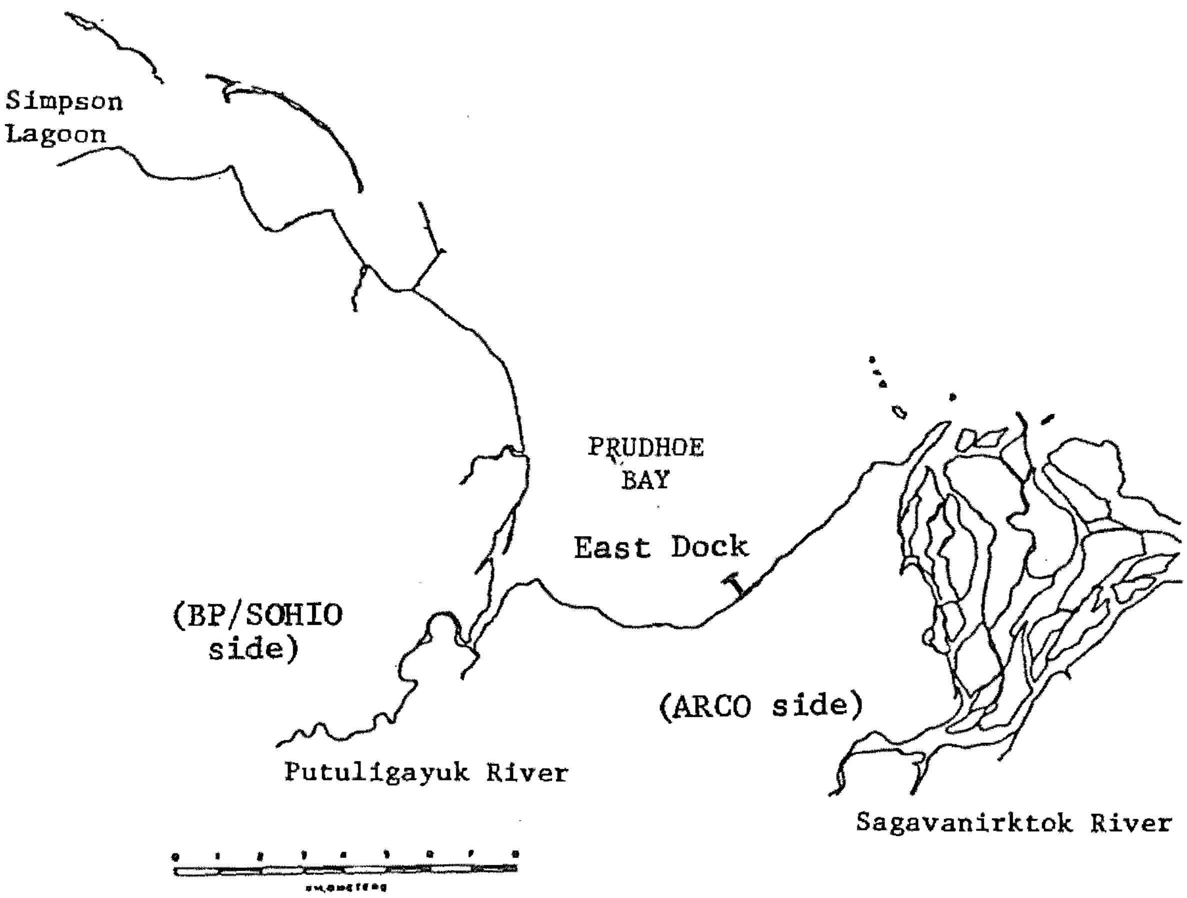
b. Prudhoe Bay

i. General Conditions

Prudhoe Bay, a shallow embayment in the Beaufort Sea, is located at the mouth of the Put River. The bay is flanked by the Simpson Lagoon and Kuparuk River to the west and the Sag River to the east. (See figure 12.) Prudhoe Bay exceeds 2 meters in depth only at its center, where it reaches approximately 2.7 meters.

A compacted gravel causeway, 2,864 meters long, is located on the western side of Prudhoe Bay, just east of Simpson Lagoon. (See figure 13.) The Arco causeway was constructed in two sections. The original causeway and dock were completed in July 1975 (1,340 meters), and an extension was completed in August 1976 (1,524 meters). The causeway extension places the farthest offshore dockhead in water of a depth of 2 meters. A smaller causeway (Dock No. 1) is located on the east side of the bay.

Figure 12. Location of Rivers at Prudhoe Bay



Adapted from Chin *et al.*, 1979

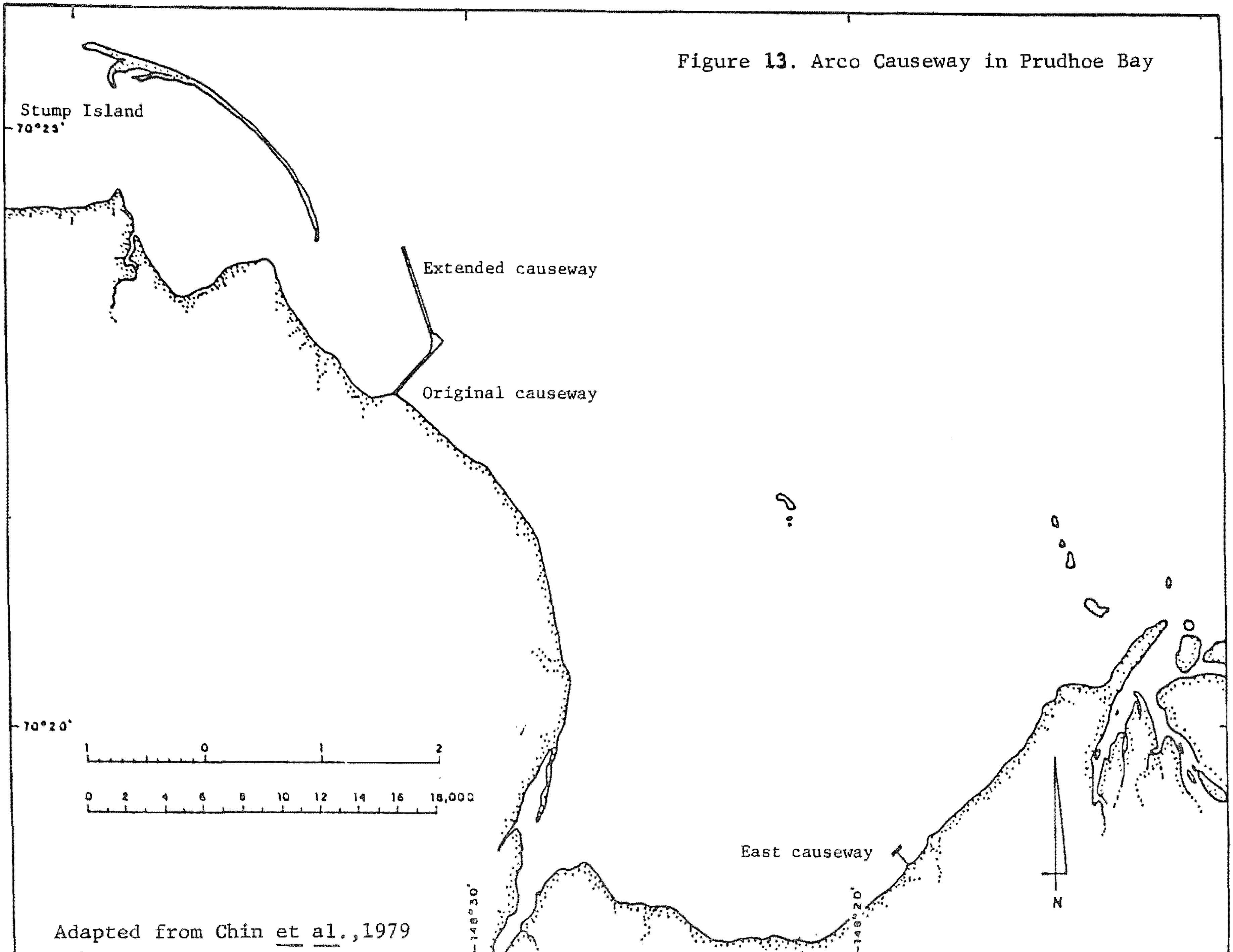


Figure 13. Arco Causeway in Prudhoe Bay

ii. Physical Oceanography

The astronomic tides in the Beaufort Sea are considerably smaller than the meteorologic tides and are generally mixed semidiurnal with mean ranges from 10 to 30 cm. The tide appears to approach the shelf from the north. The average lunar tidal range in Prudhoe Bay is 15 cm., and the maximum recorded tidal range is 21 cm. The tides of Prudhoe Bay are characterized by two unequal highs and lows per 25-hour cycle.

From November to May, there is no significant wave activity along the Beaufort Sea coast because the sea is frozen. As the ice begins to break up in June, the predominately northeastern winds generate waves of less than 1 meter. The highly variable winds occurring in July and August generate waves in the Beaufort Sea typically less than 50 cm. in height, although some waves have been recorded as high as 1-3 meters during severe storms. Wave activity declines in October, and virtually all waves are less than 1 meter. The average wave heights in the Beaufort Sea are small because the fetch is limited by islands and nearshore ice. Information on the direction of waves along the Beaufort Sea coast east of Point Barrow during July, August, and September is presented in table 13.

The maximum recorded wave height for Prudhoe Bay is 0.3 meter. This measurement was taken on the east side of the extended causeway when east-northeast winds on the order of 10 to 20 knots hampered safe boating operations. Chin calculated the water elevation resulting from the wave setup created by a theoretical 10-knot onshore wind from 040^{0}T (true north) to be 0.006 meter and the average wave heights to be less than 0.3 meter.

TABLE 13 DIRECTIONS (%) OF WAVES ALONG THE COAST OF THE BEAUFORT SEA EAST OF POINT BARROW DURING JULY, AUGUST, AND SEPTEMBER

Direction	July	August	September
N	1	2	3
NE	7	10	11
E	14	20	19
SE	1	5	6
S	1	1	1
SW	1	2	4
W	4	8	13
NW	9	6	14
calm or indeterminate	61	45	29

Source: Brower and others, 1977

Throughout the nearshore Beaufort Sea, currents are caused primarily by the wind. Observation of sea ice flows and modeling of the currents of the Beaufort Sea confirm that circulation during the summer is related closely to local wind patterns. In the Beaufort Sea, westerly winds generally produce easterly currents and easterly winds produce westerly currents, while winds from the north generally drive surface currents easterly and south winds produce westerly currents. Current velocities decrease as the depth of water decreases, which results in slower nearshore currents.

The currents and circulation patterns of Prudhoe Bay are very complex because of the variability of the bottom topography and absence of barrier islands. Gyres, counter currents, and null areas occur frequently within the bay and are influenced markedly by wind direction and velocity. The Arco causeway influences the circulation of the western part of the bay to some extent. Computer simulation of a variety of wind conditions demonstrated that the Arco causeway separated the bay into two different but related wind-responsive circulation patterns.

Circulation patterns and current velocities are determined principally by wind because of the relative weakness of tidal forces and small tidal amplitudes. Chin and others reported that mean current speed in August approximated 2.3 percent of the wind's speed. This result agrees well with observations reported by Barnes and others in 1978 for Simpson Lagoon (3 percent of the wind's speed). These wind-generated currents usually are strong enough to mix waters of different salinities or temperatures, preventing persistent stratification of water layers. The effect of the wind on currents appears to persist through a large portion of the water column. Direct, nearbottom current measurements at approximately 3- and 5-meter depths were also found to be well correlated with local winds.

The coast erodes at a rate of 1.4 meters per year. A slight erosion rate was evident on the mainland of Prudhoe Bay between August 1976 and August 1977. Measurements indicate that during the 12-month sampling period, the shoreline receded between 0.5 and 1.5 meters. Mildly severe windstorms, expected to occur every 5 to 6 years, will generate waves of 0.6 to 1.2 meters and will accelerate this "normal" erosion rate. Estimations have been made that 30 to 60 cm. of the Arco causeway embankment will erode during a storm of this magnitude over 2 or 3 days.

The character and depositional pattern of sediments in Prudhoe Bay are influenced primarily by the Sag and Put Rivers. Figure 14 illustrates the extent of mixing of the waters from the two rivers in Prudhoe Bay. The very fine materials are found in water deeper than 1.8 meters because of their movement offshore in response to nearshore wave energy. Gravel is present, although not prevalent, in a few areas west of the Arco causeway.

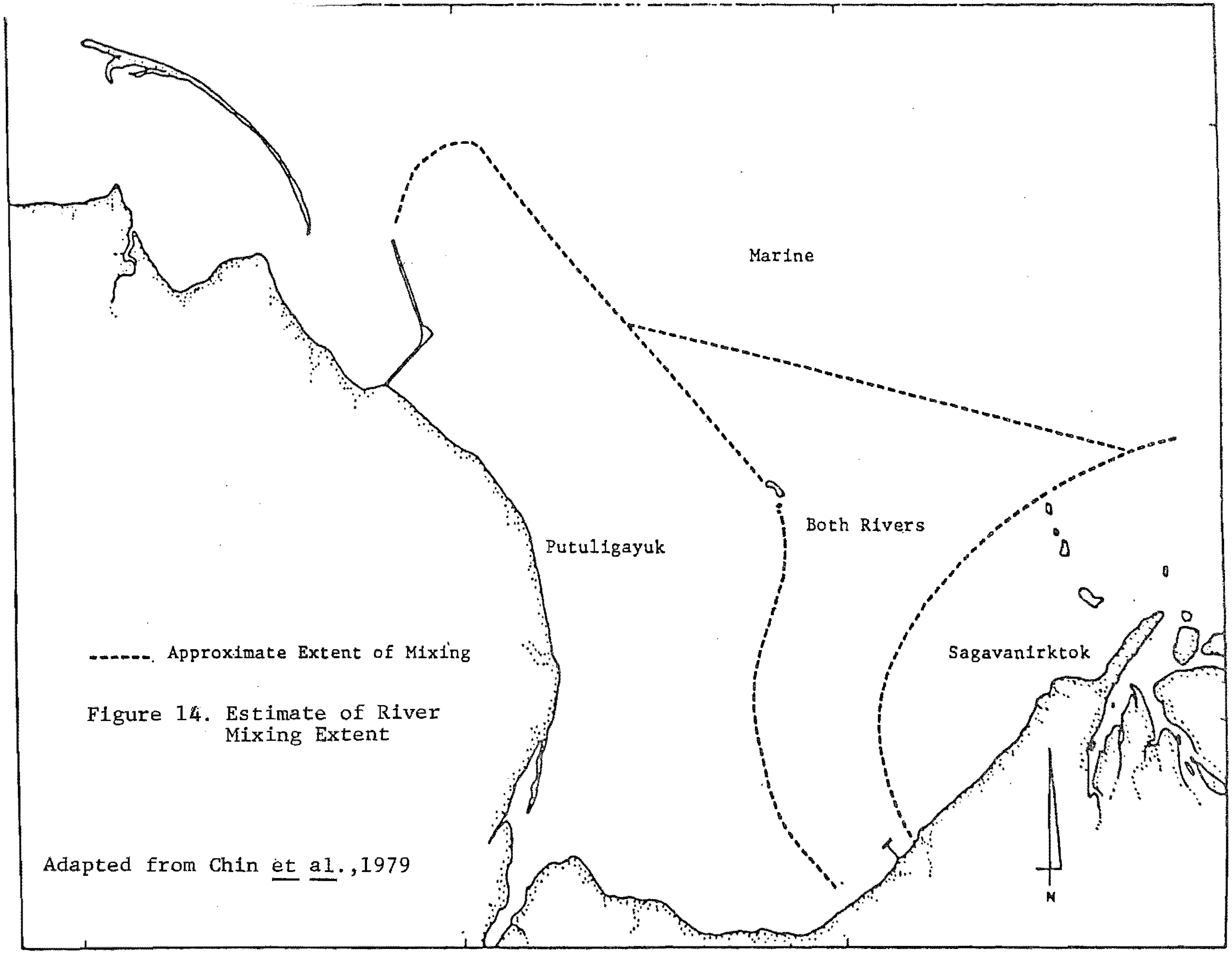


Figure 14. Estimate of River Mixing Extent

Adapted from Chin et al.,1979

The sands, sandy silts, and silty sands contain little organic carbon (average 0.37 percent of weight). This is because of the relatively low biological productivity of the bay. Because of the greater amount of fine material sediments, deeper waters (1.8 meters) have higher values of total organic carbon. It has been reported that total organic carbon valves are 2.95 percent of weight from the deeper bottom samples of Prudhoe Bay.

Temperatures in Prudhoe Bay for July and August range from 2°C. to 9°C. In June, the temperature of the water under the ice was as low as -4°C. Winter temperatures in the trapped pockets of salt water may reach -5°C. to -12°C. Mid-August temperatures are 6°C. on the east side of the bay, 6.8°C. on the east side of the Arco causeway, and 2.3°C. on the west side of the causeway. These differences result from the warm water, sometimes as high as 12°C., entering from the Sag and Put Rivers. During calm weather, a temperature gradient of 6°C. can exist in the Simpson Lagoon, where the depth is similar to that of Prudhoe Bay. However, winds can mix the water so that there are only minor differences in temperature between the surface and the bottom.

Prudhoe Bay generally is frozen over from September to June. Ice begins to form in early September and thickens at the rate of approximately 1 cm. per day. The exact time of total freeze varies with the weather and the winds. Two weeks may pass between the first shoreline ice formation and the total freeze. The ice can reach 2 meters in thickness. Most of Prudhoe Bay is frozen to the bottom, except in the deepest part of the bay, where approximately 0.5 meter of water remains. During the winter, there is very little movement in the seashore ice, except for tidal and thermal tension cracks.

The ice begins to weaken and melt in May and breaks free of the beach in June, but the area is not clear of ice until July. During storms, drifting ice can move close to or onto the shore, often scouring the bottom in the process. In May and June, river water flows out onto shorefast ice. As channels melt in this ice, the river water drains through it and may scour the bottom sediments. This "strudel" scour can excavate depressions several meters deep. These depressions are filled with sediments entering from the rivers following break-up.

iii. Chemical Oceanography

The Beaufort Sea generally has a salinity of 30 parts per thousand (ppt). In Prudhoe Bay, recorded summer salinities range between 13 and 22 ppt, with the exception of a 6-ppt reading in late July. The low reading may have resulted from freshwater from the Sag and Put Rivers.

The Arco causeway affects the salinity of nearby waters, apparently by influencing the currents and the mixing patterns. Salinity measurements taken during several weeks in August on each side of the causeway are shown in figure 15. Lower salinities on the east side of the causeway probably reflect the presence of Sag and Put River waters that had not mixed the seawater to the west of the Arco causeway.

As the surface of the bay freezes in winter, a layer of dense, salty water forms just beneath the ice. This is caused by "freezing out" of 80 percent of the salt from seawater. This layer of high-salinity water sets up mixing currents that may cause an influx of low-salinity waters from offshore areas into high-salinity nearshore waters. Nevertheless, nearshore bottom waters rapidly become very salty as the ice thickens. Salinities of 72 ppt in Prudhoe Bay have been recorded. Salinities in isolated pools of under-ice brine have been measured at 182 ppt.

Because the waters of Prudhoe Bay are well mixed by the wind, they are likely to have dissolved oxygen concentrations near the saturation level. Nearshore waters, although cut off from the atmosphere during the winter, apparently retain a significant oxygen content. Biological metabolism depletes the oxygen level during the winter, but this process occurs slowly because of the low temperatures. Dissolved oxygen is forced from the ice into the underlying water as the surface freezes to compensate for this depletion. Although oxygen concentrations of 4 to 5 parts per million (ppm) were recorded in the waters of Harrison Bay and Elson Lagoon during late April, oxygen levels may approach 0 ppm in pockets of seawater trapped below the ice.

Organic compounds in the water under the ice are broken down by bacterial action. This produces nitrates and ammonia that become available to plants. Mixing currents caused by salinity differences may carry some of the nitrogen compounds into offshore waters. The concentrations of nutrients reach an annual peak in the spring, which stimulates the growth of algae under the ice. During periods of open water, additional nitrogen compounds are added to the nearshore waters by river outflow and by shoreline erosion.

These sources apparently do not provide sufficient nitrogen to achieve maximum growth rates for algae, however. Small floating algae (phtoplankton) generally require 15 atoms of nitrogen for 1 atom of phosphorus to achieve maximum growth. In the nearshore Beaufort Sea, there are only five atoms of nitrogen to one atom of phosphorus in Prudhoe Bay during August. Phosphorus concentrations range from 0.3 µg/1 to 0.6 µg/1. Concentrations of silica in the nearshore waters, especially those close to river outflows, are high enough not to limit the growth of algae that require silica. Measured silica concentrations in Prudhoe Bay waters are up to 28 µg/1 in July but only 16 µg/1 in August. Consequently, the nearshore system of Prudhoe Bay apparently is nitrogen limited.

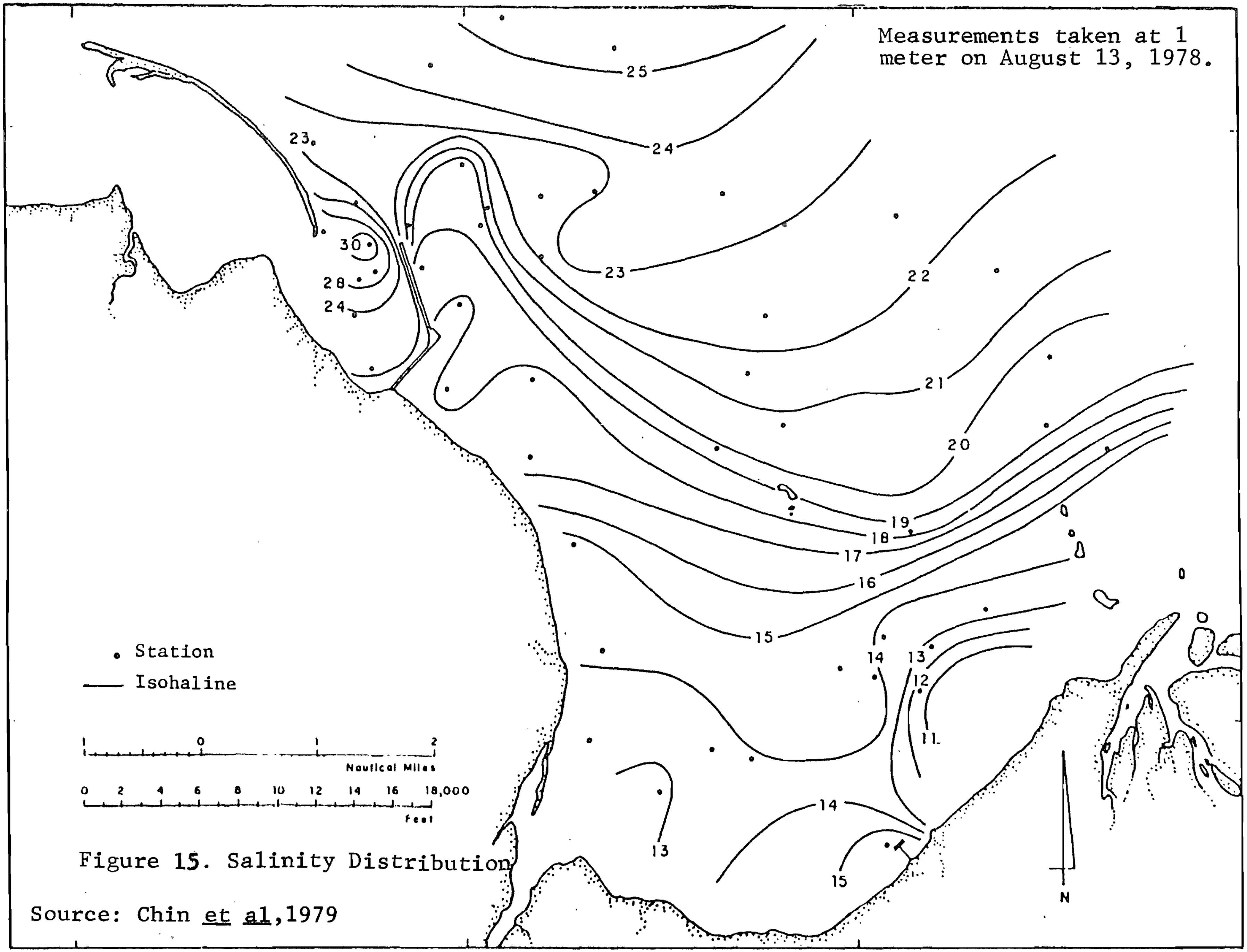


Figure 15. Salinity Distribution

Source: Chin <u>et al</u>,1979

An unusual aspect of the nutrient supply in the nearshore Beaufort Sea is the significant input of carbon from eroded tundra peat. In most ecological systems, living plants maintain a supply of carbon by converting CO_2 into plant tissue through photosynthesis. In this arctic system, tundra peat (decomposed plant remains that have accumulated over many years) is being eroded and carried into the nearshore waters by the Put and Sag Rivers. This peat may supply 25 to 50 percent of the carbon entering the system. Detritus of tundra origin also may be important in the diets of some of the shallow water benthos of Prudhoe Bay.

4. Air Quality

The ambient air quality at the Prudhoe Bay site is excellent. Table 14 presents the results of an Arco air monitoring study performed in 1974. The site does experience periods of artic haze; however, this is a seasonal occurence and is not generated on the site. The project site is in an extremely rural area, with little industry or population.

Since the Metronics study was completed, the staff has analyzed air pollution dispersion to estimate the current air pollutant levels from the operation of the existing facilities and Arco's EPA-approved prevention of significant deterioration (PSD) facilities at the Prudhoe Bay site.1/ The analysis estimated maximum groundlevel concentrations by modeling "worst-case" meteorological and operational conditions. (See table 15.) A comparison between the predicted results (table 15) and the monitored results (table 14) using a power law formula indicates that the predicted results are very similar to or more conservative than the monitored results.

The CO monitoring results are considerably higher than the predicted results, however. This would be because there was considerable construction around the site at the time of the monitoring program. Further, both the predicted and monitored CO concentrations are insignificant when compared to the standards. As table 15 shows, the estimated pollutant levels from the operation of the existing facilities and Arco's PSD-approved facilities are within both the National and Alaskan Ambient Air Quality Standards.

1/ Metronics Associates, Inc. "Air Quality and Meteorological Baseline Study for Prudhoe Bay, Alaska, June 1974-June 1975," Technical Report No. 217, January 12, 1976.

TABLE 14

AVERAGE BASELINE POLLUTANT CONCENTRATIONS AT THE PROJECT SITE, ARCO 1976

POLLUTANT	MONTHLY AVERAGE BASELINE CONCENTRATIONS ppm (μg/m^3)	ALASKAN AIR QUALITY STANDARDS ppm (μg/m^3)
Nitrogen Dioxide	<0.005 (9.4)	0.05 (annual) (94)
Nitric Oxide	<0.005	
Total Nitrogen Oxides	<0.005	
Ozone	0.035 (68.6)	0.08 (1-hour) (156)
Hydrogen Sulfide	<0.005	
Sulfur Dioxide	<0.005 (13.1)	
Total Sulfur	<0.005	0.02 (annual)
Methane	1.6	
Non-Methane Hydrocarbons	0.3	0.24 (3-hour)
Total Hydrocarbons	1.9	
Carbon Monoxide	0.08 (92)	9.0 (8-hour) (10,000)
Total Suspended Particulates	5	60 μg/m^3 (annual)

TABLE 15

MAXIMUM PREDICTED AMBIENT AIR QUALITY BACKROUND LEVELS AND NATIONAL AMBIENT AIR QUALITY STANDARDS

(Values are in $\mu g/m^3$)

Pollutant	Averaging Time	Background Level[a]	National Ambient Air Quality Standards	Alaska Ambient Air Quality Standards
TSP	Annual	0.6	75	60
	24-hour	21.8[b]	260	150
	1-hour	27.4	—	—
SO_2	Annual	0.6	80	60
	24-hour	19.3[b]	365	260
	3-hour	27.5[b]	1,300	1,300
	1-hour	33.2	—	—
CO	8-hour	1[c]	40,000	40,000
	1-hour	1[c]	10,000	10,000
NO_2	Annual	24.0	100	100

[a] These levels represent groundlevel concentrations calculated using emissions from the major and approved existing sources in the area. Maximum levels were predicted to occur 1 km. downwind from the proposed facilities with the exception of NO_2, which was reported at 2 km. downwind.

[b] Turner's 0.17 power law equation was used to correct the 1-hour predicted values to 3-hour and 24-hour values.

[c] Based on the low CO emission rates from the major point sources and the small amount of vehicular traffic in the area.

[d] Source: 36 CFR 8996

Artic haze is a turbid layer of air encountered in the arctic regions. Such layers have been found to be from 1 to 3 km. thick and hundreds to thousands of kilometers wide. The turbid layers can occur either individually or in multiple layers at different heights and can occur at nearly every level of the troposphere (the layer of the atmosphere extending from the surface of the earth from 11.5 to 16.4 km.) The turbidity results from very fine aerosols (a suspension of liquid or solid particles in the air).

Studies performed on arctic haze in Barrow by Rahn and others in 1977 and Rahn and Shaw in 1978 deal with the constituents, concentration fluctuations, and probable sources of arctic haze. Their findings indicate that arctic haze is prevalent in the winter and that it is a product of a long-range transport system rather than a product of local emission sources. The principal route of the aerosols and gases to the arctic currently is unknown.

Table 16 presents the constituents of arctic haze and their concentrations. Although sulfate represents only one-fourth of the aerosols by weight, its probable particle size approximates the wave length of light, giving the sulfate considerable haze-forming potential.

TABLE 16 COMPOSITION OF BARROW AEROSOL, DECEMBER 1976 - FEBRUARY 1977

Constituent	Concentration, $\mu g/m^3$
Sulfate (Nonmarine)	1.2
Soil	0.3
Sea salt	3.3
Nonsulfate pollutants	0.2
Total	5.0

Source: Rahn and Shaw, "Briefing on Arctic Haze and Arctic Aerosol," Washington, D.C., 1978.

5. Noise Quality

A noise measurement survey was conducted on February 14 and 15, 1979, to determine the existing sound levels at the Prudhoe Bay field. The ambient air temperature was -38°C. on February 14 and -29°C. on February 15. The wind speed on both days was less than 4.5 meters per second. (The measurements are typical of winter sound levels and may not be representative of summer levels.) Measurement locations were selected on both the SOHIO and Arco oil fields to determine the noise levels produced by equipment such as drilling rigs, compressors, and gas turbines. In addition, measurement locations at the perimeter of the Prudhoe Bay field were selected to determine the background ambient noise level from all the equipment noise sources. (See figure 16.) Noise levels were measured on the A-weighting network of a Burel & Kjaer 4426 Noise Analyzer set to read out the equivalent sound level. (See table 17.) Because of the very cold weather, levels were sampled for 5 minutes.

The major noise sources in the Prudhoe Bay field identified by the staff were the central compressor plant, the central power plant, and the drilling sites. However, onsite Arco personnel identified the major noise generators as the flow stations and the gathering centers. Measurements obtained at the northern perimeter of the field, adjacent to the Beaufort Sea, indicate a background sound level of 32 dB(A). This level is assumed to be the lowest sould level in the area at any distance from the oil fields. Closer to the fields, the sound level increases to the range of from 39 dB(A) to 44 dB(A). The ambient sound of 32 dB(A) can be assumed to be the sound level to which the wildlife in the area are accustomed.

6. Terrestrial Communities

The tundra which dominates the Arctic Coastal Plain is generally wet. The major influences upon this region, and on the arctic ecosystem in general, are the extremes of both the physical environment and the seasons. Both factors are important in causing annual population cycles in animals and plants.

The wet tundra area is typically a mosaic of small lakes, ponds, and marshes. Sedges and moss are the predominant wet tundra species. Approximately 75 percent of the wet tundra vegetation is comprised of several species of sedges (especially *Carex aquatilis*). Many species of moss grow in the understory, but few lichens occur in the wet habitat. Secondary species include cottongrass, lousewort, and buttercup in the wetter sites and heather and purple mountain saxifrage in the raised drier habitats.

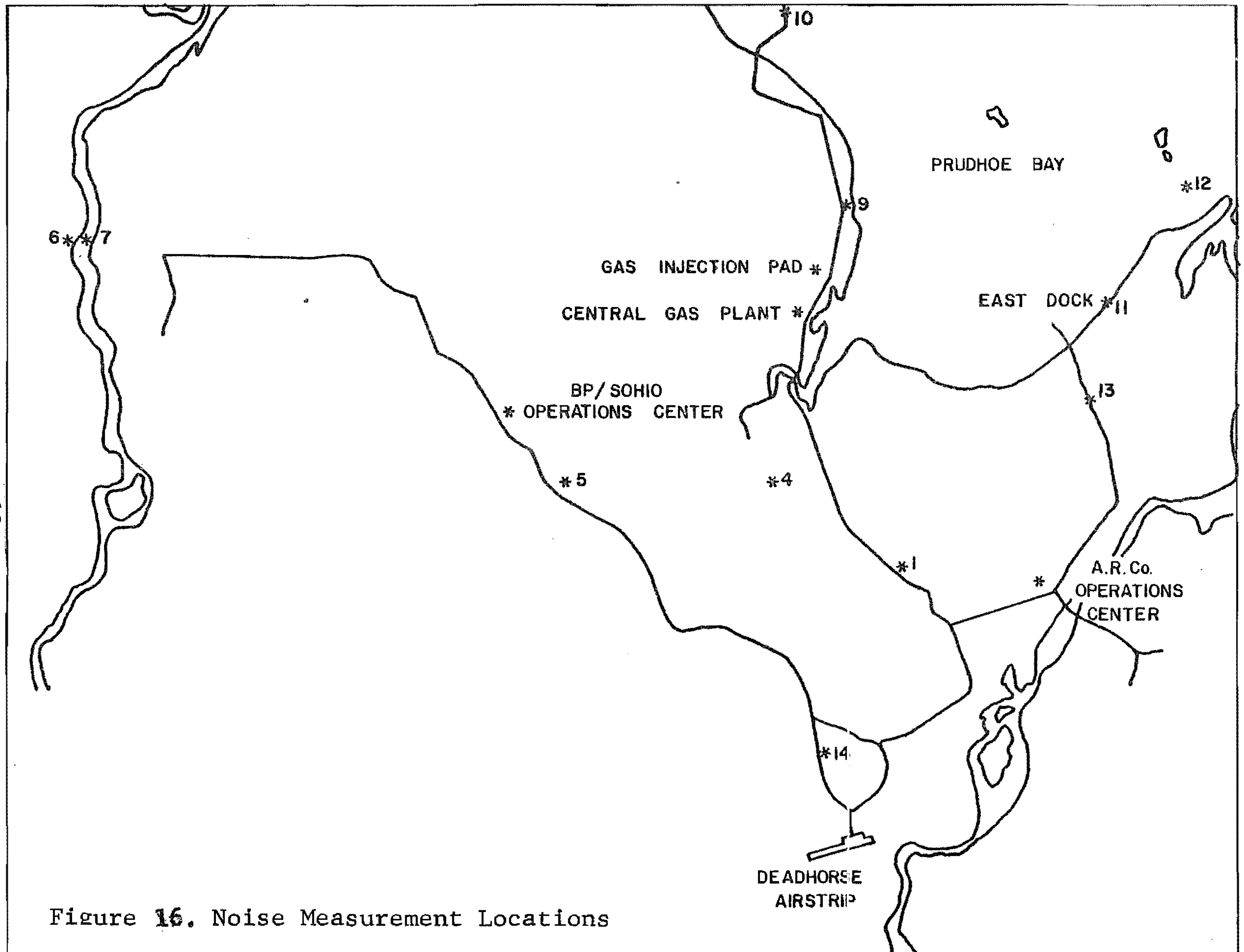


Figure 16. Noise Measurement Locations

TABLE 17

SOUND LEVELS (dBA) MEASURED IN THE PRUDHOE BAY AREA ON FEBRUARY 14-15, 1979

Measurement	Location 1/	Equivalent Sound Level (Leq)
1	300 m. from flow station #1	56
2	Central compressor plant-- 15 m. from turbine air intake	74
3	Central compressor plant-- 120 m. from flare operation	60
4	0.8 km. from central compressor plant	57
5	100 m. from SOHIO central power plant	67
6	600 m. from SOHIO drilling site	44
7	Bridge over Kuparuk River	39
8	1.2 km. from drilling site (DS) 7	44
9	1.7 km. from East Dock	44
10	10 km. north of gas injection pad	35
11	3.1 km. north of gas injection pad	32
12	Niakuk Island	32
13	1.8 km. south of East Dock	33
14	60 m. from drilling site #13	65

1/ Locations are illustrated in figure 16.

The arctic coastal beaches in the vicinity of Prudhoe Bay consist of mudflats, sandy shorelines, and coastal dunes. The dominant salt-tolerant vegetation found in this area is Dupontia, a medium-sized grass. Other grasses or sedges, willows, and mosses are found in association with Dupontia along the beaches.

The most common mammals in the wet tundra region are the brown and collared lemmings, the staple food for the arctic foxes and avian predators in the area. Wolves and, to a lesser extent, wolverines, are also observed in many of the drainages in the area. Wolves feed on ungulates, ground squirrels, lemmings, and other small animals. Grizzly bears may also be found, but usually only in the major river valleys, particularly after emerging from dens. The North Slope area is primarily the bears' summer range where they eat a variety of plants and animals. Caribou are scattered across the wide coastal and foothill regions, mostly between the Anaktuvik and Sag Rivers. The coastal region near Prudhoe Bay was previously a portion of the calving grounds for the Central Arctic herd. Calving was reported within or immediately adjacent to the Prudhoe Bay area up to 1972. With expansion of facilities and continued human activity over the next several years, local caribou occupancy generally decreased, and in 1975 no newborn calves were observed in the northernmost section of the haul road near Prudhoe Bay. Disturbance-related abandonment of range is thought to be a gradual process as the introduction of adverse stimuli increases. The recent history of changing caribou occupancy near Prudhoe Bay reflects this pattern. Generally there are few caribou in this area during winter. However, they may migrate through the Prudhoe Bay area, using this location as part of their summer range while feeding on grasses, sedges, and lichens. Figure 17 indicates some patterns of caribou movement through the Prudhoe Bay field during the summer of 1977.

The many ponds, lakes, and marshes of the area are important waterfowl habitat. The bird populations within this area are characterized by a pronounced seasonality, with the majority of birds present only from May to September. Many bird species feed and molt here, while some may come to nest and breed, and still others are only migrating through the region on their way to and from breeding grounds in other areas of the Alaskan, Canadian, and Soviet Arctic. Shorebirds found in the wet tundra include the long-billed dowitcher, dunlin, common snipe, and pectoral, Baird's, and semipalmated sandpiper. The red phalarope is especially abundant. Arctic terns, glaucous gulls, and all species of jaeger also prey on small birds and mammals of the wet tundra. Waterbirds that nest and feed in wet tundra include yellow-billed, arctic, and red-throated loons; whistling swans; pintails; oldsquaws; and Stellers, king, and spectacled eiders. Canadian geese commonly rest on dry sites such as well-drained steambank bluffs and pingos.

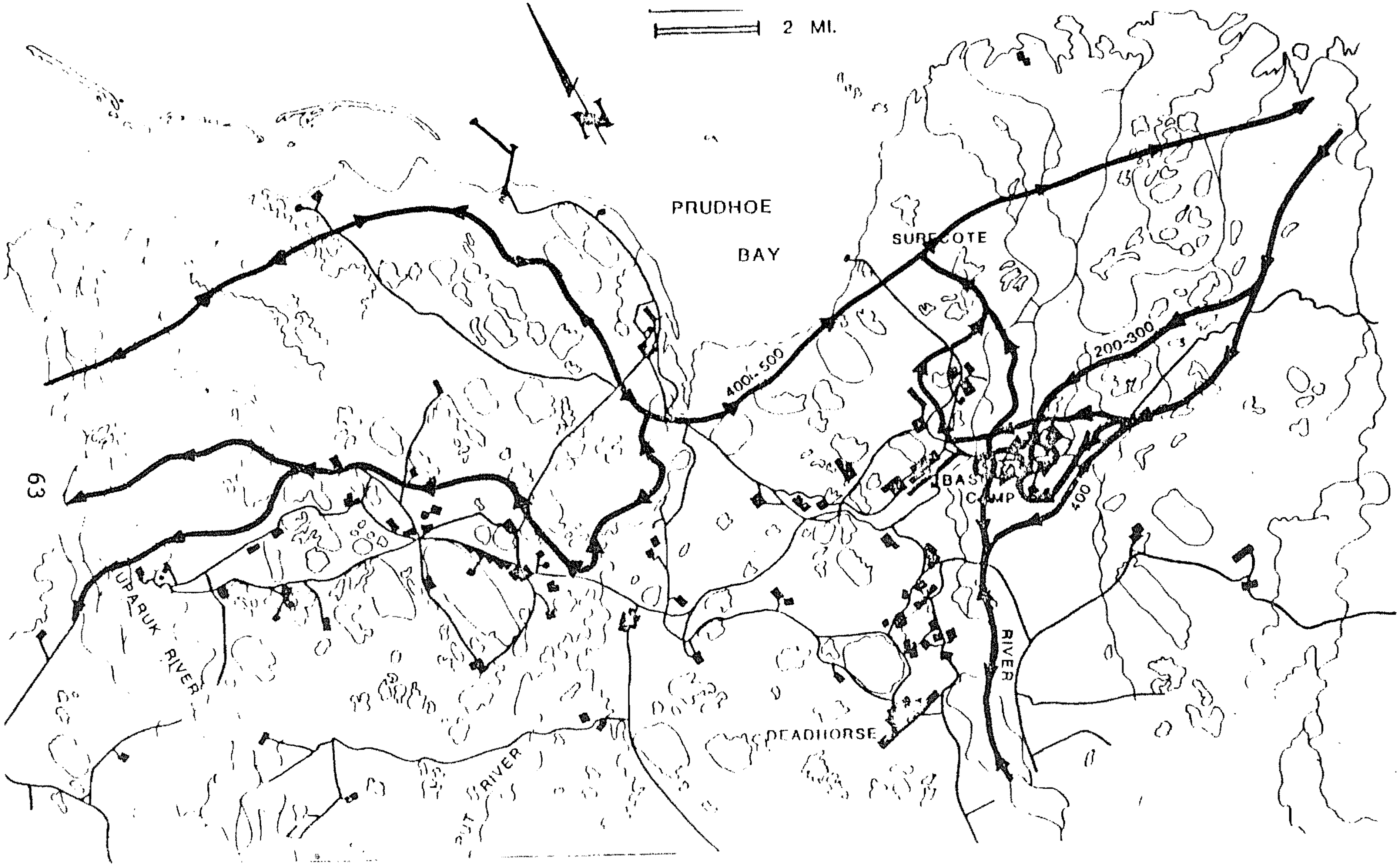


Figure 17. Some Patterns of Caribou Movement Through the Field During the Summer, 1977. Some Movements Were Back and Forth Over the Same Routes.

Source: Angus Gavin, Caribou Migrations and Patterns, Prudhoe Bay Region, Alaska North Slope, 1969-1977, 1978.

The endangered peregrin falcon (Falco peregrinus tundrius) may utilize the coastal area around Prudhoe Bay and the lower end of the Put River as hunting areas. However, there are no known peregrine nesting sites within the vicinity of the proposed project.

7. Aquatic Communities

Within the project area, the Put River empties into the southwest corner of Prudhoe Bay. (See figure 1.) It is a tundra drainage stream displaying intermittent flow during summer and no flow during winter, and it has been used for gravel operations since 1969. There is little available information on the existing aquatic flora and fauna of the Put River, but apparently it has little or no fishery value. There is some indication that the lower end of the river in the delta area of Prudhoe Bay may provide primary summer habitat for freshwater, anadromous, and some juvenile saltwater fish species.

A fisheries survey of the Beaufort Sea coastal area including Prudhoe Bay found that freshwater and anadromous species dominate the nearshore fish fauna during the open water season. Arctic char, arctic cisco, and least cisco were the most widespread and abundant anadromous fishes, while fourhorn sculpin and arctic cod were the two most abundant marine species surveyed. Table 18 lists the fish species captured in this study. Figure 18 shows the relative abundance of all species captured within the research area, and figure 19 indicates the seasonal distribution of all species captured in Prudhoe Bay. Generally, the species diversity and the number of fish within the Beaufort Sea-Prudhoe Bay coastal area are low compared with those in other areas.

Anadromous fish enter the Beaufort Sea at breakup and forage for variable distances along the coastline. Adults reenter freshwater systems to spawn and overwinter earlier than juveniles and nonspawning members of the same species. The movements of juvenile fish along the coastline are predominently found in the less saline, protected waters of major river deltas and lagoons. Anadromous whitefish and char spawn during the fall in a variety of river habitats ranging from perennial groundwater springs in headwater tributaries to isolated pockets of under-ice water in river deltas. Over-wintering habitat has not been identified in the fast ice zone of the Beaufort Sea.

TABLE 18 NEAR-SHORE SPECIES CAPTURED BETWEEN HARRISON BAY AND BROWNLOW POINT

Scientific Name	Common Name	Species Abbreviation
Salmonidae		
Salvelinus alpinus	Arctic char	AC
Coregonus sardinella	Least cisco	LCI
C. autumnalis	Arctic cisco	ACI
C. nasus	Broad whitefish	BWF
C. pidschian	Humpback whitefish	HWF
Prosopium cylindraceum	Round whitefish	RWF
Thymallus arcticus	Arctic grayling	GR
Osmeridae		
Osmerus mordax	Boreal smelt	BSM
Mallotus villosus	Capelin	CAP
Gadidae		
Boreogadus saida	Arctic cod	ACD
Eleginus gracilis	Saffron cod	SCD
Cottidae		
Myoxocephalus quadricornis	Fourhorn sculpin	FSC
Pleuronectidae		
Liopsetta glacialis	Arctic flounder	AFL
Gasterosteidae		
Pungitius pungitius	Ninespine stickleback	NSB
Liparidae		
Liparus sp.	Snailfish	Lip

Source: T. Bendock, Beaufort Sea Estuarine Fishery Study, 1977.

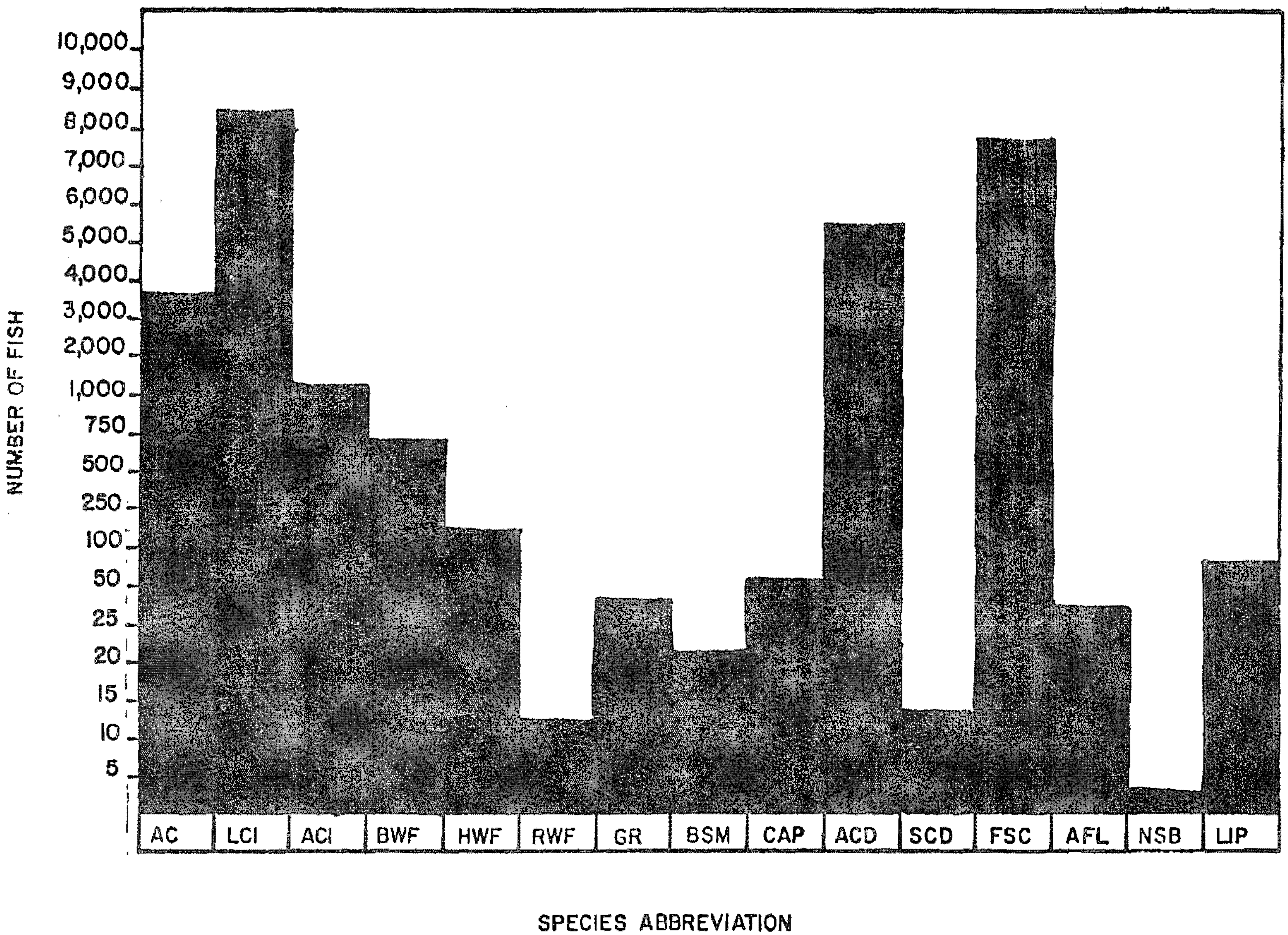


Figure 18. Relative Abundance of Freshwater, Anadromous, & Marine Fish at Prudhoe Bay

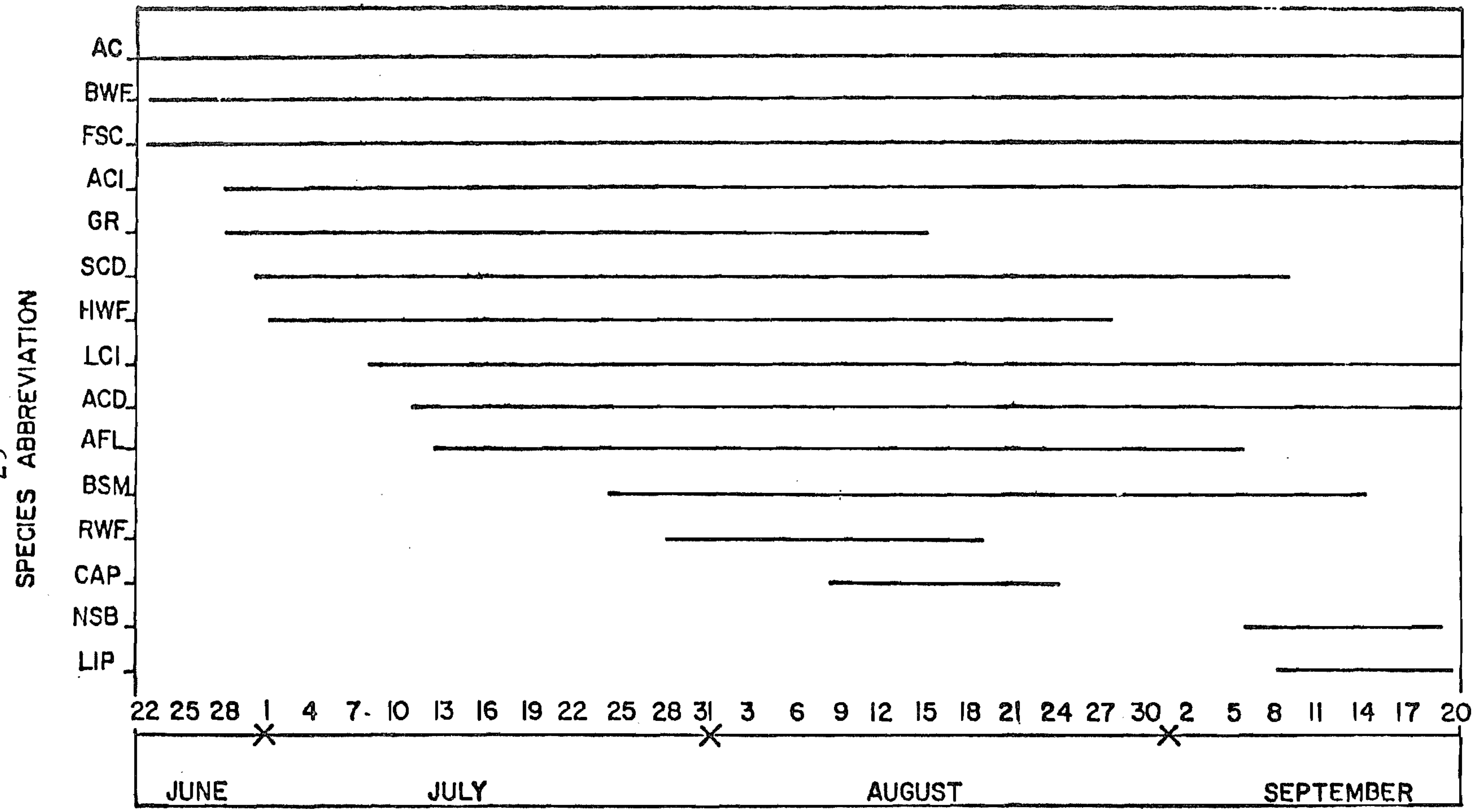


Figure 19. Seasonal Distribution of Fish Species Captured in Prudhoe Bay,1976.

Source: T. Bendock, Beaufort Sea Estuarine Fishery Study, 1977.

Primary production in the near-shore waters of the Beaufort Sea-Prudhoe Bay area consists of three types of primary producers: 1) planktonic algae (phytoplankton) floating in the water, 2) primary producers growing on the bottom (benthic microalgae and macroalgae), and 3) primary producers growing in the ice (epontic algae). The relative annual rates of production for these three types in Prudhoe Bay have been estimated in the following quantities: phytoplankton 31 percent; benthic microalgae, 62 percent; epontic algae, 6 percent.

Phytoplankton blooms characteristically occur as localized blooms in late spring when leads open in the ice and as more intense blooms in early summer when ice breakup usually occurs. The epontic algae, although not very productive, are probably important because of their proximity to the ice leads along which animals migrate into the Beaufort and because of their very early productive (maximum concentration in May). The very productive benthic microalgae occur primarily in calm, shallow coastal lagoons.

Zooplankton includes a variety of animals such as microscopic crustaceans and early life stages of fish serving as food for many larger invertebrates and fish. Because of the short duration of the phytoplankton bloom in the Beaufort Sea, the zooplankton feeding and growth period is short. There is no indication of any consistent pattern of zooplankton abundance in the offshore waters. However, the euphausiid _Thysanoessa_, which is an important prey of the bowhead whale, is abundant in lagoon and offshore waters.

The invertebrate benthos populations in the Beaufort Sea vary greatly, both seasonally and annually, as do the primary producers. Polychaetes represent 70 to 80 percent of the total benthic infauna. The benthic infauna typically consume diatoms, phytoplankton, and sinking organisms in the water column and take in organisms from tundra and peat runoff. Living on top of the sediments are the immobile benthic organisms called epibenthos. Over 75 percent of these epifauna are echinoderms, which include brittle stars, sea cucumbers, sea urchins, sea lillies, and sea stars. Echinoderms provide little nutritional value to other organisms except in their planktonic stages. Other epibenthos organisms, however, such as amphipods, mysids, and ispods, are extremely important as prey species for the populations of fish, birds, and mammals within the project area.

The fauna of the Beaufort littoral (2 meters depth to shoreline) region is poor in species and biomass and is depopulated annually by shore-fast ice. In general, inshore areas that are exposed to ice gouging support benthic organisms adapted to this seasonal destruction. These are opportunistic species with reproductive cycles not closely associated with other biological cycles. Benthos species living in deeper water are more dependent on the seasonality of the area and may not adapt as easily as inshore counterparts. A study of benthos populations in Prudhoe Bay determined that near-shore invertebrates display increased species diversity, density, and biomass with increasing distance from shore.

When compared to the Bering and Chukchi Seas, the Beaufort Sea is a less productive environment for marine mammals, but nevertheless supports significant numbers. Although a number of different whale species have been sighted in arctic waters, only two--the bowhead and the beluga--are numberically or culturally significant in the Beaufort Sea. The gray whale, although not commonly found in the Beaufort Sea, may also appear along the arctic coast during the summer. Both the bowhead and beluga whales follow the ice leads during the spring migration, while the gray whale is a nearshore species but not found in the ice.

Beluga whales are common in the Beaufort Sea area as summer visitors, beginning their northward migration into these waters in April. By May and June, some belugas may have reached the eastern Beaufort Sea and the pack ice around Banks Island. During the summer and fall, belugas enter river estuaries as soon as the ice moves offshore. The fall migration commences in September, when the beluga are likely to be associated with the ice pack edge. The Bering Sea is probably the wintering ground for beluga from the Siberian, Canadian, and Alaskan arctic, although confirming data are lacking. Beluga presumably feed on a variety of fish while offshore, especially arctic cod, crustaceans, and squid. When they move inshore, they may feed first on fingerlings moving down river; later in the season, they prey on adult salmon moving upstream to spawn.

The bowhead whale population may be dangerously low, and consequently it is protected by the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973 from all but subsistence hunting by Alaskan Natives. The latest population estimate of 2,264 whales (range 1,783 to 2,865) was based on the number of bowheads passing Barrow, Alaska, between April 15 and May 30, 1978 (U.S. Department of Commerce, 1978). Bowhead whales migrate from the Bering Sea into the Chukchi and Beaufort Seas from March through June. Depending on annual ice conditions, bowheads may begin arriving in the Canadian Arctic by mid-May, first near Banks Island and later near the Mackenzie River delta. Bowheads will also summer in the Amundsen Gulf. Eskimos have observed whales within 91 to 182 meters of the shorefast ice. The bowhead returns to the Bering Sea on its southern migration from September to December. Figure 10 indicates the proposed spring and fall migration patterns of the bowhead whale in the Bering Sea and the Arctic Ocean. Very little information is currently available on bowhead breeding areas, reproduction, or growth. It is also not certain whether the Chukchi/Beaufort Sea provides calving grounds for the bowhead, although Eskimo whalers have observed calving in the area of the Colville River, west of the vicinity of the proposed project. These whales may do little feeding while migrating, especially during spring. However, mysids, phytoplankton, amphipods, small fish, muddwelling tunicates, and vegetation have been obtained from bowhead stomachs during fall migration. Again, the euphausid, _Thysanoessa spp_ (especially _raschii_) is the prey species most likely taken by bowheads.

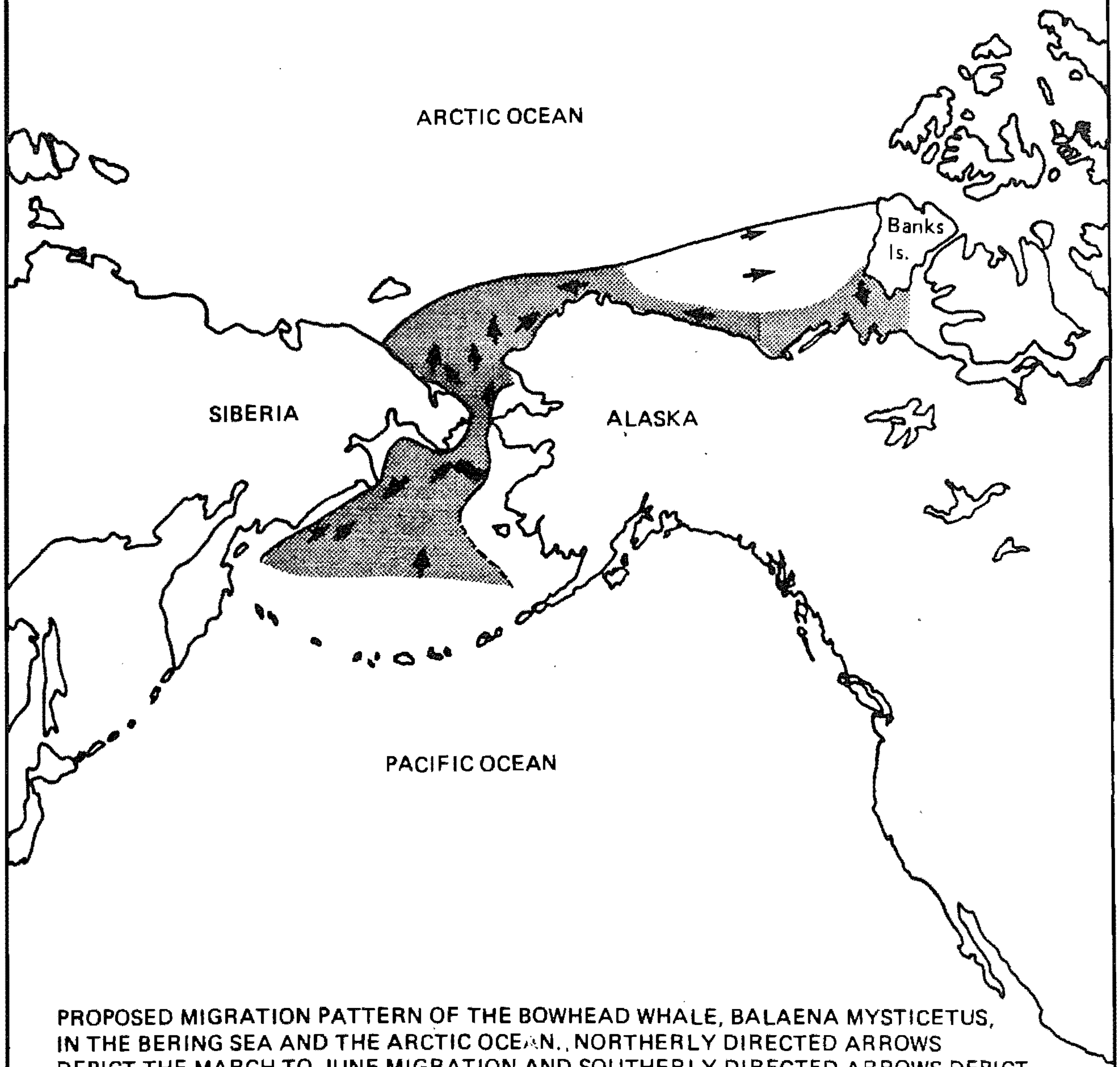


Figure 20. Suspected Migration Routes

SOURCE: Braham, Krogman & Fiscus 1977

Although rarely sighted in the Beaufort Sea, gray whales have been seen along the arctic coast of Alaska from Cape Thompson to Point Barrow. However, a few whales have been reported by the Eskimos along the shores of the Beaufort Sea as far east as Barter Island.

There are three species of ice-related seals found in the offshore area of Prudhoe Bay: the bearded seal, the ringed seal, and the spotted seal. The ringed seal and the bearded seal are permanent residents of the Beaufort Sea, while the spotted seal appears in July and leaves the Beaufort Sea area in the fall as ice reforms. The ringed seal usually inhabits areas of shorefast ice in winter and migrates farther north with the retreat of the ice pack in spring and summer. Pupping occurs in late March and April in landfast ice, and the seal pup remains in its birth lair for a 4- to 6-week nursing period. During summer and fall, feeding is intensive, consisting mainly of crustaceans and fish. The adult bearded seal is almost always associated with ice, but the young usually remain in ice-free areas, frequently bays and estuaries. Mating season is in May and June, and pups are born in the following April and May. Bearded seals eat a variety of benthic invertebrates and some fishes. Spotted seals are found seasonally along the entire northern Alaska coast and also congregate near the edge of the pack ice. These seals commonly make use of the nearshore areas, hauling out on coastal beaches and offshore islands where they rest and feed. Harbor seals may enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fish.

The area of the proposed project also includes the habitat for the Alaskan population of polar bear. Some of the most intensive denning on the Arctic coast occurs from the Coleville River east to the Canadian border. This area, including the offshore islands, is approximately 80 km. wide and includes a corridor of land extending about 40 km. from the coast and the strip of adjoining shorefast ice. Pregnant females seek dens in undisturbed areas, and denning occurs from October until late March or April. Polar bears feed primarily on ringed seals, bearded seals, walruses, and carrion.

Marine birds, such as murres, black guillemots, and fulmars, are found on the open waters. The offshore barrier islands are important nesting habitat for eiders, shorebirds, and gulls. The protected lagoons behind the barrier islands may be even more important in providing a migration route along the coast, since most waterfowl and shorebird species found in this region are coastal migrants.

8. Land Use and Solid Waste Disposal

a) General Land Use

Just over 10 years ago, the North Slope of Alaska was, for all practical purposes, one of America's last great wildernesses used by indigenous Eskimo residents for subsistence fishing and hunting. Since that time, the country's largest domestic reserve of oil and gas has been discovered in the area, numerous oil industry support facilities have been located in the immediate Prudhoe Bay/Deadhorse area, and a road has been built to connect Prudhoe Bay to the rest of the state.

The Prudhoe Bay/Deadhorse industrial enclave is located 13 to 16 km. inland from Prudhoe Bay near the mouth of the Sag River. The enclave encompasses a 995 square km. area containing oil production and operations facilities, support services, and living quarters for persons who work the oil fields. Oil production facilities occupy approximately 259 square km. of the Prudhoe Bay enclave. The facilities are connected by a gravel road running from the northwest to the southeast, with access roads leading to individual facilities. Facilities in the camp are strung out along the road and to the north and east. Prudhoe Bay is solely a work camp organized for onshore oil operations. As such, it does not contain social and governmental institutions that are associated with typical communities.

The small enclave of Deadhorse is located immediately south of Prudhoe Bay. This development, which consists of a state-owned and -operated airport and service company base camps, is the northern terminus of the haul road.

With the exception of several military Defense Early Warning (DEW) line stations and a scattering of Native allotments, almost the entire Prudhoe Bay coastal area belongs to the State of Alaska. The state has leased several tracts between the Canning and Coleville Rivers for oil and gas exploration and development. Soon the Beaufort Sea offshore area may also be leased for similar purposes. To the east of this state-owned land is the Arctic National Wildlife Range. To the west is the National Petroleum Reserve-Alaska area, presently under the supervision of the Department of the Interior.

Prior to the arrival of the military in the 1950's and the oil industry in the 1960's, the land in the Prudhoe Bay coastal area was entirely subsistence oriented. Most of this activity is now generally dispersed along the coast, the barrier islands, and the major rivers, where subsistence resources are most likely to be plentiful.

The Alaska Coastal Management Program (ACMP) was approved by the Department of Commerce on July 6, 1979. It is based on the Alaska Coastal Management Act (ACMA) of 1977. Although the ACMP has been approved as a part of the ACMA, the North Slope Borough (NSB) published the draft of its program for developing its own management plan within the Prudhoe Bay area.1/ The NSB is primarily concerned with developing a program that causes the least possible impact on the fish and wildlife and subsistence needs of its residents. In this proposed program, the borough would classify the existing Prudhoe Bay/Deadhorse complex and the pipeline/haul road utility corridor as a zone of preferred development zone. Although the ACMP has been approved, the NSB Prudhoe Bay program has not been approved and amended into the ACMP. In the interim, the borough may implement plans and ordinances as interim measures.

b) Solid Waste Disposal

The North Slope Borough established Service Area 10 to handle and dispose of solid wastes in the Prudhoe Bay area. The borough has an Alaska Public Service Commission Certificate to operate a solid waste utility. The utility is authorized to process and to dispose of all solid wastes in the Prudhoe Bay area. The borough incinerator is currently undergoing acceptance and permitting testing. Other incinerators will eventually be phased out of use. The proposed refuse incinerator for the SGCF most likely will not be necessary because the borough incinerators at Deadhorse will have about four times the capacity needed to incinerate the maximum solid waste generated at the Prudhoe Bay oilfields (8.5 pounds per capita x 4,000 persons = 17 tons per day).

The landfill presently utilized by Arco and the other North Slope companies is operated by Arco in the dunes area near the mouth of the Sag River. It is a state-approved landfill, but because of the uniqueness of the dunes and their shifting character, pressure has been exerted to have the landfill closed. Operation will continue until a new site can be approved.

At the existing landfill site, refuse is dumped in an excavated area where dune sand was previously removed to near the normal ground level. Because the sand is dry, there is adequate material available for cover during the summer. Covering the refuse may be feasible at the Arco landfill in winter also, except perhaps in periods of extreme cold. Biodegradable wastes, however, cannot be buried in the landfill at any time.

1/ The North Slope Borough is a local governmental unit which encompasses the natural physiographic province of the Arctic Coastal Plain.

The North Slope Borough in conjunction with Arco is exploring the feasibility of using the Put River borrow area, an oxbow where about 3 million cubic yards of gravel have been removed, as the replacement landfill site. This site also is proposed as the gravel source for the proposed SGCF. The existing excavated area would be adequate as a landfill for the expected lives of all oil and gas activities in the Prudhoe Bay area (30 years). Assuming 4,000 persons (estimated maximum oilfield population) on the North Slope generating wastes at 19 pounds per capita per day (76,000 pounds or 38 tons per day) and dumping them directly into the excavated area with compaction to a density of 800 pounds per cubic yard, the presently excavated area would last 88 years. Additional capacity would be created if the borrow area were excavated further.

Although 6.1 to 7.6 meters below ground surface, the borrow pit is dry. This is not unusual in permafrost areas. If the gravels were well drained before being frozen, they usually remain dry but below freezing temperatures until they are disturbed. Any water leaching through the tundra is quickly frozen until an impermeable ice-gravel layer caps the gravel strata.

A dike has been placed between the borrow pit and the Put River to protect against severe flooding. The solid waste site plan specifies another dike around the area as a backup to insure site dryness.

All lands in the North Slope oil field are the property of the State of Alaska, and land-use permits are issued by the Department of Natural Resources (NDR). Any landfill operation also must be permitted by the Alaska Department of Environmental Conservation (ADEC). Until these permits are obtained, the landfill cannot be transferred to the Put River borrow area. The plan for the new landfill has not been approved by the State of Alaska or by EPA Region X. Also, the State of Alaska may require that certain "non-buryable" items be backhauled to Fairbanks, Anchorage, or the lower 48 states for reuse and recovery.

The Parsons report does not indicate the production of any toxic or hazardous wastes that would require special disposal practices. During 1977-1978, Arco made a survey of its North Slope operation to determine if there was any equipment that contained or generated PCB's. None was found. Three methods currently are available to Arco to dispose of hazardous wastes. The wastes can be pumped into an existing injection well, oxidized in a thermal oxidizer, or shipped south for reclamation.

9. Socioeconomic Considerations

The only permanent residents of this area have been the Inupiat Eskimos. In the treeless tundra of the North Slope, four Native villages exist within 320 km. of the Prudhoe Bay complex: Barrow--population 2,800; Kaktovik--population 136; Anaktuvick Pass--population 99; and Nuiqsuit--population 161. Other residents of the area--including Federal, state, and local government employees who provide services to the local Eskimo population, military employees at the DEW Line stations, and those associated with oil and gas resource extraction--are essentially transients.

The last state population estimate of July 1, 1977, indicated there were 9,163 people in the North Slope Borough, an increase of 158 percent since the 1970 census. Of these, only an estimated 3,612 people were living in permanent borough communities. The composition of these permanent communities is approximately 85-percent life-long Inupiat residents and 15 percent other residents who have moved to the borough for employment in public service.

The major source of recent population growth was the development of the Prudhoe Bay field and the resulting construction of TAPS. Construction of TAPS ended in August 1977. The only people now in the region because of this project are maintenance and pump station personnel.

In 1970, the population composition of the North Slope Borough was approximately 83-percent Inupiat. Since that time, Alaska Natives are no longer the dominant group. As of July 1977, 57.6 percent of the borough's total population consisted of persons engaged in oil- and gas-related activities in the Prudhoe Bay area, plus those associated with pipeline camps. The Prudhoe Bay complex population continues to be dominated by males between the ages 18 and 65. Alaska Natives made up less than 10 percent of the population at Prudhoe Bay and Deadhorse in 1970, even though they comprise 83 percent of the population in the North Slope region as a whole.

According to statistics published by the Alaska Department of Labor, the Barrow North Slope division had an unemployment rate of 8.0 percent in 1976. However, this figure may not be representative of conditions in all areas. In July 1976, 71.1 percent of the borough's population lived outside traditional communities, mainly in the Prudhoe Bay/Deadhorse area and in pipeline camps. All of these people were employed, and when their jobs ended, they simply left the region. Therefore, in some of the borough's traditional communities, unemployment rates are relatively high.

Persons employed at the Prudhoe Bay/Deadhorse complex and along the Alyeska pipeline route enjoy extremely high incomes compared to those in the borough's traditional communities and even to incomes statewide. Furthermore, these incomes are not substantially diminished by the high cost of living on the North Slope, since most goods and services are provided by the employer and almost all dependents live outside the region. Although income levels in traditional communities in the North Slope region have improved significantly since 1970, they remain, on the average, well below state levels. Because of high living costs and large families, a significant portion of the region is still living in extreme poverty. Consequently, subsistence hunting and fishing is still an economic necessity.

Compared with the rest of the state, the North Slope Borough has relatively undeveloped trade and services sectors. This is common in rural Alaska, where people with limited incomes and locally high costs of living rely almost exclusively on mail order purchases and demand few services. The lack of development reflects the sizeable transient population housed in pipeline camps which makes virtually no demands on the region for goods and services.

The Prudhoe Bay/Deadhorse complex is not an organized political unit of government but rather a private industrial development located primarily on state-owned land within the North Slope Borough. It pays taxes to the borough and is subject to its areawide powers. The property taxes levied on the facilities at Prudhoe Bay account for approximately 90 percent of the borough's budget. In the past, the borough has been required to provide only limited services to the Prudhoe Bay industrial area. As a result of an agreement between the oil companies and the North Slope Borough shortly after incorporation in 1972, Prudhoe Bay has remained a private industrial complex generally responsible for providing its own services. However, in 1976, because of recurring problems with the subdivision's solid waste, sewage, and water supply systems, the borough created a utility service area at Deadhorse. It will assume responsibility for these services when construction is completed.

While the cultural base of the Inupiat of the North Slope is largely the subsistence pursuits of the people, the economic base for these Eskimos, as of the entire state, is continuing to shift to the oil and gas industries. Borough taxes levied in these areas support most local government employment in the region, and greatly increased levels of spending by the borough government and its employees also support employment in other sectors. These added revenues provide needed facilities and services to the people. However, continued natural resource development in the area poses a real threat to the traditional social and cultural well-being of the North Slope Borough.

10. Recreation and Aesthetics

Even though there is considerable potential for recreational and tourist use of the North Slope and Prudhoe Bay coastal area, there is currently little demand for these activities because the region is remote and because facilities and access are lacking. Generally, existing recreational facilities are limited to conveniences installed by the oil companies at the Prudhoe Bay/ Deadhorse complexes for the use of their employees. Some tour buses have been allowed to use the haul road to visit the Prudhoe Bay complex. However, as long as access to the area is largely limited to air transport, tourism and recreational use of the area will remain limited. If the haul road is opened to unrestricted use, there would undoubtedly be a marked increase in the demand for recreation and tourist facilities in the Prudhoe Bay area.

A few nonresident hunters and fishermen fly into the area annually to fish and hunt moose and caribou, but exact numbers are unavailable. Prudhoe Bay complex personnel are allowed to fish in the area; hunting is prohibited. Currently, there is little demand in the coastal area for recreational boating. However, if portions of the Coleville River are designated as wild and scenic, the demand for that use will increase. Portions of the Sag River in the south have been identified for Wild and Scenic River consideration. The North Slope area with its flat topography and low vegetation are particularly conducive to sightseeing and wildlife and waterfowl viewing. Cross-country skiing and snowmobiling are potential late winter and early spring sports when days are longer and temperatures have moderated.

Probably the greatest attraction of the Prudhoe Bay coastal area is its primitive condition and the wide variety of unique arctic geological and ecological phenomena that exist there. To protect the unique ecological, biological, and geological features of the arctic lowland from intrusion by development, the National Park Service initiated a program in 1974 to identify unique examples of tundra environment to be included in the Natural Landmark Program.

11. Cultural Resources

Although there is currently no permanent Native population living within the immediate Prudhoe Bay area, the land has been the site of numerous temporary settlements and seasonal hunting and fishing camps. Recent archaeological and historical studies undertaken by the North Slope Borough and the Federal government have identified numerous old grave sites, sod hut and ice cellar outlines, and a variety of artifacts indicating the historical and cultural significance of the land. These sites are heavily concentrated along the entire coast, the barrier islands, and the river valleys, particularly the Coleville River.

The Prudhoe Bay area was included in a 1975 archaeological site file and literature search conducted by Iroquois Research Institute for the Federal Power Commission. This study assessed the cultural resource potential of competing routes for the ANGTS. One recent Eskimo shoreside site has been recorded on Prudhoe Bay. The study notes that the Prudhoe Bay area has all the ecological prerequisites attractive to prehistoric and historic Eskimo bands and recommends a field survey for archaeological sites be taken before any facilities are constructed.

C. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

1. Climate

Because of the size of the project and relatively insignificant amount of heat that will be given off by construction and operation of the facility, neither would affect the existing temperature, wind, or precipitation patterns on either a short-term or a long-term basis. There might be some micrometeorological, or site-dependent, impacts. The gas turbine units and the space and process heaters associated with the SGCF might cause an increase in "snowfall" near the units during December, January, February, and March, when the ambient air temperature averages between -23°C. and -29°C. Water vapor from the units would freeze along the lateral borders of the plumes; the larger water droplets ($\geq$ 20 microns) would form large ice crystals and fall out as snow. This would generally occur in the immediate vicinity of the units and could occur up to 1 km. downwind of the units. Distribution of this "snowfall" would depend on ambient air temperature, wind velocity, and the size of the water droplets or snowflakes. This phenomenon would not significantly increase the measurable snowfall in the Prudhoe Bay area, nor would it have any long-term effects on the precipitation patterns of the area.

The construction of the proposed project would not exacerbate ice fog in the project area because a majority of construction would occur during the summer. The operation of the proposed facility would have a minimal effect on the frequency and severity of ice fog. The major contributing factors would be increased pickup and diesel truck use, an increased number of fossil fuel space heaters, increased use of the sewage treatment plant, and additional population. The gas turbine facilities are not expected to be a major contributing factor to ice fog. This is because the plume rise from the gas turbines is sufficient for the plume to poke through the inversion layer. Thus, the plume would not be trapped under the inversion layer and therefore would not add to the ice fogging conditions. The discharge of treated effluent would also contribute to this phenomenon.

The impact of the ice fog would generally be micrometeorological, that is, site-dependent. In isolated areas, the effects would be primarily operational, resulting in delays or interruptions of air and surface traffic. Outside the immediate vicinity of the facilities, impacts would be insignificant.

2. Topography, Geology, and Soils

The primary impact to topography would result from cut-and-fill, gravel pad emplacement, excavation, and permafrost degradation, should that occur. To avoid excessive permafrost degradation and consequent engineering hazards, very little cut-and-fill is expected. It is possible, however, that isolated mounds would have to be removed if they could not be avoided. Depressions would probably be filled with additional gravel.

Excavation would occur at gravel pits and at the water reservoir and the wastewater lagoon. The reservoir and lagoon would be formed by modifying existing lakes; gravel pits would probably tap river channel deposits or large thaw lakes underlain by gravels.

Surface area of the wastewater lagoon would be approximately 20 acres, assuming a depth of 2 meters. More definite figures for the location or depth of this facility are not available, so the quantity of material to be excavated cannot reasonably be estimated--especially because existing lakes and/or depressions would be utilized to some extent. The Parson's report estimates 306,000 cubic meters of excavation for the water storage reservoir.

This project would impact geologic resources, erosion and siltation, and permafrost. Construction of the facility would facilitate the transportation and therefore the use and ultimate depletion of natural gas from the Prudhoe Bay area. This is compatible with the national goal of making this resource available for use.

The only other geologic resource required by this project would be gravel needed for roads, workpads, foundations, etc. This resource is currently being extensively utilized for development of the Prudhoe Bay area. Construction of TAPS drew on these resources, as will construction of the Northwest Alaskan pipeline. Further use may be expected during exploration and development of the Beaufort Sea. 1/ However, gravel for the Beaufort Sea lease area will come primarily from offshore sources.

1/ U.S. Department of the Interior, Bureau of Land Management, Alaska OCS Office, DEIS on Proposed Federal/State Oil and Gas Lease Sale, Beaufort Sea (Anchorage, 1979).

Gravel would provide an insulating base under roads and all facility components to avoid permafrost degradation. These gravel pads, about 1.5 meters thick, would be similar to those used under most of the existing facilities at Prudhoe Bay. Gravel would also be required for a dike around the proposed flare area and for expansion of the existing dock or for construction of a new dock and causeway. A minimum of approximately 1,747,000 cubic meters of gravel would be required. (See table 19.) However, if a new dock and causeway were to be constructed, more than 470,000 cubic meters would have to be added to this total.

Extraction of gravel, excavation of waste disposal and water reservoir areas, and construction of the gravel foundation mats would all increase turbidity and siltation. Turbidity levels would be very high but would be contained within the construction areas. The primary exception would be gravel extraction from river- and streambeds, where turbidity and siltation could be carried downstream. However, most of the impact would probably be borne by areas affected by existing extraction activities.

Because of the relatively low slopes and low rainfall in the project area, water erosion should not be a serious problem. This is especially true because of the limited excavation required. If construction removed the layer of organic material lying over the soil, wind erosion could be a problem. However, because of engineering and environmental constraints related to permafrost, disturbance of this organic mat would be minimal.

Permafrost is highly sensitive to temperature changes. Any modification of the amount of solar radiation reaching the surface of the ground or the ability of the surface materials to absorb that radiation changes the thermal regime and will change the extent of the permafrost. Most construction affects the thermal regime. The resultant effects on permafrost persist for many years, since the entire column of frozen material from the permafrost table to the bottom of the permafrost must come to equilibrium with the new regime.

Temperature changes can result from climatic changes, from changes in the insulation qualities of the surficial material, and from water standing or flowing over this material. A climatic change would be an increase or decrease in the mean annual temperature or in the variation of temperature of the near-surface permafrost. Compaction or removal of the surface material would reduce the insulation between the permafrost and the surface, allowing more summer heat to reach the permafrost. The creation of standing water bodies would raise the effective average temperature and decrease the seasonal temperature variation at the ground surface; removal of such water would lower the average

TABLE 19

SUMMARY OF GRAVEL REQUIREMENTS

Construction Areas		Gravel Requirements cubic yards (cubic meters)
MODULE PADS		
	SGCF pad	723,000 (553,000)
	Camp pad	612,000 (468,000)
	Crude cooling pad	28,000 (21,000)
	Subtotal	1,363,000 (1,042,000)
ROADS	SGCF north access	19,000 (15,000)
	SGCF south access	27,000 (21,000)
	Camp pad east access	12,000 (9,200)
	Camp pad west access	105,000 (80,000)
	Camp-SGCF road	42,000 (32,000)
	Flare road	60,000 (46,000)
	Subtotal	265,000 (203,000)
OTHER		
	Dike for flare area	43,000 (33,000)
	Dock expansion	613,000 (469,000)
	Total	2,284,000 (1,746,000)

Source: Parsons, 1978, and Plengrer, 1979.

ground surface temperature and increase the amplitude and duration of seasonal temperature fluctuations.

Degradation of the permafrost results from one or both of the following mechanisms: thermal erosion or thawing. Excessive heat will thaw some permafrost. Heat sources include direct solar radiation, warm air, and free water. If permafrost is brought into contact with running water, thermal erosion will take place, since the water not only melts whatever interstitial ice exists but also carries away the soil particles. Gullying and new drainage patterns may result. In an ice-rich area, subsidence of the permafrost soil may result as the ice melts, saturating the soil and reducing its ability to support loads, including the weight of the soil itself.

Human activities that disrupt the vegetation include vehicular traffic, placement of structures, and excavation. The builders would probably follow normal construction methods such as placing approximately 1.5 meters of gravel directly on the undisturbed tundra in building roads and gravel parking areas. This thickness has been determined by mathematical models and by trial and error to be adequate to preserve the permafrost in the Prudhoe Bay area in most instances. If too much gravel is placed, the permafrost table (top of the permafrost) is raised into the fill. Although this could produce frost heaving, frost heave would not be a problem as long as the original active layer were not very thick.

There would be changes in drainage patterns along gravel pads and roads. Snow would drift on the leeward side of these structures and, upon melting, would cause ponding of water on the tundra if no drainage were provided. Operating companies on the North Slope have found that ponding along roads has not caused significant degradation of the permafrost. There is evidence that the areas immediately adjacent to the roads and pads melt sooner than other areas. This early melting is caused by the heat absorbed by dust blown from the roadways onto the snow, but it has not created any major permafrost degradation. The ponded water will gradually evaporate or, if the tundra is not disturbed, percolate horizontally through the active layer. The convective cooling caused by the evaporation process reduces the transfer of heat to the active layer.

To determine the potential for permafrost degradation from the wastewater disposal lagoon, it was assumed that a full 8-month wastewater flow would be stored in a 1.83-meter deep lagoon. 1/ The side slopes of the lagoon are assumed to be

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1/ 150,000 gallons/day x 8 months = 36 million gallons.

1V by 3H; thus, the lagoon would have a surface area of 77,700 square meters (19.4 acres). The area covered by the bottom of the lagoon would be 18.1 acres (268 meters by 268 meters).

Because the lagoon would receive warm water from the base camp, the staff assumed the minimum water temperature at the bottom of the lagoon to be 4°C. and the mean annual soil surface temperature to be -10°C. Thus, the steady state thaw would occur approximately 57.9 meters below the bottom. 1/ This is a 57.44-meter increase in the steady state thaw level because, as Alaska Consultants, Inc. reported in 1978, the maximum naturally occurring thaw level in the area is 46 cm. deep. The length of time for this to occur and the extent of the thaw bulb were not determined. The lateral thaw is not expected to be more than 61 meters; thus the potential for structural damage can be limited by careful planning. It is estimated that it will take 5 to 8 years to reach the maximum thaw condition.

The effect of the proposed water storage pond on the permafrost was similarly determined. The staff assumed, however, that a natural lake would be excavated and enlarged. If the slopes of the pond were 1 by 3 and the pond was 7.0 meters deep, the surface of the bottom of the square pond would be 39,600 square meters (9.8 acres). The temperature of the water in the lake is estimated to be about 1.5°C., because the lake would generally receive only spring flow from the Put River. Based on these assumptions, the depth of thaw below the pond would be 12 meters.

Since the soils in the project area have very little potential for agricultural use because of the climate and the low level of nutrients, impact to fertility would not be significant. Construction could impact the engineering properties of the natural soils, as previously discussed.

3. Hydrology

a) Surface Drainage

Construction of the proposed facilities would local alter surface drainage patterns. Road embankments, gravel pads, and berms would be sufficiently thick to prevent thaw of underlying permafrost. However, the permafrost table could rise under the

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1/ Determined by utilizing the graphical solution advanced by Lachenbruch (1957).

gravel emplacement and dam lateral movement of water above the permafrost. This would create new areas of wet and dry conditions. A secondary impact of concentrated or redirected surface drainage would be the potential for both thermal and surface erosion.

Any spills or leaks of petroleum products associated with construction and operation which entered surface watercourses would adversely affect water quality.

The flood hazard for the proposed facilities would be negligible. The proposed facilities are located about 1.6 km. from the Put River at an elevation of about 7.6 meters MSL. Water withdrawal pumps, located in the active flood channel, would be constructed to withstand flood flows. No flood hazards maps are available for the area. At the USGS gauging station 11.8 km. upstream from the mouth of the river and 61 meters upstream from the SOHIO river crossing culverts, the recorded maximum gauge height is 7.47 meters above MSL. This height was caused in part by the formation of ice dams at the culverts during ice breakup.

Table 19 summarizes gravel requirements for constructing gravel pads and roads, and expanding the existing dock. The Put River has been used as a gravel source, and the applicant implies that it could supply a portion, if not all, of the gravel required for the proposed project.

Physical changes in stream length, pool-riffle ratios, substrate, groundwater, water velocity, gradient, width, and depth can result from gravel removal. Even if gravel were initially extracted from outside the water channel, shifts of water throughout the floodplain could eventually bring the excavation into the watercourse. Sediment transport could be increased. The river profile would adjust during high water cycles by refilling the excavation with materials from the upstream side of the excavation. The deep water would migrate gradually until the river profile had reached a new point of equilibrium. This straightening of the river channel increases water velocity in the channel and alters pool-riffle ratios.

According to 1973 studies by Forshage and Carter of the Brazos River in Texas, substrate changes could also occur. Following gravel extraction there, the river depth in the dredged zone increased and the substrate changed from gravel to sand. Additionally, substrate changes in the river were observed as far downstream as 1.6 km., and turbidity increases were detectable 12 km. downstream 6 months after gravel extraction was completed.

The Alaska Department of Fish and Game has commented that the Put River site has been nearly depleted of gravel and that the 2.3 million cubic yards of material required for the SGCF project represents approximately 15 average Alyeska Pipeline Service Company material sites. Further concerns about future exploitation of floodplain gravel sources have been expressed by the Economic Development Division of the Greater Fairbanks Chamber of Commerce (GFCC). Additionally, the Outer Continental Shelf Environmental Assessment Program (OCSEAP) investigators concluded that "Quarrying on inland sites should be prohibited in river channels and floodplains and in other onshore wetlands, and should be restricted to upland sites and to biologically acceptable thaw lakes."1/ In a draft environmental report discussing proposed waterflood facilities, Dames and Moore indicate that Put River oxbows contained an estimated 8 to 13 million cubic yards of additional extractable gravel volumes.2/

The GFCC suggests that gravel is available from upland sites, but that mining it would be "prohibitively expensive" and would cause potentially significant impact to the environment. At upland sites, the useable material is frozen and overlain with 1 to 3 feet of frozen silt and organic tundra. Environmental considerations associated with mining upland sites would include where and how the overburden would be disposed of and how wind erosion of the disposed material would be controlled. U.S. Army Corps of Engineers permits would be required for the disposal of overburden. Additional environmental impacts would occur if gravel access roads to inland material sites were required.

OCSEAP investigators concluded that large biologically acceptable thaw lakes, deeper than 2 meters and located a kilometer or more inland, are the most desirable sites for mainland gravel pits. Gravel in these sites is likely to be naturally thawed; biological impact would be minimal; and after quarrying, the pits could be filled with water for a year-round reservoir. OCSEAP investigators also concluded that excavation sites in the Sagavanirktok Paleovalley on the open Beaufort Sea Outer Continental Shelf would be the environmentally preferred sources of sand, gravel, and mud fill and that they could furnish gravel almost anywhere it would be needed on the coastal plain. While current information suggests that impacts on marine biota from this operation would be more concentrated than natural disturbances of sediment and bottom on the Beaufort Sea shelf, the "perturbing effects of dredging appear to be acceptable . . ." (OCSEAP report, p. 19).

1/ Environmental Stipulations Relating to OCS Development of the Beaufort Sea, Proceedings of a Synthesis Meeting of OCSEAP Investigators, (Fairbanks, September 15, 1979), Special Bulletin, #25 p. 20.

2/ Prudhoe Bay Waterflood Project Environmental Assessment, Vol. I (April 1980), p. 2-57.

As a consequence of these comments, the staff believes that serious consideration for gravel sources should be given first to the Sag River Paleovalley, next to large biologically acceptable thaw lakes, and finally to upland sites (in conjunction with the use of winter ice access roads rather than gravel roads).

b) Water Resources, Withdrawal System, and Disposal System

The water supply system for the proposed project would be similar to the existing Prudhoe Bay field unit system. Water would be pumped from the Put River as necessary to replenish a reservoir lake. Water from the reservoir would be drawn through a treatment plant and then distributed throughout the camp. Minor amounts of filter backwash and sediment, the direct by-products of the water treatment facilities, would be conveyed to the sewage treatment facilities.

The reservoir would be constructed in an existing thaw lake (figure 21) and would require excavation of 305,824 cubic meters of material. Excavating the two existing 0.71-meter (2 feet) deep lakes to a depth of 7 meters (23 feet) would provide a 10.4-acre working reservoir capacity of 1.5 million barrels (63 million gallons) below the 1.8-meter (6-foot) winter ice cover.

According to a winter water availability study performed for FWS, such artificial storage of excess spring-summer surface runoff is one feasible solution to water use conflicts between humans and fish and wildlife during the winter. Support for this method has been provided by OCSEAP investigators, FWS, USGS, State of Alaska Fish and Game Commission, Arco, and SOHIO.

Arco and SOHIO have both used the Put River for water supplies. The lower Put River has been deepened, and Arco uses brackish water from this "reservoir" primarily for well drilling. Water Permit No. 890, issued by Alaska's Department of Natural Resources, provides Arco with up to 300,000 gpd from the Put River until January 1981. SOHIO has extracted gravel from an oxbow lake adjacent to the Put River and used the deepened lake as a reservoir. In February 1977, SOHIO indicated plans to enlarge this reservoir, even though it had been only marginally successful because of high salt content. It also was considering construction of an additional reservoir somewhat upstream from the first. In comments on the DEIS, Arco indicated that SOHIO's current water reservoir is the Kuparuk River.

Arco's comments on the DEIS attempt to justify withdrawing water from the Put River because of its limited biological value--i.e., the absence of game fish there. This is inappropriate

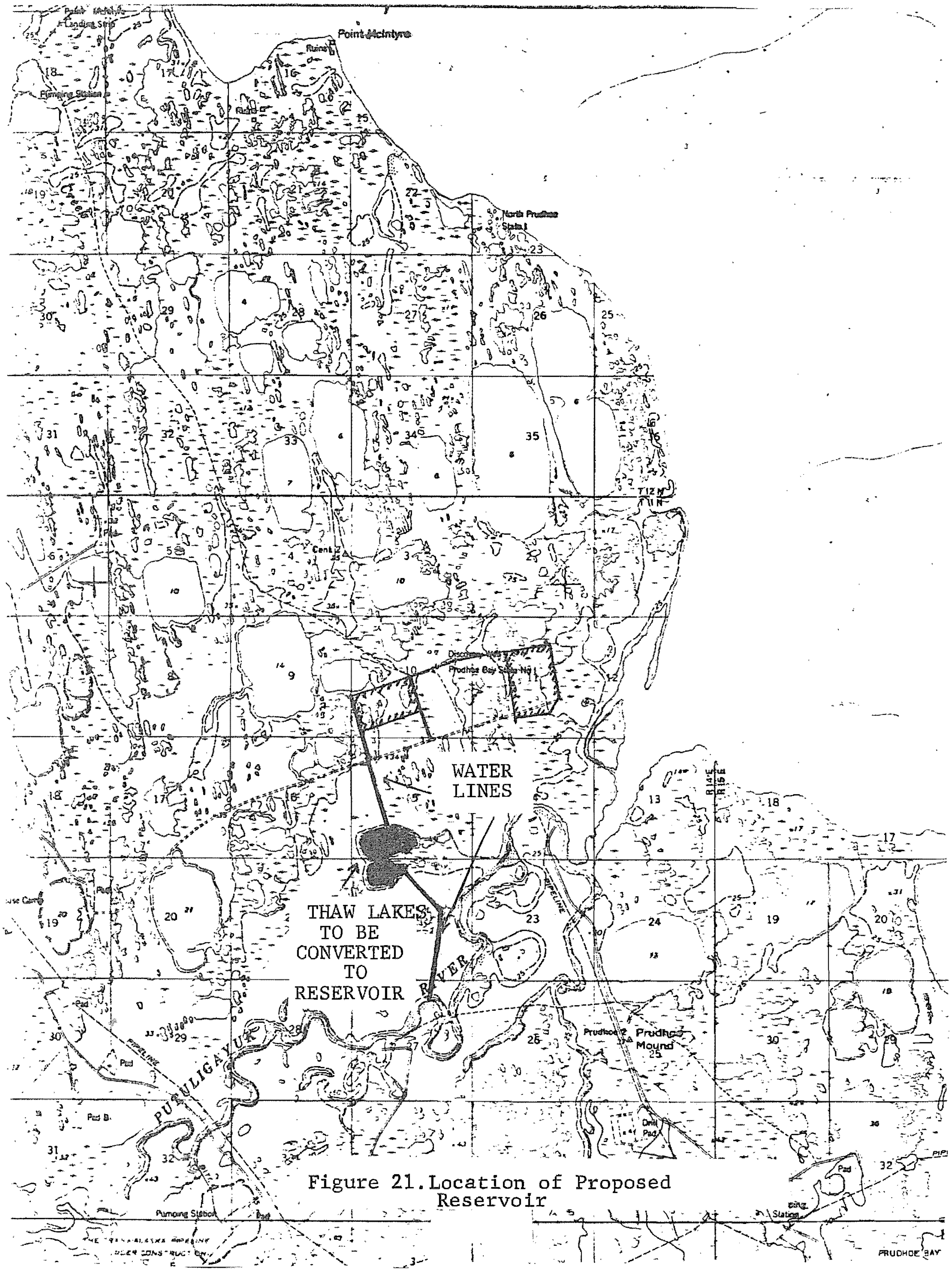

Figure 21. Location of Proposed Reservoir

reasoning. As with any individual component of a natural system, significant modification of the characteristics of one element would affect the rest of the system. The amount of freshwater discharged into Prudhoe Bay by rivers affects the salinity of the bay and thus has an effect on biological populations. Additionally, the salinity transition zone in rivers provides a nursery for some juvenile fish.

However, the staff does not believe that a maximum water withdrawal rate of 1.35 cfs would significantly reduce the river's June discharge, when 84 to 97 percent of the river's total annual flow occurs. 1/ Furthermore, if river flow permitted continuous pumping through July, August, and September, the amount withdrawn would equal approximately 0.85 percent of the annual average discharge. Therefore, the staff believes that while it would be prudent to obtain as much of the required water as possible during June and July when sufficient flow is assured, the diversion of 1.35 cfs at any time would not significantly affect biological populations or the aquatic environment.

The impact of construction in the channel of the Put River could be more extensive than the impact of water withdrawal. The riverbed may be adjusting to the effects of past construction, especially the two culvert causeways and the berms for the gravel removal operations. The main channel location and elevation may be changing; if so, stabilization and maintenance of the channel would be required before the pump intakes could be installed, since the pump intakes must be located in the main channel to be effective during low flow. Sediment concentrations accompanying changes in channel stability might interfere with the water supply system operations.

Saltwater can intrude in river channels which are below sea level once freshwater flow ceases during the winter. However, the staff does not anticipate that brackish water would enter the water supply intake pumps in the Put River when sufficient flow was available to supply the proposed reservoir.

Information on where spoil from reservoir excavation would be dumped is unavailable. If the area of the reservoir were 10.4 acres and usable gravel were overlain by 1 to 3 feet of organic material, approximately 17,000 to 50,000 cubic yards of

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1/ The maximum pumping rate planned is 400 gpm (0.89 cfs). A maximum of an additional 300,000 gpd (0.46 cfs) could be withdrawn under Arco's water use permit.

spoil would be displaced. If not properly isolated from flowing water during spring flooding, ice-rich spoil would increase siltation.

Heat from water and sewage pipelines and the reservoir and disposal lake would thaw permafrost, in turn altering local groundwater flow systems. Permafrost thawing could produce some groundwater that would drain along the water and sewage pipeline trenches.

Returning camp waste waters to the disposal lake would increase ice fog and icings. If the proposed wastewater treatment facilities were designed and operated similarly to the existing Arco plant, the environmental impact would be minimal. The disposal pond for the SGCF would be located well downstream from any potable surface water source. Because the permafrost extends 468 meters below the ground surface, vertical percolation of water from the disposal pond would not be a problem. Nutrient-rich effluent that might escape from the pond through the active tundra layer or flow over the tundra would cause minimal adverse effects because nitrogen and phosphorous in the water would be absorbed by the tundra plants. No changes in tundra species composition, density, or plant vigor are reported in the literature as the result of nutrient enrichment from a wastewater stabilization pond. Bacterial contamination should not be significant because the wastewater would be chlorinated before discharge to the stabilization pond; regardless, the active layer would not be used as a source of potable water. If the active layer were saturated, effluent would move very slowly through the active layer.

c) Docking Facilities

Enlargement of the existing facilities would require widening the causeway and expanding the docking area. The short-term effects of widening the causeway with gravel would include the following:

- Increased turbidity would occur as gravel placement stirred up the bottom silt. This would decrease the amount of light available for algal growth. Bottom-dwelling organisms could be covered as the fine particles settle.
- Biotic communities established on the gravel slopes of the existing causeway would be eliminated when covered by additional gravel.

- Resuspension of detritus into the water column and subsequent decomposition of organic material could reduce the level of dissolved oxygen.

- Reentry of nutrients into the water column could stimulate additional algal growth. Whether turbidity or added nutrients would have the greater overall effect on algal growth would depend on the nature of the disturbed sediments.

A significant weakness of the Prudhoe Bay area as a proposed site for the construction of the SGCF is the potential for ice-related delays. During some open-water seasons, meteorological conditions are such that summer pack ice moves in. If barges carrying supplies, equipment, or the component modules of the SGCF were pushed around by pack ice, experienced hull damage, or could not enter Prudhoe Bay, a construction season could be significantly hampered or lost entirely.

A long-term effect of the expansion of the existing causeway would be the loss of habitat. If the causeway were widened, some of the bottom habitat and some of the gravel slope habitat would be replaced by a new gravel slope. Depending on the configuration of the widened causeway and enlarged dock, additional modifications of the nearby circulation patterns, biological environment, ice movement and character, and nearshore thermohaline regimes could occur.

In referring to a new causeway and dock or an additional new arm on the existing causeway, Arco indicated in comments to the DEIS that "To Arco's knowledge, none of these kinds of facilities are planned either with this project or in conjunction with any other project." There is evidence, however, which suggests that the existing causeway is impacting the bay in ways which could be mitigated. Comments by the Alaska Department of Environmental Conservation indicate that the existing causeway is presently deflecting estuarine surface water northward along the causeway, altering the marine environment on the western, nearshore side of the causeway. Impeded nearshore circulation between Stump Island and the mainland is apparently increasing accumulation of fine sediments in the sheltered lee of the island. The shallow area behind Stump Island could eventually be filled in by this accumulation. In addition, although a large percentage of the suspended sediment load of the Sag River (including terrestrially derived nutrients) is probably dispersed normally offshore before reaching the vicinity of the dock. The Alaska Department of Environmental Conservation suspects that a sizeable percentage which would normally be transported westward between Stump Island and the mainland is now being artifically diverted offshore to seaward of Stump Island. The Alaska Department of Environmental Conservation believes that this could or has adversely affected the island and near-island marine habitat for birds.

Changes in annual temperature, salinity, and nutrient regimes attributable to changes in circulation, ice cover, and wave regime could occur or have occurred because of the uninterrupted causeway. In a general discussion of causeways in the Beaufort Sea Oil and Gas Lease Sale area, OCSEAP investigators indicate that bridged gaps in causeways would mitigate many of these effects.

In discussing breaching of proposed waterflood facilities (See section A.b.), Dames and Moore indicate that it could be necessary for any, or a combination of, the following reasons:

1. To ameliorate the water quality and circulation changes caused by the existing or an extended causeway, if breaching is an effective means of doing so.

2. To provide fish migrating near shore an alternative to going around the causeway.

3. To provide fish migrating eastward near the shore and following the extended causeway seaward an alternative to encountering the project intake screens and the predators that may concentrate off the end of the causeway.

However, studies conducted by Dames and Moore indicate that the breach design Arco and SOHIO are considering (for the waterflood causeway extension only) would not significantly ameliorate water quality and circulation changes caused by the existing or extended causeway, even if several breaches were used. Consequently, Dames and Moore concluded that, "Because of the high cost of constructing and maintaining each breach, it does not appear that a breaching scheme, adequate to significantly influence the changes in water quality caused by the extended causeway is economically feasible."

Dames and Moore also indicate that a 1980 interagency meeting formulated the following criteria for breaching which would create the maximum fish passage:

a) Breaches should have maximum possible wetted cross-sectional area.

b) Breaches should intersect both the water surface and the seafloor to provide light to guide fish, airflow to speed wetting, and a "natural" bottom. An air space of 0.5-1 meter (1.6 - 3.3 feet) would be desirable.

c) Breaches should be inside DH2 in about 1 meter of water (to allow fish to move along the shoreline) and in the extended causeway (to allow fish to by-pass the intake).

d) Breaches should be ice-free soon after breakup at least 75 percent of the time.

e) Water velocity in a given direction should be within the swimming capabilities of the weakest swimming anadromous species.

Arco and SOHIO, however, found the breaching designs in the Dames and Moore report "impractical" for the existing causeway either because of the difficulty in accommodating loads in excess of 2,000 tons or because of the need to heat breaching culverts.

The staff believes that the proposed widening of the existing causeway would contribute to impacts already significantly affecting the bay. It also believes that as much effort should be invested in achieving a practical restoration of "natural" circulation in Prudhoe Bay as has been made in overcoming obstacles to obtain oil and gas from the Prudhoe Bay area.

4. Air Quality

a) Construction-Related Impact

During construction of the SGCF and its ancillary facilities, pollutant emissions would depend on the type and amount of equipment used and the extent of equipment use. Concentrations of pollutants would also depend on the relative locations of the construction activities. Generally, the emissions would include hydrocarbons (HC), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur oxides (SO_x), particulates (TSP), and water vapor. The major activities that would produce emissions include gravel extraction and placement, including dock expansion, and transportation of the modules from the barges to the pads and other support functions. Detailed estimates of these pollutants are contained in appendix E.

The extraction and the placement of the gravel could contribute significant quantities of dust to the air. Water spraying would be used to minimize the dust. Spraying water prior to extraction, periodically throughout extraction and placement, and immediately after placement would reduce the dust emitted to the atmosphere substantially. Periodic spraying of any gravel access roads would minimize the dust created by trucks hauling gravel, construction materials, and equipment to the various construction sites. Until revegetation occurred in the borrow area, dust might be a minor problem during the summer. However, 8 months of the year the borrow area would be covered with snow, and fugitive dust would not be a problem.

Construction of the SGCF would cause temporary and minimal deterioration of the ambient air quality in the vicinity of the project site, as can be seen in table 20. Dust would be visible

TABLE 20

COMPARISON OF NAAQS STANDARDS AND MAXIMUM DOWNWIND GROUND-LEVEL INCREASES IN POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION EQUIPMENT

Pollutant	Time of Average	Primary Standard	Secondary Standard	Estimated Maximum Groundlevel Increase in Pollution Concentrations
Particulate matter (TSP)	24-hour	260 µg	150 µg [a]	0.76 $\mu g/m^3$
Sulfur oxides (SO_x) (measured as SO_2)	24-hour 3-hour	365 µg (0.14 ppm) [a] --	 1,300 µg (0.5 ppm) [a]	1.15 $\mu g/m^3$ 3.24 $\mu g/m^3$
Carbon monoxide (CO)	8-hour 1-hour	10 mg (9 ppm) [a] 40 mg (35 ppm) [a]	Same as primary Same as primary	2.60 $\mu g/m^3$ 49.67 $\mu g/m^3$
Hydrocarbons (HC) (nonmethane measured as CH_4)	3-hour (6 A.M. to 9 A.M.)	160 µg (0.24 ppm) [a] (guideline for O_3 standard)	Same as primary	11.35 $\mu g/m^3$

a Concentration not to be exceeded more than once per year.

over the natural landscape. Adverse impact on the aesthetics of the natural landscape would not be significant, however. Because of the limited population in the Prudhoe Bay area and the short-term nature of construction, the dust would have a minimal impact on visibility.

Dust settling in the area would increase snowmelt to some extent during construction. It would reduce the amount of light reflected from the ground surface, thus increasing the surface air temperature and the rate of snowmelt.

b) Operation-Related Impact

The staff conducted an air pollution dispersion analysis for the SGCF and its ancillary facilities. Results indicate that the increases in ground-level concentration resulting from the estimated emissions would be below the maximum allowable Class II PSD increments. (See table 21.) In addition, increases in ground-level concentrations over the predicted background levels will not violate NAAQS. (See table 15.)

Several assumptions were used in the dispersion analysis to assure conservative results:

- All nitrogen oxide emissions were assumed to be NO_2.
- No reduction in NO_x emissions was assumed, although a lower combustion temperature resulting from the exhausting of waste CO_2 through the gas turbine unit will reduce NO_x emissions.
- Exit velocities used for the turbines were multiplied by 0.24 to reduce the plume rise by at least 30 percent for all stability conditions.
- The three turbine units were assumed to be operating at 100-percent load 100 percent of the time, although only two units would run while the third would be kept in reserve.
- The space and process heaters were assumed to be operating at 100-percent load 100 percent of the time, although two of the process heaters and one space heater would be kept in reserve.

TABLE 21

COMPARISON OF PREVENTION OF SIGNIFICANT DETERIORATION INCREMENTS WITH THE MODELING RESULTS

	Maximum Allowable Increase ($\mu g/m^3$)	Maximum Predicted Increase ($\mu g/m^3$)
Class II Area		
Particulate matter		
Annual geometric mean	19	0.7 a/
24-hour maximum	37	8.3 b/
1-hour maximum	-	14.2 c/
Sulfur Dioxide		
Annual arithmetic mean	20	0.27 a/
24-hour maximum	91	3.30 b/
3-hour maximum	512	4.70 b/
1-hour maximum	-	5.70 c/
Nitrogen Dioxide		
Annual	-	19.6 a/
1-hour	-	383.0 c/

a/ Annual levels were predicted using the EPA VALLEY computer program. Maximum levels were predicted to occur 5 km. west of the proposed facilities.

b/ Turner's power law equation was used to correct the 1-hour predicted values to 3-hour and 24-hour values.

c/ One-hour levels were predicted using the EPA PTMPT 4.5 computer program. Maximum levels were predicted to occur 1 km. from the proposed facilities during C stability conditions with a wind speed of 10 meters per second.

- A worst-case mixing height of 900 meters was used to prevent the plume from rising above the top of the temperature inversion lid.

For a more detailed review of the air pollution dispersion analysis, refer to appendix F.

There would be no significant increase in air pollution emissions produced by transportation related to the operation of the SGCF facilities. Onsite use of vehicles and the use of the haul road is expected to be minimal. The majority of the supplies would be barged by sea. In addition, scheduled commercial flights would be adequate to accommodate the operation's work force, and therefore, no additional air flights to Prudhoe Bay will be necessary.

The operation of the SGCF would not result in any significant deterioration of the ambient air quality. Emissions during operation would have minimal impact on the aesthetic character of the area and would cause minimal deterioration of structures. Particulates might soil surfaces of facilities in the immediate vicinity of the plant. They might also act as catalysts to increase the corrosive reactions between metals and gases. Inorganic gases (i.e., SO_2 and NO_2) are likely to tarnish and corrode metals. Over the lifetime of the facilities (20 years), these impacts may require cleaning and/or replacement of components. Plumes from the stacks will be visible for several miles under various meteorological conditions. This is not considered a significant impact.

Although estimated maximum ground-level concentrations of all but one of the pollutants are below the minimum significance levels, there is no threshold concentration below which health effects do not occur. Any increases in pollutant concentrations could adversely affect the health of some individuals. As table 20 and table 15 show, the proposed facilities would not add significant amounts of pollutants to the atmosphere, and the NAAQS will not be violated. Because the primary standards were established to protect public health, it can be assumed that the existing and future population at Prudhoe Bay would not experience any adverse health effects from the operation of the SGCF.

5. Noise Quality

The general construction plan assumes three phases of work: a small sealift in the first year of construction supplemented by truck hauling and two major sealifts in the subsequent 2 years of construction. Pre-sealift work at the Prudhoe Bay site would be initiated the first year of construction. Typical activities for each phase of construction include the following:

- Extraction and placement of gravel for module work pads, access roads, staging areas, construction camp, and operations center.
- Installation of piling, using the auger drilling and slurry placement method.
- Unloading and transporting of modules and cargo.
- Erection of the module units.

Gravel placement and grading will generate the most noise. These activities require construction equipment with high noise levels for long work periods, whereas other phases of construction, such as pile driving (dock construction) will generate lower noise levels for shorter duration, assuming that haulers and bulldozers would bring gravel from an extraction site and that a grader would roughly level the gravel. The noise levels produced by the major equipment expected to be used at the SGCF site are:

Equipment Type	Engine Power (hp)	Maximum Noise Level at 15m
Bulldozer	235-410	89 dBA
Grader	135	96 dBA
Scraper	415	91 dBA

These noise levels are based on equipment with mufflers. Assuming a worst-case condition of simultaneous operation of the equipment, the resulting noise level during gravel placement and grading would be 98 dBA at 15 meters. This phase of construction, therefore, would be audible from the construction site. The noise generated by all construction activities would depend on the duration and number of work shifts and the use of construction equipment each day. Other than at the camp dormitories, there are no humans within a 3-km. radius of the proposed construction site.

The major noise source associated with operation of the SGCF would be the compressor plant. It would be located next to the existing central gas compressor plant. The expected noise level with both plants in operation is 63 dBA at 0.8 km., an increase of 6 decibels above the existing noise level.

The background ambient sound level at the peripheral areas around the oil fields is expected to be 39 dBA, an increase of 3 decibels.

6. Terrestrial Communities

The proposed construction would destroy wet tundra vegetation in the immediate vicinity of the proposed facilities. Changing the thermal balance by removing or reducing vegetative cover would result in thermokarst subsidence, slumping, rutting, and other types of permafrost degradation. Once initiated, these processes are long lasting and difficult to control. There is little information on what effect such a vast new network of roads, collecting pipelines, and permafrost degradation could have on the flora of the tundra wetlands. Possibly such facilities could alter water levels and form new wetlands, thereby influencing vegetative growth and succession.

Because of the relatively short duration of construction and the scattered construction sites, pollutants emitted to the air would not have significant impact on vegetation. The equipment used would have minimal effects because the resultant ground-level pollutant concentrations will be low. The dust created by construction could have adverse effects, but it would be in the immediate vicinity of the construction sites. Potential effects include abrasion and impairment of plant functions.

Primary effects on wildlife from pollutants emitted during construction and operation of the proposed facilities would be minimal since predicted ground-level concentrations are low and wildlife populations residing in the immediate vicinity are small. Secondary effects on wildlife are also expected to be minimal. These effects would be caused primarily by emissions affecting the lichen community, the source of food for most indigenous wildlife communities. The impacts on the lichen community are expected to be minimal.

Emissions from construction and operation and resulting increased ground-level concentrations could adversely affect vegetation. Effects could include impairment of plant functions, susceptibility to microbial infections, and reduced plant growth. Vegetation in the Prudhoe Bay area is limited, and lichens are often the predominant vegetation.

Lichens are also often the only accessible forage material during the arctic winter and therefore determine the carrying capacity of reindeer and caribou. Any disturbance of arctic lichen communities could have far-reaching ecological implications. However, terricolous or saxicolous lichens, which are the predominant lichens in the area, are considered less sensitive to air pollutants than other species. Exposure to SO_2 concentrations of 775 $\mu g/m^3$ would inhibit essential metabolic activities of lichens at Prudhoe Bay. The predicted maximum SO_2 ground-level concentrations of 38.4 $\mu g/m^3$, however, are substantially less than the concentrations reported to produce adverse effects to lichens.

Removing the wet tundra wetland vegetation to construct the work camp, gas processing facilities, and roads, would eliminate lemming habitat. Gavin states that there were few if any lemmings in the immediate area around Prudhoe Bay in 1977. However, lemming populations are prone to cycles of abundance, and their population are also affected by other physiological and biological factors.

Because construction would occur in the same area as the SOHIO-Alyeska facilities, many of the impacts would be cummulative--e.g., noise and pollutants from the proposed gas conditioning facility added to noise and pollutants from existing oil facilities. Noise from construction coupled with increased noise from construction vehicles would reach unnaturally high levels for the area and could have a significant effect on the area's wildlife. No definite studies have quantified long-term impacts of noise on wildlife. Studies do indicate that the most probable effect would be to reduce use of habitat areas impacted by noise. Whether this effect would be long- or short-term is unknown. The kind and severity of the impact would vary by season, type of species, and probably life stage. For those species that do not migrate from the area, such as fish, seals, arctic fox, and polar bears, the impacts of winter activity would be more severe than summer activities. During the winter, the habitat of these species is severely restricted by ice cover, and animal survival needs are more precise. Migratory species would be more affected during their periods of Beaufort Sea occupancy. Certain species of seabirds, for instance, would be more susceptible to spring and summer activities that would disturb their nesting habitats, possibly causing the failure of a year's nesting cycle.

Post-calving concentrations of caribou use coastal zones, beaches, and spits for relief from insects from late June to August. Caribou have been observed throughout the Prudhoe Bay enclave development during the exploration, development, and production phases of the oil and gas field there. While there has been a decline in one of the major herds that utilizes the North Slope, evidence has not shown that development was the prime or only cause. Because construction would disturb caribou during their summer activities and reduce their habitat, it is probable that caribou populations using the area will decline. The extent of this decline is unknown.

Human disturbance would have its major impact on avian species from May through September, the most intense period of avian activity on the arctic coast. During this time, the greatest concentration of birds would occur in the nearshore areas, which include deltas, barrier islands, and lagoons. The most sensitive species to human disturbance are whistling swans, geese, oldsquaw, eiders, phalaropes, semipalmated sandpipers, black guillemot, Ross' gulls, and sabine's gulls. The greatest impact would be the loss of habitat. However, the extent of the impact is not currently quantifiable.

In accordance with the Endangered Species Act of 1973, as amended, the FERC staff submitted a biological assessment for the endangered peregrine falcon (Falco peregrinus tundrius) to the U.S. Fish and Wildlife Service (FWS) for the Northwest Alaskan Pipeline Company portion of the ANGTS and the proposed SGCF at Prudhoe Bay. The FERC staff found no peregrine nesting sites within 35 km. of the proposed SGCF; the nearest occupied nest was approximately 42 km. away. Because of the distance to the nearest nesting site, the staff concluded that no impact to the peregrine would be expected from the SGCF at Prudhoe Bay. In an October 17, 1979, letter to the FERC, FWS indicated that the FERC should initiate informal section 7 consultation. FWS further stated that the project as currently proposed would have no effect on the peregine falcon if the FERC stipulates certain terms and conditions in the certificate authorizing the project. Meetings are currently planned in Alaska to discuss these stipulations as they relate to the proposed ANGTS project.

7. Aquatic Communities

Ship traffic to the Prudhoe Bay area would use the same access route as the bowhead and other whales. This disturbance might affect whales along their entire migration route, as well as on their summering grounds in the Beaufort Sea. Human activities offshore could disturb those whales using shallow waters for migrating, breeding, or feeding.

There is additional concern about the effects of noise on whales. Inupiat whalers have stated that whales are highly sensitive to high-frequency noises produced by outboard engines as well as boat paddles. In addition, there is recent evidence that suggests bowheads "vocalize" in the frequency range of 40 hertz to 2 kilohertz and perhaps slightly beyond. This range is well within the low frequency sounds expected from drilling and ship operation. 1/ It is not known what effect such overlapping of frequency ranges may have on bowhead navigation or communication.

Bowheads may incur greater impact from construction during their fall migration, when they are assumed to be closer to shore. (See figure 20.) Any offshore construction or vessel traffic when bowheads were in near-shore waters could affect the whales' migration patterns, feeding behavior, and possibly birthing.

Both the bowhead (Balaena mysticetus) and gray whale (Eschrictius robustus) are endangered species that may occur within the area of the proposed action. In compliance with section 7 consultation requirements of the Endangered Species Act, the FERC staff submitted a biological assessment to the National Marine Fisheries Service (NMFS). In its biological opinion of November 13, 1979, the NMFS stated that "there are no scientific data which will allow us to conclude that vessel harassment problems will result such as were observed for gray whales near California and Mexico or for humpback whales in Alaska and Hawaii." In further response in a December 26, 1979, letter to FERC, the NMFS concluded that the "proposed activities would not adversely impact either gray or bowhead whales" and that "the proposed activities are unlikely to jeopardize the continued existence of gray or bowhead whales or their habitat." Complete copies of both the FERC biological assessment and the NMFS biological opinion appear in appendix G.

Evidence indicates that certain seal populations can be quite sensitive to human disturbances and that human harassment has caused them to avoid their traditional habitats. Onshore and offshore construction and operation of facilities and noise resulting from construction and vessel traffic could cause a decline in seal populations in this area. Human activity and concomitant noises may cause certain seals to abandon traditional hauling rounds, breeding rookeries, and foraging areas, and may cause the seals to alter their migratory routes.

1/ Letter from Howard Braham of March 12, 1979. Leader, Arctic Whales Research Program, Marine Mammal Division, National Marine Fisheries Service.

Increased noise and activity could affect polar bears within the area. Denning females might resort to sea ice instead of land or landfast ice. However, sea ice may be less stable as a denning environment and more susceptible to current movements and fracturing. Additionally, it is not known how much disturbance denning polar bears will tolerate and what effects this disturbance could have on critical adult-cub relationships.

Construction would require gravel from open pit mines, the Beaufort Sea, beaches, streams, or riverbeds. Gravel removal from streams or rivers may alter stream morphology, creating a number of impacts on the aquatic biology.

Gravel removal or other construction activities in a stream during fall freezeup, when fish are beginning to inhabit an overwintering area, could block fish passage. Additional significant impact would occur as a result of increased siltation caused by the gravel removal operations. Freshwater fish would suffer direct and indirect mortality, reduced growth rate, decreased resistance to disease, and modifications to migrations and movements. If sediments were introduced near freezeup, they could cover spawning gravels, smother newly deposited eggs, or divert spawning fishes away from their spawning and overwintering grounds to less productive areas. The silt would also reduce the escape cover of young fry and reduce the available food supply needed by the fry.

Year-round water supplies for the proposed project would be drawn from the Put River and either Prudhoe Bay or offshore Beaufort Sea. However, withdrawal during biologically sensitive times--mid to late winter and the months preceding and following freezeup--may have serious consequences on organisms concentrated in or around unfrozen waters for spawning, feeding, or overwintering.

Immediate or near-immediate alteration of overwintering habitat may stress organisms concentrated there. Winter withdrawal from unfrozen pockets of water, increased sport or subsistence fishing of fish harbored in these pockets, and waste discharge which may percolate into aquatic habitats beneath ice cover would create direct conflicts. If all water were withdrawn from an area supporting aquatic organisms, mortality of some species might occur. If only a portion of water were removed, crowding the organisms into the remaining volume may cause a buildup of the organisms' waste metabolities or dissolved oxygen concentration could decrease. Partial removal might dewater marginal gravels which contain developing fish embryos.

Construction of the dock would impact some aquatic flora and fauna. Dredging would destroy some benthic organisms within the immediate area, and the resulting increased turbidity could decrease levels of primary and secondary productivity. Turbidity from dredging or construction of offshore structures could have potentially significant impact on anadromous and marine fish. Arctic char from the Sag River and Least cisco from the Coleville River both use the nearshore and offshore area of Prudhoe Bay for migration. However, anadromous fish populations originating from other drainages may be present at any particular coastal location as well.

The Sag River Arctic char population may be particularly susceptible to impact. There are indications that the last four new-year classes (1971-1974) of Sag River Arctic char did not enter the river in the migrating group of the anadromous stock for 1975. The exact cause of this has not been definitely ascertained, although it is believed to be related to gravel removal in and around the Sag River. If these are accurate observations, additional losses to the migrating group of the anadromous stock as the result of offshore construction could result.

The completed dock facility could change existing water temperatures, salinities, circulation patterns, and fish migration routes. It could also effect a change in turbidity, reducing effective light penetration and thus decreasing photosynthesis of phytoplankton. The decline in photosynthesis would cause direct changes at the bottom of the food chain. The completed dock facility could affect the availability of food for fish, birds and other organisms. Primary sources of food along the arctic coast are the erosion and coastal transport of peat in the shore zone; both of these may be affected by the dock. Any of these impacts or a combination of them would result in reduced populations of some species because of a redistribution or a reduction of food items or habitat quality.

8. Land Use and Solid Waste Disposal

a) General Land Use

The development of oil and gas resources in the Prudhoe Bay area on the North Slope of Alaska has caused subsistence land use by Alaskan Natives which existed 10 years ago to suffer. Residents of the area indicate that the increased presence of men and machinery has decreased the fish and wildlife populations upon which the Inupiat Natives depend for a living. Oil and gas development has also compromised the former "wilderness" land use of the area.

Adding a new gas processing plant within the existing Prudhoe Bay development complex would probably have little additional impact on the land use as it exists at the present time. Since the modification from subsistence and undisturbed wilderness to a petroleum complex has already taken place, the addition of a gas processing plant on the premises would cause little additional land use impact. However, the addition of facilities spurring further gas and oil development leads to some concern about the continuing impact to traditional land uses.

Continued increased oil and gas development in the area will add the possibility of opening the haul road to increased public use. North Slope Borough residents contend that public use of the road, with the potential for an influx of large numbers of people, will put extreme pressure on the fish and wildlife and, therefore, the land resources of the area. Borough officials are concerned that open access will necessitate their providing extensive facilities and services to motorists, which could become an economic burden. Increased access to the area would bring outside visitors into direct contact with local villages and, with the exception of Barrow, none of the villages currently have facilities to accommodate visitors.

Alaska's coastal management program (ACMP) was developed in response to coastal conservation and development pressures. The ACMP, approved by the Department of Commerce, establishes new coastal policies, rules, responsibilities, obligations and relationships, but relies principally on shared local and state coastal management responsibility.

ACMP approval indicates that the national interest has been recognized in Alaska's coastal zone by including uses and facilities that are of national significance in its definition of "uses of state concern." An approved program cannot unreasonably or arbitrarily restrict or exclude uses of state concern. When the North Star Borough-Prudhoe Bay coastal area management plan is approved by the Alaska Coastal Policy Council and the state legislature, it will become part of the ACMP. One criteria for approval is that the district program not unreasonably or arbitrarily restrict or exclude "uses of state concern"; these include the use of resources and the siting of facilities for energy production in the coastal zone.

Page 203 of the ACMP and final environmental impact statement released to the public on May 30, 1979, evaluating the ANGTS, states that "since the gasline would be a use of state concern, it enjoys the protections available for such uses under the Alaska Coastal Management Program, and so the facilities and activities associated with the point of origin may not be arbitrarily or unreasonably excluded." Such facilities could include the proposed SGCF at Prudhoe Bay.

Comments from the State of Alaska have indicated that if the SGCF were to be located at Prudhoe Bay, the project would have to be consistent with a number of coastal management "Use and Resource Standards." This is in accordance with the Coastal Zone Management Act and amendments, which require that Federal actions in or affecting the coastal zone be consistent to the maximum extent practicable with the approved ACMP. Appendix H identifies the specific state comments that affect the appropriate ACMP standards. At the present time, it is uncertain whether the proposed project would be considered a part of the ANGTS project or a separate component outside the jurisdiction of the FERC. In any event, the future SGCF developer should be cognizant of the ACMP's "Guidelines and Standards" and should work towards seeking a consistency review and determination by the state for the SGCF proposal.

b) Solid Waste Disposal

Any disturbance to the surface cover over permafrost increases the depth of the active layer. In silty soils, this can create environmental problems, such as subsidence and erosion. In dry frozen sands and gravels, however, the effect of the increased depth of the active layer is nil. There are no ice lenses to melt causing subsidence, and no water is present to increase erosion. Both the existing landfill and SGCF sites are situated on well-drained soils.

Solid waste placed in the existing or proposed landfill would be frozen permanently within several years whether it is covered on the surface or buried in a trench in the permafrost. If covered with approximately 1.5 meters of cover, the active layer will move up into the cover material within a few years and the materials in the fill will be frozen perpetually.

At the present time, no known hazardous wastes are expected to be generated by the proposed project. It is assumed that the multiple disposal system now available to Arco will be available to the operators of the SGCF.

Because the conditions of the pending state and Federal permits will require the landfill to be properly designed and operated, the environmental impacts of the landfill operation on groundwater and surface waters are expected to be minimal. The normal precipitation is not expected to penetrate the active surface layer of the fill, which would create a leachate problem. Even if it did, the active zone of the permafrost (about 0.45 meters deep) is not used as a source of potable water. There is little water in the active layer because it is shallow, rainfall is limited, and it is frozen 9 to 10 months of the year. Furthermore, during the winter, most lakes either freeze to the bottom or concentrate dissolved solids to the point that the water is not potable. In addition, both the existing and the planned landfill sites are underlain and surrounded by well-drained permafrost that does not readily transmit water.

The existing landfill is well above flood elevations of the Sag River and of Prudhoe Bay. The proposed landfill is below the natural ground surface but presently is and will be protected further from inundation by the floodwaters of the Put River by dikes. The available disposal area at the Put River borrow is more than adequate for the estimated 30-year life of the Prudhoe Bay oilfields. No alternative sites for the landfill have been proposed.

9. Socioeconomic Considerations

The oil and gas "industrialization" of the North Slope Borough has increased business opportunities, services, and facilities for the people of the North Slope. It has also provided a source of increased tax revenues. On the other hand, the continued natural resource development in the area poses a real threat to the traditional social and cultural well-being of the North Slope Natives.

These facilities would do little to add or detract from the impact which has already occurred to the Native socio-economic and cultural framework. However, construction of the SGCF at Prudhoe Bay would have little impact upon the local economy because 1973 tax legislation restricts the NSB's Prudhoe Bay revenue authority from taxing the SGCF.

The traditional communities of the North Slope would again experience some growth in population and employment. Construction of the proposed SGCF could provide temporary peak employment for up to 1,000 people. Operation of the facility could add about 200 long-term jobs. Employment related to construction would probably affect only a few Native people, since about 20 percent of the workforce is local. Operation of the facility would probably require only skilled personnel brought in from outside the area, unless the facility operator is committed to a training program for Alaskans. Some basic maintenance activities could be carried out by local people.

The cumulative effect of additional industrial facilities in the area would probably spur increased oil and gas development, producing future socioeconomic and cultural impact to this area.

These proposed facilities could be utilized for any future oil and gas resources that are discovered and developed, both onshore and offshore, along the North Slope. Increased development could lead to industrial expansion outside the immediate confines of the Prudhoe Bay complex, which could then affect additional subsistence hunting and fishing areas or result in intrusions on Native villages themselves.

Subsistence living, with all of its attendant aspects of sharing, bonding, identification, pride, nutrition, and adventure, is gradually being replaced by a cash-based lifestyle. As a result of the proposed construction of the SGCF and other industrial facilities, lifestyle in the traditional North Slope communities is expected to continue toward the cash-based lifestyle. Because there are so many unpredictable events on the village level, quantitative projections cannot be made with a high degree of accuracy. Older residents fear that the increased cash income will lessen dependency on subsistence hunting and fishing. With the need to hunt and fish removed, the old skills required to conduct these activities will be lost, thus affecting the basis of the Inupiat Native culture.

10. Recreation and Aesthetics

The "unspoiled wilderness" and associated aesthetic values of the immediate Prudhoe Bay area have already been impacted by facilities installed there for the TAPS project. The SGCF will add only incrementally to this existing impact. This type of impact must be considered less harmful to the aesthetics of the area than placing the new facilities in an as yet unimpacted area on the North Slope. If the SGCF adds to air quality degradation in the area, this could also increase aesthetic impact to an area which 10 years ago was undisturbed.

The SGCF would have little direct effect on the recreational resources of the area. Construction workers will probably engage in limited sport fishing in the Prudhoe Bay area, although the companies in the area generally frown on it. However, if these facilities increase oil and gas development in the area, pressure on the recreational resources of the area will also increase.

Tourism into the Prudhoe Bay coastal area is not expected to increase because of the SGCF. The proposed construction and operation will not provide tourists with new embarkation points, and existing tourist attractions have very limited as well as costly transportation approaches and accommodations.

11. Cultural Resources

The land in the area of Prudhoe Bay has been the site of numerous temporary settlements and seasonal hunting and fishing camps of the Alaskan Natives. Associated with this activity are various grave sites, sod huts, and ice cellar outlines which still exist today. Although these types of historical landmarks have been found in the area, it is not known at this time if any exist on the Prudhoe Bay industrial complex or on the immediate site of the proposed SGCF. If any are present on the proposed site, installation of the proposed facilities would cause irreversible impact to these resources.

This impact could be minimized, however, if a thorough historical and archaeological survey of the site were carried out before construction was allowed to proceed and any historical or archaeological finds were salvaged. The fact that this immediate area has already been substantially impacted by humans and machinery also minimizes the potential impact to historical resources, since less relative damage would be done to an area already impacted than to an area previously unimpacted.

12. Water Injection Facilities

Cumulative impact from construction and operation of both the waterflood facilities and the SGCF and associated pipeline would result where organisms use habitats or other resources affected by the two projects. Cumulative losses of marine or terrestrial habitat that support the same populations would deplete these populations and perhaps decrease their potential maximum sizes. Migratory individuals, especially caribou and anadromous fish, which move over large territories in search of food and/or breeding areas, would be especially vulnerable. Distribution of food resources could also be altered. Thus, these populations might suffer additional reduction in growth, reproduction rates, or survival as a result of contact with more than one project. Depending upon the relative locations of structures for different projects, nonmigratory populations could also be affected by cumulative regional changes in air or water quality, circulation patterns, or shoreline configuration produced jointly by these structures or their operation.

A total of 5.6 million cubic yards of gravel would be required to construct the SGCF (2.3 million cubic yards) and water injection facilities (3.3 million cubic yards). According to comments of the Alaska Department of Fish and Wildlife, this is the equivalent of 36 Alyeska Pipeline Service Company average-sized material sites. Dames and Moore indicate that the applicants for the water injection facilities expect to extract gravel from existing mines that would be expanded to provide for project needs.1/ Gravel for the SGCF might come from the Put River. According to the Dames and Moore report, an estimated 12 to 17 million cubic yards of gravel is available from Put River oxbows, Kuparuk Dead Arm, and SAG C sites.2/ These are recently active riverine deposits isolated from their parent streams. Removal of the required 5.6 million cubic yards of gravel for the two projects would directly destroy 105.2 acres of terrestrial or wetland habitat (assuming extraction to an average depth of 11 yards (10 meters). Removing gravel from the floodplain could change the river channel pattern, width of flow, slope, sediment regime, area of flooding and subsequent ponding, flow obstructions, intergravel flow, and aufeis development. The overall impact to a river system could be substantial, widespread, and potentially long term. Additionally, environmental impact would include noise disturbance to surrounding areas from heavy equipment and blasting (when the ground is frozen).

1/ Vol. I (April 1980), p. 2-55.

2/ Dames & Moore, p. 2-57.

D. MEASURES TO ENHANCE THE ENVIRONMENT OR TO AVOID OR MITIGATE ADVERSE ENVIRONMENTAL EFFECTS 1/

Avoiding or mitigating any adverse effects to the environment, the regional economy, and the safety of the public and plant personnel is essential. Approval of Federal, state, and local agencies on various aspects of the applicant's proposed SGCF is required, and the regulations and stipulations of these agencies must be followed during construction and operation. These agencies, their jurisdictions, and the statutes and codes defining their authority are listed in appendix I. Standards applicable to the construction and operation of the proposed conditioning facilities are listed in appendix J.

1. Design and Construction

The severe climate on the North Slope makes conventional construction methods inefficient; therefore, modular construction would be used to construct the SGCF. This involves constructing a steel frame building supported by a steel base to house the processing equipment at a site in the lower 48 states, not yet selected. The modules would then be barged to the North Slope, unloaded, moved to the plant site by low-speed transporters, and placed on a prepared foundation. This method of construction would minimize the amount of work that must be done on the North Slope, thereby avoiding higher construction costs and minimizing the environmental effects of construction.

Since barges are considered unmanned, there are fewer U.S. Coast Guard regulations for them than for other vessels. However, after two stability casualties with barges this past year, Coast Guard concern for adequate design and loading stability of barges has increased. In addition to the load line requirement on barges of 150 gross tons and design/strength regulations, the Coast Guard has stability guidelines for the industry to follow covering amount of roll, 4.6 meter (15 foot) degrees to highest part of righting arm curve. (The righting arm is the built-in torque that a ship has to right itself.)

1/ The project assessed in this section of the EIS is the project proposed in the Ralph M. Parson's Inc. study conducted for the North Slope gas and oil producers.

Regulations for "Cargo and Miscellaneous Vessels" are found in 46 CFR part 90-109, subchapter I.

Barge operators must possess certificates of inspection from the U.S. Coast Guard to operate oceangoing barges of 100 gross tons. The U.S. Coast Guard regulations require an annual inspection of ships (including oceangoing barges) after initial certification. In addition, there is a required dry docking inspection every 5 years. Since the barges for this project are already being used by an oceangoing shipper, they should currently be certified for operation; the certificates note the permissible load line and height limits of each barge. With operation through ice hazard areas into Prudhoe Bay, the Coast Guard may require additional barge strengthening for heavy module shipments.

The U.S. Coast Guard monitors all ship/barge movement. The Officer in Charge of Marine Inspection (OCMI) is in touch with all activities in his district. The OCMI also monitors critical ice flows and potential hazards to navigation; the OCMI has a daily plot of activities, weather, and troubles. The Alaska North Slope activities are under the jurisdiction of U.S. Coast Guard Seventeenth District in Juneau.

The principal barge route to Prudhoe Bay from Seattle uses the inland passage, across the Gulf of Alaska/Pacific Ocean, through the Aleutian Islands into the Bering Sea northwards, skirting the Seward Peninsula and entering the Arctic Ocean to Prudhoe Bay. U.S. Coast Guard involvement in environmental impact and protection is limited to regulating harbors and waterway shipping activities to avoid vessel collisions.

Inquiries directed to headquarters Coast Guard personnel have revealed no information on potential barge/bowhead whale conflicts.

The pile foundation which would support the SGCF would be prepared by drilling holes in the permafrost, inserting thermal piles, and filling around the piles with sand. The piles could not be driven through the permafrost. Concrete would be used as an insulator between the modules and the piles to minimize heat transfer from the modules to the permafrost.

The areas between the piles would be filled with gravel. It would also provide an insulating blanket to protect the permafrost, since it would be thicker than the thaw depth of the permafrost. The gravel would be gathered from streams, lakes, or rivers. The applicant has not announced any provisions for mitigating the effects of increased siltation which would result from gravel removal. However, one precaution would be to avoid removing gravel from active streambeds.

Gravel would be needed for three major pads: the SGCF pad, the camp pad, and the crude cooling unit pad. The camp pad, which would support the construction camp and operations center, would be located 914 meters from the SGCF, while the crude cooling unit would support the facilities to cool the NGL's from the SGCF before they were blended with the crude oil streams.

In addition to construction convenience, the modular design of the SGCF would allow the entire plant to be totally enclosed and protected from the severe climate. Each module would be installed on the gravel pad and sealed to an adjacent module so that plant personnel would have easy access between modules.

2. Safety and Fire Protection

The modular design of the SGCF, while convenient from construction and operation points of view, presents unique safety problems requiring careful design of safety and fire protection systems. To this end, the applicant has stated that the NFPA Life Safety Code 101 and NFPA Standard 70 National Electric Code would be followed.

For fire protection, the SGCF would be subdivided into fire zones, each enclosed within walls constructed of metal studs covered with gypsum board. These walls would be rated to withstand a 2-hour fire. According to the National Electric Code, the fire zones would be classified as hazardous or nonhazardous. Potential ignition sources such as switches and electric motors would generally be located in nonhazardous areas. Those located in hazardous areas would be sealed and certified explosion-proof. Ventilation systems would maintain higher pressures in nonhazardous zones than in hazardous zones to prevent the migration of flammable or explosive gases into areas containing ignition sources. Differential pressure gauges with alarms would be installed between fire zones to ensure that differential pressure is maintained.

Each fire zone would be protected by a hydrocarbon gas detection system and a fire detection system. The hydrocarbon gas detection system would be composed of primary gas detectors calibrated for methane and secondary detectors calibrated for propane and heavier hydrocarbons. If a gas sensor detected a gas concentration of 25 percent of the Lower Explosive Limit (LEL), alarms would sound and the ventilation system would double the air circulation rate to help disperse the gas. This would also occur if a propane sensor or a methane sensor detected a gas concentration of 75-percent LEL. It is not known how long the applicant would allow this condition to exist before shutting down to search for the source of the leak. If two or more methane sensors detected a gas concentration of 75-percent LEL, the halon extinguishing/inerting system would be activated, inerting the area where the gas was detected and preventing ignition.

The fire detection system would consist of thermal and ionization (smoke) detectors. Ultraviolet detectors would not be utilized. Activation of an ionization detector would cause alarms to sound and the halon system to discharge. If a thermal detector sensed a temperature of 88°C., the ventilation system would be shut off.

An automatic halon inerting/extinguishing system would be installed in each fire zone. Halon is an odorless and colorless gas which is an effective fire and/or explosion suppressant. It has a low toxicity and will not damage electrical equipment. During an emergency, the halon system could completely inert a fire zone within 10 seconds. The system would discharge automatically if it received a signal from two or more methane detectors and/or a signal from a thermal detector. Manual activation would also be possible.

In most fire situations where Halon 1301 automatic protection systems have been used, the concentrations of HF and HBr have been found to be less than 20 parts per million (ppm), often barely detectable to the nose. The results of severe fire tests have indicated that larger concentrations of HF (200 to 300 ppm) and HBr 40 to 50 ppm) are produced when Halon 1301 decomposes while extinguishing a large, hot fire. Such concentrations are noxious and irritating and may be harmful if exposure is prolonged. The primary effect of the decomposition products is irritation. Irritation becomes severe well in advance of hazardous levels. Test animals exposed to sublethal concentrations of decomposed Halon 1301 appeared to recover completely after exposure. The effects of exposure are not believed to be cumulative. Combustion products of the fire, especially carbon monoxide, generally are potentially more hazardous than the thermal decomposition products of Halon 1301.

To aid in assessing the impact of a Halon dump, an estimated maximum, downwind ground-level concentration was determined, using the box model under the following assumptions:

- A complete dump of 24,000 pounds of Halon.
- Meteorological conditions with a windspeed of 5.45 meters/second and a mixing height of 500 meters.
- A total Halon evacuation time from the modules of 24 hours.

Under the above conditions, a maximum downwind, ground-level concentration of 134 µg/cubic meter was obtained. Based on these results, it is believed that no significant impacts on human health, wildlife, or the surrounding environment would result from a Halon dump.

A firefighting water system would be provided at the SGCF to supplement the halon systems. The water would be stored in a 420,000-gallon storage tank and pumped through a distribution network by two 1,500-gpm pumps to hose stations and connections for mobile pumpers. Hand extinguishers and wheeled dry chemical units would also be provided, along with cart-mounted skids carrying dry chemical and foammaking solution.

In addition to the onsite fire protection systems, agreements have been reached to share firefighting equipment with other facilities on the North Slope.

No information has been submitted describing the training program to be given to plant personnel to acquaint them with the firefighting equipment or techniques for fighting hydrocarbon fires.

A nitrogen generation plant at the SGCF would provide an inert gas for purging air or combustible vapors from equipment during emergencies or maintenance. The generation plant would be a packaged unit which would extract enough nitrogen from the air to purge one CO_2 removal train three times within 24 hours.

3. Other Emergency Systems

To contain the effects of a plant emergency, an emergency shutdown system (ESD) would be installed to allow a full or partial shutdown of the SGCF. Activation of fire or gas detectors would cause an automatic local shutdown. A total ESD could only be activated manually and would block off all flow into, out of, or through the SGCF and vent the appropriate systems to the flare stack.

A hydrocarbon spill containment and disposal system would be provided to direct spills away from process areas and dispose of them safely. Ramps would be provided at doorways to prevent the spilled liquid from migrating between modules.

A drain sump would be provided in each fire zone to collect all spills. A sump pump would automatically send the spilled hydrocarbons to the slop oil system via an open drain system which would be designed for hydrocarbon and water rates of 525 gpm. A closed hydrocarbon drain system would be provided to contain equipment drainage during operation and/or maintenance. Vapors from this system would be vented to the low pressure flare, and liquid would be pumped to the slop oil tank. There, the water would be separated, some of the hydrocarbons would be recycled to the deethanizer, and the rest would be disposed of. The method of disposal is unknown.

All joints between the wall and floor around the perimeter of each module would be sealed with a caulking compound to provide a liquid-tight seal.

4. Vent and Flare System

Two relief systems would be provided at the SGCF. A high pressure system would provide relief for all loads greater than 200 psig; a low pressure system would be provided for loads under 200 psig. The flare would be located north of the plant, while the burning area would be over a lake. The prevailing winds would direct the flare away from the plant. A 40-acre area would be provided to dissipate radiation from the flare. A constant flow of low Btu "sweep" gas would keep the flare system purged, and high Btu pilot gas would keep the flare burning during normal plant operations. Approximately 250 Mcf of gas per day would be needed for this operation.

A cursory analysis was performed on the potential impact of the flare. It is estimated that downwind concentrations of the total plume emissions (including water vapor, CO, CO_2, HC, NO_x, SO_x, etc.) could reach as high as 7,176 mg/cubic meter. However, most of the plume at this point would consist of water vapor and CO_2. Only a relatively small percentage of the total plume is made up of the criteria pollutants. At this time, it is impossible to determine the exact concentrations of the criteria pollutants, because the makeup of the gas that will be flared is unknown. Further analysis should be performed once the constituents of the feed gas are known and the emission rates of the criteria pollutants can be established.

The area where the flare would burn would be enclosed with a gravel berm to contain any liquid hydrocarbons which might drip from the flare tip. A radiation fence would be mounted on the berm.

5. Electrical Power

Three 25.9-megawatt (MW) gas turbine generators would be provided at the SGCF. Two would supply the plant's electricity requirements; one would be a reserve. The maximum continuous load on the generators would be 45.8 MW during the summer. The maximum winter load would be about 40 MW, because half of the air coolers would be shut down. At various points in the gas conditioning process, power would be recovered by installing generators driven either by hydraulic turbines using solvent letdown or by expander turbines using stripping gas letdown. In this way, approximately 12 MW of power would be recovered.

Emergency power would be provided by one of four of the 2.5-MW gas turbine generators used during construction. This generator could be operated with field fuel gas or diesel oil and would provide power for lighting, instrumentation, and fire protection. There is considerable excess capacity in the emergency system, since 10 MW are available but only 2.3 MW are required for the emergency systems. A battery system would supply electricity if the emergency generators failed to start. The batteries would be able to power lights, instrumentation, communication, and fire detection systems for about 30 minutes.

6. Operation

Normal SGCF operations would be controlled from a central control room. Local control rooms would also be provided to monitor and control specific process equipment during startup and shutdown. Enough instrumentation would be provided in the local control rooms to allow an operator to sustain steady state operations for a short time during power outages. In addition to the necessary instrumentation, monitors, and controllers to maintain normal operations, the central control room would have indicators for monitoring the smoke, gas, and thermal sensors, controls for the ESD and ordinary shutdown systems, alarm indicators and controls, and the centralized communications and data transmission system. No detailed design of the control system has been done at this time. Neither operating procedures nor maintenance schedules and procedures have been developed.

Potable and utility water for the SGCF would be brought in by tank truck from the existing water treatment plant at the operations center. Expansion of the treatment plant would not be necessary to serve the SGCF; however, it would be necessary to expand the gathering system. An additional water intake at the Put River would be necessary, and the existing water reservoir would have to be expanded by about 305,824 cubic meters, to a total capacity of 1,500,000 barrels. Water is usually pumped from the Put River throughout the summer to replenish the reservoir. The applicant has not discussed how the 305,824 cubic meters of dredge material will be handled, nor the measures to be taken to avoid any effects on the permafrost from dredging.

To house plant and support personnel, an operations center would be constructed about 914 meters from the SGCF. Approximately 200 persons could be housed in these facilities. Construction would be accomplished by modular techniques; however, steel piles would be used instead of the wooden piles used for the SGCF, and a 2.13-meter (7-foot) open air space would be provided between the module and the gravel pad. A fire station would be provided at the operations facility, as well as an ambulance, two fire trucks, and a rescue truck.

Solid waste would be burned in an incinerator large enough to accommodate the waste from 1,500 workers. Collection trucks would dump waste inside the building to prevent windblown trash from being scattered in the tundra. A waste treatment plant would be provided at the operations center. It would have a capacity of 150,000 gallons per day, which would be treated by an activated biofilter process followed by tertiary filtration. Sludge would be processed by centrifuge and filter press before being incinerated. The effluent would be chlorinated and pumped to a disposal lake. No information is presently available on construction of the lake or its effects on permafrost.

Two 6,000-gallon utility water drums would be provided to supply enough water to serve plant personnel for 1 week. A chlorinator would be provided as part of the system, and periodic laboratory analyses would be performed to determine the necessary rate of chlorination. A vacuum-assisted collection system would direct all sanitary waste into a collection tank which would be periodically trucked away to a sanitary landfill near the Sag River.

Internal communications would include a sound-powered telephone system which would require no external power source and is ideally suited for maintenance, construction, operation, or emergency situations when power is unavailable. A conventional telephone system would also be provided, as would a paging system. A separate telephone system would be provided for offsite communication. Transmission on this system would be via microwave. All fire alarms would be connected to this system. External communication systems would also include a low-powered radio system to contact persons not otherwise accessible.

The principal gaseous pollutants that may cause odor emissions from a typical SGCF are hydrocarbons, hydrogen sulfide, and mercaptans. Odor can be minimized in a number of ways, including good housekeeping procedures and maintenance checks of all process equipment. Under normal operating conditions, a constant low Btu (CO_2 enriched) sweep gas would be flared at the proposed plant's flare system. If overpressurization or malfunction of process vessels should occur, all hydrocarbon vapors would be discharged through the emergency flare system. The expected hydrocarbon emissions from the low Btu sweep gas and hydrocarbon vapors generated during an emergency shutdown would have little adverse impact upon the existing air quality.

E. UNAVOIDABLE ADVERSE IMPACT

Implementation of the proposed project would result in several unavoidable adverse changes in environmental quality during the construction and operation of the SGCF. During construction, there would be a temporary increase in dust and noise levels resulting from vehicle traffic and construction activities in the Prudhoe Bay area. There would be some localized degradation of air quality during operation of the facility, but the regional aggregate impact on air quality will be small.

The onshore construction would result in minimal loss of wildlife habitat. Significant shifts in species composition and distribution can occur through habitat alteration. Offshore construction would result in adverse impacts that would affect existing physical and chemical patterns , resulting in impacts to nearshore biological producitivity. As a result of the continuing industrial development and increased human presence in the Prudhoe Bay area, a further reduction in wildlife population may occur in the immediate vicinity of the Prudhoe Bay site. Further reduction of any wildlife populations utilized by the residents of the area would produce the unavoidable effect of further eroding the subsistence lifestyle.

During the construction of any offshore facilities, bottom sediments would be resuspended, resulting in a short-term increase in turbidity, and these suspended sediments would have a minor effect on long-term water quality. If the Put River were used as the source for gravel requirements, then the proposed project would cause the continuation of the degradation of the hydrologic features of this river.

Unavoidable impacts on land and present land use would be minimal since many of the roads, gravel pits, airfields, and other existing facilities in the Prudhoe Bay/Deadhorse area would be used for construction of the SGCF and most of the new land impacts would be contained within the existing industrial enclave.

The North Slope haul road is expected to be open to the public sometime after the ANGTS has been completed. When this occurs, sport hunters and fishermen may be encouraged to hunt and fish in the area, putting them in competition with many of the Natives who are true subsistence food gatherers. As Prudhoe Bay development continues, as evidenced by TAPS construction and the proposed construction of the SGCF in connection with the ANGTS, the lifestyle of the Native residents may be affected. The subsistence lifestyle may gradually be replaced (especially among those in the younger generation) by a lifestyle dependent on cash and commercially available foods.

Further degradation to the wilderness qualities within and adjacent to the Prudhoe Bay are unavoidable should the proposal be implemented. Since the proposed SGCF would be located near an existing industrial facility, the impact would be minimal.

Unavoidable damage may occur when historic sites are not preserved or are not identified in time to take action for their preservation. Onshore archaeological sites or artifacts may not be detected with total certainty by surveyors. Those which remain undiscovered may be damaged or destroyed partially or wholly if construction occurs.

The proposed construction of the SGCF involves the barging of prefabricated modules from west coast fabrication site(s) to the Prudhoe Bay site. This would cause an increase in barge traffic in the Pacific, Bering, Chukchi, and Beaufort ocean waters. The number of barge arrivals at Prudhoe Bay could range from 2 to 25 over a 2-to 3-year period, depending on whether a full capacity or phased start is initiated. Barge traffic may utilize a transportation route along the North Slope during the time of several marine mammal migrations. At the present time, it is impossible to identify unavoidable effects as a result of this activity on the marine mammal populations.

F. THE RELATIONSHIP BETWEEN THE LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

In the short term, the gas conditioning plant is not expected to produce any adverse environmental effects which cannot be effectively minimized. To date, the concerns of North Slope citizens have focused on the incremental expansion of the Prudhoe facilities as well as any future expansion of petrochemical operations. However, any expansion of the proposed facility will take place only after environmental acceptability of the project has been demonstrated and after the appropriate permits are obtained from the state and Federal governments. The state will also review and approve operating permits every 5 years. Some of the Federal permits, such as the NPDES permit, also require review and renewal every 5 years. These procedures are designed to protect and enhance the long-term productivity of the environment. They will also allow local planners, citizens, and other decisionmakers the opportunity to determine the extent and degree of growth that will or will not take place.

G. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The principal natural resource which would be irretrievably lost because of the proposed action would be the land on which the facility is built. The tundra covering the 200 acres of the SGCF site and the construction camp would also be lost. Removal of this vegetative cover and the active layer of permafrost, following the installation of the gravel pads, would destroy the habitat of small mammals and birds which could occupy the area.

The project would commit large amounts of renewable and nonrenewable resources. Substantial amounts of labor, energy, gravel, cement, steel, and other construction materials would be irretrievably committed to the proposed use. Construction of the conditioning facility is an irreversible action, since it is unlikely that the facility would be removed.

Important fossil fuel resources would also be irretrievably expended. The development and consumption of these large gas reserves would constitute a significant depletion of this nation's nonrenewable hydrocarbon resources which, of course would not be available as a primary oil recovery medium.

H. ALTERNATIVES TO THE PROPOSED ACTION

This section discusses alternative siting of the SGCF, alternative pipeline pressure, and alternative process designs. Other considerations such as (1) alternative pipeline routes, (2) alternative gas transportation modes and systems, (3) alternative sources of energy, (4) energy conservation, and (5) the alternative of no action were previously addressed in the FEIS's prepared by the Federal Power Commission and the U.S. Department of the Interior issued in April 1976 and March 1976, respectively; they are adopted by reference.1/

1. Alternative Site Criteria

In an effort to determine the most suitable SGCF location from environmental, engineering, and economic standpoints, the staff conducted a multiphased site-selection analysis. Certain physical requirements for continued operation of the proposed project, combined with environmental and safety concerns, were used to formulate several criteria for analyzing each specific alternate site. An ideal site would meet or exceed all these requirements; however, the possibility of locating such a site is remote. Therefore, the most suitable gas conditioning site would be one whose physical characteristic correspond most closely to the criteria.

a) Location

To maximize economic feasibility and minimize the environmental disruptions associated with the construction and operation of a gas conditioning facility, a proposed site should be located as close as possible to the source(s) of unconditioned gas. It should also be located in the vicinity of an existing or potential end-user of Alaskan royalty gas, NGL's, and crude oil so that the state can utilize its hydrocarbon products most efficiently.

1/ Federal Power Commission, Alaska Gas Transportation System: FEIS (Washington, D.C., April 1976).

U.S. Department of the Interior, Alaska Natural Gas Transportation System: FEIS (Washington, D.C., March 29, 1976).

The facility would ideally be located adjacent to a large body of water so that large oceangoing barges could transport construction materials to the site. Large-scale docking facilities capable of loading and unloading these barges should already exist or be capable of being modified to meet project needs. If barging construction materials is not feasible, an adequate combination of air and rail facilities and highways must be located within the vicinity of the site.

b) Topographic and Seismic Conditions

To minimize preconstruction site preparation, the site should have few topographic irregularities such as hills, valleys, or terraces so that extensive site preparation is unnecessary. Sites which would require excavation into the bases of mountains or leveling large topographic irregularities would necessitate hauling large quantities of spoil material and developing spoil disposal sites. This would increase cost as well as the potential for additional adverse impact.

The slope of the site should be minimal but sufficient to permit adequate drainage. Construction on poorly drained sites could increase the potential disruption to the active layer of the permafrost.

The plant site should not be located on or adjacent to any fault zones which could jeopardize the structural integrity of the facility by ground movements or other events which could accompany a major seismic disturbance.

The site should not have a potential for extensive shoreline damage from tsunamis. Areas with past histories of shoreline damage could pose a threat to a gas conditioning and storage facility. The site should be well above the elevated water levels resulting from major storm tides, river flooding, or tsunamis.

c) Foundation Conditions

Foundation conditions at the proposed site should provide adequate stability during both static and dynamic loading. Soils in the continuous and discontinuous permafrost regions should be dense and granular to provide strength and resist settlement. The soils should not be susceptible to liquefaction caused by rainfall, subsurface water movement, or seismic events. If bedrock is present, it should be relatively close to the surface in order to preclude high tension pile loads, but at a sufficient depth to avoid interference with site preparation.

d) Climatic Conditions

The plant site should be sited in an area which is conducive to safe and economical year-round operation with minimum downtime resulting from major adverse climatic conditions. Winds exceeding a velocity of 50 knots should occur infrequently and only for brief periods. Ice fog should not pose a potential safety problem to normal plant operations.

e) Land Use Conflicts

The site should not be located where conflicts would arise between operation of the proposed project and existing, planned, or potential land uses on or near the site. These potential conflicts include residential-, commercial-, recreation-, or conservation-oriented activities.

f) Air Quality

All estimated air emissions at the site should meet EPA and state air pollution standards. The atmospheric dispersion of all air pollutant emissions should preferably not cause an air quality control region to violate Federal or state air pollution standards nor exacerbate existing air pollution in a nonattainment area. In cases where nonattainment of the standards occur, air pollution trade-offs will be required. Meteorologic and topographic characteristics of the site should promote good air pollutant dispersion.

g) Noise Quality

Noise levels are a function of the numbers and types of equipment being used, the operations being performed, and the size of both the construction and operating areas. Noise levels should attenuate to ambient levels within several hundred feet of the facilities or within the confines of the site.

2. Initial Alternate SGCF Sites

After a regional overview of Alaska and portions of Canada in conjunction with discussions with the State of Alaska staff and other experts familiar with the Alaska and Canadian environs, the following six sites were initially chosen for alternative siting analysis: (1) Fairbanks, Alaska, (2) TAPS Yukon River Crossing, Alaska, (3) Tok, Alaska, (4) Haines, Alaska, (5) Whitehorse, Canada, and (6) Haines Junction, Canada. (See figure 22.)

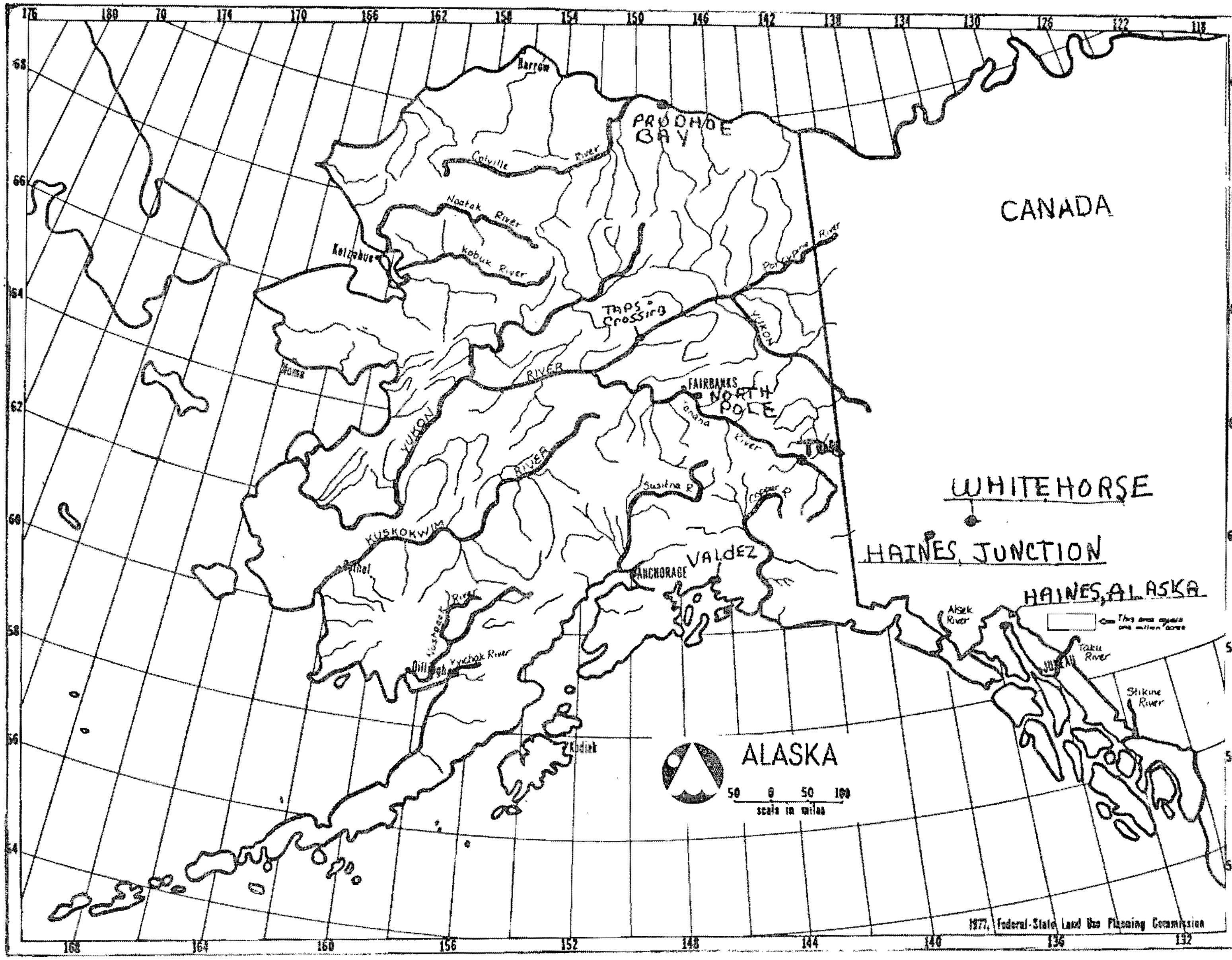

Figure 22
Alternative Sites

The primary engineering factor limiting selection of the SGCF site is the selection of a 1,260-psig pipeline system by the FERC in its Commission order dated August 6, 1979, Docket No. CP78-123. Hydrocarbon dewpoint calculations generated by Arco, Exxon, and SOHIO have shown that a 1,260-psig pipeline system requires that most heavier molecular-weight hydrocarbons must be removed from the unconditioned gas stream at Prudhoe Bay. All lower molecular weight hydrocarbons (C_1 - C_3 fractions) would then be blended into the pipeline gas, while the heavier molecular weight portions (C_4's - C_5's) would be blended into TAPS for transport to Valdez.1/ Thus, if the 1,260-psig system is adopted by the FERC and the gas transporters, none of the six alternative sites would be feasible from an engineering standpoint.2/

Even if a higher pressure pipeline system were adopted--e.g., a 1,680-psig system--an alternative site must still be located within the vicinity of an existing or sincere potential end-user of Alaskan royalty gas, NGL's, and crude oil. At present, none of the six identified alternatives meet this criteria, with the possible exceptions of Fairbanks and the TAPS Yukon River Crossing site, which would require a separate NGL pipeline to Fairbanks. A point of note here is that the State of Alaska specifically requested the FERC staff to examine these two sites.

Another disadvantage of the Tok and the two Canadian alternatives is the absence of either barge transporation or other adequate transportation network to carry construction material and personnel to the sites. Although Haines would have barge transportation available, it would require construction of an additional 161 km. (100 miles) of pipeline from the Northwest Alaskan system, a considerable economic and environmental expense.

3. Analysis of Retained Alternative Sites

a) Fairbanks

Construction of a gas conditioning facility at Fairbanks or in the surrounding vicinity would require all construction materials and process equipment to be transported to the site by railcar or truck. Although barging of construction materials is not feasible, an excellent transportation network consisting of air/rail/highway presently exists in the Fairbanks area. In addition, the Fairbanks

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1/ The staff recognizes that the C_4 fractions may be blended into both the gas and oil pipelines in varying volumetric proportions.

2/ The Commission order of August 6, 1979, stated that the amount of gas liquids in the gas stream also depends on the carbon dioxide content of the gas; the Commission has previously said it will consider carbon dioxide content in a separate proceeding.

area is close to the Northwest Alaskan pipeline system. The method of transportation would dictate the size and number of vehicles required. The Fairbanks alternative would require subarctic construction techniques and completely enclose process equipment for safe and efficient year-round operation. A Fairbanks alternative would require construction of at least a 1,680-psig pipeline system from Prudhoe Bay to the proposed alternate site.

Four specific sites southeast of Fairbanks were initially screened in the DEIS. Three of these were identified by the State of Alaska, while the fourth was selected by the FERC staff. The fourth site (the North Pole site) had all the merits of the state's selections with the advantage of being located within a parcel of land previously zoned for industrial development. In addition, an existing "topping" plant which could be expanded to use the NGL's and ethane as a feedstock is located here. An environmental impact statement has been issued for this topping plant.1/ For these reasons, the DEIS examined only the fourth site in further detail. As the DEIS indicated, a significant disadvantage of this site is that it is immediately adjacent to a nonattainment area for carbon monoxide pollutants.

Since the publication of the DEIS, the Fairbanks North Star Borough has identified six other sites for staff's review. These six sites and the four original sites are identified in figures 23 and 24. Pertinent features of the six sites, supplied by the borough, are attached as appendix K to the FEIS. The FERC and borough staffs conducted a helicopter overflight of the six sites in September 1979. After further consultation with the borough staff, the FERC staff decided that one of the six sites, the Johnson Road site, was the most feasible of the six alternatives. This decision was based on the criteria presented in section H.1 and the pertinent data presented in appendix K. This site and the North Pole site are examined in further detail in this FEIS. A significant advantage of the Johnson Road site is that, unlike the North Pole site, it is not near a nonattainment area for air pollutants. Thus, a conditioning plant at this location could use coal for all primary energy and basic process heat. The associated environmental impact of using coal at the Johnson Road site is also addressed in this FEIS.

1/ Environmental Protection Agency, Region X, Final Environmental Impact Statement: Energy Company of Alaska Topping Plant, North Pole, Alaska, Seattle, 1976. This EIS would probably have to be supplemented should this plant be expanded.

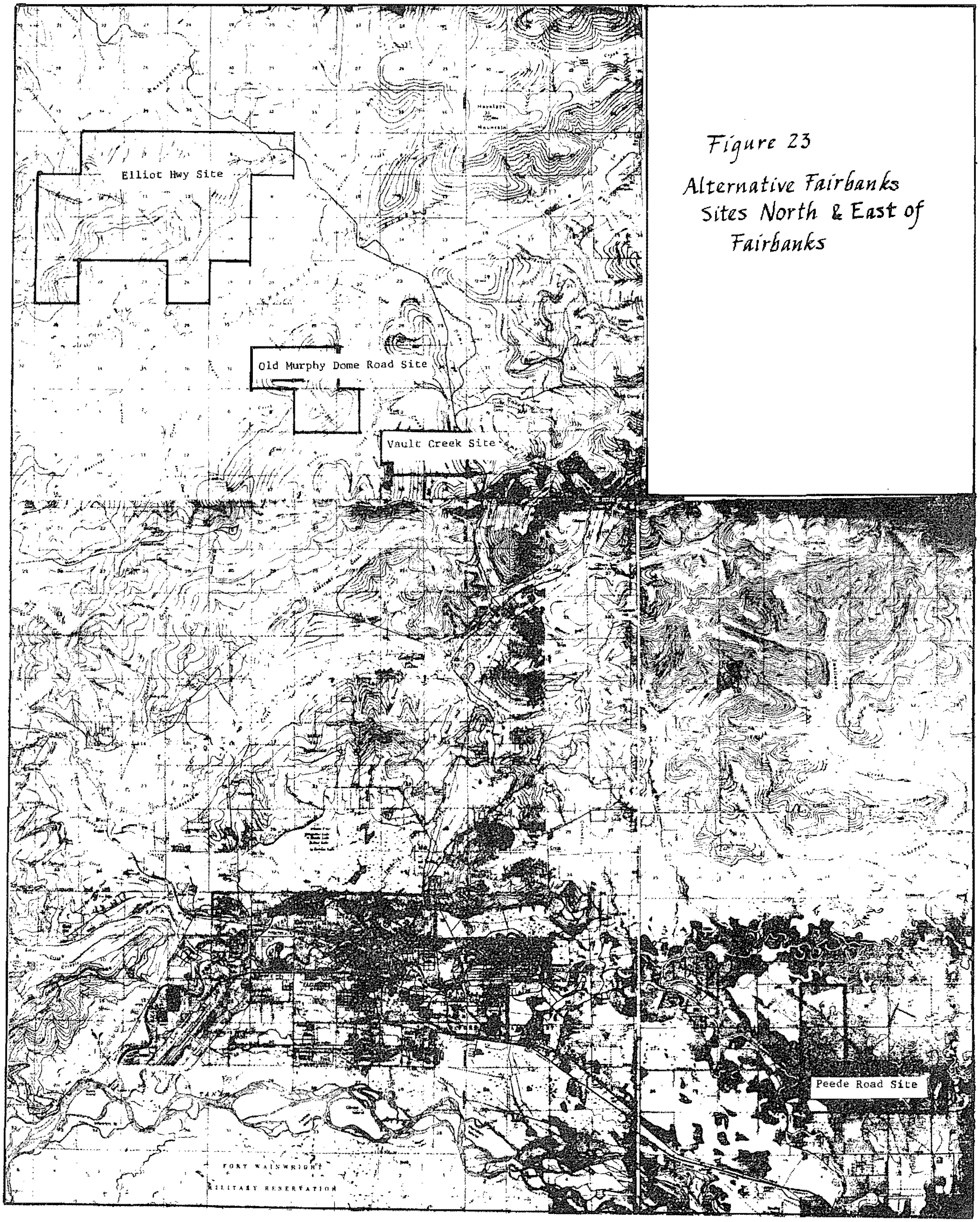


Figure 23
Alternative Fairbanks Sites North & East of Fairbanks
Elliot Hwy Site
Old Murphy Dome Road Site
Vault Creek Site
Peede Road Site
FORT WAINWRIGHT
MILITARY RESERVATION

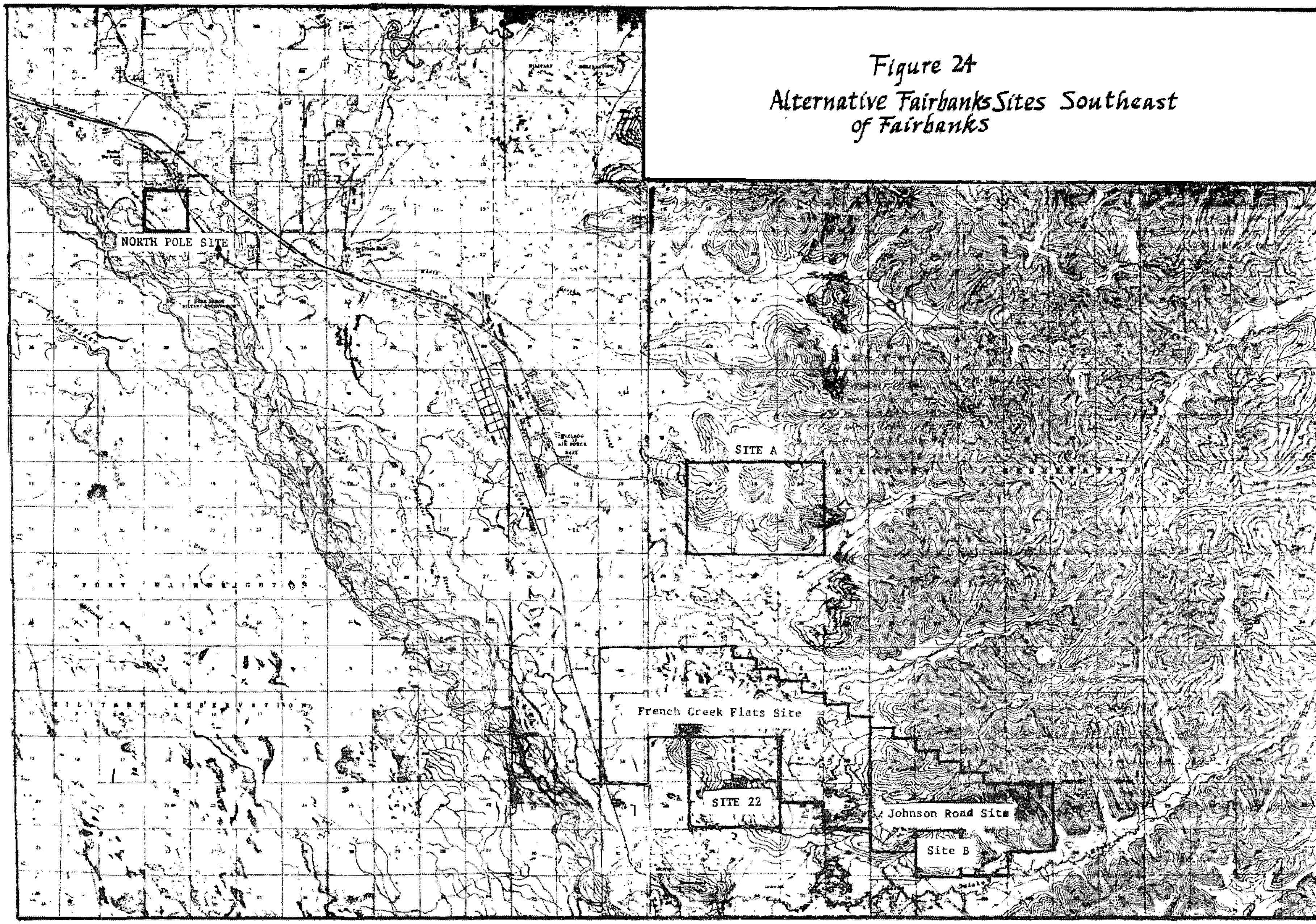


Figure 24
Alternative Fairbanks Sites Southeast of Fairbanks

i. North Pole Site

Climate

The Fairbanks area, including the North Pole alternative site (figure 25), has a continental climate. The sun is above the horizon from 18 to 21 hours each day during the months of June and July. During this period, daily average maximum temperatures reach the lower 70's. Temperatures of 27°C. or higher occur on about 10 days each summer, and extreme highs of 32°C. or more occur during the months of May through August. Conversely, during the period from November to March, when the period of sunshine ranges from 10 hours to less than 4 hours per day, the lowest temperature readings are below -18°C. Extreme temperatures of -40°C. and colder occur, on the average, only 14 days each winter. Extremes of near or below -51°C. have occurred during the three midwinter months.

Fairbanks is a semiarid area, with a normal annual precipitation of approximately 30.5 cm. Precipitation is highest during the months of June, July, and August. The highest precipitation normally occurs during August (7.6 cm.). Snow appears almost year-round. July is the only month for which snowfall has not been reported. Snowfalls of 10 cm. or more in a day occur only three times during an average winter, and blizzard conditions are extremely rare. There is a noticeable decline in precipitation from September through November. The lowest monthly average precipitation occurs during April, the month with the largest percentage of sunshine.

Ice fog occurs frequently during the winter months and can occur any time from late November through March. Ice fog occurs as a result of introducing water vapor into a stagnant atmosphere sufficiently cold (lower than -23°C.) to cause extremely rapid condensation, cooling, and freezing. It is the direct result of urbanization in cold regions, since the major sources of water vapor are stationary combustion processes (home heating, power plant stacks), open water surfaces, and vehicular exhaust. In Fairbanks, the depth of the ice fog layer is usually less than 91 meters (300 feet), but it has been observed as deep as 182 meters during prolonged cold periods. Exhaust plumes from power plants normally create minimal surface ice fog.

Ordinarily, air cools at higher altitudes and moves horizontally and vertically. The resulting turbulence mixes and clears the air. In cold, snow-covered areas, however, radiation from the earth's surface cools the air by natural convection, reversing the gradient from cold to warm. This reversal creates an inversion and limits mixing within the lower atmosphere. The inversion and ice fog become thicker as the extreme cold continues.

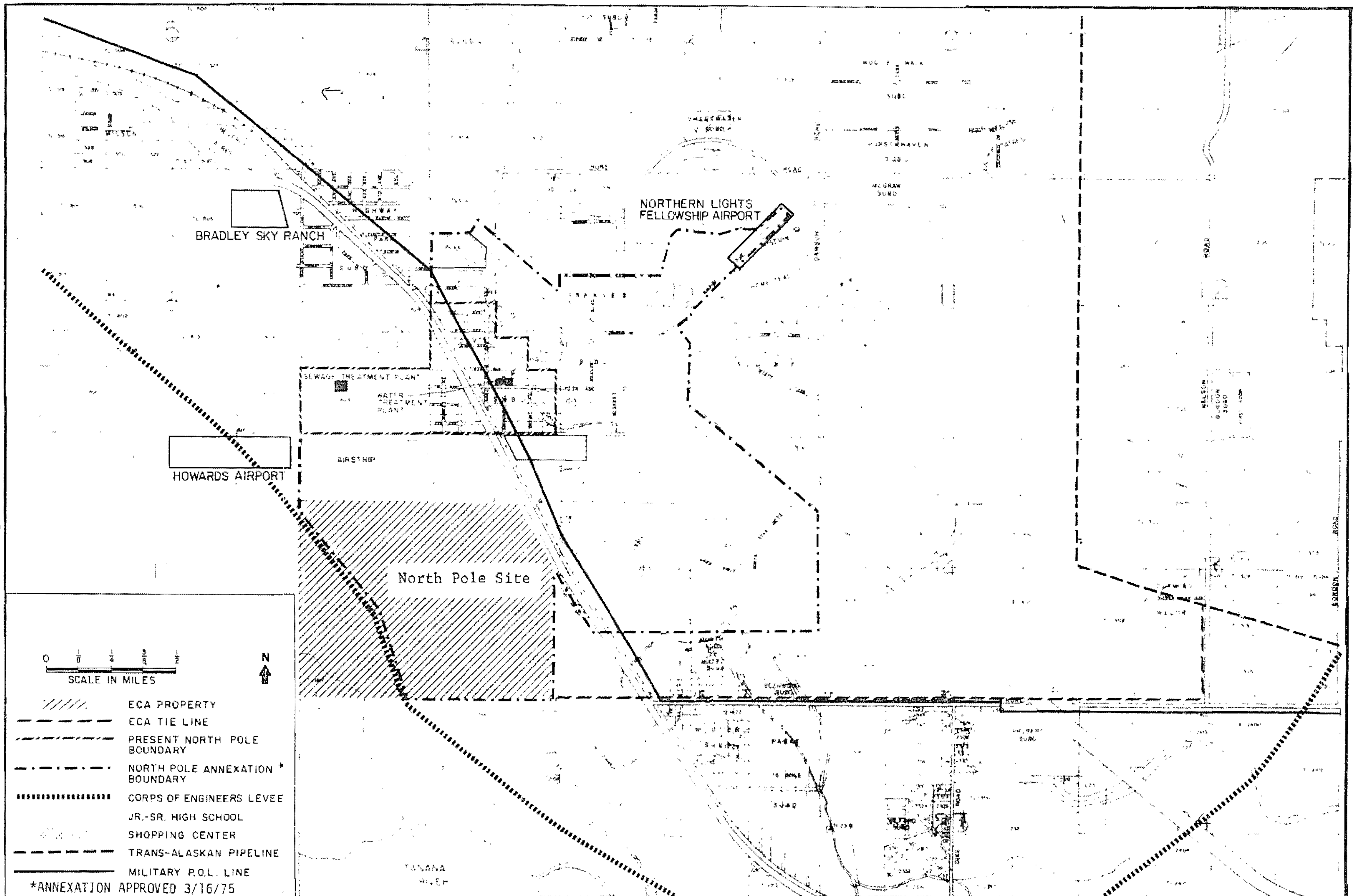


Figure 25

North Pole and Vicinity

When warm exhaust gases are discharged into the air, the air may cool 150°C. in a few seconds. Many small ice crystals (10 microns) form, creating serious visibility problems. Once these crystals form, they act as heat sinks from which convective heat is radiated faster from the surrounding air.

Three major factors in the Fairbanks area cause ice fog to disappear. The first is horizontal transport winds, generally stronger than 7 knots. The second is warmer temperatures, which may or may not be associated with strong winds. A third major factor in eliminating or preventing ice fog is the onset of snow, which combines warmer temperatures with cloud cover. The cloud cover helps reduce radiation from the top of the ice fog layer, thus preventing growth of the layer. (See figure 26.)

The impacts that can be expected as a consequence of the construction and operation of the proposed facility on this alternative site are similar to the impacts to be expected from the construction of the facility at Prudhoe Bay. The only dissimilar projected impact would be possible increase in the severity of the ice fog phenomenon. As previously mentioned, the occurrence of ice fog in the Prudhoe Bay area is minimal, primarily because of the constant winds at that location. However, this is not the case in the Fairbanks area. Low-lying areas near Fairbanks can experience long periods (up to 1 week) of ice fog conditions when the temperatures are below -32°C. and the meteorological conditions are stable. Construction of the proposed facility in a low-lying area in the vicinity of Fairbanks would aggravate the ice fog problem in the affected region. The construction of the facility would increase the severity but not the duration of ice fog episodes, because the duration is a function of ambient temperature and stability and most construction is expected to take place during the summer. It is conceivable, and in fact quite probable, that the operation of the facility would add to the overall severity of the ice fog episodes in terms of increased concentrations and extent (physical boundaries).

Topography, Geology, and Soils

The North Pole site is located within Section 16 of T2S, R2E Fairbanks Base Line in the Tanana-Kuskokwim Lowland section of the Intermontane Uplands and Lowlands physiographic division. It is within the floodplains of the Tanana and Chena rivers at an elevation between 145 and 152 meters. There is very little relief on the site, and the average slope is less than 4 meters per kilometer. The topography surrounding the North Pole site is identified in figure 27.

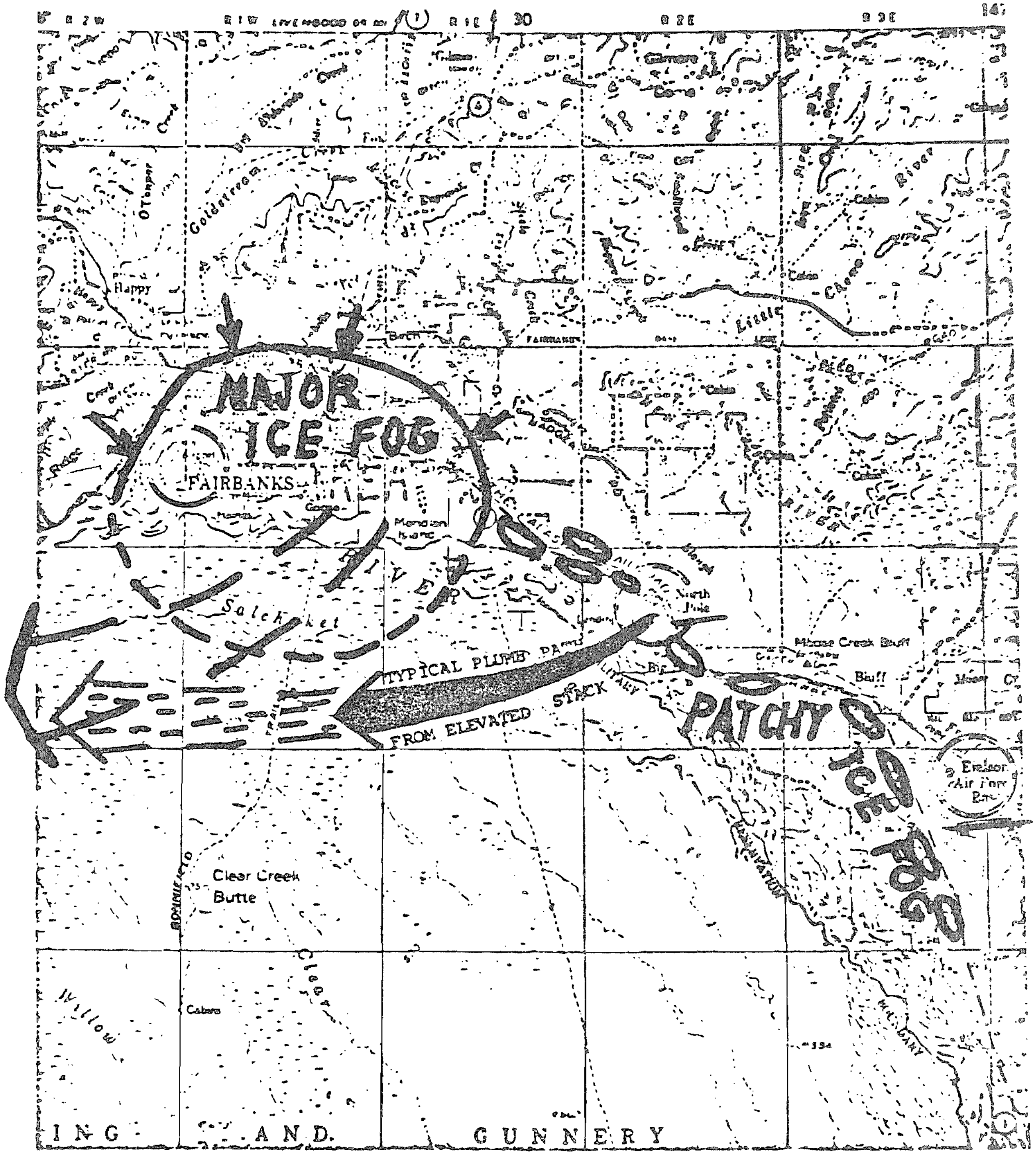


Figure 26. Typical Patterns of Light Surface Airflow During Extended Ice Fog Periods and Associated Plume Path From an Elevated Stack Source Near North Pole, Alaska.

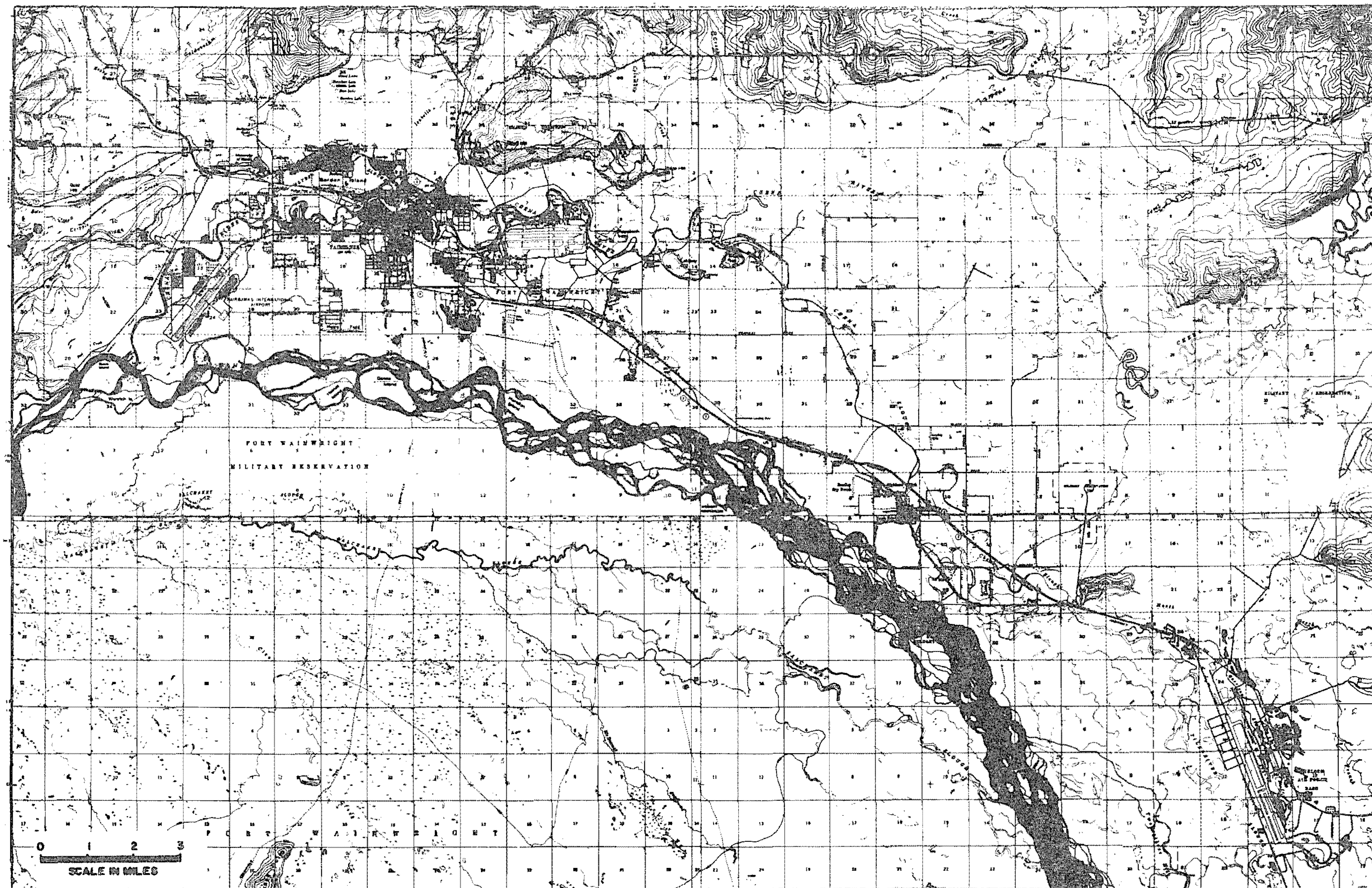


Figure 27. Topography Surrounding the North Pole Site

Only very minor impact would be expected at this site. Because it is nearly level, there should be no need for cut-and-fill, and the general absence of permafrost should reduce the need for the extensive foundation preparation required at the Prudhoe Bay and Yukon River sites.

Because of the proximity of the Tanana River and the existence of a commercial water supply, no reservoir would be required. Some wastewater treatment facility would certainly be necessary because of the limited capacity of existing facilities; however, such a facility would not require a wastewater lagoon.

The North Pole site, which is within the Tanana lowland of the Tanana River basin, is also within the floodplain of that river. The floodplain has been strongly influenced by the very large coalescing alluvial fans to the south and by the hills bordering the lowland to the north. The alluvial fans are formed of sediments carried north from the Alaska Range by tributaries to the Tanana.

Although the North Pole area was not glaciated during the Pleistocene Epoch (roughly the last 2 million years), most of the floodplain deposits are derived from glaciated areas. Outwash deposits of gravel and sand are as much as 200 meters thick near the river. This coarse material is commonly covered by 0.3 to 7 meters of alluvial sand and silt within which the present soil profile has formed.

The site is within the discontinuous permafrost zone. Because of the proximity of the Tanana and Chena Rivers and the nature of the onsite soils and geologic materials, most of the site should be free of permafrost. Those areas where minor stream channels and sloughs have existed contain more fine-grained material, are more poorly drained and would be more likely to contain permafrost. Permafrost occurred in about 25 percent of the borings made during the planning for the existing facilities near the site, resulting in a revision of the facility locations.

There are no known major faults in the immediate vicinity of this site; however, the Fairbanks area in which this site is located is one of high seismicity. The largest recorded event in the site area occurred in July 1912 and registered 7.4 on the Richter scale. The Modified Mercalli Intensity assigned to this event, which has a mean recurrence rate of about 40 years, was VIII. The maximum projected intensity for this area is IX-X, which would correspond to considerable damage in specially designed structures.

Selecting this site would have minor impact on erosion, siltation, geologic resources, and permafrost. The onsite soils are not very susceptible to erosion and that fact, coupled with the very low relief of the site, reduces the potential for erosion and subsequent siltation to a minimum.

Because of the general absence of permafrost on the site, the extensive foundation preparation necessary at Prudhoe Bay would not be required here. While a certain amount of gravel would still be required, it would probably be an order of magnitude less and would be readily available. Some material could probably be obtained onsite.

The permafrost at this site, where it exists, is not ice-rich; therefore, degradation of the permafrost should not cause subsidence. If large patches of permafrost thawed, problems could be avoided by design measures or by intentionally thawing the permafrost before construction. Neither approach would result in significant impact.

Although a number of soil types have been mapped within the floodplain of the Tanana River, only three are present on this site. About 90 percent of the site is covered by the well-drained, sandy Salchaket soils, with the poorly drained Bradway and imperfectly drained Tanana soils comprising about 10 and 1 percent, respectively.

The Salchaket soil is a very fine sandy loam generally grading from ML within the upper 0.3 meter to SM or ML within the next 0.3 meter and then underlain by GP or SP. In other words, there is a general increase in grain size with depth. The seasonably high water table is 3 to 5 meters below the surface, with permafrost at a depth of at least 5 meters, if present at all. Alluvial gravels are generally 0.3 to 2 meters below the surface. This soil is generally suitable to build on.

The Bradway soil is a poorly drained very fine sandy loam occupying old stream channels--two of which cross the site. The upper 5 cm. has a high organic content and is classified OL; the rest is classified ML. The high water level is generally 0.3 meter below the surface. Permafrost may be at a depth of 1 meter, and alluvial gravels are more than 2 meters below the surface. The high water table and permafrost are the primary adverse engineering features of this soil.

Soils within the area affected by construction would be removed from the site, and structures would occupy the cleared space. Obviously, this area could not be used for agriculture during the life of the facility and for an extended period thereafter, because topsoil would have to be replaced after removal of the facilities. Construction of a feeder pipeline from the Northwest Alaskan pipeline to the site would reduce the fertility of the soil above the pipeline trench and within the right-of-way. However, existing rights-of-way could probably be utilized, thereby reducing the additional impact of this project.

Because these soils are not very susceptible to erosion, only minimal impact of this kind would be expected.

Hydrology

The Tanana River originates in the mountainous regions near the Canadian border and flows generally west and north to its confluence with the Yukon River. Most of the Tanana River's largest tributaries from the south drain glacial meltwaters from the Alaska Range and, consequently, carry high silt loads. Streams entering from the unglaciated north are generally cleaner. Major tributaries of the Tanana include the Chisana, Nebesua, Salcha, Chena, Nenana, and Kantishna. As the Tanana River flows past the proposed site, it is a wide, heavily braided stream. The annual streamflow pattern of the Tanana River basin consists of high flows during May through September and minimum flows during the winter.

According to USGS records, the Tanana's average discharge at Nenana is 24,350 cfs. The 10-year (1963-1972) maximum peak discharge was 186,000 cfs, and the minimum daily discharge observed during this same period was 4,800 cfs. At Nenana, the Tanana drains approximately 27,500 square miles, which is approximately 7,000 square miles more than it drains at the proposed site. Mean annual runoff rates average about 0.5 to 1.0 cubic foot per second per square mile (cfsm) in the lowlands and basins north of the Tanana River, and approximately 1 cfsm to more than 4 cfsm in the upland regions in the Alaska Range.

Flood flows of the Tanana River in the vicinity of the proposed site are controlled by the Tanana-Chena Levee. The levee design specifications suggest that floods would overflow the proposed site no more than once every 200 years.

Studies conducted by EPA and the Arctic Environmental Research Laboratory during February 1975 showed the water quality in the Tanana River to be very good. Sulfides, phenols, and oil and grease were at or below detectable levels. The dissolved oxygen concentrations was 14 mg/l at 0°C. The chemical analysis results for the samples taken during these two winters are presented in tables 22 and 23. The results of hydrological studies near the North Pole Refinery indicated that some sloughs of the Tanana River have very low flows (0.1 cfs) during the freeze-up period. Any wastes dumped into a low flow area could degrade the water quality. The Chena River, which drains into the Tanana several kilometers downstream of the alternative site, receives waste discharges from the Fairbanks area and is the major source of pollution in the Tanana River.

At the North Pole plant site, the groundwater table is thought to be influenced by the nearby Tanana River. Depth to the water table at the site varies from 1.5 to 3 meters. A shallow drilled well near the Tanana River probably would produce water of acceptable quality and quantity. Shallow wells properly constructed in the sands and gravels of the Tanana Valley have yielded water at rates of 1,500 to 3,400 gpm. A well of this size would produce between 2.2 and 4.9

TABLE 22. WATER QUALITY OF THE TANANA RIVER NEAR NORTH POLE, ALASKA

	T-900[a]		T-800[b]	
	Range	Average[c]	Range	Average[c]
Total solids (mg/l)	180-200	194	180-200	190
Total volatile solids (mg/l)	60-110	87	64-120	84
Total suspended solids (mg/l)	3-6	4.2	3-5	3.4
Volatile suspended solids (mg/l)	1	1	1	1
pH	6.7-7.4	7.2	7.3-7.7	7.5
Turbidity (JTU)	2.0-3.3	2.4	2.2-3.3	2.6
Conductivity (umhos)	220-291	244	220-275	246
COD (mg/l)	1-6	5.6	1-8	4.0
Cl (mg/l)	1.7-2.0	1.8	1.7-3.4	2.3
Ca (mg/l)	42	42	42	42
Ag (mg/l)	<0.01	<0.01	<0.01	<0.01
Hg (ppb)	<0.1	<0.1	<0.1	<0.1
Na (mg/l)	3.8-4.0	3.9	3.8-4.0	3.9
Mg (mg/l)	14-15	14.8	13-15	14.2
K (mg/l)	2.0-2.1	2.1	1.9-2.1	2.0
Cu (mg/l)	<0.01	<0.01	<0.01	<0.01
Total carbon (mg/l)	27-30	28.8	27-31	29.2
Total organic carbon (mg/l)	15-25	21.2	15-26	22.0
NH_3-N (mg/l)	0.01	0.01	0.02-0.05	0.03
NO_3 (mg/l)	0.08-0.19	0.14	0.10-0.18	0.13
O-PO_4 (mg/l)	0.002-0.006	0.004	0.002-0.012	0.004
SiO_4 (mg/l)	13-14	13.8	14-15	14.2
Total nitrogen (mg/l)	0.04-0.06	0.05	0.03-0.13	0.10
Total phosphorus (mg/l)	0.007-0.014	0.010	0.007-0.013	0.011

[a]Approximately 3 miles upstream from the Topping Plant site.

[b]Approximately 15 miles downstream from the Topping Plant site.

[c]N=5

NOTE: Samples were collected by the Arctic Environmental Research Laboratory during an 11-day interval beginning in late February 1975 and were analyzed by that EPA laboratory.

Source: EPA, 1976.

TABLE 23. WATER QUALITY OF THE TANANA RIVER

Parameter	Concentration (mg/l)[a]
Total suspended solids	3.6
Chemical oxygen demand	1.3
Total Kjeldahl nitrogen	0.016
Ammonia (as nitrogen)	0.11
Nitrate-nitrite (as nitrogen)	0.16
Total phosphorus	0.042
Calcium	26
Fluoride	<1
Sulfide	<0.02
Phenolic compounds	<0.002
Oil and grease[b]	0.2
Cadmium	0.003
Chromium	<0.001
Copper	0.004
Iron	0.480
Nickel	0.015
Zinc	0.002
Lead	0.02
Manganese	0.13

[a] Samples collected in a channel (140 cfs) of the Tanana River near the ECA site.

[b] Gravimetric method of analysis (American Society of Testing and Materials). The reported value is essentially at the detection level.

Source: Samples taken on February 6, 1976 (EPA, 1976) million gallons of water per day. Chemical data for water from a well adjacent to the proposed SGCF site that was drilled for the Golden Valley Electric Association are presented in table 24. Because this well is shallow and possibly subject to contamination, the potable water supply should be disinfected.

The main hydrological concerns about constructing and operating the proposed facilities at the North Pole site would be those associated with the domestic water supply and sewage disposal and groundwater impacts resulting from construction. The Fairbanks treatment plant went on line in December 1976. It is an indoor, pure oxygen, activated sludge plant with disinfection of the effluent before disposal to the Tanana River. The plant is designated for an ultimate capacity of 8 million gpd but presently is operating significantly under that capacity, at approximately 3.6 million gpd. Assuming that many operators would live in Fairbanks, the 100,000 gpd additional flow generated by an additional 1,000 residents could easily be handled by this plant. The plant has effluent limitations of 25 mg/1 BOD and 25 mg/1 suspended solids. After initial startup problems, the plant is now consistently meeting these criteria.

The operating plant is assumed to have toilets and showers for the work crew. The daily flow is assumed to be 25 gallons per capita. The domestic sewage would be treated to meet the EPA discharge standards by a small onsite extended aeration plant. The effluent would be disinfected before it is discharged to a slough of the Tanana River, which has adequate flow during the winter.

The city of North Pole's potable water supply and distribution system consists of a deep well, storage tank, chlorination, a green sand pressure filter, and both constant pressure and circulation pumps. The system is presently designed to serve a population of 4,000 people. The SGCF as proposed for Prudhoe Bay requires accommodations for a construction crew of 1,000 and an operations staff of 200. There should be no significant impacts associated with obtaining a sufficient domestic water supply for the proposed facilities. If the existing city water system were insufficient, a water treatment facility is proposed in association with the SGCF, and adequate water sources are available.

Discharges of treated domestic wastes from the proposed facilities should have very little impact on the Tanana River, whether discharged through the municipal plant at Fairbanks or through a separate treatment facility at the SGCF.

TABLE 24. RESULTS OF THE ANALYSIS OF WATER FOR THE PROPOSED GOLDEN VALLEY ELECTRIC ASSOCIATION WELL AT NORTH POLE, ALASKA

Parameter	Concentration Range (mg/l)
Iron	0.05
Barium	0.1
Silica	0.1
Suspended solids	0.1
Sodium	68-106
Potassium	10
Calcium	4
Magnesium	6-7
Sulfate	22-26
Chloride	8-10
Hydroxide	--
Carbonate	--
Bicarbonate	195-281
Total dissolved solids	214-297
pH	6.5-6.6[a]
Total hardness ($CaCO_3$)	39
Total alkalinity ($CaCO_3$)	160
Fecal coliform bacteria	--[b]

[a]Standard units.

[b]No./100 ml.

NOTE: Samples were obtained from a shallow (20-foot) well at Station G-2 on 26 May 1975.

Adapted from EPA, 1976.

Because of the modular construction of the SGCF, excavation at the North Pole site would not be anticipated. As a consequence, the near surface groundwater table would not be exposed in the course of construction, and adverse impacts would not be expected. It is possible that this shallow aquifer could become contaminated by oil or chemical spills. The plant construction procedures should be such that runoff would be diverted away from the well area into impervious settling basins before it is allowed to enter the river. All spill containment pits should be lined with impervious materials.

Air Quality

The ambient air quality in the Fairbanks area generally is good, with the exception of carbon monoxide (CO) levels. Fairbanks is located in the Fairbanks North Star Borough Air Quality Control Region (AQCR). The air quality standards applicable to the Fairbanks alternative site (i.e., NAAQS and AAAQS) are the same as those applicable to the site at Prudhoe Bay. The Air Quality Attainment Plan for the North Star AQCR (February 26, 1979) indicates that the North Pole site is adjacent to a nonattainment area for CO. The major contributing sources to the CO problem in the AQCR are vehicles, and residential, small commercial, and industrial heating units.

It is not possible at this time to quantify the impacts that might result from constructing the SGCF at the North Pole site for two reasons. First, the proposed facility must be "stick or skid built" rather than totally prefabricated at a site in the lower 48. This means that the facility, as presently designed, cannot be constructed at this site. A different design would require a radically different approach to construction of the proposed facility. This, in turn, could require totally different construction vehicles (and thus different emission rates), a change in the size of the construction site, and a need for ancillary and support vehicles.

Second, the materials and equipment necessary to construct the proposed facility cannot be brought to the site on large barges because there is no nearby waterway sufficient to accommodate such barges. Instead, the materials would be transported to the site by rail and/or truck. Because there is no design for this stick-built type of plant, there also is no definitive transportation strategy that would permit selection of the mode of transport or estimation of the number of carriers.

No matter which alternative process were selected or how construction were approached, the fact remains that the North Pole alternative site is adjacent to a nonattainment area for CO. Any construction would exacerbate this situation and make it more difficult for this area to achieve attainment status.

The impacts resulting from the operation of the SGCF at this alternative site also are impossible to quantify until several critical decisions are made. It has not been determined if the proposed facility would obtain energy from the local utility district or would supply its own power. If the proposed project could in fact obtain power from the local utility, numerous problems could be solved. If, however, the proposed facility must produce enough energy to meet its own needs, three more problems would arise.

First, operation of the proposed project would exacerbate CO nonattainment levels to some extent. Second, the meteorological conditions of this area are not conducive to dispersion of pollutants. This is especially true during the winter, when there are long periods of extreme stability with very low mixing heights (approximately 300 to 600 meters). It is expected that the gas turbine units would not pose much problem during the winter. The operation of the space and/or process heaters, however, could produce very high pollutant levels within 1 or 2 km. downwind of the proposed facility. Finally, if the SGCF were required to supply its own power, there would be an increase in the severity and physical extent of the ice fog that occurs frequently in the area during the winter. If the North Pole site receives further serious consideration as a possible site, an in-depth study should be undertaken to more adequately determine these potential impacts.

Noise Quality

Ambient noise levels have not been monitored at the North Pole alternative site. The ambient noise level at this site has been estimated to be about 40 dB(A). This estimate is based on the general characteristics of the site, which is a semirural area with one industry located in the general vicinity.

It is impossible at this time to quantify the noise impacts associated with construction of the SGCF at the North Pole site, for the reasons listed in the air quality section. However, the overall impact that results from the construction of the proposed facility should be insignificant because of the location and character of the site. The site is not in a heavy residential area; therefore, the impact on a surrounding population should not be a problem. Conversely, because the site is not entirely rural, no large sensitive wildlife populations would be affected.

If the SELEXOL process were utilized at this site and the SGCF at this site included the gas turbine facility, the level of noise generated by the SGCF at the North Pole site would not differ significantly from the level of noise generated at the Prudhoe Bay site. The noise increase produced by the operation of the facility at Prudhoe Bay was estimated to be at 6 dB at 0.8 km. from the facility. Because of the location and the semiindustrial character of this site, the impacts on human and sensitive wildlife populations would be minimal.

Terrestrial and Aquatic Communities

The forest which covers the landscape in the Fairbanks-North Pole area is termed "taiga," a spruce-dominated coniferous forest characteristic of subarctic climates.

The North Pole site is located in an ecosystem oftentimes referred to as a lowbush bog or muskeg. The characteristic vegetation is dominated by the black spruce-tamarack and the dwarf or resin birch, an ericaceous shrub type. Other common vegetation in this area includes occasional willows, tinleaf alders, and poplars growing in a substrate of grasses, lichens, and mosses of various species.

Wildlife is relatively plentiful in the heavily forested outlying areas of Fairbanks and North Pole. The more common large mammals in the area include the snowshoe hare, red squirrel, beaver, wolf, red fox, mink, lynx, moose, and black bear. Many species of small mammals--shrews, lemming, voles, muskrat, rat, and porcupine--are also found in this area.

Numerous species of birds are residents of the Tanana Valley (either year-round or in the summer) or nest and forage there during migration. The Tanana River and its floodplain provide appropriate habitat for a variety of waterfowl and shorebirds, including mallards, pintails, green-winged teal, bufflehead, lesser yellowlegs, snipe, and sandpipers. Various raptors, gamebirds, and passerine birds are also found in the general area. Peregrine falcons, ospreys, and bald eagles are known to nest in the Tanana Valley. Other raptors there include goshawks and sharpshinned hawks; great horned, great gray and boreal owls; and red-tailed, Harlan's Swainsons, rough-legged, marsh, pigeon, and sparrow hawks. Gyr falcons are observed usually above 760 meters (2,500 feet) elevations.

The Tanana River, like other glacially fed rivers in Alaska, is typically high and heavily laden with silt during the summer and low, clear, and ice-covered during the winter. The drastic seasonal changes in the character of the Tanana River bring about corresponding seasonal variations in fish populations. The year-round fish residents include the burbot, humpback whitefish, inconnu or sheefish, and suckers. Fish that reside in the Tanana River only during winter include the arctic grayling, round whitefish, and northern pike. King salmon, chum salmon, silver salmon, and arctic lamprey use the Tanana River primarily as a migration route.

During the spring, there are several intense but short sport fisheries for arctic grayling or round whitefish in the Tanana River. These usually occur in the vicinity of the mouths of tributaries. During the winter, the burbot is fished all along the Tanana.

No threatened or endangered species are known to inhabit the alternate site.

The construction of the proposed facility at the alternative North Pole site would result in cumulative impact to the fauna and flora, since much of the area near the site has already been subject to human disturbance. Cumulative impacts would include increases in noise from construction and operation of the SGCF, incremental air and water degradation, and the commitment of additional acreage to an industrial facility siting.

The vegetation which would be eliminated would include those species which characterize bog-type communities, such as stunted, noncommercial tree species (dward birch and black spruce) and numerous shrubs. None of the species affected are classified by the U.S. Fish and Wildlife Service as threatened or endangered.

The removal of approximately 200 acres of vegetation for construction of the proposed facilities would eliminate existing available habitat for many small mammals, such as shrews, rats, porcupines, voles, and muskrat. These small mammals would probably be lost or displaced. Displaced wildlife would be forced to compete for comparable habitat which may exist in the surrounding area. The competition for food and cover and other environmental stresses, such as increased predator pressure, might substantially reduce the populations of small mammals in the area.

This area is not considered winter range for moose; however, they have been observed in the area during the summer. Moose and other large mammals, such as black bear, would not frequent the project site area because of increased human activity and disturbance.

Construction of any water lines to the Tanana River would not be expected to have significant adverse impact on the fisheries resources of the river. Construction of these lines would result in short-term, reversible impacts such as increased turbidity and sediment load. Sedimentation increases in the Tanana River would be insignificant during the summer when the river carries a heavy silt load. However, sediment increases when arctic grayling spawn could be detrimental to these populations. Sedimentation and related impacts to fish populations would be similar to those at the Prudhoe Bay site.

Land Use and Solid Waste Disposal

The alternate site at North Pole is located in the North Pole Planning Area, which covers approximately 67 square miles east of Fairbanks and Fort Wainwright, extending along Badger Road and the New Richardson Highway. The alternate site at North Pole is zoned Heavy Industrial; the state-owned property north of the site is zoned General Agriculture; property to the east and on the opposite side of the Old Richardson Highway is zoned General Agriculture and Rural Residential, respectively; and privately owned property south of the alternate site is zoned for unrestricted use. Figure 28 indicates the existing land use patterns for the North Pole alternate site.

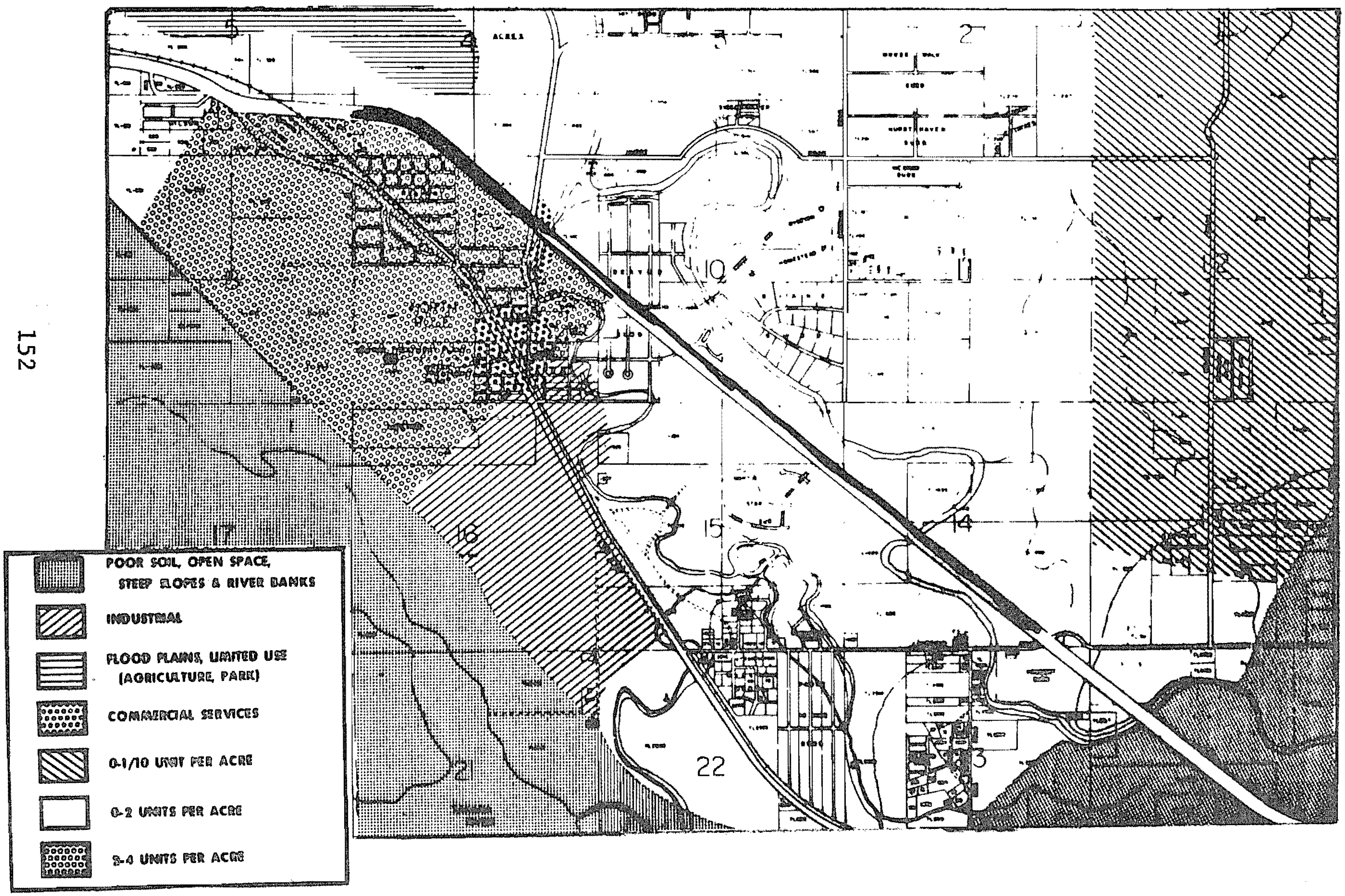
The Fairbanks North Star Borough adopted its Comprehensive Plan for land use in 1976. Among the many recommendations made, those pertinent to the North Pole area include: (1) concentrated commercial, urban, and suburban residential development in the North Pole city center, within the capacity of the existing water and sewer systems, (2) low suburban-rural densities on land suitable for development but outside the limits of sewer and water services, (3) retention of lands along Chena Slough as part of a proposed open-spaced trail system, and (4) heavy industrial use south of the city center, between the Old Richardson Highway and the Tanana River and east along the railroad tracks. At the present time, the zoning plan for the North Pole Planning Area is consistent with the borough's comprehensive land use plan.

The alternate SGCF site would be adjacent to the Energy Company of Alaska Topping Plant that has been operational since August 1977. This plant is significant as the first of the "pipeline industries" and as the first oil refinery to be located on freshwater in Alaska. The topping plant is designed to process up to 25,000 barrels per day of crude oil from TAPS and is capable of manufacturing heating oils, diesel fuel, industrial turbine fuel, military, and commercial jet fuel, and asphalt. As previously indicated, locating the SGCF adjacent to the oil refinery would place it in an area that has been designated for industrial growth.

Although many of the streets in North Pole are unpaved and many residential streets are not equipped with street lighting, generally an excellent network of air/rail/highway systems presently exists in the Fairbanks area. For instance, the New Richardson Highway runs east of North Pole and accommodates the Fairbanks -Eielson Air Force Base traffic. A road joining the Chena Hot Springs area northeast of Fairbanks to North Pole was completed in late 1975. In addition, the Fairbanks-North Pole area is situated in proximity to the already constructed TAPS and the future ANGTS.

Figure 28

LAND USE RECOMMENDATIONS FOR THE NORTH POLE AREA



The most significant land use impact would be the conversion of the site from undeveloped woodland to additional industry. Such a commitment would make this land area unavailable for other uses and could conflict with the surrounding land which is zoned for less intensive uses.

Increased use of existing roads as a result of increased traffic due to construction and permanent SGCF personnel will intensify the need for additional maintenance and repair of these roads. There will also be an increase in traffic hazards and noise levels. The increased traffic, including truck traffic, will affect the in-town circulation patterns to some degree.

Presently, the Fairbanks-North Pole area is an important air and road hub for people and materials enroute to the North Slope. As a result, this area is projected as having a high growth potential. Because of such ongoing developments, the impact of the SGCF on land use patterns in the borough is expected to be minimal. However, placing this facility near the existing oil refinery at North Pole could stimulate the development of other industries in the area. Such an industrial complex could significantly influence the borough and North Pole plans for future industrial growth and land use planning policies.

Solid wastes from a SGCF at the North Pole site will probably be hauled to the Fairbanks North Star Borough refuse disposal facility by a private contractor. Solid waste generation rates should be similar to the current generation rates of 5.9 kilograms/capita/day for the general population and 4.5 kilograms/capita/day at the North Pole topping plant. The Fairbanks North Star Borough operates the solid waste disposal facility, located approximately 3 km. south of the city, for the residents and industry within the borough's boundaries. Some wastes are received from the North Slope of Alaska. Except for charges for the refuse from the North Slope, the facility is financed by the general tax revenues. Little effort was made to determine the quantities of refuse placed in the fill during construction of TAPS.

With the installation of a baler at the landfill site, disposal practices have changed. Automobiles, large appliances, and scrap metal are segregated, baled, and sold. Community organizations collect aluminum, which is baled and sold. Money from the sale of the aluminum goes to the community service organizations, whereas money from the sale of other scrap goes into the general fund. General refuse is baled to a density of 1,043 to 1,283 kilograms/cubic meter.

The baler capacity is approximately 400 tons per day. At present, the facility is processing and disposing of approximately 150 to 200 tons per day. There is adequate volume for the foreseeable future, and the operation and site characteristics conform to all applicable Federal, state, and local codes and criteria. The borough has indicated that it might discourage the incineration of refuse to simplify the baling operation. It is also possible that the incinerator ash would simply be used as cover material. In either case, the operation could easily handle the additional solid waste (possibly up to 4 tons per day, unincinerated). The environmental impact would be negligible for either case.

The baled refuse volume for the 1,000-person construction crew would be 5.7 cubic meters per day. During the construction period of 4.5 years, the total volume of landfill needed would be 9,290 cubic meters. For the operating period, the daily volume generated is estimated to be 1.9 cubic meters. The borough does not anticipate that these quantities would create any problems in its existing landfill operation.

During construction, the daily solid waste generation for the borough would increase by 1.6 percent over what is presently generated by the 64,000 residents. During operation, the increase would be only 0.3 percent above this current level. Over a 20-year period, the increase in landfill area needed would be 0.7 acre. The impact on the existing site would be minimal.

Socioeconomics

The North Pole alternate site is within the Fairbanks North Star Borough. Borough population estimates indicate a 13-percent drop in area population in 1978 over 1977, with 27,116 persons residing in Fairbanks and 33,729 outside the city but within the borough. These current estimates also indicate a 21-percent increase in population over prepipeline levels in 1973 but a 16-percent drop from the borough's peak population in 1976 during pipeline construction. Recent information indicates that there are about 800 people living within the North Pole city boundaries and over 12,000 living outside the city but within the North Pole Planning Area.

Until the existing refinery became operational in August 1977, North Pole was generally regarded as a residential community dependent on outside employment centers. However, residents of North Pole remain largely dependent on commercial and professional institutions in Fairbanks, at Fort Wainwright, at Eielson Air Force Base, and those provided by Alyeska for its employees.

In the past, North Pole has obtained the majority of its operating revenues from water and sewer receipts and from state and Federal revenue sharing. More recently, North Pole has received significant increases in revenues as a result of the construction of the North Pole refinery.

Besides the refinery, there is no other appreciable nongovernmental industry in the Fairbanks North Star Borough to provide economic support for the area. Construction has primarily occurred in public or military projects rather than in private developments. Lack of manufacturing in Fairbanks requires that most manufactured goods be imported; this creates an outflow of monies from the local economy, thereby reducing internal development potential. Government, trade, and services currently dominate the Fairbanks economy in its role as the distribution center for the north-central region of Alaska.

Even before construction of TAPS, the cost of living in Alaska was higher than in the United States as a whole. Part of the increase in Alaskan price levels can be attributed to the impacts of TAPS construction. Since Fairbanks was directly impacted by the pipeline to a much greater extent than Anchorage, it is generally believed that inflationary pressures in Fairbanks were more severe than in Anchorage. Fairbanks had a relatively small support sector prior to pipeline construction. Pressures on the economy produced gross dislocations, shortages, and rapidly rising prices. Economic developments in Fairbanks during the pipeline construction, which included expansion of the retail trade, service, and transportation sectors of the economy, increased competition. This likely dampened inflation somewhat. Presently, prices in Fairbanks are somewhat higher than in Anchorage, but considerably lower than prices in the small, remote villages of western and northern Alaska which have traditionally experienced the state's highest costs.

Both Fairbanks and the North Pole area have historically experienced critical shortages in housing at times of rapid economic growth. This shortage has been caused not only by large in-migration of workers seeking pipeline construction jobs but also by the rising cost of building materials, a labor-intensive construction industry, severe climatic and topographic constraints, and an isolated, fluctuating market. More recently, however, the Fairbanks borough has become more able to fill housing needs. The 940 rental units vacant in October 1978 and the 1978 household density average of 2.7 indicate that this area could absorb 2,500 people with no new housing construction.

Construction of TAPS did not have the major impact on school enrollments originally expected in the Fairbanks North Star Borough, since most incoming pipeline workers were either single or left their families in their home states. Consequently, the present decrease in school enrollments is not as great as estimates for the decrease in total borough populations would otherwise suggest.

The Fairbanks area, along with other areas along TAPS, has undergone noticeable changes in socioeconomic structure as a result of construction of TAPS. The "boom" of the boom/bust cycle associated with such a project has already taken place. However, there is a hesitancy to describe the present economic situation in Fairbanks as a "bust" trend, although the economy has slowed down significantly.1/

Unemployment levels in Fairbanks declined to 15.2 percent for the period ending February 1980, but they still remain higher than the state-wide jobless rate of 11.4 percent. Despite this general downturn in the Fairbanks economy, employment remains substantially above prepipeline levels. The present outlook is for slow growth in the Fairbanks area and rising employment levels caused by some increase in tourism and preparation for construction of the ANGTS.

The construction and operation of the SGCF in the Fairbanks-North Pole area would result in an influx of employees into this area. Most of these workers would be moving into the area from the surrounding locality and from outside Alaska. Some of these personnel may bring their families, but most construction workers are usually single or leave their families in their home states. Additional construction workers beyond the 1,000 for the proposed Prudhoe Bay site would be required to build the alternate site at North Pole. The size of the modular units might be smaller since the mode of transportation would be limited to air, rail, or truck into the Fairbanks area, as opposed to larger-sized modules on barges. Smaller module sizes would necessitate increased numbers of units, therefore requiring greater numbers of workers for transporting and assembling these facilities. However, this consideration may be offset by greater worker productivity in the less severe climatic conditions of interior Alaska.

Construction of the SGCF at the North Pole alternative site would help remedy the present decline in construction- and transportation-related employment in the Fairbanks area. Most of the new permanent jobs would probably require at least semiskilled workers. Since very few unskilled workers will be employed by the

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1/ State of Alaska, Department of Labor, Research and Analysis Section, Alaska Economic Trends (January 1979), p. 7.

SGCF, this industry would probably have little significant direct effect on unemployment rates in the area, unless the facility operator is committed to a training program for Alaskans. Additionally, Fairbanks has several educational facilities that could provide any required training.

Temporary employment for construction personnel and the permanent operation and maintenance jobs resulting from the construction and operation of the SGCF would also increase the number of employees that would be hired by supportive facilities and service industries necessary to serve the additional people. The job opportunities created by these support and service facilities might favorably affect unemployment rates. In addition, all of these facilities, including the SGCF, would generate additional tax revenues for the area. For example, construction of a gas conditioning facility would represent approximately $2 billion in capital investment. At the borough's present 7.2 mill tax rate, this would yield $14.4 million in property taxes alone, or approximately twice the revenue it now receives from all property taxes. This figure is also approximately twice the revenue the North Star Borough currently receives from sales taxes. Likewise, if the facility were located within the city of North Pole, it would pay approximately $11.6 million dollars of revenue annually, assuming the current property tax rate of 5.8 mills.

The demands of the approximately 200 permanently employed SGCF personnel and their families on the services and facilities of Fairbanks and the borough would be adequately met with minimal impact. However, if all 200 persons and their families decided to reside in North Pole, the impacts on some of the city's existing facilities and services would be substantial. The largest problem would be the city's past inability to provide sewer and water services to new residential developments.

Construction of the SGCF at the North Pole industrial site could potentially have significant impact on the housing market in the area. It might or might not require construction of a workcamp. If a workcamp were constructed, there would not be a severe strain on the local housing situation. However, if a construction camp were not constructed, a greater demand would again be placed on both rental housing and new housing. Such a demand would increase rents, which until recently had dropped an average of 20 percent since the height of the pipeline boom. New housing starts, which decreased 45 percent during a 6-month construction season in 1978, might be stimulated again. It may be possible to house construction crews on the north side of Fort Wainwright in the same buildings used for the TAPS crews.

If most of the SGCF employees live in Fairbanks and commute to North Pole, there would be a "leakage" of wages to areas outside the North Pole community. If the leakage is great, it could evolve into a critical problem. The city of North Pole would be burdened with accommodating the needs of new industry without the means to do so. The community might have to pay for the necessary public services while losing spending to other areas.

Temporary construction personnel moving into the area might again create the boom economy in the Fairbanks area that occurred during TAPS construction. Fewer temporary construction workers would be required than during peak TAPS construction, but these SGCF construction workers would be primarily concentrated in the Fairbanks-North Pole area for the duration of the construction. Personnel required for ANGTS construction may be moving into the Fairbanks area at about the same time, creating cumulative impacts to the local economy. Following construction of the SGCF and the ANGTS, the Fairbanks area might again experience a downturn in the economy similar to what is presently occurring in the area. However, approximately 200 permanent long-term jobs would have been created at the SGCF in North Pole. This could lessen the downturn by stimulating the local economy, as would the increased tax base the SGCF would provide.

From its earliest days as a gold rush town, Fairbanks has followed a classical boom/bust cycle. An SGCF in the Fairbanks area would replace that cycle with a base industry whose effects would be long term. For instance, the Fairbanks North Star Borough proposes that the SGCF could be built in conjunction with the development of a petrochemical industry and that most of the energy needs for these facilities could be met by coal resources in Alaska. The potential for such future development would encourage private industry to make investments that create a long-term private enterprise solution to economic distress. This mitigation of any future boom/bust cycle is the reason the Fairbanks North Star Borough is encouraging the establishment of the SGCF in the central Alaska area.

Recreation and Aesthetics

Existing camping and picnic areas include the Chena River Wayside, the Harding Lake Recreation Area (located 64-65 km. from Fairbanks), the Salcha River Picnic Wayside, Growden Memorial Park, and the North Pole City Park. A few other recreational facilities are presently being considered for development in the area (e.g., hiking or bicycle trail routes), and these new developments should help to minimize the demand on existing facilities.

The city of Fairbanks maintains numerous parks for day activities. Additionally, the surrounding area is valued recreationally for its "back country" terrain and character. Recreational activities such as backpacking, skiing, snowmobiling, hunting, fishing, and boating are enjoyed outside the confines of urban areas such as Fairbanks.

The influx of people associated with the construction and operation of the SGCF, both directly and indirectly, would intensify use of existing recreation areas in the vicinity of North Pole and Fairbanks. The increased population of temporary construction personnel would intensify the shortage of informal park areas and recreational facilities needed for organized sports. The existing recreational facilities would be more frequently used by visitors than by residents of the area, especially during the summer.

Increased recreational activity, such as boating, hiking, skiing, and snowmobiling, would all increase disturbance to local wildlife and possibly damage the environment. Such activities would impact to some degree the fish and wildlife of the area and their habitats and would affect local subsistence hunting and fishing.

The combustion products from the power generation system associated with the SGCF could aggravate the existing air quality problems in the Fairbanks area. The gas processing itself, or its power generation system, would not add significantly to the ice fog problem in this area. However, the operation of the process area space heaters associated with the operation of the facility and the secondary effects of the construction and operation of the facility (i.e., increased auto use, people, power requirements, etc.) would significantly add to the ice fog problem. The continual occurrence of such air quality events would create aesthetic problems and annoyance to the people seeking the pristine nature of the surrounding countryside.

Cultural Resources

Records of archaeological sites from surveys of TAPS are contained in the Heritage Resource Survey, a statewide depository of cultural resource information maintained by the Alaska State Historic Preservation Officer. Applicability of these data to the gas pipeline and gas processing plant depends, of course, on how closely the facilities follow the TAPS right-of-way.

The southern half of the pipeline corridor in Alaska crosses one of the most favorable areas for continuous human occupation. This provides an ideal situation for recovering new information on the developmental sequences of society in the area. The orientations of tribal units to major river arteries suggest that archaeological sites within the pipeline corridor could reveal valuable information on earlier economic patterns and social systems.

The Alaskan interior contains numerous historic sites of the Gold Rush era, including dredges, steamboat relics, saloons, and courthouses. Particularly south of Fairbanks, historical resources are abundant along the route. Roadhouses sprang up along all major travel routes in Alaska, offering services to travelers in the primitive and harsh country. Depending upon the precise placement of the gas processing facility, such sites might be directly impacted if identification and salvage operations are not carried out in advance. See page 735 of DOI-FEIS, Alaska Volume, for more detailed historical information for Fairbanks area. Page 753 of the same volume discusses general impacts to historical resources.

Part of the North Pole alternative site has been surveyed for archaeological resources. The survey archaeologist has indicated that a complete survey would not be productive.

ii. Johnson Road Site

Climate

The climate at the North Pole site is similar to the climate at this site; the reader is therefore referred to that discussion. However, using coal for fuel at a conditioning plant here would generate impacts which would not occur elsewhere.

Meteorological phenomena that affect groundlevel concentrations of coal combustion products include precipitation scavenging, dry deposition, and effluent transformation. Precipitation may remove gaseous, liquid, or solid effluents from the plume, thereby reducing the amount of pollutants and decreasing groundlevel airborne concentrations. This process is precipitation scavenging. Gases may absorb onto particulate matter and fall from the plume to the soil or onto vegetation, a process called dry deposition. In addition, other chemicals or particles in the plume or the atmosphere may react with the effluents and sunlight to form different products or decay to stable gaseous or solid compounds. This is called effluent transformation. Chemical reaction rates for certain effluents are well known, but they may vary considerably depending upon temperature and availability of water vapor, other chemicals, sunlight, catalysts, or suitable particulates.

Reduced visibility results when light is scattered from surfaces of airborne particles. The degree of light scattering is related to particle size, aerosol density, and thickness of the affected air mass, as well as the physical characteristics of the suspended particles. The particles can be natural, such as wind-blown dust or fog, or artificial, such as smoke or chemical releases. In addition, secondary pollutants such as photochemical smog contribute to visibility reduction. No national standards for visibility are presently in effect, and visibility measurements are of limited usefulness in assessing the impacts of pollutant emissions or the trends in air quality. However, since the SGCF will be considered a new major source of air emissions, a PSD permit review of its design will be required by the EPA. A portion of the PSD review includes visibility impact analysis for any Class I area that could be affected by the proposed new source.

The acidity of rain and snow falling upon the United States has been rising for several decades. Evidence suggests that acid rain damages trees and other plants and is linked to sharp declines in the number of fish in streams and lakes. In addition, increased acidity accelerates weathering of buildings and corrosion of materials. Increased acidity of rain is apparently caused by increases of strong acids (sulfur, nitric, and hydrochloric) in the atmosphere. The major new source of these strong acids is the combustion of fossil fuels, particularly coal. Coal emits greater quantities of strong acids than petroleum and far more than natural gas. However, the application of flue gas desulfurization (FGD) technology, using highly efficient new scrubber units, may slow this trend.

Since the Johnson Road site is isolated from the Fairbanks and North Pole communities, few automobiles, the major contributor to ice fog, will be present and the number of ice fog incidents should be lower. Although these incidents are expected to result from plant operations, no major environmental impact is expected. The plant would be designed so that all process vessels and equipment were enclosed in modules. A properly designed and engineered exhaust gas stack would limit these ice fog formations by dispersing the gaseous plant emissions above the inversion layer. No ice fog from the operation of an SGCF at the Johnson Road site is expected to impact the cities of Fairbanks and North Pole.

Topography, Geology, and Soils

This alternative site is located on the border between the Tanana-Kuskokwim Lowlands and the Yukon-Tanana Upland, both of which are portions of the Intermontane Uplands and Lowlands physiographic division. The site occupies the lower elevations of the hills which mark the transition between these two regions; it encompasses about 5,680 acres of the central and western portions of T4S, R5E, Fairbanks Meridian. TAPS pump station 8 is located in the southwestern portion of the site.

Site elevations range from about 240 to 500 meters above mean sea level. Most of the site slopes to the south or west at 80 to 300 meters per kilometer. See figure 29 for the location and topography of this site.

Because the site is generally not level, substantial grading would be required to prepare it for the facilities. The specific design of the facilities would dictate the extent of grading necessary. Since substantial portions of the site should be free of permafrost, the extensive site preparation necessary at Prudhoe Bay and the Yukon River sites would not be necessary here.

In spite of the proximity of the Little Salcha River, it is likely that a water reservoir would be required. However, the Tanana River is only 8 to 10 km. away and could provide a reliable water source. A wastewater treatment facility would also be needed, and the installation of these facilities would require considerable topographic modifications.

The Johnson Road site is within the discontinuous permafrost zone. However, permafrost is unlikely to be present on south or southwesterly facing slopes. In addition, bedrock should generally occur within 2 meters of the surface.

The seismicity of this site is essentially the same as that of the North Pole site. However, the presence of bedrock close to the surface at this site would tend to reduce the risk which exists at the North Pole location.

The most extensive soils at this site are Subarctic Brown Forest soils. In order of decreasing topographic elevation, these soils include the Gilmore, Steese, and Minto series, all of which have developed under forest. They are well drained silt loams, medium to strongly acid, and their base saturation is high. They occur primarily on south-facing slopes where permafrost is generally absent.

Low-Humic Gley soils, principally the Ester, Saulich, and Goldstream series, occupy north-facing slopes. They are poorly drained and underlain by permafrost at 1 meter or less. Since much of the available land at the site faces the south or west, these soils are much less common than the forest soils.

All of these soils exhibit high erodibility and are, for the most part, highly susceptible to frost action. Consequently, steps would have to be taken to prevent excessive erosion on the one hand and to assure proper drainage around foundations to avoid frost heave on the other. Techniques to resolve both of these problems are routinely applied during construction in the Fairbanks area. Careful adherence to erosion control measures would reduce and perhaps eliminate any potential for siltation in the Little Salcha River.

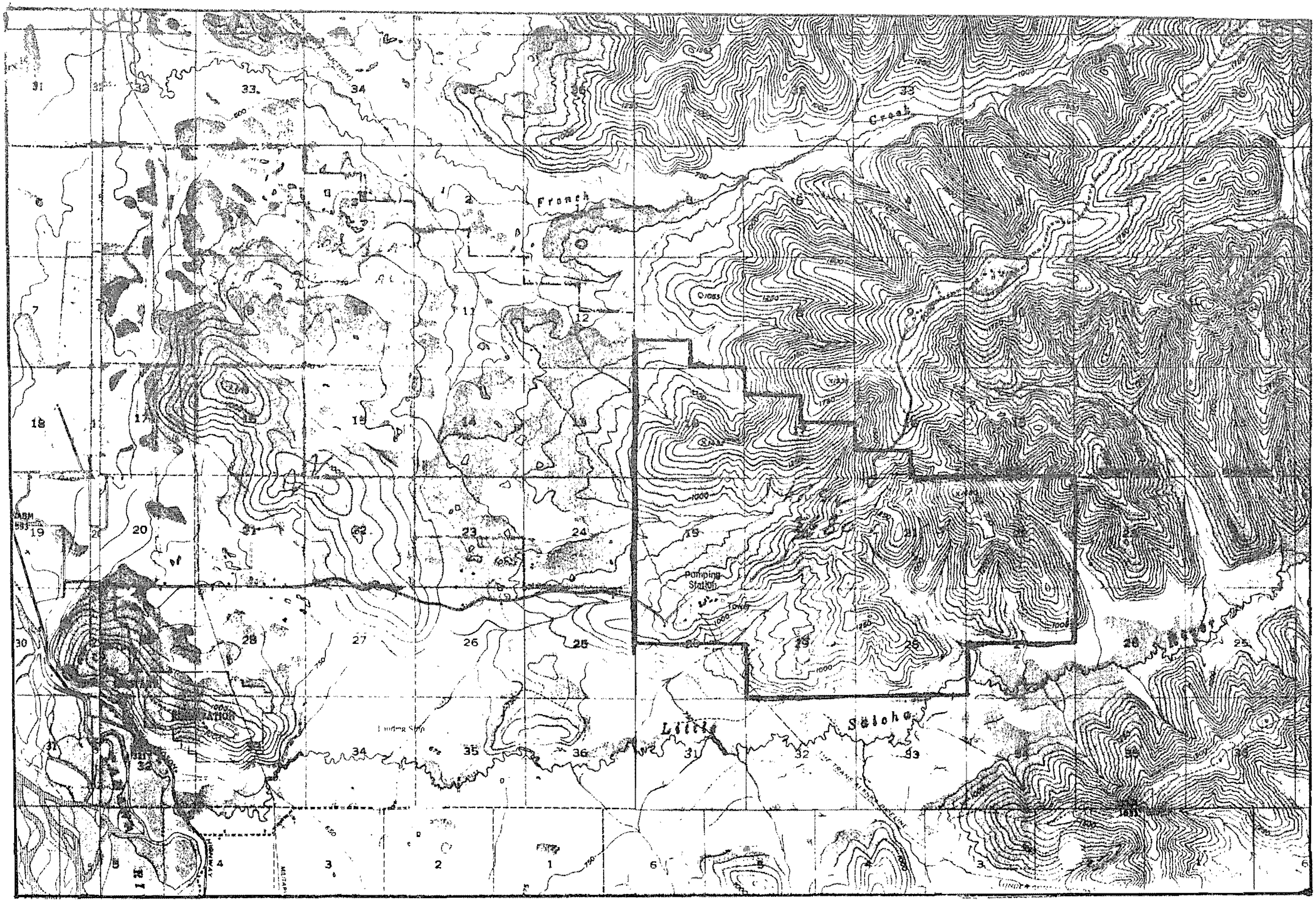

Figure 29. The Johnson Road Site

Only minor impact would be expected on geologic resources. In contrast to the gravel requirements at Prudhoe Bay and the Yukon River, only minor quantities of gravel would be required at the Johnson Road site; the necessary amounts are probably available within reasonable distance.

Hydrology

The site is within the Tanana River drainage basin approximately 21 miles southeast of the North Pole site. Here the Tanana River basin forms a wedge between the Chena and Salcha River drainage basins and encompasses the Little Salcha River. (All three rivers are tributaries of the Tanana River, entering from the north.) General characteristics of the Tanana River basin are discussed under the North Pole site.

The Little Salcha River is not regularly monitored by the USGS, and flow and quality data are not available. However, assuming the mean annual runoff in the Little Salcha drainage basin to be 1.0 cfsm and the drainage basin area to be approximately 67 square miles, the mean annual discharge of the river would be 2.1×10^9 cubic feet. A similar computation for the Put River suggests that the annual discharge volume of the two rivers is approximately comparable.

The water quality of the Little Salcha River is probably very good, with little transportation of suspended sediments.

Alluvial deposits in the Tanana basin have the highest potential for groundwater yields in Alaska, exceeding 1,000 gpm in the floodplains. However, upland deposits yield less than 100 gpm. Within the Yukon region, wells drilled near the headwaters of smaller streams contain calcium bicarbonate-type water of acceptable quality.

The Little Salcha River might be used for water supply for facilities at this site if sufficient water were available. The staff assumes that a water supply system similiar to that proposed for the Prudhoe Bay site would be required in this case. This would necessitate construction of water supply lines approximately 2 miles long and some provision to store required quantities of water during the winter freeze. An alternative would be to use the Tanana River as a water supply source. This would necessitate laying approximately 7 miles of water line and presumably would eliminate the need for a large reservoir.

Construction of the SGCF and appurtenances would cause local alterations of surface drainage patterns. Spills or leaks of petroleum products associated with construction which entered surface watercourses would adversely affect water quality. Insufficient precautions against erosion could cause siltation into the Little Salcha River. Because the facilities would probably be constructed in a permafrost-free area, significant permafrost-related hydrologic impact would not be anticipated. The need for gravel would be minimized, thus reducing the potential for altering active stream channels by extracting gravel. Construction of a reservoir, if required, should not cause significant hydrologic impact. With the possible exception of permafrost-related problems, the discussion of wastewater treatment facilities for the Yukon River site presented later in this EIS would apply to this site.

If the plant were powered by coal, several processes would generate liquid waste of varying quality. The major effluent would be from the ash handling area and the water used for quenching and transport. The flow rate of this effluent would depend on the quantity of ash contained in the coal. Runoff from the coal storage area would contain a variety of chemicals leached from the coal itself. The major constitutent--sulfuric acid--is generated when pyritic sulfur is oxidized by dissolved oxygen in the rain. In general, this runoff is combined with other waste effluents and sent to a recycling basin. The water could be reused within the plant.

Fugitive liquid emissions could arise from leaks around pumps, piping, and other process equipment. In addition, ponds and spills in and around the plant could allow liquid to migrate into the groundwater. Ash quench water or transport water could be effectively contained in the ash pond by lining it with plastic liners, clay liners, or other bulk materials such as asphalt or concrete. Leaks from process equipment could be controlled by sound maintenance or by collecting and recycling the effluent.

Air Quality

The general air quality statements for the Fairbanks area, presented in the discussion of the North Pole site, are equally relevant to the Johnson Road site, with the important exception of nonattainment for CO pollutants. This would not be a problem at the Johnson Road site. However, this site could use coal for its primary energy and basic process heat system. This would create definite air quality impact.

Coal combustion produces stack gas emissions containing a variety of elements and compounds, including SO_x, nitrogen oxides (NO_x), particulates (fly ash), trace elements, radionuclides, hydrocarbons, CO_2, and CO. The 1977 amendments to the Clean Air Act impose strict requirements on the amounts of particulates, SO_x, NO_x, CO, and nonmethane hydrocarbons (NMHC), that may be emitted by new facilities.1/ The EPA is currently investigating other emissions from direct coal-fired plants; standards for these facilities may be issued in the future. Emissions under investigation include benzene soluble organics (BSO), particulate polychclic organic matter (PPOM), benzo (a) pyrene (BaP), and polyhalogented bioshenyls. Expected emissions from the SGCF at Fairbanks appears in table 25. A wide variety of pollution control devices and techniques are available to reduce emissions to allowable limits. A short description of selected control methods is presented in appendix L.

In addition, coal combustion releases a number of trace elements into the environment. Research is presently being conducted to identify the toxicological and epidemiological appraisal of each of the elements.

Fugitive emissions from coal handling are similar to those from handling ash. Fugitive air emissions consist of gaseous and particulate pollutants which would be released in small quantities from the plant in general--e.g., when coal is dumped, transferred from belt to belt, or from storage--and not from specific uniform openings within the plant. Most fugitive emissions generated from handling fine, dry ash can be controlled by water sprays or by chemical sprays that form a coating which resists wind erosion. Other methods of controlling fugitive emissions include covering the site with a daily earth cover, revegetating the area, or using shrubs and other plants as windbreaks.

Air emissions from surface coal mining operations to produce the coal for the conditioning plant would originate from diesel-powered equipment and from wind erosion of the disturbed land. Since air emissions would be a function of the type of equipment, number of vehicles, and the type of fuel used, the potential regional and site-specific air quality impact cannot be assessed at this time.

1/ A PSD review by the EPA Region X office would be required before plant construction and operation began. The three pollutants that would be reviewed for potential air quality impact are NO_x, particulates, and SO_x.

TABLE 25

AIR EMISSIONS FROM A COAL-FIRED SGCF AT FAIRBANKS

	Uncontrolled[1/] (Tons/year)	NSPS[2/] (Tons/year)
Particulates	3.536×10^5	7.02×10^2
Gases		
SO_x	1.383×10^4	4.149×10^3
NO_x	2.34×10^4	1.404×10^4
HC	3.9×10^2	No standard
CO	1.3×10^3	No standard
Aldehydes	6.5	No standard
Organics[4/]		
BSO	73	No standard
PPOM	0.39	No standard
BaP	0.10	No standard

1/ Emission Factors for bituminous coal combustion of $5,344 \times 10^6$ Btu/hr from a single furnace. (EPA, "AP-42 Compliation of Air Pollutant Emission Factors," Research Triangle Park, N.C.)

2/ "New Stationary Source Performance Standards; Electric Utility Steam Generating Units for which Construction is Commenced after September 18, 1978." Effective date, June 11, 1979.

3/ The Pace Company Consultants and Engineers, Inc., "Emission Factors for Organics, Evaluation of Coal as an Energy Source," Houston, December 1979.

4/ The EPA has listed organics as hazardous pollutants. Emission factors for coal and supplemental wood burning utilities will be issued in 1980.

The extent to which coal transportation would affect air quality would depend primarily on the degree to which existing transportation facilities could be used. Transportation impact would also be affected by the efficiency of equipment and the number of trips made to the Johnson Road site. Air emissions from all modes of coal transportation would consist of wind-borne dust from the coal during transport and the rail diesel fuel combustion products. Windblown dust from open car tops would be substantially reduced if the coal were sprayed with oil before shipment.

Each transportation mode makes its own characteristic contribution to air quality degradation. Unit trains (70 to 100 cars per load) provide more efficient coal transporation and therefore contribute fewer air pollutants than do conventional trains. Mixed or conventional trains have almost twice as much wind loss and particulate emissions as unit trains because it usually takes them longer to travel a given distance since they must stop to load and unload other freight. A 2-percent wind loss is normally assumed for conventional trains, as opposed to a 1-percent loss for unit trains. Currently the Alaskan railroad is upgrading its existing track network to handle the tonnages required for unit train operation.

Noise Quality

It is not possible at this time to quantify the noise impacts that might occur from the construction and operation of an SGCF at the Johnson Road site for two reasons. First, the proposed facility would be "stick or skid" built rather than totally prefabricated at a site in the lower 48. This means that the facility presently designed could not be constructed at the site. A different design (steam/electric, cogeneration-chemical solvent process) would be required; this in turn would require different emission rates. Second, the plant layout and size of the construction site would be different from the Prudhoe Bay scheme and would include various coal support facilities.

The only present source of noise emissions at the proposed Johnson Road site is TAPS pumping station No. 8.

Terrestrial and Aquatic Communities

This site is within the influence of the Tanana-Salcha River valleys. The area is dominated by the lowland forest of evergreen and deciduous trees, with black spruce commonly forming extensive pure stands. Slow-growing stunted tamarack is associated with black spruce in wet lowlands. Rolling basins and hills in the lowlands support varied mixtures of white spruce, black spruce, paper birch, quaking aspen, and balsam poplar. Bogs and muskegs commonly occur on lower ground.

Undergrowth includes willows, dwarf birch, lingenberry, blueberry, rose, Labrador tea, crowberry, bearberry, cottongrass, ferns, horsetail, lichens, and sometimes a thick cover of sphagnum and other mosses.

The southwest interior valley of the Tanana River is among the best nesting habitat for aquatic birds in Alaska. However, the Arctic Environment Information Data Center has indicated that this alternative site has been indicated as an area of low density waterfowl habitat. The types of waterfowl that occur at the Yukon alternate site would be similar to those at the Johnson Road site. Additional populations of birds using this area include ptarmigans, ravens, hawks, woodland owls, spruce grouse, ruffed grouse, and songbirds.

Wolves and wolverines range throughout various habitats in this area and may occur anywhere from the main river channels to high mountain ridges in either winter or summer, wherever they can find adequate food. Moose may be seasonally distributed on the Little Salcha and Salcha Rivers. Other mammals that may be encountered in this general area include the black bear, brown grizzly bear, snowshoe hare, coyote, red fox, lynx, weasel, marta, and red and flying squirrels.

The Tanana River is a major spawning area for chinook salmon, which arrive in the Tanana in early July and spawn generally during August. Some areas of the Tanana also provide overwintering habitat for arctic grayling.

The Salcha River in this area is also a major chinook salmon producing area. Summer and fall run chum salmon as well as coho salmon spawn in this area. These runs occur from August to November.

The types of impacts that would occur to terrestrial communities at the Johnson Road site would be similar to those described for the Yukon River alternate site. The loss of 200 or more acres from construction of the SGCF at this site would reduce wildlife populations of local and regional significance by directly removing available habitats. Additional wildlife habitat would be lost if construction of approximately 16 km. of railroad spur were required. Additional noise-producing activities resulting from increased rail and/or road traffic bringing materials and workers to this site could affect the behavior of some of the more sensitive wildlife species in this area. For instance, construction and operation of the SGCF at the Johnson Road site might change behavior patterns of the moose that are seasonally distributed along the Little Salcha River.

Any erosion problems resulting from construction of the SGCF at this site could increase sedimentation and turbidity in the Little Salcha River. However, this impact would be temporary and should not create any long-term environmental degradation to fish populations in the river.

No threatened or endangered species are known to inhabit this alternate site.

Land Use and Solid Waste Disposal

The Johnson Road alternate site is in an undeveloped area within the North Star Borough. This area is currently zoned for unrestricted use, and the officials of the Fairbanks North Star Borough have indicated that no further action would be required to allow plant construction at this site.

The southwest portion of this site, which includes the TAPS right-of-way and pump station 8, would also include the proposed right-of-way for the ANGTS. The northern boundary of this tract is bordered by a designated military reservation area; Eielson Air Force Base is approximately 16 km. to the northwest. Richardson Highway passes within 10 km. to the west of this tract.

Presently, this tract includes mostly undeveloped forest areas providing good access for fishing, hunting, and recreation. Both the nearby Tanana and Salcha Rivers support intensive recreational fishing and hunting. Construction of the SGCF at this site would discourage some of this activity. If excess space were available at Eielson Air Force Base for private use, some temporary housing construction could be avoided. This would lessen some of the land use impact.

The construction of the SGCF at this site could encourage residential construction as permanent employees and their families seek to live closer to the SGCF. This could produce a gradual migration and expansion of residential communities southeast of Fairbanks and North Pole. Other industrial and service businesses might also be attracted to this area and, as a result, change the present land use character of the area.

The discussion on solid waste disposal for the North Pole site is equally applicable for this site, except for the possibility of burning coal here. Solid waste from the ash handling area must be disposed of in an environmentally acceptable manner. Dry ash from the ash hopper in the boiler could be combined with fly ash from the particulate control devices and sent to a landfill for disposal. Ash high in nitrogen content could be routed to a fertilizer plant for primary processing.

The prevalent method for disposing of fly ash is by wet sluicing from the fabric filters to onsite ash ponds. The water requirements for this operation range from 1,200 to 40,000 gallons per ton of ash. The pond could be lined with an impermeable substance (i.e., clay) to retard seepage. The ash would settle out and, in many cases, the effluent would be discharged directly into natural surface waters. However, depending on the quality of the water, this effluent could create environmental problems if discharged before pretreatment. Bottom ash may be combined with fly ash or disposed of separately. Where FGD is employed, ash is often mixed with scrubber sludge after it has been treated. After evaporation has occurred, these ash ponds are covered with soil or excavated and the material trucked to a sanitary landfill. Where feasible, strip or deep mines may be used to dispose of this material.

Scrubber sludge is the waste material generated by throwaway FGD methods. The quantity of sludge produced depends on the sulfur content of the fuel and the amount of coal burned. Sludge consists mainly of calcium carbonate, calcium sulfite, and calcium sulfate, with traces of calcium hydroxide. Some trace elements from the flue gas may also be present. The proportion of solids and water in the sludges can vary from 30 to 70 percent by weight, depending on the process used in dewatering this material. The sludges are thixotropic (i.e., become fluid when disturbed and set to a gel when allowed to stand); for this reason, they are often treated with a fixative before ultimate disposal to stabilize them, to give them long-term mechanical properties, and to improve their resistance to chemical leaching.

Socioeconomics

Construction of the SGCF at the Johnson Road site would result in socioeconomic impacts similar, for the most part, to the impact described for the North Pole site. The Johnson Road site is located in the Fairbanks North Star Borough approximately 40 km. southeast of North Pole and 65 km. southeast of Fairbanks. The only large facility near the site is Eielson Air Force Base, located 16 km. to the northwest. Except for the base, the area is very sparsely populated.

Construction workers at this site could not live in private housing, since there is not enough vacant housing available any closer than Fairbanks. Construction workers could possibly be billeted at Eielson Air Force Base; if the base could not be used, a workcamp would have to be built.

The permanent employees of the facility and their families would also be faced with a lack of nearby vacant housing. The employees would probably use all available housing in the North Pole area, and some employees would probably have to live, at least initially, in Fairbanks. Over time, it could be expected that the employees would increase the demand for new residential construction in North Pole and in the area along the Richardson Highway south of the city. This residential growth is likely to be fairly limited unless major new industrial development--e.g., a petrochemical plant using natural gas liquids which would be available if a SGCF at the Johnson Road site uses coal instead of the natural gas liquids--were to occur in the area as a result of the SGCF. Figure 30 identifies some potential products that could be produced from ethylene from natural gas liquids at a downstream petrochemical plant.

A SGCF in the Fairbanks area fueled by coal could produce 23.3 million barrels a year of propane, 12.9 million barrels a year of butane, and 39.7 million barrels a year of ethane. The Economic Development Division of the Greater Fairbanks Chamber of Commerce anticipates that a world-scale petrochemical plant could be built in the Fairbanks area using 11 million barrels of ethane a year as feedstock. There would be little demand for gas liquids in Alaska except as feedstock. Surplus butane and propane could either be transported to the lower 48 states or exported. The ethane not used in Alaska would probably have to be blended back into the pipeline gas, since ethane's lower Btu value makes it economically unfeasible to transport over long distances as a separate product.

Recreation and Aesthetics

The Richardson Highway provides convenient access for fishing, hunting, and recreation as it passes from the Fairbanks-North Pole area to the south.

Construction of the SGCF at the Johnson Road site could temporarily increase vehicular traffic along the Richardson Highway. This could discourage some people from fishing and hunting in the area because of the inconvenience of increased noise and traffic. However, following construction, any new access roads that might be built from Richardson Highway to the SGCF could attract additional people to the area for fishing and hunting.

As at the Yukon River site, clearing for the additional right-of-way required for the ANGTS and the construction of the SGCF on the Johnson Road tract would cause cumulative aesthetic impact to the area. This would continue to degrade any aesthetic appeal of the area for sport and recreation enthusiasts.

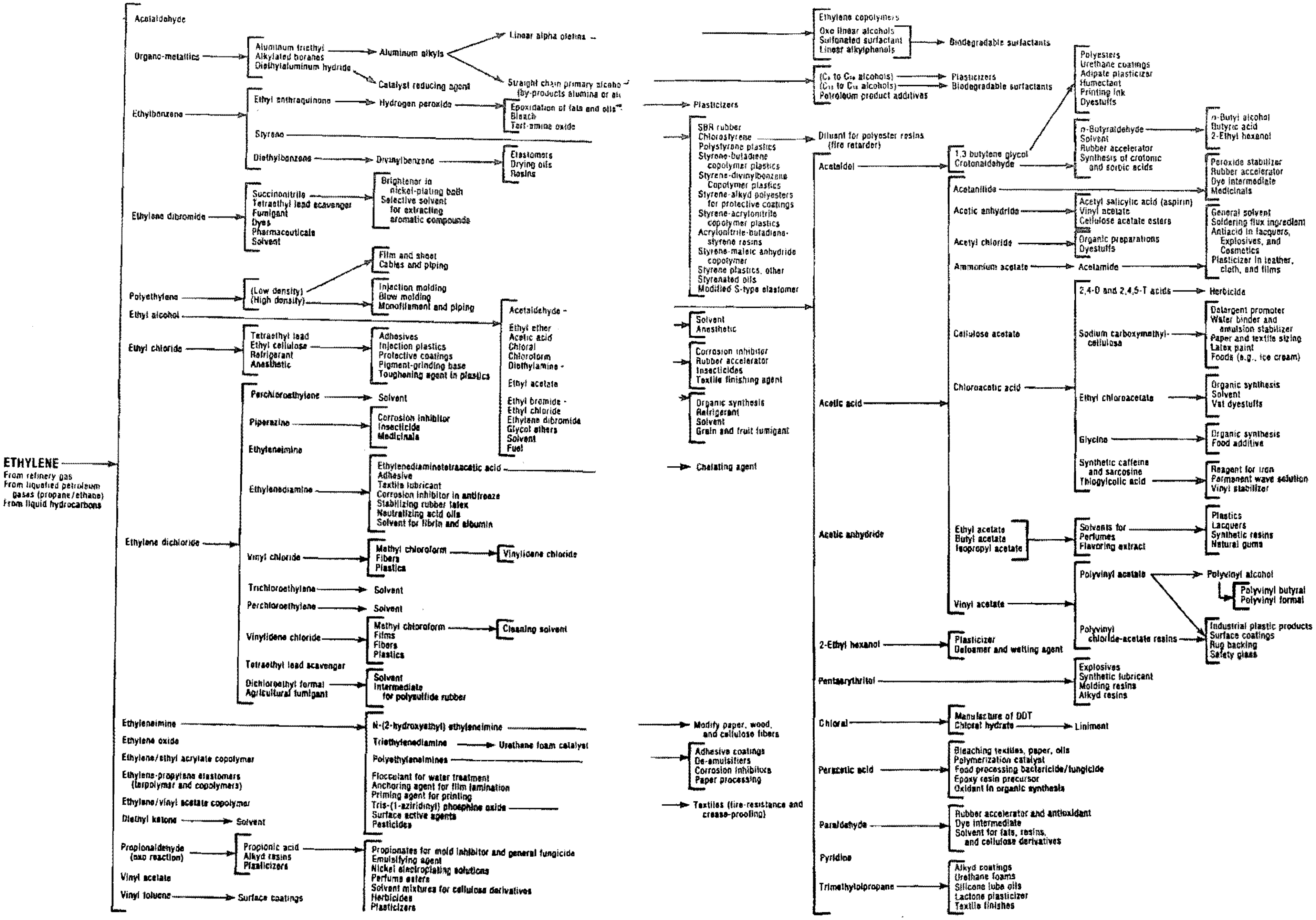

Figure 30
Potential Products from a Selective Petrochemical Plant

Cultural Resources

The southern part of the Johnson Road site is more likely to be archaeologically sensitive than the rest of the site because of it southern exposure, gentler relief, and the nearby Little Salcha River. Areas near the smaller creeks would also be more likely to have archaeological remains than the remainder of the site. A site identification study would be necessary before construction of the proposed facilities.

iii. Yukon River Crossing

The TAPS crossing of the Yukon River is located about 6 km. upstream from the Ray River, about 40 km. downstream from Stevens Village, and about 160 km. northwest of Fairbanks. The Yukon River flows westward in an incised channel past the TAPS crossing. Looking downstream, the left (south) bank is steep and high with no floodplains. The right (north) bank is a fairly level floodplain about 800 meters wide. The channel width ranges from about 600 meters at the TAPS crossing to 900 meters near the Ray River mouth. (See figure 31.) The land south of the Yukon TAPS crossing is generally high rolling hills, whereas the land on the north side of the river is somewhat flatter.

Since the river is a navigable stream, it is possible that barging construction modules to the site from the lower 48 would be economically feasible. If not, the river at or near the alternate site would have to be dredged to the proper depth. Because the modules would be quite large, it would be difficult if not impossible to move them over uneven ground. This means that only the relatively flat terrain to the north could be used as a potential site for the gas conditioning facility. However, this area is subject to flooding at undetermined intervals. This might be mitigated by locating the facility on slightly higher ground. The only other location for a AGCF at the Yukon River crossing would be the old TAPS construction camp located on the high rolling hills just north of the Yukon River. However, this site would also be inadequate because it would be difficult if not impossible to move the large modules over uneven terrain. If the gas conditioning facility could not use modular construction techniques, it would not be economically feasible at this site.

The Yukon River crossing would offer advantages similar to the Fairbanks alternative, except that barging modules to the Yukon site might be economically feasible; this would make the Yukon Crossing alternative consistent with the Prudhoe Bay cost estimates. The major disadvantage would be the required construction of at least a 1,680-psig dense-phase high-pressure pipeline to this site, as well as additional pipeline(s) to transport conditioned hydrocarbons from the site to a present or future customer in or in the general vicinity of Fairbanks.

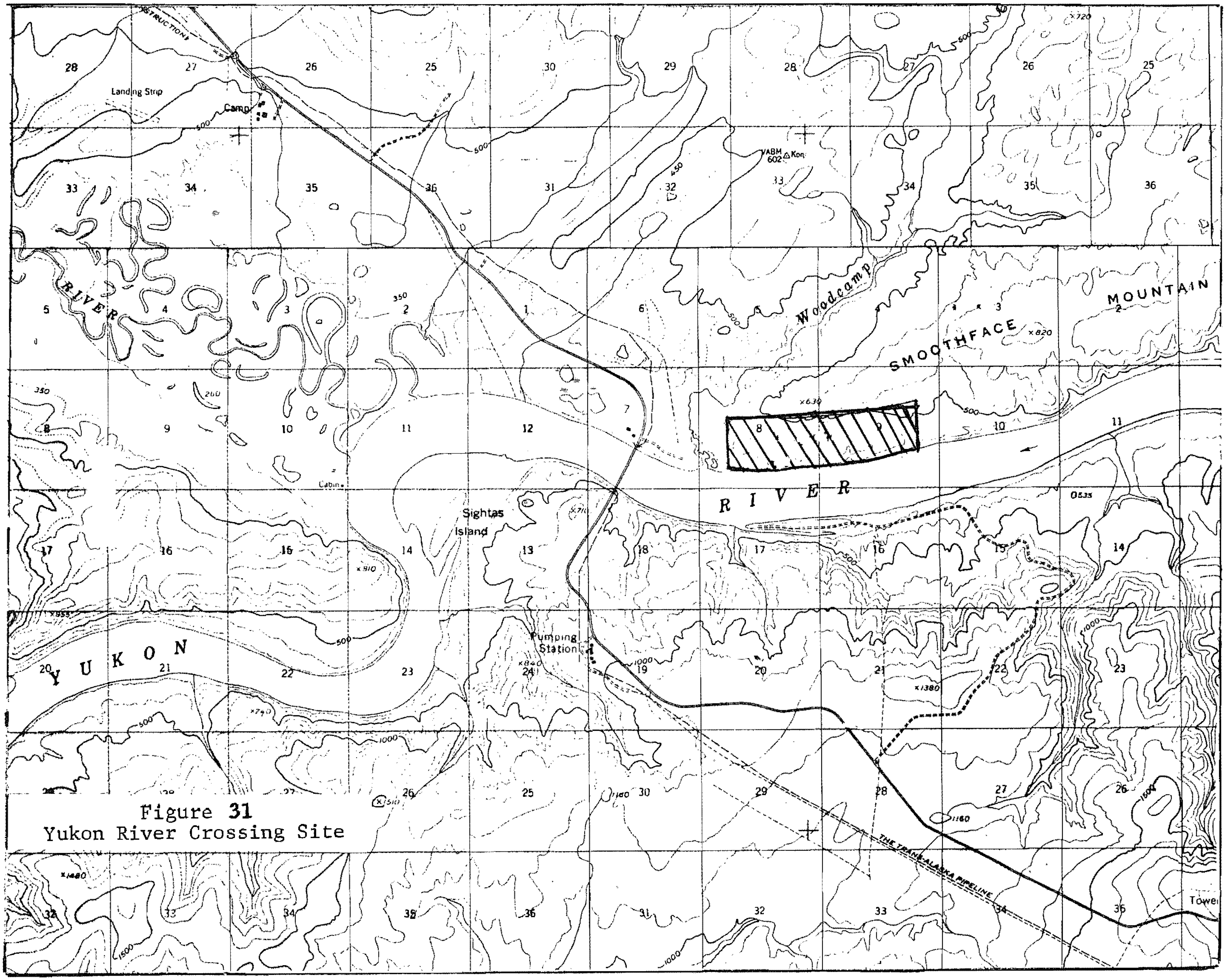

Figure 31
Yukon River Crossing Site

Climate

There are no climatological data available for this site. However, many comparisons can be drawn between the North Pole alternative site and the Yukon River alternative site.

- They are only 120 km. (75 miles) apart; the Yukon River site is northwest of the North Pole site.

- They both have a continental climate.

- Their topography is similar.

Based on these similarities, it can be assumed that the existing conditions at the Yukon River site are similar to those at the North Pole site.

It can also be assumed that the impacts projected for the North Pole site are valid for this site, with the exception of the ice fog phenomenon. Because this site is more remote than the North Pole site, there is little artificially induced ice fog. Therefore, the proposed facility would not add to an existing problem, nor would it impact any significant population.

Topography, Geology, and Soils

The Yukon River alternative site is on the north bank of the river and east of the TAPS crossing. This part of the river is within the Kokrine-Hodzana highlands section of the Intermontane Uplands and Lowlands. Although the highland is generally comprised of rounded ridges of 600 to 1,200 meters in elevation (mean sea level), near the river and, in particular, near this site, the elevation is generally below 600 meters.

The alternative site ranges between elevations of 180 meters and about 60 meters, the elevation of the river, with most of the site between 90 and 150 meters. Most of the surface of the site slopes to the south and west at about 56 meters per kilometer.

Extensive modification of the topography would be required for this site. Not only would permafrost conditions require foundation preparation similar to that proposed at Prudhoe Bay, but an unknown amount of cut and fill would be required in preparation for module erection. Finally, and probably most significantly, a haul road would have to be constructed between the dock and the site. Such a road would have to be a minimum of 12.2 meters wide with up to 3 meters of clearance on each side and would be approximately 600 meters long.

No water supply reservoir or waste water disposal lagoon are likely to be needed at this site.

Surficial deposits at the site are predominantly windblown silts (loess) which cover the bedrock to depths of up to 30 meters. The bedrock consists of dark mafic igneous rocks, with some related sediments ranging in age from 200 to 300 million years. Bedrock does not outcrop on the site.

This site is within the northern portion of the zone of discontinuous permafrost. The maximum depth to the base of permafrost is about 100 meters, with the top of the permafrost about 1 meter deep. The ice content of the permafrost is highly variable, with locally occurring ice wedges up to 10 meters thick.

The Yukon River site is within the highly seismic area of central Alaska. The largest recorded event in the area occurred in October 1968 and registered 7.1 on the Richter scale. Earthquakes of this size can be expected to occur every 80 years, with a maximum projected Modified Mercalli Intensity of about IX, which corresponds to considerable damage in specially designed structures.

Evidence of faulting was observed in excavations for the Yukon River bridge. No evidence of Holocene faulting was observed. The Kaltag fault, a major strike-slip feature, follows the Yukon River southwest of the site but has not been shown to extend in the direction of the site. It has been suggested that it is a continuation of the Tintina fault system, which is mapped southeast of the site; however, this does not necessarily alter its importance to the site. Of more concern is the Mintook Creek fault, which is associated with a high level of seismicity and which passes less than about 10 km. west of the site.

Substantial amounts of gravel, probably in excess of those required at Prudhoe Bay, would be needed at this site. The only readily available source is the Yukon River, and the quantity available is unknown. Impact on this resource would be appreciable.

Permafrost would be a major, and perhaps the most significant, onsite construction problem. In addition to probable loss of soil-bearing capacity after thawing, downhill flow--either solifluction (slow movement) or mudflows--would be a serious potential problem. Thermokarst pits would be another problem here. These pits form when ice masses within the soil melt, leaving cavities whose tops then cave in.

Another potential problem relating to permafrost at this site is icing. If construction measures to avoid permafrost degradation caused the permafrost table to rise, a localized block to groundwater flow could form within the active layer. This obstacle would force the water to flow to the surface and over the site in the summer, causing messy conditions at best and, at worst, aggravating slope stability problems. In the winter, this flow would continue until the active layer had completely frozen, so the site, or a portion of it, would be covered with a sheet of ice.

No detailed soil surveys are available for the area of this site; however, regional exploratory surveys have been conducted. Soils to be expected on this site are predominantly silt loams, which are moderately well to poorly drained. They may be covered with a peaty layer. Erosion potential of the unprotected mineral soil is moderate to severe. Permafrost is generally within 1 meter of the surface, and deeply buried ice masses may be present in some soils. The properties of these soils impose moderate to severe limitations for construction of low buildings. Detailed studies would be required to outline the areas suitable for construction. In general, the soils have a low bearing capacity and, where ice masses exist, may be susceptible to the formation of deep pits if these masses melt.

Soils within the area affected by construction would be destroyed. This area would be larger than at Prudhoe Bay or North Pole because the land surface is more irregular, requiring more cut and fill. In addition, construction of a haul road would affect about 2 acres. Agricultural use of these areas would be precluded during the life of the facilities and for an extended period thereafter because topsoil would have to be replaced after removal of the facilities.

Since the erosion potential of the site soil is moderate to severe and significant grading of the land would be required, there would be erosion on the site. Some siltation would occur in Woodcamp Creek. Additional sediment load in the Yukon River would be insignificant compared to its normal load.

Hydrology

The Yukon River lies entirely within the Yukon River Drainage Basin, bounded by the Brooks Range to the north and the Alaska Range to the south. The Yukon River site is within the Upper Yukon subregion. The Yukon River at Rampart (approximately 64 km. (40 miles) downstream of the site location) has a drainage area of 199,400 square miles. Average flow over a 12-year period of record (1956-1967) was 128,500 cfs.

The streams in the Upper Yukon subregion typically begin to freeze over by late September. Flow is diminished to practically nothing by April. At Rampart, the minimum discharge over a 12-year period was 9,000 cfs. In May, the ice in the rivers is broken up by the higher flows of runoff from snowmelt. The relatively short summers concentrate the major portion of the annual runoff into less than 5 months. On the larger streams, the peak flow for the year usually occurs within 1 or 2 weeks of the breakup. Throughout the rest of the summer, rains usually sustain a relatively high discharge. Because of underlying permafrost, infiltration losses are minimal, and severe flooding can occur from June through September. In August 1967, a maximum flow for the 1956-1957 period of 950,000 cfs was recorded at Rampart. This flood caused almost $100 million in damages in east-central Alaska, even though the area is very sparsely inhabited. Extensive severe flooding can also occur during spring breakup between May and early July. When spring flow begins, it overflows the massive ice that is still frozen to the channel bed. Ice jams increase the height of the floodwater.

At the site, mean annual runoff is approximately 0.5 cfsm. Mean annual low monthly runoff is approximately 0.1 cfsm. The chemical quality of surface water in the subregion is good. All of the waters are of the calcium bicarbonate type. During the summer, the Yukon transports a suspended sediment concentration ranging from 200 to 400 mg/1, 70 to 80 percent of which is finer than 0.062 millimeter.

At the Yukon River site, groundwater would be expected to be available along the riverbank, where the warming effect of the river influences the thickness of permafrost. Alluvium is thought to be unfrozen beneath the riverbed along the entire course of the Yukon River. However, thin permafrost occurs in the floodplain alluvium adjacent to the river and is thought to thicken farther away from the river.

The chemical quality of groundwater in the upper Yukon area varies widely. Shallow wells near the larger rivers, such as the one at Fort Yukon near the Yukon River, probably receive water mainly by infiltration from the river. Consequently, these well waters are relatively low in dissolved solids content. Because of low population, very little development of surface water or groundwater has taken place in the upper Yukon area.

The impact on water resources of operating the proposed SGCF at the Yukon River site would be expected to be minimal. Extensive experience has been gained in wastewater treatment practices for isolated, arctic construction camps during the TAPS project, and it is likely that this experience will be utilized during construction of the SGCF project. Thirty construction camps were built during the TAPS project, each with its own wastewater treatment system. Because the type of construction camp envisioned for the SGCF should be similar in most respects to those on the TAPS project, it should be possible to extrapolate the data and operational characteristics of those plants to the SGCF study. Three types of camp wastewater treatment systems were utilized: two types of physical-chemical (P/C) plants (units A & B) and biological, extended aeration, activated sludge plants. All three types were housed and operated indoors.

According to a 1978 summary study by Eggener and Tomlinson, the per capita wastewater generation rate was approximately 70 gallons per capita per day (gpcpd). (This rate generally was independent of the total camp population.) A composite sample of effluent wastewater, collected weekly for 17 months at 20 camps, contained 456 mg/1 BOD_5, 1,078 mg/1 chemical oxygen demand (COD), and 491 mg/1 suspended solids. Numerous startup and shakedown problems were encountered, but once these were alleviated, the average effluent characteristics (for the same period) were:

	BOD_5 (mg/1)	COD (mg/1)
Unit A	23.3	57.5
Unit B	33.4	58.8

The concentration of suspended solids was consistently 5 mg/1 or less. All wastewater sludge was incinerated at the site. Over the 2-year period, the percentage of BOD_5 removal improved steadily because of operational refinements, operator training, and other factors. For the last 6 months of the project, the removal was 95.6 and 97.5 percent for units A and B, respectively. If this shakedown improvement experience were to be used by the gas conditioning plant camp, it is possible that these levels could be achieved at the beginning of the project.

The major pertinent conclusion of this study was that "after the initial startup period, the biological, extended aeration plants performed at least as well as the P/C units in terms of BOD_5 removal." The concentrations of suspended effluent solids generally were higher for these plants than for the P/C units, but seldom exceeded 30 mg/1. Another conclusion that can be drawn is that the adverse conditions of the arctic environment do not present obstacles that cannot be overcome to allow an excellent degree of wastewater treatment. The proposed method of wastewater treatment of the SGCF construction camp will be a biological treatment plant that can be described as follows:

> The sewage treatment system will have the capability for treating high BOD domestic sewage at flow rates up to 150,000 gpd. The system will utilize the activated biofilter process followed by tertiary filtration and standby physical and chemical processing. The system will be conservatively designed and will meet all existing State and Federal regulations. Sludge will be processed by centrifuge, filter press, and incineration. The effluent will be chlorinated. A discharge pumping station is provided. (Parsons)

Although there is no arctic camp experience with this specific type of unit, these conclusions can be extended to imply that any type of well-established conventional treatment that can be operated indoors can be operated to achieve the same degree of treatment that it could in a less severe environment. The presence of a standby unit ensures that acceptable treatment would be performed in the event that an upset or breakdown would occur on the primary unit. At an estimated generation rate of 70 gpcpd, the 1,176-person construction camp could be expected to produce 82,000 gpd of wastewater. Thus, the proposed 150,000-gpd capacity plant will be capable of handling these wastewater volumes.

It is very likely that the wastewater disposal for the camp will be governed by the same stipulations that applied to most of the pipeline camps, and specifically by those presented in the waste disposal permit for the Five Mile Camp. These effluent limits, imposed by the Alaska Department of Environmental Conservation (DEC), are:

The treated liquid waste discharge for any month shall not be permitted to exceed the following limitations:

Final Effluent Characteristic	30 Consecutive Day Average	7 Consecutive Day Average	Daily Maximum
Biochemical Oxygen Demand	30 mg/1	45 mg/1	60 mg/1
Suspended Solids	30 mg/1	45 mg/1	60 mg/1
Oils and Greases	8 mg/1	10 mg/1	15 mg/1
Fecal Coliform Bacteria	200/100 ml	400/100 ml	800/100 ml

- Permittee shall operate and maintain the treatment plant to not exceed the limitations above or to remove not less than 85 percnet of the biochemical oxygen demand and suspended solids from the plant influent prior to discharge to the flow control management.

- The pH of the effluent shall not be less than 6.0 standard units nor greater than 9.0 standard units.

- The chlorine residual of the physical-chemical treatment plant effluent shall be greater than 1.0 mg/1 and less than 2.0 mg/1.

- There shall be no discharge of visible floating solids or visible foam.

- Sludge from treatment facilities will not be discharged to waters of the state.

- The method of disposal of sludge shall be incineration or other method approved by the Department.

Surface disposal of treated wastewater was allowable under the following conditions:

> During the period beginning on the effective date and lasting through the expiration date or termination date, the permittee may, after receipt of written permission from the Department, on a case-by-case basis, be authorized to transfer treated liquid waste to the land or surface waters of the State. Not less than 30 days prior to a planned disposal of treated liquid waste permittee shall submit an engineering plan, scaled by a professional civil engineer registered in the State of Alaska, for surface waste disposal, to include recent waste analyses, quantities, proposed locations, proposed frequency of discharge monitoring, and methods of waste disposal to minimize receiving environment impacts.

Based upon the experience of the TAPS project, the impacts of wastewater treatment and disposal on the environment in isolated areas such as the Yukon River site are limited. It is assumed that the treatment facilities will meet all state and Federal regulations and thus will impact the environment only as far as the regulatory agencies allow. Although no groundwater monitoring was performed during the TAPS project, there have been known instances where groundwater contamination has occurred from the use of percolation lagoons. Due to the lengthy period required for regrowth of vegetation in the arctic, these lagoons have been characterized as permanent solutions to temporary problems. Another possible impact of this type of disposal would be the thawing of the permafrost by the warm wastewater, with subsequent erosion problems. Again, experience from the TAPS project indicates that this theoretical concern has not been supported by any field observations. The DEC is now in the process of assimilating its monitoring information and is considering elimination of percolation lagoons as an unnecessary requirement in favor of land application or stream discharge. Thus, percolation lagoons may not be required at the SGCF construction camp. If discharge to a stream is allowed for the treated wastewater, the Yukon River would be the likely receiving stream. The impact of 70,000 gpd (0.1 cfs) of highly treated wastewater on even the minimum flow of 9,000 cfs would be negligible.

Sufficient quantities of water suitable for domestic purposes would be available year-round.

Construction of the proposed facilities could potentially cause more significant impacts. Any spills or leaks of petroleum products associated with construction which entered surface water-courses would adversely affect water quality. Local alterations of surface drainage patterns which might occur at the Prudhoe Bay site from the proposed construction would also result here.

Although no information is currently available, it is anticipated that dredging within the Yukon River would be necessary to accommodate unloading module barges. Yukon River sediments in the vicinity of the Yukon River site are composed of silty sands and, as a consequence, dredging would result in significant turbidity levels.

Air Quality

There are no ambient air quality data available for the Yukon River/TAPS site. It is assumed, however, that the general air quality is good and that state and Federal air quality standards are currently not violated. There are only three sources of air pollutants located within a 48-km. (30-mile) radius of the proposed alternative site: the Five Mile Camp and pumping station associated with TAPS and the haul road. The emission characteristics of the Five Mile Camp are insignificant compared to the emission characteristics for the existing development at North Slope and are not expected to affect the air quality in the region significantly. The haul road is used infrequently and is not a significant source of air pollutants.

The impacts that might result from construction of the SGCF at the Yukon River alternative site would not differ significantly from the impacts predicted for the construction of the proposed facility at Prudhoe Bay. This expectation is based on several assumptions:

- The SELEXOL process would be used at this site.
- The modules would be transported to the site by barges.
- The module size will not differ from those proposed.

No significant differences are anticipated between the construction impacts associated with the Yukon River site and those associated with the Prudhoe Bay site. The same three operations required at the Prudhoe Bay site (i.e., gravel extraction and placement, module unloading, and support equipment, would be required at the Yukon River site. Therefore, the number, type, and use of vehicles would be similar for both sites. Furthermore, the time restrictions on the construction schedules for both sites are similar. Finally, the Five Mile Camp would be used as the construction base camp. Therefore, no new housing facilities would need to be built.

It is expected that the operational impacts of the SGCF at the Yukon River alternative site would not differ significantly from those for operation of the proposed facility at Prudhoe Bay, with the exception of ice fog. This expectation is based on the assumption that the SGCF to be constructed on the Yukon River alternate site would be the same as the facility built at Prudhoe Bay. The emissions from the significant sources (the gas turbines and the space and process heaters) would be the same for both sites. The features of the surrounding terrain would affect the dispersion characteristics of the gas turbines plumes only minimally and only under adverse meteorological conditions.

As mentioned previously, ice fog formation resulting from the operation of the SGCF would be a problem at this site. Both this alternative site and the Fairbanks alternative site are topographically and meteorologically prone to ice-fog episodes. The gas turbine units associated with the SGCF should not contribute significantly to the problem. The space and process heaters, with their poor dispersion characteristics, probably would be major contributors to any ice fog episodes that might occur. If this site receives serious consideration as the preferred site, an in-depth study should be undertaken to more adequately determine the potential impacts.

Noise Quality

Ambient noise levels have not been monitored at the Yukon River alternative site, but they are estimated to be about 30 dB(A). This estimate is based on the general characteristics of the area, which is completely rural. The haul road, TAPS, and the Five Mile Camp are the only areas of human activity within a 16-km. (10-mile) radius of the site.

If the SGCF built on this site were an exact replica of the facility proposed for the Prudhoe Bay site, the noise impacts that would result from construction would not differ significantly from construction impacts at the Prudhoe Bay site. The noise level generated by construction is estimated to be 98 dB(A) at 15 meters from the construction site. It also is estimated that this noise will be audible at a distance of 3 km.

The noise levels generated during construction would have no impact on human populations in the vicinity because there are no residents in the area.

Noise impacts that would result from the operation of the facility on this site would not differ significantly from those at the Prudhoe Bay site. The noise level associated with the operation of the facility is expected to be 63 dB(A) at 0.8 km., an increase of 6 dB(A) above the existing noise level.

There are no humans living in the area, and thus no residents would be affected by the noise levels associated with operation of the proposed facility.

Terrestrial and Aquatic Communities

The alternate site would be located in an area described as an upland spruce-hardwood forest. These forests consist of tall to moderately tall closed forests of white and black spruce, paper birch, aspen, and balsam poplar. White spruce with scattered birch or aspen is commonly found on moderate south-facing slopes, while black spruce is found on northern exposures and poorly drained flat areas. The understory within the upland spruce-hardwood forest consists of spongy moss and low brush on the cool moist slopes, grasses on dry slopes, and willow and alder with dwarf birch in the high open forests near the timberline.

Some of the lowest relief terrain in this area along the Yukon River may be characteristic of a floodplain thicket which forms on newly exposed alluvial deposits that are periodically flooded. The main dominant shrub types include willows and occasionally alders, with a number of lower shrubs under the canopy.

Numerous species of birds are found along the Yukon River in this area, but waterfowl--ducks and geese--are the most conspicuous. Ducks include the American wigeon, lesser scaup, pintail, green-winged teal, white-winged scoters, northern shovelers, and canvasbacks. Geese include Canadian geese, white-fronted geese, and trumpeter swans. Additional waterfowl include lesser sandhill cranes, Arctic loons, and horned and red-necked grebes. Seabirds also occurring on the flats include herring, mew, Bonaparte's gulls, Arctic terns, and long-tailed jaegers; shorebirds such as golden plovers and spotted sandpipers are also found in this area.

Twenty species of raptors occur in the Yukon Basin, and 18 are known or suspected to breed there. Bald eagles nest in small numbers along or near the Yukon River in the lowlands, while a few golden eagles may nest on ledges. Other raptors found in this area include ospreys, goshawks, red-tailed hawks, and great-horned owls, and America's largest falcon, the gyr falcon. The peregrine falcon, an endangered species, may be found along the Yukon, nesting on bluff faces. The birds may use a nest site repeatedly, though it is common for a pair to utilize several sites.

Muskrats, mink, and river otters occur throughout the region. Beavers may be found wherever there are slow-flowing or still waters and sufficient food. Moose, frequently seen throughout the region, spend much of their time in lakes, feeding on tuberous lily roots in relative freedom from fly and mosquito attacks.

The most widely distributed fish in the Yukon River basin are several species of whitefish, Arctic grayling, slimy sculpin, burbot, Arctic lamprey, and three species of salmon--chum, king, and silver. Inconnu, which are widespread in the Yukon River drainage, are known to spawn in the Yukon River in this area. A small commercial fishery for chum and king salmon exists in the mainstem of the Yukon River. Minor subsistence fisheries also exist for whitefish, inconnu, northern pike, and burbot. The Ray River nearby is a major spawning area for summer and fall run chum salmon.

The noise levels generated during the construction and operation of an SGCF at this site would have some impact on the wildlife populations residing in the vicinity, especially the more sensitive species. It is anticipated that these sensitive species will migrate from the affected area, possibly resulting in a loss of some of these individuals.

A potential of approximately 200 acres of brush and forest would be destroyed by constructing the SGCF at the Yukon River alternate site. Additional but unknown acreage would be disturbed to construct connecting roads and dock facilities. Areas of floodplain thicket that are cleared might be replaced by plant species better adapted to drier soils. Clearing large numbers of trees along the Yukon might result in soil erosion and increased runoff and sediment problems in the Yukon River.

The construction, operation, and maintenance of the Yukon alternative SGCF would reduce wildlife populations of local and regional significance by directly or indirectly destroying their habitats. The reduction would be caused by direct and indirect harassment during critical periods of an animal's life cycle and/or destruction of wildlife because of the introduction of pollutants to the ecosystem and the inability of certain species to adapt to human presence.

Bird populations in the Yukon River region would probably suffer the most significant impact of any wildlife species in the area. Potential conflicts between construction and operations of the SGCF at the Yukon site and bird populations could occur from disturbance, habitat destruction, pollution, and direct mortality. Although the Yukon River alternative site is downriver from the comparatively more productive Yukon Flats, construction and operation could increase stress and alter normal bird behavior patterns during critical phases such as spring migration, nesting, molting, or fall migration staging. Such disturbances could decrease reproductive success or cause the birds to desert traditional molting areas or nesting sites. The degree of impact of disturbance to a particular species is a function of the type and intensity of the disturbance, the time of year, the location, the mobility of the disturbance sound, the distribution pattern of the bird, and the species' sensitivity to disturbance.

There are significant numbers of raptors in the area. The major impact on these species would be from the destruction of traditional critical nesting areas, as well as potential reduction of food supplies.

The Yukon River at or near the SGCF site location would have to be navigable or dredged to the proper depth for barge transportation. Such dredging operations would modify or destroy aquatic habitats and result in a long-term loss of fish. This would be more damaging to most fish species than any short-term environmental degradation.

The primary impacts of SGCF construction and operation on fish would be adverse, arising from increases in suspended particles, reduction in dissolved oxygen, and introduction of pollutants. The effects of these impacts on fish populations would be similar to those described for the proposed Prudhoe Bay site and the alternate site at North Pole.

Land Use and Solid Waste Disposal

The Yukon River alternate site is in an uninhabited, undeveloped area. The site would be located on classified lands designated by the Bureau of Land Management for retention in Federal ownership as the Arctic Transportation and Utilities Corridor. It includes the northern part of TAPS and the proposed route for the ANGTS. This area is used intermittently for recreation, sport hunting and fishing, subsistence, seasonal residences, and resource exploration.

To the northeast of the site, the Yukon Flats area has been proposed as a National Wildlife Refuge to protect the high density wetland waterfowl habitats and adjoining upland wildlife habitats. The Rampart section of the Yukon River, which includes the Yukon River at the alternate site, is also recommended for potential scenic river designation pending clarification of land status in the area and after further study and classification of surrounding land or uses of the river have been completed.

There has been increasing interest in Alaska's interior forests and the possible development of a forest industry. Most of this potential commercial or subcommercial timber operation is projected for the upper sections of the Yukon River, in the general area of the Porcupine River. However, several small scattered sawmills are operating in the area and are producing, when in operation, about

5,000 board feet per day. Two proposed hydroelectric projects (Rampart and Porcupine) have been identified in the area, but there is currently no significant demand for the potential power, flood control, or water storage to be derived from such projects.

The Yukon River is presently navigable by shallow draft barge up to 4 months of the year over most of its length. Existing roads in the area consist of a road from Livengood to the Yukon River and thence along TAPS. However, air is the principal mode of transporation in the area, with the main service from Fairbanks. The TAPS Five Mile Camp airport, approximately 10 km. northwest of the alternate site, is a privately owned airport with a gravel runway.

Because of this area's designation as a utility corridor, the existing TAPS right-of-way and the proposed route of the ANGTS are also included in this region. However, construction of the SGCF at the Yukon River alternate site would have significant impacts on present land use.

These lands are now largely undisturbed wilderness used mostly as habitat for wildlife species which depend on extensive areas for their well-being. The wildlife, in turn, provide the base for the subsistence hunting and trapping economy unique to rural Alaska. Subsistence hunting and/or fishing opportunities would be reduced as a result of construction and operation of the SGCF at the Yukon River alternative site. If a part of the TAPS Five Mile Camp could be used for construction workers, some land use impacts would be lessened. However, construction of the SGCF along the Yukon River would probably influence the river's potential scenic river designation.

Alyeska Pipeline Service Company was issued a permit by the DEC to operate a solid waste disposal site (designated as MS 79-1) for Five Mile Camp. Pump Station No. 6, located south of the Yukon River, utilized this same solid waste disposal site. Although the Alyeska permit has expired, the disposal site is still open and operational. Should the Yukon River site be selected for this project, ample capacity is available. DEC officials describe operation of the site as acceptable and usually in conformance with the strict requirements included in the permit. The requirements on the operation of this site (which probably would apply if it were used during the SGCF project) were that all papers, cardboards, and putrescible solid wastes be incinerated before disposal. The only other wastes disposed of were scrap wood (generally disposed of simply by burning), nonsalvageable scrap metals, and foam insulation. Compacted cover was put over the cells weekly, and a final cover was put on when the cells became full.

It is likely that this same disposal site would be utilized by any future construction camps located in this area. The DEC encourages the use of a single site rather than scattered smaller ones. However, if it were not possible to use this site, another suitable site could easily be located. Groundwater depth and preference for already disturbed lands would be the major considerations in selecting a new site. Any new site would probably be required to comply with the same DEC permit stipulations.

With TAPS now complete, the impact of the existing solid waste disposal site on the existing environment is minimal. The DEC has estimated that the rate of generation of solid wastes from a pipeline construction camp would be 8 pounds/capita/day, which would be a total of 4 tons/day for a 1,000-worker camp. Although it is not possible to estimate the volume and weight reduction achieved by prior incineration because of the limited data available, the reduction would be quite large.

Socioeconomics

The nearest named inhabited place to the alternate site is Stevens Village. Stevens Village, located approximately 32 km. from the site, is representative of a Native subsistence community. In 1970, Stevens Village had a Native population of 72 out of a total population of 84 and was declared eligible for village land selection under the Alaska Native Land Claims Settlement Act in 1971.

The people of Stevens Village live primarily by subsistence hunting and fishing. The annual average subsistence harvest for the years 1969-1973 had an estimated gross weight of 88,370 pounds. Fish, principally salmon, grayling, whitefish, and pike, made up 83.3 percent of the total; mammals, principally black and grizzly bear, muskrat, and hares, 13.9 percent; birds, principally ducks, 1.1 percent; berries, 1.1 percent; and garden produce, 0.6 percent.

In the 1970 census, 19 of the 24 villagers (79 percent) in the local employment survey were listed as unemployed on a cash-economy basis.

Construction of the SGCF at the alternative Yukon River site would result in impact to local Native communities. Construction would bring permanent facilities and concentrate human activities in areas that have been valuable for subsistence uses in the past. Annual subsistence harvests by nearby Native villages would be affected if construction and operation of the SGCF caused impact to wildlife populations in the area that are used for subsistence needs.

Small villages such as Stevens Village would not be able to provide housing, public services, or other amenities required for workers involved in construction, operation, and maintenance. Housing for both temporary construction workers and permanent SGCF employees may be provided by construction of a new work camp or possible utilization of the TAPS Work Camp 5. Most of the trade and service necessities required by workers would probably be provided by the Fairbanks area, the major distribution center for this northern area of Alaska. Only a few residents of the isolated villages in the area would probably be employed in either construction or operation of the proposed facilities at the Yukon River alternate site.

As with any development, there would be potential for significant changes in the existing way of life for the local communities. Any changes in lifestyle would likely be long-lasting. The changes affecting the Native residents in the Yukon River area would be similar to those described for the Native residents at the proposed Prudhoe Bay site.

Revenues to the state and local governments would increase as a result of construction of the SGCF at the Yukon River alternative. However, these increased returns would be accompanied by increased costs for services as more people move into remote and uninhabited regions of Alaska. It is not known whether Native communities in the area would forego economic development to retain cultural and social values.

Recreation and Aesthetics

Alaska has a diversity of landscapes, from broad low wetlands to high mountains and lake-dotted coastal plains to rugged, rain-drenched coastlines. The Yukon River, which traverses many of these types of landscapes, has remained largely unaltered from its natural state. It provides recreation, primarily boating and fishing in the summer and early fall. Swimming is not a major activity. During winter, the frozen Yukon provides a thoroughfare for recreational travel by foot, dogsled, or snowmobiles. Travel is severely curtailed during spring and fall when ice on the Yukon is unsafe and snow is insufficient or soft.

Scenic features along the Yukon River for boaters or hikers may include colorful bluffs, canyons, rock outcroppings, mountains, rapids, falls, or a variety of vegetation. Wildlife observation opportunities also occur along much of the Yukon drainage, and this river possesses prehistoric, geological, and paleontological values as well.

If construction of the SGCF at the Yukon River alternate site improved the access to this region, either by better airports, roads, or water navigability, then recreational use would increase. Because dredging would be required in certain areas of the river in order to offload the modules to the site, increased recreational boating and larger vessels would be expected to occur on the river.

Clearing brush and forest for the existing TAPS right-of-way, the additional right-of-way for the proposed ANGTS, and the construction of the SGCF at the Yukon River site would combine to significantly alter the natural environment and would consequently degrade the region's aesthetic values. The major aesthetic impact would be the sight of those facilities that catch the eye from roads, trails, or from boats on the river. Construction of the SGCF at this site would contribute to the continual deterioration of this area as a wilderness environment in interior Alaska.

Cultural Resources

There is a good probability that the Yukon River alternative site is an archaeologically sensitive location. Although no sites were found at the TAPS crossing, the river has been an important transportation corridor for prehistoric and historic peoples and a major caribou hunting area. The Iroquois Research Institute study also notes that confluences of streams, rivers, and bluffs on river basins--the conditions at this site--are zones of high archaeological potential. Most sites in the area are hunting lookouts and chipping stations. An intensive site survey would be necessary before construction at this site.

4. Alternate Pipeline Pressure Design Considerations

The options that presently exist for the segment of the Northwest Alaskan pipeline system north of Whitehorse are: (1) a 48-inch diameter, 1,260-psig system, (2) a 42-inch diameter, 1,680-psig system, (3) a 48-inch diameter, 1,440-psig system, and (4) a 42-inch diameter, 2,160-psig system. The AGPO must recommend to the Commission the maximum operating pressure for the Alaskan leg of the Northwest Alaskan pipeline system. After hearings conducted with applicants, the Canadian Government, and the State of Alaska and an internal study, the AGPO decided ("System Design Inquiry," February 1978) to recommend to the Commission a 1,260-psig, 48-inch diameter pipeline that can be upgraded to a 1,440-psig system if necessary. (See Transcript of Proceedings, Systems Design Inquiry, December 15, 1978.) On August 6, 1979, the Commission approved a 48-inch diameter pipeline for the Alaskan portion of the system and a 1,260-psig pressure.

The choice of pipeline must also take into consideration the possible modes of transporting the various hydrocarbons produced from the gas conditioning facility. These possibilities are:

(1) Transportation through TAPS or a new NGL pipeline;

(2) Transportation through the ANGTS;

(3) Use within field as fuel for production, processing, and conditioning facilities;

(4) Use as fuel for flow stations on TAPS and fuel for compressor stations on ANGTS;

(5) Transportation in a 1,680-psig, dense-phase pipeline;

(6) Reinjection; and

(7) Some combination of these procedures.

The possible methods of using hydrocarbons will be determined by the pressure selected for the Northwest Alaskan pipeline; however, the hydrocarbon dewpoint will dictate the amount of hydrocarbons that can be blended into the gas transmission line for transportation to a present or future customer. The staff used hydrocarbon dewpoint data supplied by Arco, Exxon, and SOHIO in its analysis of alternative systems design.

a) Arco's Position

Previously, Arco had stated that all of the gas could be transported at 2,160 psig without any prior conditioning, while at 1,680 psig, the pipeline could carry all of the propanes and lighter hydrocarbons and 50 to 98 percent of the butanes.1/ The remainder of the butanes and the heavier molecular weight hydrocarbons would have to be removed during the initial processing. At a pipeline pressure of 1,260 psig, all of the propanes and lighter hydrocarbons could be transported as a gas, along with 25 to 60 percent of the butanes. Additional quantities of butanes and heavier molecular weight hydrocarbons would be transported by TAPS. Carbon dioxide, which enhances hydrocarbon-carrying capacity, need not be removed prior to conditioning or pipeline transportation, because it would not corrode the pipeline.

1/ The range of butane results from the selection of a chemical or physical solvent CO_2 extraction process rather than a pipeline limitation.

In its comments to the DEIS, Arco maintains its reservations concerning a 1,680 psig pipeline design. Arco calculations and test data taken in December 1977 indicate that the dewpoint pressure of the gas produced at about 20° to 30°F. is approximately 1,480 psig and that the future combined sales gas would have a slightly lower but similar dewpoint. Operating a pipeline with this dewpoint without two-phase flow would require a minimum suction pressure at each compressor station no less than 1,500 psig. Such a pipeline would require a significant increase in the number of compressor stations. In addition, standby compressors would be required at each station to prevent pressure drop if a compressor failed. Arco summarizes that while it may be technically possible to operate a 1,680-psig pipeline without removing any heavy hydrocarbons from the Prudhoe Bay gas, it would not be economically feasible.

Arco's main concern is that additional cooling of the oil pipeline, required to maintain a constant vapor pressure within the pipeline so that additional quantities of butane can be transported, may lead to wax formations within the pipeline.

Arco has also stated that if a petrochemical plant were eventually built in the Fairbank's area, there would be sufficient volumes of ethane and propane available in a 1,260-psig pipeline for petrochemical plant feedstock.1/

b) SOHIO's Position

SOHIO claims that the total volume of gas may be transported at 1,680 psig, provided no CO_2 is removed. This would be compatible with the specifications of a dense-phase pipeline, since dewpoint curves indicate that the maximum dewpoint pressure of natural gas, NGL's, and CO_2 blended in the pipeline is approximately 1,360 psig. However, SOHIO states that upset conditions for the 1,680-psig pipeline would occur at 1,300 psig and -23°C. While the gas would still remain in a single phase at this pressure, there could be little variation in temperature before fallout occurred, damaging the pipeline system and causing system shutdown. A slight increase in temperature to -21°C. would cause some of the gas to condense, resulting in a two-phase flow inside the gas pipeline.

SOHIO also claims that approximately 62 to 75 percent of the butanes can be transported through a 1,260-psig gas pipeline. However, heavier molecular weight hydrocarbons would have to be moved through the oil pipeline.

1/ It has also been reported that a consortium led by Dow Chemical Company and Tesoro Alaskan Petroleum Company may use Prudhoe Bay gas liquids as feedstock for an ethylene plant to be located at a port city in south central Alaska. Another plant, to extract the liquids, would be built at Prudhoe Bay and connected to the southern facility by an 18-inch diameter pipeline. In June 1980, it was further reported that six other oil and chemical companies/consortiums submitted proposals for feasibility studies for establishing a petrochemical complex using NGL's from Prudhoe Bay to the Alaskan Natural Resources Department.

At oil production rates greater than 1.2 million barrels a day, some additional cooling of the oil pipeline is required. Because constructing and operating cooling facilities would cost less than increasing pipeline compression to 1,680 psig, transporting the butanes in the oil pipeline would be cost effective.

c) Exxon's Position

Exxon, like Arco, claims that the gas may be transported at a pressure of 2,160 psig without prior conditioning. However, it states that the 12 percent by volume of CO_2 presents some risk of corrosion. In an apparent contradiction, Exxon has stated that there may be some difficulty in obtaining financing for a lower pressure, 1,680-psig pipeline because design and construction of such a large-diameter, high-pressure pipeline would require new technology and present greater risks.

The company has stated that a 1,440-psig pipeline would be feasible but not economical. A 1,260-psig pipeline would be more economical at a low flow rate, while the 1,680-psig pipeline would be more economical at high flow rates (above 3.8 Bcfd). The 1,440-psig pipeline would be more economical only in the 3.6 to 3.8 Bcfd range.

In summary, while there has been disagreement over the need to remove the pentane plus heavier hydrocarbons at a pipeline pressure of 1,680 psig, there appears to be agreement that the issue is not one of need but of economical feasibility.

d) Additional Design Considerations

Present specifications dictate that the conditioned gas will contain 1 percent by volume CO_2. The common CO_2 volumetric standard for pipeline quality gas is approximately 3 percent. If a 3-percent standard is adopted, an additional 165 trillion Btu's of natural gas would be delivered to the ANGTS over the life of the project than if a 1-percent CO_2 standard is in effect. Increasing the CO_2 in the gas pipeline would serve two additional functions: the cost of conditioning the feed gas would be reduced substantially, and since CO_2 acts as a carrying agent for the NGL's, more NGL's could be blended into the pipeline.

This latter point, like the pipeline pressure question, is important if NGL's are used as feedstock for any future petrochemical plant in the Fairbanks area.1/ The staff has examined NGL availability

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1/ Again, Arco has stated that sufficient ethane and propane would be available from the pipeline to furnish feedstock to a petrochemical plant in the Fairbank's area. See also previous footnote.

for various CO_2 levels. In the first pair of cases, "A" (3-percent CO_2) and "C" (13-percent CO_2), the additional gas flow volume shown in table 26 results from the higher CO_2 concentrations in the conditioned pipeline gas. This flow scheme is equivalent to the total gas flow rate at plant outlet presented in the original Parsons report. In the second pair of cases, "B" (3-percent CO_2) and "D" (13-percent CO_2), the gas flow rate is maintained at the levels shown in table 26 to insure a constant flow of 2 Bcfd of conditioned gas to ANGTS. Each CO_2 level--3 percent and 13 percent--is studied with a total CO_2 gas flow rate and a constant 2 Bcfd gas flow volume.1/

The applicants have expressed concern about the additional safety hazards associated with a higher pressure system, which would increase the likelihood of damage to the oil pipeline if the gas pipeline ruptured. To minimize this danger, crack arresters would be required for the 1,680-psig and 1,440-psig systems, but they might not be required for the 1,260-psig system.

Tentative calculations indicate that if a 1,260-psig Alaskan pipeline merges with the contemplated 56-inch diameter, 1,080-psig Canadian pipeline below the permafrost region so that a "hot" pipeline operation is permissible, no hydrocarbon dewpoint problems should be encountered. If a 1,680-psig Alaskan pipeline were constructed and the heavier hydrocarbons (pentanes plus) not removed at Prudhoe Bay, difficulties would be encountered where the higher pressure operation joined the lower pressure operation and also at the highest crossing in the Canadian mountain range. These problems would probably necessitate the removal of the heavier hydrocarbons before the gas reached the Canadian segment.

e) Alternative Site Cost Consideration

The DEIS made no attempt to compare the relative costs of construction and operation of an SGCF at alternative sites, particularly in the Fairbanks area. The FEIS also will not make this comparison. Unsubstantiated projections from Arco allege that the costs of constructing an SGCF in the Fairbanks area would be 50 percent higher than construction costs at Prudhoe Bay. Comments on the DEIS from the Economic Development Division (EED) of the Greater Fairbanks Chamber of Commerce argue that economic considerations strongly favor locating the facility in the Fairbanks area. It believes that major cost savings would accrue for labor, transportation, energy, and materials. The EED concept of the SGCF

1/ All flow schemes were developed by the Parsons report of February 1979.

TABLE 26. NGL AVAILABILITY

Case	Gas Flow[2] (MMSCFD)	CO_2 (Vol.%)	C_2 (BPD)	C_3 (BPD)	i-C_4 (BPD)	N-C_4 (BPD)	Net Heating Valve (Btu/SCF)	H_2S Content (grains/100 SCF)	H_2O Dewpoint @ 1000 psig °F
Plant Inlet	2800	13%	108,844	63,947	10,568	24,793	unconditioned	< 1.0	unconditioned
Plant outlet with net propane blend 1260 psig									
Base Case	2026.7	1%	54,711	23,276	630	460	1048	< 1.0	<-35
Case A	2085.5	3%	54,922	37,775	1,134	1,104	1045	< 1.0	<-35
Case B	2038.6	3%	52,953	37,996	1,109	1,080	1046	< 1.0	<-35
Case C	2312.9	13%	83,387	58,742	3,773	5,952	986	< 1.0	<-35
Case D	2028.0	13%	72,873	52,305	3,308	5,065	987	< 1.0	<-35
Plant outlet with net butane blend 1260 psig									
Base Case	2061.6	1%	54,787	23,406	8,007	18,879	1087	< 1.0	<-35
Case A	2113.4	3%	55,023	37,864	7,059	15,675	1075		
Case B	2065.3	3%	52,903	38,087	6,899	15,162	1075	< 1.0	<-35
Case C	No butanes blended								
Case D	No butanes blended								
Pipeline Gas as conditioned 1260 psig 1% CO_2									
Base Case	1987.7	1%	53,629	1,050	155	303	1033	< 1.0	<-35
Case A	2031.7	3%	52,895	5,467	473	923	1007	< 1.0	<-35
Case B	1984.0	3%	51,230	525	466	753	1006	< 1.0	<-35
Case C	2270.6	13%	81,726	33,379	3,351	5,843	959	< 1.0	<-35
Case D	1989.1	13%	71,747	29,007	2,952	4,995	958	< 1.0	<-35
Unconditioned Prudhoe Bay Gas 1680 psig pipeline	2800	13%	108,844	63,947	10,357	24,297[1]	unconditioned	< 1.0	< -35

1/ The 1680 psig pipeline will carry approximately 98 percent of the butane fractions.

2/ Flow scheme calculated by the Ralph M. Parson's Company, February 1979.

differs in several ways from the plant proposed at Prudhoe Bay: (1) using a multitrain (an estimated eight trains with smaller process vessels) chemical solvent system versus a four train large-type process vessel physical solvent system, (2) using CO_2 in a product line as a potential feedstock to a low pressure ICI methanol plant, (3) using a coal-fired steam cogeneration electric power plant for primary energy and basic process heat, and (4) using available NGL's as potential feedstock for a petrochemical plant.

While the EED study argues in favor of a Fairbanks site, it is by no means a detailed engineering and economic feasibility study such as the Parson's study for a site at Prudhoe Bay. The staff agrees with some of the arguments made by the EED study, particularly that energy and transportation costs would be lower for the operation of an SGCF at a Fairbanks site; however, the study contains equally questionable assumptions without supporting data. Nevertheless, the salient point is that the EED study (and the Earth Resources Corporation study on which it is based) lack the specific engineering and economic detail necessary to prove which site would cost more.

While the EED study is limited in its usefulness, it does question the true cost of an SGCF at Fairbanks. Staff notes here that Arco has never provided any figures, even ones of limited use, to support its assertion that an SGCF at Fairbanks would cost 50 percent more than a facility at Prudhoe Bay. The staff will not resolve the cost argument, since detailed cost studies are well beyond the scope of this FEIS and are best done by potential developers of such projects. The documentation submitted to date does not prove which site would be more cost effective.

5. Process Alternatives

To deliver an acceptable sales gas to the pipeline, the SGCF must remove most of the carbon dioxide present and a portion of the heavier hydrocarbons. Consideration of the vapor pressures of the hydrocarbons involved shows that after the carbon dioxide is removed, the ethane and propane can be left in the gas without exceeding the $-10^{\circ}F$. at 1,100 psi hydrocarbon dewpoint specification, but at least a portion of the butanes and almost all of the pentanes-plus fractions must be removed to meet the specifications.

Removal of acidic gases, such as carbon dioxide and hydrogen sulfide, is often required in the treatment of natural gas, and a variety of processes have been developed for this purpose. These processes are based on contacting the raw gas with either a liquid that physically absorbs the gas to be removed or with an alkaline solution that chemically reacts with and absorbs the undesired gas. Both types of processes are used widely in gas treatment, and both could be applicable at the proposed SGCF.

a) Chemical Absorbent Processes

These processes involve the formation of weakly bound chemical reaction products between the carbon dioxide and an amine in water solution. The amines used are typically monoethanol amine, diethanol amine, diisopropyl amine, etc. The solution containing the weak carbon dioxide-amine compound is heated in a recovery vessel to drive off the carbon dioxide and to recover the amine, which is cooled and recirculated through the process. These amine processes have certain characteristics in common that bear on their performance:

- A relatively large amount of heat is required in the desorption step. Design calculations in Perry's Chemical Engineer's Handbook (1978) give a direct-fired heater requirement of 2,500 million Btu/hr. for a 2,600 million cfd high-load diethanol amine (DEA) process, with air-cooled heat exchangers to handle 1,625 million Btu/hr.

- The absorbing solutions require the presence of water, with potential problems of freezing and corrosion.

- A relatively pure carbon dioxide stream (over 95 percent) is produced.

- There is little absorption of hydrocarbons, and further treatment would be required to meet the hydrocarbon dewpoint specification.

- The required circulation of the absorbent solution is a function of the amount of acid gas to be removed, so the processing train becomes larger as the amount of carbon dioxide in the raw gas increases.

- Gas must be dehydrated because solutions are water based.

b) Physical Absorbent Processes

Carbon dioxide is quite soluble in a number of organic solvents. The solubility is a direct function of pressure, and physical absorbent processes depend on reducing the pressure to desorb the carbon dioxide. This method consumes less energy than desorption by increasing temperature, as must be done in the chemical absorption processes. These solvents also absorb considerable amounts of methane and other hydrocarbons, so the desorption is done by reducing the pressure in several differential flashes. The earlier stage flash gases, which contain most of the absorbed methane, are recycled to the beginning of the process. Because the solubility of the carbon dioxide is increased by high pressure and low temperature, the processes normally are operated under these conditions. The higher hydrocarbons are more soluble and, thus, are removed effectively. The higher hydrocarbons, such as the C_6 fraction, may be absorbed so effectively by some solvents that they are not readily removed by stripping, and a distillation process may be required.

There are a variety of solvents that have been used in various proprietary processes, as follows:

Process	Vendor	Solvent
Rectisol	Lotepro	Methanol and others
SELEXOL	Allied	Dimethyl ether of polyethylene glycol
Propylene Carbonate	Fluor	Propylene carbonate
Purisol	Lurgi	N-methyl-2-pyrrolidone
Sulfinol	Shell	Tetrahydrothiophene-1, 1-dioxide*

* The Sulfinol process usually includes an alkanolamine and thus is a combination chemical/physical solvent process.

Processes using these and other solvents have been proposed or used for gas treatment, all operating at temperatures near ambient or below and at pressures of from a few hundred to about 1,000 psi, with desorption by pressure release. Major differences between the processes relate to the different properties of the solvents and to the differences in the process arrangements to conserve energy by using expanding gases to drive turbines and provide the desorption step. The general similarities of the physical solvent processes are:

- Less heating and heat exchange surface are required because the desorption takes place by pressure release rather than by raising the temperature. This generally results in an energy saving.

- The absorbing solutions do not contain water, reducing corrosion and freezing problems.

- The removal of carbon dioxide usually is less complete, and the purity of the high-carbon dioxide stream is less than with the chemical solvent preocesses.

- The removal of heavier hydrocarbons is much larger than with the chemical processes.

- The concentration of carbon dioxide in the solvent is a function of the pressure, inverse temperature, and the concentration in the raw gas. Thus, the removal becomes more efficient the larger the concentration of carbon dioxide in the feed gas.

- By varying the pressures, temperatures, and flash steps, there is a considerable degree of flexibility available for choice of product streams and purities.

c) Process Alternatives Environmental Factors

Out of the several alternative processes initially studied by the team composed of sponsors of the original SGCF study, only two physical solvent processes (SELEXOL and Fluor's propylene carbonate) and one physical/chemical process (Sulfinol) were selected for further investigation. The discussion that follows thus concentrates on these three processes.

i. Waste Liquid Discharges

The feed gas delivered to the SGCF would be at less than the water dewpoint, so no water would be removed from the gas during the conditioning phase. Because of potential freezing problems, air-cooling would be used to dissipate heat, and no cooling water would be used for the physical solvent processes. Thus, there are no wastewater discharges from the absorber process during normal operation from any of the two solvent processes. The Sulfinol chemical process requires water, so there would necessarily be a waste water discharge to some locations.

During emergencies, water may be used to fight or reduce the danger of fire. All of the three processes operate at similar pressures. The two physical processes, SELEXOL and Fluor, have more rotary turbines and compressors, with attendant leak potential, whereas the physical/chemical process, Sulfinol, has more pieces of equipment and more potential corrosion problems, thus increasing its leak potential. The potential for major breaks or accidents would appear to be approximately similar for all three processes, so that the choice of process does not appear to be a major factor in the possibility of emergency waste liquid discharges.

ii. Waste Hydrocarbon Discharges

There is a significant difference between the physical and the physical/chemical processes in terms of waste hydrocarbon discharges. In the physical/chemical process, Sulfinol, the separation of CO_2 is quite good, resulting in a stream that is 98+ percent CO_2, which could be used as fuel for boilers, heaters, turbines, a part of the field fuel gas system, or injected back into the formation, if desired. In all instances that the waste gas were not used as a fuel or injected into the formation, it would be incinerated before being vented to the atmosphere. In the physical processes, the CO_2-rich streams are less pure--in the 90-percent range--and would be disposed of by using them as fuel in the process and at the base camp. However, the demand for fuel is expected to be less than the amount of this high-CO_2 stream at times, and the excess would have to be disposed of in an alternate way. Injection into the formation is planned for this disposal, since the hydrocarbon content is too high to permit discharge to the atmosphere without incineration.

iii. Solid Wastes

There are no process-dependent solid wastes from the three processes.

iv. Air Emissions

The air emissions from the operation of the three alternative processes differ widely. The preferred process, SELEXOL, has been analyzed in depth, and the results of this analysis can be reviewed in section C of this EIS. Therefore, the SELEXOL process has been used as a "base-case." From this analysis, it was determined that the emissions from the space and process heaters are the major area of concern. They are not only the major potential source of ice fog during the winter months, but they also are the major source of ground-level NO_2 concentrations. The predicted maximum ground-level concentration for NO_2 was the only concentration for a criteria pollutant that exceeded the Minimum Significant Levels.

The Fluor process requires approximately 35 percent more Btu's for space and process heat, and the Sulfinol process requires over 400 percent more Btu's for space and process heat than the SELEXOL process. Based on the assumption that an increase in Btu's yields a proportional increase in total emissions, the SELEXOL process would produce the lowest NO_2 ground-level concentrations.

The SELEXOL and Fluor processes produce a 90-percent CO_2 content fuel for use in the heaters and turbine. The Sulfinol process produces only a 26-percent CO_2 fuel for use in the heaters and turbines. Addition of CO_2 to the fuel results in a lower burning temperature, therefore lower NO_x emissions. The result of this situation is an additional increase of NO_2 generation from the Sulfinol process over and above the 400-percent increase due to higher Btu demands. Total CO_2 emissions attributable to the processes are:

SELEXOL	7.3 million tons/year
Fluor	6.4
Sulfinol	8.6

An increase of 1 ppm of ambient CO_2 concentration could be expected from an emission rate of 7.5 million tons/year of CO_2. Because the atmosphere normally contains over 300 ppm of CO_2, the environmental effects of any of the processes would be negligible.

v. Construction Impacts

All three processes require the same general types of equipment and plant design, and construction impacts will be qualitatively similar. One of the major factors leading to the selection of the SELEXOL process was the fact that it required fewer process trains and major equipment items; the Sulfinol process required the most. Thus, the plant area for the Sulfinol process would probably be the largest, and the SELEXOL plant would use the least area. Quantitative comparisons are not possible, since only the SELEXOL plant has been subjected to preliminary design.

vi. Butane Fraction Disposal

A considerable quantity of butanes enter the processes with the feed gases. It is planned to combine most of the butanes with the sales gas, up to the point permissible by the dewpoint specification. A typical distribution of the butanes is as follows:

Into process with feed gas	291,000 pounds/hour
To sales gas	160,000
To local and field fuels	35,000
To crude line with C_5's	9,000
Excess	87,000

If the excess is added to the crude, the total butanes added to the crude will be 96,000 pounds/hour, or about 11,000 bbl/day. This will be about 0.8 percent when added to a crude flow of 1.4 million bbl/day.

California regulations limit the true vapor pressure of crude to 11 psia unless vapor control measures are taken during storage and use. Calculations indicate that the amount of added butanes will raise the vapor pressure by less than 1.5 psi from the original 9 psia vapor pressure of the crude at a storage temperature of 100°F., so that the 11 psia maximum will not be exceeded. However, if the pipeline is flowing at less than the 1.4 million bbl/day rate used in these calculations, the vapor pressure increase will be higher and the 11 psia limit could be exceeded. Problems could also be caused in meeting the TAPS pressure specifications, and it might be necessary to chill the crude if the butanes were to be added. Alternatively, it may be possible to add a larger amount of the butanes to the sales gas than used in the example above and still meet the hydrocarbon dewpoint; this will reduce the excess butanes which must be blended into the crude or disposed of in some other way. The Parsons report indicates that it may be possible to add almost the entire butane fraction to the sales gas at a pipeline pressure of 1,440 psig. Eighty-eight percent of the butanes could be transported at a pipeline pressure of 1,260 psig.

If it is determined that adding the excess butanes to TAPS will cause problems, alternate disposal methods must be considered. With the SELEXOL process, the 87,000 pounds/hr of butanes, equivalent to about 1,700 million Btu/hr, could be used for heater fuel, replacing high-methane content gas which could increase sales gas delivery. This figure was derived from the product distribution using the SELEXOL process. Product distribution under the Sulfinol process would be significantly different. Incineration or reinjection of the excess butanes are alternate disposal techniques.

Another available alternative is to increase the sales gas CO_2 specification from 1 to 3 percent. This would decrease the hydrocarbon dewpoint and allow the incorporation of more butanes.

vii. Noise Impacts

The noise impacts from the process alternatives are not expected to vary significantly from those predicted for the preferred alternative. Refer to section C.5 for a detailed discussion of predicted impacts from the preferred SELEXOL alternative.

I. CONCLUSIONS AND RECOMMENDATIONS

The environmental staff finds that the proposed Prudhoe Bay site is environmentally acceptable. The staff finds the North Pole and Johnson Road alternative sites in the Fairbanks area to be acceptable as well. The alternative Yukon River site is less acceptable than either the proposed Prudhoe Bay site or the two alternative Fairbanks sites. However, the alternative sites would be technically feasible only if a decision were made to construct a pipeline capable of sustaining a higher maximum pressure than the presently authorized 1,260-psig gas pipeline.

There are several advantages in locating the SGCF at Prudhoe Bay. The site is close to the source of gas and adjacent to the Beaufort Sea, which would provide a convenient means for delivering construction materials to the site. The site has a foundation of adequate stability, few topographic irregularities, minimal slope, is not in a seismically active area, and would be subject to tsunamis, storm tides, or river flooding. The land in the general vicinity of the site has already undergone significant development by the petroleum industry, and the site would be included in an area which the North Slope Borough has proposed as a zone of preferred industrial development. Neither air emissions or noise would be expected to exceed acceptable levels, though air emissions would require further review. Climatological conditions at the Prudhoe Bay site are not ideal, but this is also true of the Yukon River and North Pole alternatives. A potentially significant disadvantage of the site is that pack ice could preclude the arrival of the construction barges during the brief summer season, hampering the construction schedule.

The potential for some adverse impact because of construction and operation of the proposed facilities at Prudhoe Bay does exist. Transportation of materials to construct docking and onshore facilities would increase barge traffic along the North Slope of Alaska and within the Prudhoe Bay area. Barge routes might be similar to the migratory route of the endangered bowhead and gray whales, and the endangered peregrine falcon in northern Alaska may use the Beaufort Sea coast. In its biological opinion, the NMFS concluded that the proposed facility would not adversely impact either gray or bowhead whales and is unlikely to jeopardize the continued existence of gray or bowhead whales or their habitat. The staff has concluded that no impact to the peregrine falcon is expected from the construction and operation of the SGCF at Prudhoe Bay. Potentially less significant impact would also occur at the proposed site because of permafrost degradation, gravel extraction, drainage alterations, water use, and wetlands (tundra) and topographical alterations.

The North Pole and Johnson Road alternative sites offer many of the same advantages as the Prudhoe Bay site. However, both sites are within the highly seismic area of central Alaska. The North Pole site is also adjacent to an EPA air quality nonattainment area for CO. Costly reduction of emissions produced by other facilities could be required before the SGCF could be placed in operation. In conjunction with the climatological conditions that cause the CO problems, ice fog in the North Pole area (and to a lesser extent at the Johnson Road site) is anticipated to be a greater problem than at the Yukon River or Prudhoe Bay sites. Finally, adverse socioeconomic impact could occur to all communities no matter where the SGCF would be built. Construction and operation of the conditioning facilities at North Pole or the Johnson Road site would mitigate the current downturn of the local economy.

Little or no significant adverse impact on aquatic communities, hydrology, or geology is anticipated at the North Pole and Johnson Road sites because of construction and operation. Little or no significant adverse impact on topography is anticipated at the North Pole site; however, the Johnson Road site would require significant earth moving. Impact to soils, terrestrial communities, recreation and aesthetics, and cultural resources should be relatively minor at the North Pole, Johnson Road, and Prudhoe Bay sites.

Cut and fill operations at the Yukon River alternative site would extensively modify the topography. The foundation stability of the site is poor, and the site is located in an area of high seismic activity. Construction at the site would cause significant adverse impact to the topography, geology, soils, hydrology, aquatic community, and, potentially, to archaeological resources. Additionally, while the site would be located on lands designated by the Bureau of Land Management for retention in Federal ownership as the Arctic Transportation and Utilities Corridor, the Rampart section of the Yukon River, which includes the Yukon River alternative site, may be recommended for scenic river designation. Construction of the SGCF along the Yukon River would probably influence the decision on this recommendation.

Although the environmental staff concludes that the environmental impact associated with the construction and operation of the SGCF at Prudhoe Bay as proposed would be acceptable, it recommends that the following procedures be implemented to further mitigate potential environmental impact from the proposal.

1. Because of the rate of unemployment and percentage of families with incomes below the poverty level in the area, the applicant should use local Alaskan and Native Alaskan workers as much as possible during construction and operation of the project, e.g., roving local union halls, hiring at individual Native villages. Particular emphasis shall be given to training local Alaskans and Native Alaskans for the 200 permanent operating positions proposed for the SGCF.

2. Existing module fabrication sites shall be used to the maximum possible extent.

3. Existing facilities at Prudhoe Bay shall be used to the maximum extent possible, including but not limited to waste water systems, incinerators, water supply systems, and living quarters.

4. The applicant shall conduct and submit to the staff a study analyzing the feasibility of using waste heat produced by gas turbine units. One such use to be studied is space heating.

5. All construction and facilities shall be scheduled and/ or designed to maintain free movement and safe passage of fish, birds, and mammals, both onshore and offshore. The adequacy of the design will be determined by the Alaska Department of Fish and Game (ADFG).

6. Construction and other operations associated with the proposal shall be conducted so as to avoid or minimize degradation of fish and wildlife breeding, staging, molting, nesting, spawning, overwintering, calving, and rearing areas designated by ADFG.

7. Water use and other activities which alter natural hydrologic conditions in a manner which is detrimental to overwintering, migration, spawning, survival, or habitat of fish, seabirds, or waterfowl are prohibited unless approved by the ADFG.

8. Transportation shall be scheduled and conducted to minimize disturbance of ground cover and to minimize adverse impact on fish and wildlife. Transportation corridors must be routed around biologically sensitive areas during sensitive periods.1/ The developer shall contact the ADFG for the identification of these areas and periods.

1/ Biologically sensitive areas in the Prudhoe Bay area have been identified as part of OCS development in the Beaufort Sea. The most sensitive biological areas in the Beaufort Sea lease area are Cross and Pole Islands, Stefanson Sound, and whale migration routes. Of these three, only whale migration routes would be potentially affected by construction of the SGCF at Prudhoe Bay. See section C.7 of the FEIS and appendix G for the results of a biological opinion resulting from section 7 consultation with the NMFS concerning the effects of this project on the endangered bowhead and gray whales.

9. Fixed-wing aircraft and helicopters shall avoid low-level flights over wildlife sensitive areas identified by the ADFG.

10. The developer of the SGCF at Prudhoe Bay should be cognizant of the Alaska Coastal Management Program's "Guidelines and Standards" and work toward seeking a state consistency determination for its proposed project.

11. The developer shall consult with the appropriate state authorities (i.e., both the State Historic Preservation Officer and the state archaeologist or equivalent, unless one defers judgment to the other) and follow their advice concerning the need for a cultural resource identification study for the proposed facilities. The developer shall follow the state authorities' recommendations on survey methods, personnel qualifications, administration of artifacts and records, dissemination of results, and other standards as necessary. Construction activity should avoid disturbing significant cultural resources where practical. If a survey identifies cultural properties that would be unavoidably impacted, the state authorities and the developer shall apply criteria for local and regional significance to them. Data recovery operations at significant impacted sites shall follow the recommendations of the state authorities and standards proposed by the National Park Service in Title 36, Code of Federal Regulations, Part 66 (Federal Register, Vol. 42, No. 19, pp. 5,374-5,383, January 28, 1977). Site identification studies shall conform to the guidelines in appendix B of proposed 36 CFR 66 and shall attempt to locate alternate routes to avoid impacting significant properties. The developer shall submit to the FERC staff reports prepared by the principal investigator or project archaeologist on the identification study and the data recovery program. These reports shall include the comments of the state authorities on the adequacy of the work performed.

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APPENDIX A

PROPERTIES OF OIL FORMATIONS

Oil reservoirs are complicated systems whose physical properties, fluid contents, and latent energies within the reservoir fluids dictate the degree of ease or difficulty which the producer will experience in tapping the hydrocarbons trapped below the surface of the ground.

A petroleum reservoir consists of a porous stratum of rock which is capped with an impervious layer of rock. The shape of the structure must be such that the oil (or gas) can accumulate in the porous zone. The cap rock prevents further upward migration of the contents. The most common type of reservoir is a dome-shaped structure or "anticline." In some instances, the dome may be almost hemispherical; in other cases, it may be narrow and elongated.

Porous rocks normally contain three fluids within their pores -- oil, gas, and water. Since the fluids have different densities, the force of gravity tends to cause the fluids to segregate, with any gas, being lightest, on top, oil and water on the bottom. Where the rock stratum is flat, any gas or oil present will flow to the top of the porous rock formation. When the porous formation is tilted, gravity will cause the oil or gas to move in an updip direction until they meet some restriction, such as a fold in the formation. When oil is trapped in an anticline or other type trap, water will commonly exist downdip on the flanks of the structure. If the porous formation is quite thick, water may also exist directly underneath the oil.

The nature of reservoir rock is extremely important, because the oil is stored in the small spaces or pores which separate the individual rock grains. The porosity of a rock is the volume of all the pores and openings expressed as a percentage of the total volume of reservoir rock. If the oil is to enter or leave the rock, there must be a free connection between one port and the next. The ability of the rock to allow passage of fluids through interstices depends on the size of the connecting channels which exist between one pore space and the next (permeability).

For oil to move through the pores of the reservoir rock and into the bottom of a well, the pressure under which the oil exists in the reservoir must be greater than the pressure at the bottom of the well. As long as this differential pressure can be maintained, the oil and its associated dissolved gas will continue to flow into the producing well.

The following paragraphs summarize natural production mechanisms.

1. Water drive: When a porous formation covers an area much larger than the area of the entrapped oil, the reduction in the reservoir pressure causes the water under pressure in the porous formation (called an aquifer) to flow into the oil reservoir. The amount of energy obtained from expansion of a barrel of water under pressure as the pressure is reduced is quite small. However, in a large aquifer, the amount of water may greatly exceed the amount of oil trapped within local areas of the aquifer. If the aquifer is large enough and has a high enough permeability, the energy provided by expansion of water in the aquifer may be sufficient to cause water to move into the oil reservoir to replace all oil withdrawn. Such an oil reservoir would be said to possess an "active water drive."

If the aquifer is smaller relative to the oil reservoir or if the permeability isn't high enough to allow water to flow up to the oil reservoir fast enough to replace the oil withdrawn, a field may have a "partial water drive." This provides little of the energy necessary to produce the oil or a large portion of it. A field with a partial water drive at one producing rate might have an active water drive at a lower rate.

Under some conditions, a water drive may be the most effective mechanism to recover oil. In order to utilize the energy from a water drive most effectively, it may be necessary to limit the rate of oil production so that the aquifer water can enter the vacated section of the oil-bearing zone as the oil is extracted. If the oil production rate exceeds the rate of water entering the reservoir, pressure will decline and consequently reduce the energy available for oil production.

2. Solution gas drive: Gas is soluble in oil. In most reservoirs, considerable gas is dissolved in the oil under pressure. As oil is produced and the pressure declines, gas is released from solution in the oil. The gas, having a high expansion ability, expands to replace the oil.

In the absence of a water drive that maintains the reservoir pressure use at a high level, a portion of the energy required to produce the oil will be provided by expansion of the released solution gas. In reservoirs with no water drive, essentially all the energy may be provided by expanding gas. Far more energy is available in the gas than is required to move all the oil to the well bore in most reservoirs. Unfortunately, gas is much more mobile than oil, and as its saturation builds, it flows to the well bore in increasing amounts and is produced with the oil. Thus, much of the energy needed to produce the oil is dissipated. Consequently, a solution gas drive is generally less efficient than other recovery mechanisms.

3. Gas cap drive: When more gas is present than can be dissolved in the oil at the reservoir pressure, the free gas will collect at the highest portion of the structure (trap) above the oil. As oil is withdrawn and the reservoir pressure declines, the gas in the gas cap will expand to displace the oil and maintain reservoir pressure. A gas cap drive may be extremely efficient, exceeding the potential recovery from water drive reservoirs, or extremely inefficient, approaching recovery from a solution gas drive reservoir. The problem is that the gas cap gas, because of its high mobility, tends to finger through the oil rather than displace it or overrun the oil along the top of the reservoir and come into the producing oil wells. Thus, it is often difficult to prevent producing the gas cap gas and dissipating its energy. In reservoirs with steep dips or thick oil columns, it is sometimes possible to minimize gas cap production, and oil recoveries may be quite high.

4. Gravity drainage or gravity segregation: The force of gravity may also help in the recovery of oil. Gravity represents an inexhaustable source of energy. The problem is that the force is weak. Consequently, unless the porous rock has a high permeability, allowing oil to flow with a low energy expenditure, gravity may provide only a small fraction of the energy required. However, in reservoirs with a necessary combination of steep formation dips, thick oil columns, and high permeability, the forces of gravity may be utilized to yeild extremely high recoveries. As an example, the force of gravity opposes those forces which tend to cause gas cap gas to finger through the oil or overrun the oil and cone into producing oil wells. In reservoirs with high permeabilities where pressure drops into producing well bores is low (or where producing rates are low), gravity may minimize dissipation of the gas cap gas and allow high oil recoveries.

Even in reservoirs with no gas cap, gravity may be important. If the permeability is high enough to produce low pressure gradients, gravity will cause much of the gas to flow to the top of the trap and form a secondary gas cap (a secondary gas cap is formed from solution gas after oil production starts). This allows the energy present in the solution gas to be conserved rather than dissipated, as in most solution gas drive reservoirs, and can allow high oil recoveries.

The Sadlerochit reservoir at Prudhoe Bay has a large primary gas cap, a thick oil column, a high permeability, and a large aquifer to the south and west. The large aquifer would suggest the possibility of an active water drive. However, the permeability of the aquifer decreases away from the reservoir, and as a consequence, most reservoir engineers and geologists expect only limited water influx into the reservoir.

The thick oil column and relatively high permeability suggest that gravity forces will be useful in oil recovery. The operators plan to allow the primary gas cap to expand to displace oil. Producing rates and oil withdrawal points will be controlled to minimize gas fingering. The long producing life of the field and the high permeability will allow the weak gravity forces to displace large volumes of oil into the producing wells. This will result in good gravity drainage recovery.

PLANT AND PROCESS ECONOMICS

It has been roughly estimated that increasing the level of carbon dioxide (CO_2) from 1 percent to 3 percent by volume would reduce the gas conditioning plant capital cost in 1978 dollars by $100 million and operating cost by $5 million per year. Lowering the CO_2 content in the gas stream would provide the following cost-reduction advantages:

1. The SELEXOL solvent stripping unit (solvent regenerator) along with associated equipment (expanders and compressors) could be eliminated. Solvent regeneration would be handled by successive differential pressure flash drums already present in final process design.

2. It would reduce the SELEXOL solvent circulation rate through the absorption column.

3. The deethanizer duty could possibly be performed by an enlarged gas fractionating unit, thus eliminating the cost of a deethanizer and associated equipment.

Taking greater advantage of the low ambient temperatures which exist for a substantial portion of the year could substantially reduce fuel costs. The refrigeration system has necessarily been designed to cope with an ambient temperature of 22°C, which is exceeded only a few hours of the year at Prudhoe Bay. However, about 75 percent of the time, the ambient temperature is below -1°C. Sales gas chilling loads could be eliminated by providing adequate ventilation to all heat exchangers during winter operations. Utilizing pumps rather than differential pressure to move the propane refrigerant through the system would allow all power recovery equipment (economizers) to be located at the lowest practical pressure levels. This would make maximum benefit of the horsepower and fuel saving potential of economizers. Additional fuel and NGL savings could be realized by heating fractionater reboilers with waste heat from turbine exhaust. It has been roughly estimated that this system would result in an operating cost savings of $8 million per year ($2.00/million Btu), as well as a potential capital cost savings, by eliminating reboiler furnaces and replacing them with heat recovery systems.

Under normal operating conditions, module space heat could be supplied from process waste heat. This would amount to some 300 million Btu per hour (under winter conditions) generated without utilizing NGL's or CO_2-enriched fuel gas.

PRUDHOE PROCESS DESCRIPTION

1. Inlet Separation and Field Fuel Gas Facilities

Feed gases originating from the gathering centers and flow stations would enter the proposed SGCF through the existing Central Compressor Plant (CCP) inlet separators. These separators serve as liquid slug catchers and, in conjunction with downstream filter separators, remove and recover any entrained liquids or particulates from the feed gases.

Feed gas for the existing field fuel gas unit is withdrawn downstream from the filter separators. The field fuel gas unit feed is compressed in one of the existing first-stage injection compressors to between 1,700 psig and 1,800 psig. In the field fuel gas unit, the gas is cooled to -40°C. at 850 psig by heat exchange and Joule-Thompson expansion. Cold vapor and condensed liquid are separated, and the net field fuel gas unit conditioned gas is warmed by heat exchange with feed gas and goes to the TAPS fuel line. Cold separator liquid also is warmed by heat exchange with feed gas and is vaporized partially at about 635 psig. The separator vapor returns to the main SGCF feed, and the net separator liquid joins the deethanizer feed stream.

2. NGL Extraction

The feed stream from the inlet separators would flow to the four parallel gas conditioning trains of the NGL extraction and CO_2 removal processes. Each train could condition 33 percent of the total flow, thus effectively providing one spare train. Within each of these trains, the feed gas would be combined with the SELEXOL stripper overhead gas and would be cooled to -34°C. by heat exchange and propane refrigeration. Condensed liquids would be separated from the cooled feed stream in the low-temperature separator and would be pumped through a feed gas heat exchanger where they would be heated to -9°C. A partial demethanization flash would occur in the deethanizer feed flash drum, and the remaining liquid would be heated to about 31°C by further exchange with feed gas and then would be fed to the deethanizer.

3. CO_2 Removal

The vapor from the low-temperature separator would be heated to about -7°C by exchange with feed gas and would be fed to the SELEXOL absorber along with deethanizer feed flash drum vapor, deethanizer overhead product gas, and SELEXOL recycle flash gas. In the absorber, the feed gas would be contacted countercurrently with lean SELEXOL solvent that would absorb the CO_2, a substantial portion of methane and ethane, most of the propane, and essentially all of the heavier hydrocarbons from the gas. Propane refrigeration cooling would be required in the circulating solvent system to maintain the design operating temperature. The conditioned absorber overhead gas would be warmed by heat exchange with feed gas then chilled and finally routed to the pipeline gas compressors.

4. Pipeline Gas Compression and Chilling

The conditioned gas streams from the four NGL extraction/ CO_2 removal trains would be combined prior to compression. The propane product amd most of the butane product from fractionation would be vaporized into the combined gas stream at this point. After compression and after-cooling in the CCP equipment, the conditioned gas stream would be chilled to -4°C for delivery to the gas pipeline.

5. CO_2

The SELEXOL solvent system is a simple recirculating loop. Solvent rich in CO_2 first flows from the absorber through a hydraulic power recovery turbine to a recycle flash drum. In the recycle flash drum, a large percentage of the methane coabsorbed with the CO_2 is vaporized and compressed back to the absorber feed. Rich SELEXOL from the recycle flash drum flows through another hydraulic turbine to an intermediate pressure (IP) flash drum. A large part of the coabsorbed ethane, as well as CO_2 vapors, are released in the intermediate pressure flash. Solvent from the intermediate pressure flash drums is routed to the low-pressure flash drum, where the bulk of the absorbed CO_2

and coabsorbed propane and heavier hydrocarbons are released. The low-pressure flash gases are compressed to a nominal 325 psig level and are routed to the local fuel fractionator. A stripper is required to reduce the CO_2 content of the hydrocarbon enriched solvent to the level required to condition gas to the 1-percent CO_2 level. Solvent from the low-pressure flash drum is pumped to the SELEXOL stripper, where it contacts a slipstream of treated gas from the absorber. The stripping gas from the absorber is depressurized through two expander stages for power generation and refrigeration recovery. Stripper overhead vapor is compressed back to feed gas pressure and recycled to the feed gas NGL extraction system for recovery of stripped hydrocarbons. Stripped lean solvent is pumped from the stripper back to the absorber, thus completing the circuit.

6. NGL Fractionation

The single-train fractionation facilities would consist of the local fuel fractionator, deethanizer, depropanizer, and debutanizer. All of these columns are reboiled by direct-fired heaters. Compressed SELEXOL low-pressure flash gas is fed to the local fuel fractionator to recover the bulk of the propane and the heavier hydrocarbons from the gas. The column would have a refrigerated overhead condenser and is similar to a deethanizer. Separate feed-overhead heat exchangers would be used for the local turbine fuel and for the heater fuel portions of the overhead product. Propane would be added to the turbine fuel portion of the overhead product for enrichment. This propane would be vaporized in the feed-overhead exchanger. Local fuel fractionator bottoms product would be fed to the depropanizer.

The deethanizer feed is made up of deethanizer feed flash liquids and NGL from the field fuel gas unit. The deethanizer operates at a nominal 450 psig with a propane-refrigerated condenser. Deethanizer overhead vapor product is compressed and can go either to field fuel or to the SELEXOL absorber feed. Deethanizer bottoms product is fed to the depropanizer along with local fuel fractionator bottoms.

The depropanizer produces a liquid propane overhead product stream. The low propane content depropanizer bottoms product could be blended directly into crude oil or could be fed to the debutanizer.

The debutanizer produces a liquid butane overhead product and a pentanes-plus bottoms product. The debutanizer overhead product can be almost totally injected into the pipeline gas without exceeding the pipeline gas hydrocarbon dewpoint specification or can be blended into the crude oil up to true vapor pressure limitations.

A system is provided to inject the liquid feed for any column in the fractionation facilities alternatively into the producing formation. Therefore, an upset or equipment failure in the unspared fractionation facilities would not impair either crude oil production or pipeline gas deliveries.

A small sidestream rectifier is utilized on the depropanizer to provide refrigerant-grade propane as makeup for the refrigeration system. This column draws a small ethane-free vapor feed from below the depropanizer feed tray and produces a very pure propane overhead product. The bottoms are pumped back to the depropanizer.

7. Fuel System

The SELEXOL intermediate-pressure flash gas is collected from the CO_2 removal trains and is compressed to a nominal 500 psig for use in the field fuel. Compressor discharge heat is used to vaporize propane. The propane is injected into this stream for heating value control. Field fuel requirements greater than those available from this flash gas stream are met by adding field fuel gas unit conditioned gas (in excess of TAPS requirements), deethanizer overhead vapor, and low temperature separator vapor, in that order. The combined field fuel gas has a relatively high hydrocarbon dewpoint. This gas is heated to 60°C. by exchange with the exhaust gas from the field fuel gas compressor turbine driver to prevent condensation in the insulated field fuel distribution system.

In situations where the field fuel requirement is relatively low, there could be an excess of SELEXOL intermediate-pressure flash gas. At such times, excess field fuel compressor discharge would be bled into the local turbine fuel system.

This, in turn, would create an excess of local fuel fractionator overhead vapor. During this operation, the excess CO_2-rich local fuel fractionator overhead could be compressed and reinjected into the producing formation. If the local fuel fractionator were shut down, the feed to this column would be used for local fuel, and the excess feed would be injected using both CO_2 compressors. Also, during periods of high local fuel demand, field fuel compressor discharge would be used to supplement local fuel fractionator overhead.

8. Plant Yields

In addition to the nominal 2 billion cubic feet per day of pipeline gas conditioned by the SGCF, there are a number of other streams that are separated incidental to the pipeline gas conditioning. These include the high CO_2 NGL. The flash gases would be utilized as fuel at the SGCF and for fuel requirements of the Prudhoe Bay complex. The NGL's which include separate ethane, propane, butane, and pentanes-plus streams, could be blended into the fuel streams (propane) to control heating value, the pipeline gas to the hydrocarbon dewpoint limitation (propane or butane), or into the crude (butane or pentanes-plus) as limited by the vapor pressure specification.

The design anticipates that there would be a significant variation in the fuel requirements at the SGCF between the extremes of summer and winter operation. The demand for fuel by the Prudhoe Bay complex would vary both as a function of season and time as well as oil production rates. The blending of butanes into either pipeline gas or crude is controlled by the pipeline hydrocarbon dewpoint limitation or by economics. These variations have been incorporated in the design. The schemes illustrated represent the maximum and minimum anticipated demand for fuel by the Prudhoe Bay industrial complex and assume no blending of butanes to the pipeline gas.

APPENDIX D

MODULAR CONSTRUCTION

A generic study was developed on the possible impacts associated with the prefabrication sites required for modular construction in the lower 48 states. The discussion that follows summarizes the study. Copies are available from the FERC or from EPA's regional office in Seattle.

Construction of the SGCF would use modular construction techniques. Preassembled modules that can be assembled easily at the North Slope site would be fabricated in the lower 48 and would be shipped to Alaska by oceangoing barges. Each contained equipment module would contain as complete a system as possible. The only limiting factor for module size is logistics, that is, the physical requirements for loading, transporting, off-loading, and emplacing the modules at the Prudhoe Bay site. The modular construction method would minimize the labor required on the North Slope and would take advantage of the higher productivity of the lower 48. Modules would also reduce potential delays that could result from adverse weather conditions at the Alaskan construction site.

Modular fabrication sites would probably be located on the west coast of the United States adjacent to major deep-draft waterways that could accommodate oceangoing barges. The west coast provides favorable weather conditions, adequate labor forces, and the shortest shipping distance to the North Slope. Four existing or recently operational modular fabrication sites have been identified at Seattle/Tacoma, Washington, and Alameda and Oakland, California. These sites have produced modules, almost exclusively for Alaskan use. The modules for the proposed SGCF would be similar in size and overall construction. Most of the identified sites are located in or near major metropolitan areas, and all are within easy access of large navigable waterways. The proximity of most sites to urban areas permits access to large labor pools, ensures the availability of a wide variety of skills, and minimizes the travel time of the work force.

The four individual modular fabrication projects investigated had land area requirements that ranged from 0.65 acre/module/year to 1.25 acres/module/year. As a general rule, 1 acre per module per year would be sufficient for most modular fabrication. Parsons estimates that the SGCF would require 0.95 acre/module/year. The estimate is based on construction of 200 modules during the first year and 52 modules during the second. The site (or sites) would require the following land area during the first year:

Category	Area (acres)
Erection	102
Closed warehouse	12
Yard storage	28
Field office and parking	6
Craft parking	42
Total	190

Although the same site or sites would be used during the second year of construction, only 78 acres (1.5 acres/module/year) would be required. In comparison to the past and present projects surveyed, such a site would be one of the largest sites on the west coast, if all activities were consolidated on a single 200-acre site. It is unlikely, however, that a suitable site of this size could be located.

Wherever possible, existing fabrication sites should be used for new projects unless the purchaser requires a different location. The use of existing sites eliminates the need to acquire or lease a new site and also limits the number of site improvements required for a particular project. Several of the existing sites investigated did not have all of the facilities indicated in the Parsons Report. As a result, some limited new construction may be necessary if an existing site(s) were used; only limited new construction would be required. The required construction materials should be available readily in any major metropolitan area.

Module construction does not require raw materials as typically defined, because most components of the module are processed material. Many of the components would be available only from particular suppliers that may be located beyond the local area. The amount of materials, components, and other supplies to be used for the Prudhoe Bay modules cannot be quantified because no specific engineering plans for the modules are available.

The labor requirements for this workload under either the phased start (1982/1983) or the full capacity start (1983) are indicated in table D-1. Under either alternative, a relatively large peak labor force would be required, consisting almost entirely of construction occupations. The requirements for certain specialized skills in module fabrication exceed the number of workers available in the metropolitan areas of the

TABLE D-1

ESTIMATED MAXIMUM LABOR FORCE REQUIREMENTS FOR THE MODULAR FABRICATION OF THE PRUDHOE BAY SGCF

Labor type	1983 Full Startup	1982-83 Phased Startup
Pipefitters	1,066	1,600
Ironworkers	467	700
Electricians	467	700
Laborers	200	300
Carpenters	200	300
Sheetmetal workers	200	300
Painters	200	300
Operating engineers	200	300
Total	3,000	4,500

Source: Parsons, 1978.

selected fabrication sites. However, only a portion of the requirements are for highly qualified master craftsmen, and many of the positions could be filled by new entrants to the labor force if adequate apprentice programs were available. Also, improved job opportunities in certain occupations would cause some workers to shift occupations, either permanently or for the duration of the shortage. In general, the wages of pipefitters, electricians, and iron workers would rise relative to the wages of other workers in the area and relative to wages elsewhere. This would induce trained workers to move into the area, new workers to become trained in those occupations, and existing workers in closely related fields to switch occupations. Employers probably would economize on highly skilled workers by substituting less skilled workers requiring more supervision.

The Parsons report and the survey of existing fabrication firms indicate that the use of multiple sites for the module fabrication facilities required for the Prudhoe Bay project is both advantageous and necessary. The foremost reason is that no single existing or potential module fabrication site would be available to construct all the modules required for the first-year sealift (183 for full startup; 243 for phased startup). In addition, no major metropolitan area with adequate port facilities is likely to have available the large labor force required for this fabrication operation. Consequently, multiple sites located in different cities would probably be required.

If existing fabrication sites could be utilized, the additional costs of multiple sites would be minimal compared to the benefits of more efficient operations. Existing sites would require only limited new facilities, permitting construction to be completed more quickly. In addition, multiple sites would disperse the limited environmental impact over two or more locations.

The four sites investigated indicate that the demographic characteristics of a location are not particularly important to that area's ability to support modular fabrication operations. Although the location must have a diversity of labor skills and the typical characteristics of a major metropolitan area, other criteria such as adequate port facilities, waterway access, land availability, and shipping distance are more important. As a result, it is likely that any major west coast port including San Diego, Los Angeles, Long Beach, or Vancouver, Canada, could provide a suitable location for modular fabrication. Several of these locations were identified in the initial survey of existing fabrication sites, and the other locations might have been identified had the survey included all existing west coast fabrication sites. The following impacts were observed at the sites studied:

- No process emissions were found at any module fabrication site, because no industrial process is performed onsite.

- Sanitary wastewater generated at the sites usually was in relatively small quantities and would require no special considerations.

- The only potentially significant amount of wastewater is from the hydrostatic pressure testing of the modules, which on occasion requires that certain substances such as glycol be mixed with the testing water. However, in all of the projects surveyed, this wastewater was collected and treated off-site.

- Module fabrication operations were relatively large producers of solid waste, but this waste normally included no toxic or hazardous materials.

- Potential air pollutant emissions from a module fabrication site would result from the operation of construction and loading equipment and commuter and service vehicles. However, even under "worst case" conditions, it is unlikely that the emissions at the site would affect air quality significantly.

- Noise is not likely to be a significant problem.

In general, module fabrication sites were found to be similar to typical industrial construction sites. The only exception is that when construction is completed at a modular fabrication site, the module is removed from the site and relocated. The construction is not water- or material-intensive, and there are no significant environmental impacts or process wastes. The entire operation can be characterized as a clean construction activity that is a labor-intensive stimulus to the local economy.

Based on the Parsons report, several conclusions on the module fabrication facilities required for the Prudhoe Bay SGCF were made. They include:

- The relatively large first-year size of the project (approximately 200 modules) would require at least two separate sites and possibly as many as three or four sites. Although the multiple sites would create additional costs for management and facilities, these costs would be at least partially offset by more efficient operations that will ensure that the modules would be ready for the first-year sealift.

- The multiple-site approach is likely to require fabrication sites in several different geographical locations. This would allow a larger and more diverse labor pool to be used and would place a smaller burden on metropolitan services and facilities.

- Although the environmental impacts from the modular fabrication operations are not anticipated to be significant, multiple sites would serve to disperse them, further reducing their importance.

- Because existing module fabrication sites are expected to be used for the Prudhoe Bay project, no new construction of module fabrication sites is likely. As a result, no new impacts on environmentally sensitive or critical areas (floodplains, wetlands, critical habitats) are anticipated.

- The final location(s) selected for fabrication would experience short-term economic gains, but no significant expansion of the economic base is expected.

The overall conclusion of this analysis is that the module fabrication operations required for the Prudhoe Bay SGCF would not result in any significant environmental problems, if existing prefabrication sites are utilized to the maximum extent possible.

APPENDIX E

AMBIENT GROUND-LEVEL CONCENTRATIONS FROM THE CONSTRUCTION OF THE SGCF AND ITS ANCILLARY FACILITIES

Construction of the SGCF and its ancillary facilities will produce airborne pollutants that could adversely affect air quality in the surrounding area. To quantify the impact of construction on air quality, the staff estimated emissions from equipment used during the major construction activities. The emissions then were evaluated collectively to determine their impact on the ambient pollutant concentrations. This appendix presents the methodologies and assumptions used in estimating total pollutant emissions from all construction activities and the resulting ground-level increases in pollutant concentrations. Pollutant emissions from all construction equipment are shown in table E-1.

TABLE E-1

ESTIMATED TOTAL POLLUTANT EMISSIONS (TONS/YEAR) FROM THE EQUIPMENT REQUIRED FOR ALL CONSTRUCTION

Construction Operation	Total Estimated Exhaust Emissions				
	Particulates	SO_2	CO	HC	NO_2
Gravel extraction, transportation, and placement operations	18.5	32.0	94.80	30.70	531.5
Module unloading, transportation, and placement	1.67	2.43	40.19	6.37	41.64
Other support functions	2.98	2.20	1,475	94.4	36.50
Total Emissions	22.65	36.63	1,609.99	131.47	1609.64

1. Gravel Extraction, Transportation, and Placement

To estimate the emissions (tons/year) from the construction equipment required for gravel extraction, transportation, and placement operations, it was necessary to know the type and amount of equipment that would be used, the emission rates of the equipment, and the amount of time that the equipment would be used. The equipment to be used and the emission rates are presented in table E-2. The amount of time that the equipment will be used was determined by estimating how much

TABLE E-2

TOTAL ESTIMATED EXHAUST EMISSIONS RATES (GRAMS/HR) FOR THE CONSTRUCTION EQUIPMENT REQUIRED FOR GRAVEL EXTRACTION, TRANSPORTATION, AND PLACEMENT 1/

Equipment	Quantity	Carbon Monoxide (CO)	Exhaust Hydrocarbons (HC)	Nitrogen Oxides (NO_x as NO_2)	Sulfur Oxides (SO_x as SO_2)	Particulates (TSP)
Motor grader	1	97.7	24.7	478	39.0	27.7
Track-laying tractors	2	175.0	50.1	665	62.3	50.7
Wheeled loaders	3	251.0	84.7	1,090	82.5	77.9
Off-highway trucks (bellydumps)	40	610.0	198.0	3,460	206.0	11.6

1/ Source for emission rates: EPA, 1977.
Source for equipment requirements: Parsons, 1978.

gravel could be moved per day, knowing that approximately 1.3 million cubic meters are needed. The following assumptions were made:

1) 1,278,315 cubic meters (M^3) of gravel are needed.

2) Each bellydump holds 15.3 cubic meters.

3) Each bellydump makes 15 trips per day from the gravel extraction site to the plant site.

4) All equipment is used 24 hours a day.

Determination of how many hours each piece of equipment will operate to move 1,278,315 M^3 of gravel:

15.3 M^3/trip x 15 trips/day

= 229 M^3/day for each bellydump

x 40 belly dumps

= 9,180 M^3/day

1,278,315 M^3/9,180 M^3/day

= 140 days (i.e. approximately 140 days (around the the clock) to provide the gravel needed for pads and access roads.)

140 days x 24 hrs/day = 3,360 hours (i.e., each piece of equipment is used 3,360 hours).

Determination of total emissions:

g/hr x 3,360 hours x 2.205×10^{-3} lbs/g x 1 ton/2000 lbs

= tons/year x no. of each type of equipment = total emissions (tons/year)

Sample calculation:

- motor grader -

Determination of carbon monoxide emissions in tons per year, given an emission rate of 97.7 g/hr and assumptions 1 through 4:

$$= 97.7 \text{ g/hr} \times 3360 \text{ hours/year} \times 2.205 \times 10^{-3} \text{ lbs/g}$$

$$\times 1 \text{ ton/2000 lbs} = 3.62 \times 10^{-1} \text{ tons/year}$$

The results of this analysis are presented in table E-3.

TABLE E-3

ESTIMATED POLLUTANT EMISSIONS (TONS/YEAR) FOR CONSTRUCTION EQUIPMENT REQUIRED FOR GRAVEL EXTRACTION, TRANSPORTATION, AND PLACEMENT OPERATIONS

Equipment	Quantity	Total Estimated Exhaust Emissions				
		Particulates	SO_2	CO	HC	NO_2
Motor grader	1	0.103	0.144	0.362	0.091	1.77
Track-laying tractor	2	0.376	0.462	1.29	0.371	4.93
Wheeled loader	3	0.866	0.917	2.78	0.941	12.11
Off-highway truck (belly dump)	40	17.2	30.5	90.4	29.3	512.7
Total Emissions		18.5	32.0	94.8	30.7	531.5

2. Module Unloading, Transportation and Placement

To estimate the emissions (tons/year) from equipment required for module unloading, transportation, and placement, it was necessary to know the type and amount of equipment that would be used, the emission rates of the equipment, and the amount of time that the equipment would be used. The equipment to be used and the emission rates are presented in table E-4. Total emissions were estimated using the following assumptions:

TABLE E-4

TOTAL ESTIMATED EXHAUST EMISSION RATES (GRAMS/HOUR) FOR EQUIPMENT REQUIRED FOR MODULE UNLOADING, TRANSPORTATION, AND PLACEMENT

Equipment	Quantity	Particulates	SO_2	CO	Exhaust HC	NO_2
Crawler transporters 1 pair - 1000 ton 1 pair - 800 ton 1 pair - 700 ton	3 pairs	a	a	a	a	a
200-ton capacity crawler cranes,[b] 160 ft. boom	2	63.2	64.7	188	71.4	1030
250-ton capacity lowboy tractor-trailers[b]	3	116	206	610	198	3460
Fuel truck[c]	1	--	--	30.52	3.65	2.53
Lube truck[c]	1	--	--	30.52	3.65	2.53
Mechanics' van - outfitted[c]	1	--	--	30.52	3.65	2.53
Gear van[c] - outfitted including rigging gear	2	--	--	30.52	3.65	2.53
50-ton hydraulic truck crane[b]	1	63.2	64.7	188	71.4	1030
Portable 365 cfm air compressors[d]	2	0.44	0.39	250	15.2	4.97
30 kw generators[d]	3	0.44	0.39	250	15.2	4.97
40-ton tractor trailer[b]	1	116	206	610	198	3460
3/4-ton pickups[c]	16	--	--	30.52	3.65	2.53
10-ton loader[b]	2	77.9	92.5	251	91.7	1090
1200-ton capacity pneumatic tire vehicles	2	a	a	a	a	a
Burning van[c] with oxyacetylene equipment	1	--	--	30.52	3.65	2.53
Crew buses[c]	3	--	--	30.52	3.65	2.53

[a]Emission rates not available.

[b]Emission rates reported in grams/hour (EPA 1977).

[c]Emission rates reported in grams/mile (EPA 1977).

[d]Emission rates reported in grams/hp-hour (EPA 1977).

1) Heavy-duty equipment would be used 24 hrs/day for 77 days (module unloading, transportation, and placement time).

2) Emission rates for light vehicles (e.g., pickups and vans) were computed using EPA's MOBILE 1 program, assuming:

   - 1981 model year vehicles would be used.
   - Operation would be at $-1^{o}C$.
   - Operation would be at an average speed of 48.3 km/hr.
   - Cold-start emissions would be negligible.
   - Each vehicle would be used 32,180 km/yr.
   - Particulate and SO_2 emissions would be negligible.

3) Emission rates for nonvehicular equipment (e.g. generators and compressors) were converted from grams per horsepower - hour (EPA 1977) to tons per year, assuming:

   - Small utility four-stroke gasoline engines would be used.
   - Average horsepower of the equipment would be 5 hp.
   - Equipment would be used 16 hours per day for 6 months.

Sample calculation:

- cranes -

Determination of carbon monoxide emissions in tons/year, given an emission rate of 63.2 g/hr and assumptions 1 through 3.

= 188 g/hr x 24 hrs/day x 77 days/year

x 2.205 x 10^{-3} lbs/g x 1 ton/2000 lbs

= 0.383 tons/year

x 2 cranes = 0.766 total tons/year

The results of this analysis are presented in table E-5.

TABLE E-5

ESTIMATED POLLUTANT EMISSIONS (TONS/YEAR) FOR EQUIPMENT REQUIRED FOR MODULE UNLOADING, TRANSPORTATION, AND PLACEMENT

Equipment	Quantity	Total Estimated Exhaust Emissions: Particulates	SO_2	CO	HC	NO_2
Crawler transporters 1 pair - 1000 ton 1 pair - 800 ton 1 pair - 700 ton	3 pairs	a	a	a	a	a
200-ton capacity crawler cranes,[b] 160 ft. boom	2	0.258	0.269	0.766	0.29	4.20
250-ton capacity lowboy tractor-trailers[b]	3	0.709	1.26	3.73	1.21	21.15
Fuel truck[c]	1	--	--	0.813	0.128	0.098
Lube truck[c]	1	--	--	0.813	0.128	0.098
Mechanics' van-outfitted[c]	1	--	--	0.813	0.128	0.098
Gear van-outfitted including rigging gear	2	--	--	1.63	0.256	0.196
50-ton hydraulic truck crane[b]	1	0.129	0.132	0.383	0.145	2.10
Portable 365 cfm air compressors[d]	2	0.009	0.008	5.09	0.310	0.101
30 kw generators[d]	3	0.013	0.012	7.64	0.464	0.152
40-ton tractor trailer[b]	1	0.236	0.420	1.24	0.403	7.05
3/4-ton pickups[c]	16	--	--	13.0	2.05	1.57
10-ton loader[b]	2	0.317	0.336	1.02	0.345	4.44
1200-ton capacity pneumatic tire vehicles	2	a	a	a	a	a
Burning van[c] with oxy-acetylene equipment	1	--	--	0.813	0.128	0.098
Crew buses[c]	3	--	--	2.44	0.384	0.294
TOTAL EMISSIONS		1.67	2.43	40.19	6.37	41.64

[a] Not available.

[b] Emission rates obtained from EPA, 1977.

[c] Emission rates obtained using EPA model MOBILE I 1979.

[d] Five-hp gasoline four-stroke engine. EPA, 1977.

3. Support Equipment

In addition to the support equipment required for module unloading, transportation, and placement, approximately 135 light vehicles and 350 nonvehicular items would be used in a support function during other construction activities. Sample calculations to estimate emissions are presented below:

- light vehicle -

Determination of carbon monoxide emissions in tons/year, given an emission rate of 21.38 g/vehicle-mile and the operational assumptions:

= 21.38 g/vehicle-mile x 20,000 miles/year x 2.205 x 10^{-3} lbs/g

x 1 ton/2000 lbs = 4.71 x 10^{-1} tons/year-vehicle

x 135 vehicles = 63.64 total tons/year of CO.

- nonvehicular item -

Determination of carbon monoxide emissions in tons/year, given an emission rate of 250 g/hp-hr and the operational assumptions:

= 250 g/hp-hr x 5 hp x 16 hrs/day x 183 days/year

x 2.205 x 10^{-3} lbs/g x 1 ton/2000 lbs

= 403 tons/year (per item)

x 350 items

= 1412 total tons/year of CO.

The results of this analysis are presented in table E-6.

4. Groundlevel Concentrations

To estimate the maximum downwind ground-level increases in pollutant concentration ($\mu g/m^3$) resulting from the equipment

TABLE E-6

ESTIMATED POLLUTANT EMISSIONS (TONS/YEAR) FOR CONSTRUCTION EQUIPMENT TO BE USED IN A SUPPORT FUNCTION

Equipment	Quantity	Total Estimated Exhaust Emissions				
		Particulates	SO_2	CO	HC	NO_2
Light vehicles[a]	135	-	-	63.6	8.7	8.4
Nonvehicular items[b]	350	2.48	2.20	1412	85.5	28.1
Total Emissions		2.48	2.20	1475	94.4	36.5

[a] Light vehicles include pickups and crew buses. Emission rates were obtained using EPA model MOBILE 1 (1979).

[b] Nonvehicular items include generators, compressors, and space heaters. Emission rates were obtained from EPA, 1977.

required for all construction activities, a "box model" was used. This box model takes into account emission rate, wind speed, mixing height, and area. The box model gives an estimate of increases in pollutant concentrations using the formula

$$x = \frac{Q}{ULA^{0.5}} \times 10^6 \ \mu g/g$$

Where:

- X is the increase in concentration in $\mu g/m^3$ (dependent variable)
- Q is total emission rate in g/sec
- U is the average wind speed in m/sec for May through October; u = 12.2 mph = 5.45 m/sec
- L is the average mixing height in meters; L = 500 m
- A is the area in square meters;

  $A = 16.25 \text{ miles}^2 = 4.21 \times 10^7 \text{ m}^2$
- Long-term refers to annual; short-term refers to 24 hours.

Sample calculation for carbon monoxide:

$$X_{[CO]} \text{ long-term} = \frac{46.31 \text{ g/sec}}{5.45 \text{ m/sec} \times 500\text{m} \times (4.21 \times 10^7 \text{m}^2)^{0.5}} \times 10^6 \ \mu g/g$$

$$X_{[CO]} \text{ short-term} = X_{[CO]} \text{ long-term} \times \left(\frac{8760 \text{ hr}}{24 \text{ hr}}\right)^{0.5}$$

$$= 2.6 \ \mu g/m^3 \times \left(\frac{8760}{24}\right)^{0.5}$$

$$= 49.67 \ \mu g/m^3$$

The results of this analysis are presented in table E-7.

TABLE E-7

COMPARISON OF NAAQ'S AND ESTIMATED MAXIMUM DOWNWIND GROUND-LEVEL INCREASES IN POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION EQUIPMENT

Pollutant	Time of Average	Primary Standard	Secondary Standard	Estimated Maximum Groundlevel Increase in Pollution Concentrations
Particulate matter (TSP)	Annual (geometric mean)	75 ug	60 ug (guideline for 24-hour standard)	0.04 ug/m^3
	24-hour	260 ug[b]	150 ug[b]	0.76 ug/m^3
Sulfur oxides (SO_x) (measured as SO_2)[x]	Annual (arithmetic mean)	80 ug (0.03 ppm)		0.06 ug/m^3
	24-hour	365 ug (0.14 ppm)[b]		1.15 ug/m^3
	3-hour	--	1,300 ug (0.5 ppm)[b]	3.24 ug/m^3
Carbon monoxide (CO)	8-hour	10 mg (9 ppm)[b]	Same as primary	2.6 ug/m^3
	1-hour	40 mg (35 ppm)[b]	Same as primary	49.67 ug/m^3
Hydrocarbons (HC) (nonmethane measured as CH_4)	3-hour (6 A.M. to 9 A.M.)	160 ug (0.24 ppm)[b] (guideline for O_3 standard)	Same as primary	11.35 ug/m^3
Nitrogen dioxide (NO_2)	Annual (arithmetic mean)	100 ug (0.05 ppm)	Same as primary	0.99 ug/m^3
Ozone (O_3)[d]	1-hour	240 ug (0.12 ppm)[b]	Same as primary	--
Lead (Pb^{+2})[e]	Calendar quarter	1.5 ug[c]	Same as primary	--

[a]Concentration in weight per cubic meter (corrected to 25° and 760 mm of Hg).

[b]Concentration not to be exceeded more than once per year.

[c]Concentration not to be exceeded more than one day per year.

[d]Revised 8 February 1979; 44 FR 8220.

APPENDIX F

REPORT ON THE AIR POLLUTION DISPERSION ANALYSIS FOR THE SALES GAS CONDITIONING FACILITY AND ITS ANCILLARY FACILITIES

An air pollution dispersion analysis was performed to predict the maximum ground-level concentrations of air pollutants that would be produced by the SGCF and its ancillary facilities. The significant sources modeled in the effort included the gas turbine units and the space and process heaters. These sources were modeled under worst-case meteorological and operational conditions. The results of this effort were compared to the Prevention of Significant Deterioration (PSD) increments and Minimum Significance Levels.

All major existing and EPA PSD-permitted sources were also modeled. This analysis was performed to predict the air quality background levels of the region. These sources were modeled under "worst-case" meterorological and operational conditions. The results of this analysis were compared to the primary NAAQS.

EPA handles the program for PSD. Construction or modification of most sources (28 catagories of industries and production facilities) of air emissions which have the potential to emit more than 100 tons per year of any air pollutant and other sources which have the potential to emit 250 tons per year of any pollutant require EPA's PSD preconstruction approval. To receive PSD approval, a proposed facility must not violate the PSD air quality increments, meet the best available control technology, and not violate national ambient air quality. At present, only particulates and sulfur dioxide air emissions have increments associated with them. However, other applicable pollutants must meet the latter two conditions.

This study was conducted to:

- Estimate the maximum long- and short-term increases in air pollution concentrations resulting from the operation of the SGCF and its ancillary facilities located at the Prudhoe Bay site. The analysis was performed by combining the emission rates of the significant emission sources associated with the SGCF.

- Determine whether the predicted increases in maximum ground-level concentrations resulting from the operation of the proposed facilities would exceed the PSD increments or would cause the entire oil production operation to violate the NAAQS.

- Predicted the air quality background levels of the Prudhoe Bay site by modeling all major existing and EPA PSD-permitted emission sources associated with the major oil production operation.

1. Emissions From the Proposed Facility

There are three significant sources of air pollutants associated with the proposed SGCF--the gas turbine units associated with power production, the gas turbines associated with operational processes, and the space and process heaters. Emission characteristics for these sources are presented in table F-1.

The power associated gas turbine facility would consist of three 25.9 MWe simple cycle units. Two units will be operated at a partial load, while the third unit will be kept in reserve. For purposes of this study, all three units were assumed to run at 100-percent load 100 percent of the time.

The gas turbines associated with the operation of the facility are presented in table F-2. All units were assumed to run at 100 percent load 100 percent of the time.

The process heaters would supply process heat to the fractionation portions of the conditioning facility. The space heaters would supply heat to the living, working, and recreational portion of the facility. There will be six process heaters, three 70 x 10^6 BTU/hr. space heaters. Two of these heaters would be running continuously, and one would be kept in reserve. For the purpose of this study, all nine units were assumed to run at 100-percent load 100 percent of the time.

Emissions data for the existing and EPA PSD-permitted facilities were obtained from ARCO's Prevention of Significant Deterioration Permit Application. The emission characteristics of the existing facilities are presented in table F-3. The emission characteristics of the permitted facilities are presented in table F-4.

The meteorological data used for the analyses were collected at the Barter Island weather station. Barter Island is approximately 190 kilometers east of the Prudhoe Bay site. Barter Island experiences generally the same meteorological and climatological conditions as those experienced at the Prudhoe Bay site.

TABLE F-1. EMISSION CHARACTERISTICS FOR THE PROPOSED SGCF AND ANCILLARY FACILITIES AT THE PRUDHOE BAY OIL FIELD[a]

Source	UTM		TSP		SO_2		NO_x		HC		CO		Stack Parameters[b]			
	(East)	(North)	g/s	t/y	g/s	t/y	g/s	t/y	g/s	t/y	g/s	t/y	HS(m)	DS(m)	Ts(°K)	Vs(m/s)
Power gas turbine units (3)	443.7	7802.2	1.794	624	0.078	2.7	52.958	1842	5.348	186	14.663	510	30.0	2.69	755	50
Process associated gas turbine units (19)	443.7	7802.2	8.235	2864	0.358	12.3	243.109	8455	24.550	853	67.312	2341	30.0	2.69	755	50
Space and process heater (9)	443.7	7802.2	1.179	41	3.163	110	11.788	410	0.201	17	1.179	41	30.0	0.03	623	10.6

[a] Indicated emissions are gram per sec (g/s) and tons per year (t/y) for maximum continuous operation.

[b] Indicated stack parameters are stack height (HS) in meters (m), stack diameter (DS) in meters (m), stack exit temperature (Ts) in degrees Kelvin (°K), and stack exit velocity (Vs) in meters per second (m/s).

TABLE F2
Operation Associated Gas Turbine Units

Quantity	Description	HP - Each
4	Stripper Overhead Turbine/ Compressors	14,630
5	Refrigeration Turbine/ Compressors	26,334
2	Field Fuel Gas Turbine/ Compressors	28,920
2	CO_2 Injection Turbine/ Compressors	11,400
6	Sales Gas Turbine/ Compressor Units (Alt. design case)	29,459

TABLE F-3. EMISSION CHARACTERISTICS OF EXISTING FACILITIES IN THE PRUDHOE BAY OIL FIELD[a]

Facility Description	UTM		TSP		SO_2		NOx		HC		CO		Stack Parameters[b]			
	(East)	(North)	g/s	t/y	g/s	t/y	g/s	t/y	g/s	t/y	g/s	t/y	HS(m)	DS(m)	Ts(°K)	Vs(m/s)
A.R.Co. Operation Center P-357																
Gas Boilers (4)	449.5	7,794.6	0.019	0.7	0.001	(c)	0.434	15.1	0.006	0.2	0.032	1.1	7.6	1.0	623	10.6
Space Heater	449.5	7,794.6	0.003	0.9	0.001	(c)	0.030	1.1	0.001	(c)	0.004	0.1	22.8(d)	0.3	623	10.6
A.R.Co. Construction Camp Power Plant P-358 COTU Gas Heater (81.8 mm BTU)	448.4	7,794.7	0.117	4.1	0.007	0.2	2.700	93.7	0.035	1.2	0.198	6.9	22.8(d)	1.0	623	10.6
A.R.Co. Crude Oil Topping Unit P-136																
Gas Fired Crude Oil Htrs (3)	449.3	7,794.4	0.116	4.0	0.000	0.0	1.330	46.3	0.170	6.0	0.000	0.0	22.8(d)	1.2	555	10.6
Waste Incinerator and Gas Afterburner	449.3	7,794.4	0.038	1.3	0.113	3.9	0.396	1.4	0.706	24.6	0.940	33.0	10.7	0.9	1,033	6.9
A.R.Co. Flow Station No. 1 P-138																
Gas Turbine Compressors (2)	446.0	7,795.2	0.502	17.5	0.021	0.7	14.800	515.8	1.500	52.4	4.120	143.4	13.1	2.5	644	20.1
Production/Space Htrs (6)	446.0	7,795.2	0.025	0.9	0.000	0.0	2.980	103.7	0.380	13.5	0.000	0.0	22.8(d)	0.3	623	10.6
A.R.Co. Flow Station No. 2 P-381																
Gas Turbines Compressors(2)	449.5	7,795.5	0.502	17.5	0.021	0.7	14.800	515.8	1.500	52.4	4.120	143.4	13.1	2.5	644	20.1
Production/Space Htrs (6)	449.5	7,795.5	0.025	0.9	0.000	0.0	2.980	103.7	0.380	13.5	0.000	0.0	22.8(d)	0.3	623	10.6
A.R.Co. Flow Station No. 3 P-443																
Gas Turbine Compressors (2)	440.7	7,795.7	0.502	17.5	0.021	0.7	14.800	515.8	1.50	52.4	4.120	143.4	13.1	2.5	644	20.1
Production/Space Htrs (6)	440.7	7,795.7	0.025	0.9	0.000	0.0	2.980	103.7	0.38	13.5	0.000	0.0	22.8(d)	0.3	623	10.6
A.R.Co. Field Fuel Gas Unit P-326 Process Htrs (4)	443.7	7,802.2	0.500	1.8	0.000	0.0	0.578	20.1	0.075	2.6	0.000	0.0	16.1	0.9	611	10.6
A.R.Co. Central Compressor Plant P-324																
Reinjector Turb/Comp (12) @ 25,000 hp each	443.7	7,802.2	5.580	194.3	0.239	8.3	164.000	5729.0	16.700	582.0	45.700	1,339.0	26.8	2.4	755	50.6
Combustion Htrs (2)	443.7	7,802.2	0.066	2.3	0.004	0.1	1.530	53.3	0.020	0.7	0.113	3.9	9.1	1.1	519	10.6

Source: Dames and Moore(1978)

TABLE F-3. Continued.

Facility Description	UTM (East)	UTM (North)	TSP g/s	TSP t/y	SO_2 g/s	SO_2 t/y	NOx g/s	NOx t/y	HC g/s	HC t/y	CO g/s	CO t/y	Stack Parameters[b] HS(m)	DS(m)	Ts(°K)	Vs(m/s)
Sohio Const. Camp No. 1 P-338																
Trash Incinerator No. 1	435.8	7,799.5	0.176	3.3	0.063	1.2	0.076	1.3	0.076	1.3	0.250	4.4	7.3	0.5	1,088	6.9
Sludge Incinerator No. 2 and Oil Afterburner	435.8	7,799.5	0.160	3.0	0.064	1.2	0.261	4.6	0.032	0.6	0.009	0.2	7.3	0.5	1,088	7.4
Sohio Central Power Plant P-185																
Gas Turbine Generators (6)	437.5	7,792.2	3.700	128.8	0.158	5.5	109.200	3801.8	11.400	397.2	30.300	1,055.0	15.8	2.7	777	50.6
Gas Turbine Generator	437.5	7,792.2	0.690	24.0	0.029	1.0	20.310	707.1	2.120	76.0	5.630	196.3	15.8	2.7	777	50.6
Dowell Div'n Warehouse/ 24-Person Bldg. P-325-A																
Diesel Generators (2)	447.9	7,792.0	0.044	1.5	0.059	2.0	1.250	43.8	0.125	4.4	0.767	26.7	3.7	0.2	721	15.2
Sludge Incinerator and Diesel Afterburner	447.9	7,792.0	0.067	2.3	0.160	0.6	0.078	2.7	0.004	0.2	0.006	0.2	3.7	0.2	721	7.4
NANA/Prudhoe Bay Solid Waste Utility P-413																
Trash Incinerator No. 1	447.3	7,791.0	0.176	6.1	0.375	6.6	2.510	43.8	0.000	0.0	0.000	0.0	15.2	0.9	921	6.9
Trash Incinerator No. 2 and Diesel Afterburner	447.3	7,791.0	0.022	0.8	0.447	7.8	2.660	46.4	0.007	(c)	0.010	(c)	15.2	0.9	921	7.4
Alyeska Pipeline Pump Sta. No. 1 P-289																
Turbines/Pumps (3)	439.0	7,796.0	0.850	29.6	0.036	1.3	25.100	875.1	2.550	89.0	6.990	243.0	13.7	3.3	727	22.8
Turbines/Generators (4)	439.0	7,796.0	0.035	1.2	0.001	0.1	1.040	36.2	0.105	3.7	0.289	10.1	13.7	3.3	727	22.8
Heaters (3)	439.0	7,796.0	0.067	2.4	0.004	0.1	1.560	54.3	0.020	0.7	0.115	4.0	13.7	1.0	623	10.7
Trash Incinerator No. 1	439.0	7,796.0	0.001	(c)	0.014	(c)	0.094	(c)	0.000	0.0	0.000	0.0	7.9	0.4	1,144	6.9
Sludge Incinerator No. 2 and Diesel Afterburner	439.0	7,796.0	0.003	0.1	0.010	0.2	0.062	2.2	0.002	(c)	0.001	0.1	7.9	0.4	1,144	7.4
NANA/Prudhoe Bay Solid Waste Utility																
Diesel Generator (1,850 kw) P-423	444.4	7,789.4	0.690	24.0	0.640	22.3	9.660	336.0	0.770	26.8	2.090	72.7	7.6	0.5	421	18.3
Waste Incinerator P-424	444.4	7,789.4	0.707	24.6	0.113	3.9	0.396	1.4	0.706	24.6	0.004	0.2	10.7	0.9	1,033	6.9
VE Construction P-482																
Diesel Generators 670 kw (2)	446.0	7,791.6	0.500	13.4	0.470	16.4	7.000	243.5	0.560	19.5	1.510	52.5	7.6	0.5	421	15.2
Waste Incinerator	446.0	7,791.6	0.350	12.3	0.055	2.0	0.195	0.7	0.350	12.3	0.470	0.8	10.6	0.9	1,033	6.9
A.R.Co. Operations Center																
Trash Incinerator and Afterburner P-355	449.8	7,794.6	0.047	1.2	0.431	4.6	0.722	[illegible]	0.397	6.6	0.153	1.6	12.2	1.1	971	6.9
Sludge Incinerator and Afterburner P-356	449.8	7,794.6	0.018	0.5	0.038	0.4	0.249	2.9	0.012	0.4	0.010	0.1	12.2	0.8	1,366	7.4

TABLE F-3 Concluded.

Facility Description	UTM (East)	UTM (North)	TSP g/s	TSP t/y	SO_2 g/s	SO_2 t/y	NOx g/s	NOx t/y	HC g/s	HC t/y	CO g/s	CO t/y	Stack Parameters[b] HS(m)	DS(m)	Ts(°F)	Vs(m/s)
Sohio Base Operation Center																
P-191 Sludge Incinerator and Afterburner	435.8	7,799.5	0.020	0.7	0.034	1.1	0.128	2.2	0.008	0.1	0.007	0.1	12.2	0.5	1,366	6.9
Trash Incinerator and Afterburner	435.8	7,799.5	0.002	(c)	0.052	0.1	0.113	0.1	0.404	(c)	0.130	0.1	12.2	0.5	1,088	7.4
Standby Ops. Generator P-266	435.8	7,799.5	0.400	0.3	0.530	0.3	11.400	7.1	1.140	0.7	6.910	4.4	6.7	0.5	660	18.3
Sohio Construction Camp																
No. 2 Power Plant P-374 Trash Incinerator	430.0	7,803.5	0.066	2.3	0.047	0.9	0.056	1.0	0.056	0.1	0.187	3.3	12.2	0.5	1,088	6.9
Sludge Incinerator and Afterburner	430.0	7,803.5	0.041	1.4	0.054	0.9	0.214	3.7	0.022	0.4	0.009	0.2	12.2	0.5	1,088	7.4
Deadhorse Airport 3,000 kw Diesel Generation (est)	445.0	7,789.0	1.120	39.0	1.140	39.7	15.670	545.9	1.250	43.5	3.380	117.6	10.7	0.6	428	22.8
Frontier Constr. 1,500 kw Diesel Generator	445.7	7,791.2	0.560	19.5	0.520	18.1	7.830	272.0	0.630	21.9	1.690	58.8	10.7	0.5	428	18.3
Alaska General Constr. 500 kw Diesel Generator	427.0	7,801.8	0.190	6.6	0.170	5.9	2.610	90.8	0.210	7.3	0.560	19.5	10.7	0.3	428	18.3
Downtown Deadhorse Area 2,500 kw Diesel Power Generation (est)	446.5	7,791.2	0.930	32.4	0.870	30.3	13.060	454.3	1,040	36.2	2.820	98.1	10.7	0.6	428	15.2

[a] Developed from the permit files maintained by the Alaska Department of Environmental Conservation, except that emergency generators were not included in this table. Alyeska Pipeline P.S. No. 1 Camp (P-276) and Sohio Fuel Gas Plant Process Vent are no longer in operation and were not included in this table. Short-term and annual emissions do not always compare when the facility operates intermittently.

[b] Indicated emissions are grams/second (g/s) for maximum 1-hour emissions and ton/year (t/y) for annual emissions. All emissions are based on EPA emission factors for combustion sources (AP-42), except where noted.

[c] Less than 0.05 t/y.

[d] Stack height increased over original heights reported by Dames & Moore (1978) to reflect realistic heights.

TABLE F-4. EMISSION CHARACTERISTICS OF PERMITTED FACILITY ADDITIONS TO THE OIL FIELD[a]

ID	Facility Description	UTM (East)	UTM (North)	TSP g/s	TSP t/y	SO_2 g/s	SO_2 t/y	NO_x g/s	NO_x t/y	NC g/s	NC t/y	CO g/s	CO t/y	Stack Parameters[b] HS(m)	DS(m)	Ts(°K)	Vs(m/s)
P1	ARCO Central Compressor Plant Gas Fired Turbine/Compressors 3 @ 25,000 horsepower (hp) Each	443.7	7802.2	1.395	48.5	0.059	2.1	41.17	1432.0	4.20	145.5	11.42	398.0	26.8	2.43	755	50.6
P2	ARCO Flow Station No. 2 Gas Fired Turbine/Compressors 2 @ 25,000 hp Each	449.5	7795.5	0.920	32.0	0.038	1.4	27.06	945.0	2.77	95.8	7.53	262.0	26.8	2.43	755	50.6
P3	Sohio Central Power Plant Gas Fired Turbine/Generators 2 @ 67,000 hp Each	437.5	7797.2	2.510	87.4	0.107	3.7	73.80	2578.0	7.51	261.9	20.56	716.8	16.7	2.80	755	102.1
P4	Sohio Gathering Center Plant Gas Fired Turbine/Compressors 2 @ 32,500 hp Each	430.0	7801.8	1.196	41.6	0.050	1.8	35.16	1228.0	1.80	124.6	9.78	340.6	16.7	2.69	755	50.0
P5	Sohio Gathering Center No. 3 Gas Fired Turbine/Compressors 2 @ 17,000 hp Each	436.7	7798.5	0.598	20.8	0.024	1.0	17.58	614.0	0.90	62.2	4.90	170.4	16.7	2.69	755	35.0

[a] Indicated emissions are gram per sec (g/s) and tons per year (t/y)for maximum continuous operation.
[b] Indicated stack parameters are stack height (HS) in meters (m), stack diameter (DS) in meters (m), stack exit temperature (Ts) in degrees Kelvin (°K), and stack exit velocity (Vs) in meters per second (m/s).

Source: Dames and Moore (1978)

The meteorological data were obtained from NOAA in the standard STAR format. This format was modified by combining two pairs of stability classes. This modification reduced the number of stability classes to six from eight to make the data acceptable for the computer codes used in the analyses.

The meteorological inputs to the short-term (PTMTP) model included the worst-case mixing height of 900 meters (2952.9 feet) and the average worst-case temperature of 10^{o}C. reported for the area. The meteorological inputs to the long-term (VALLEY) model included the annual average temperature of -13^{o}C. (The average mixing height is set internally by the program to a very large value for stable cases.) The models used are described in the following section.

2. Analyses

The mathematical analyses used for estimating the dispersion of nonreacting pollutants are based on Gaussian plume models. The atmospheric dispersion models employed were the PTMTP and VALLEY models. These models are included in EPA's UNAMAP (User's Network for Applied Modeling of Air Pollution) series of computer programs. The programs were run on a remote terminal used to access a Xerox Sigma Nine-based computer system.

PTMTP is a comprehensive extension of the PTMAX and PTDIS programs. The PTMTP program allows a more thorough estimate of pollutant concentrations for 1- to 24-hour averaging periods.

PTMTP produces hourly concentrations at up to 30 receptors whose locations are specified from up to 25 point sources. Inputs to the program consist of the number of sources to be considered and, for each source, the emission rate, physical stack height, stack gas temperature, volume flow (or stack gas velocity and diameter), and the location (by coordinates). The number of receptors, the coordinates of each, and their heights above ground also are required. Concentrations for a number of hours up to 24 can be estimated, and an average concentration over this time period is calculated. For each hour, the meteorological information required is: wind direction, wind speed, stability class, mixing height, and ambient air temperature.

The VALLEY model is a steady-state, univariate, Gaussian plume dispersion algorithm designed for estimating annual concentrations resulting from emissions from up to 50 (total) point and area sources. Calculations of ground-level pollutant concentrations are made for each frequency designation in an array defined by 6 stabilities, 16 wind directions, and 6 wind speeds for 112 program-designated receptor sites on a radial grid of variable scale. Empirical dispersion coefficients are used, adjusted for plume rise and limited mixing. Plume height is adjusted according to terrain elevations and stability classes. The program requires meteorological data in STAR format (a joint frequency summary of stability, wind speed, and direction), point source emission data, and receptor point distances and elevations relative to the point source. The model uses Gaussian steady state dispersion with the Briggs Plume Rise equation. This model was used with the no terrain option, because the Prudhoe Bay site is flat, treeless tundra with virtually no significant terrain features.

The results obtained from the PTMTP model estimate short-term (1-, 3-, and 24-hour) levels, and the results obtained from the VALLEY model estimate long-term (annual) levels. So that the results would reflect that plume rises from the gas turbines are different than plume rises from other releases, EPA requested that the results of the gas turbine plume rise equation be multiplied by a factor of 0.70. In order to avoid major adjustments in the models that would be required to treat plume rises from turbines differently than those from other releases in the same computer run, all gas turbine exit velocity inputs were multiplied by a factor of 0.24. This resulted in decreases in plume rises of at least 30 percent for all atmospheric conditions (unstable/neutral, stable, and stable/calm). Therefore, under conditions most prevalent in the project area, resulting plume rises were at least 70 percent of the calculated values.

The results of the modeling indicate the receptor locations where pollutant concentrations are highest. The PTMTP model identifies these receptor locations regardless of their direction from the source. Wind directions, therefore, were not required inputs. The receptor distances used were 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0. 7.5, 10.0. 12.5, 15.0, 17.5, 20.0, and 25.0 kilometers from the project site. For the VALLEY model, receptor locations are fixed by the program to include 112 receptor sites. The scale chosen was 1 inch equals 2.5 kilometers.

In addition to predicting the impact of the proposed project, the models were used to estimate background pollutant levels from the existing and EPA PSD-permitted sources in the area. The VALLEY model was utilized similarly to that used for predicting impact. The stack parameters of 46 of the 47 surrounding point sources are used as inputs to the programs. The resulting worst-case background levels then were added to the maximum impact levels (although these two levels do not occur at the same location) to obtain a conservative estimate of the maximum ground-level pollutant concentrations.

The PTMTP model had to be handled in a different manner to estimate background levels. The maximum short-term impact of the proposed facility is predicted to occur 1 kilometer downwind. In order to estimate background levels, existing and permitted facilities located at various distances from the proposed project site were lumped together into clusters and lined up with the proposed facility. The clusters were assumed to be no more distant, in relation to the proposed facility, than the distance between the closest cluster and the proposed facility. The value predicted at 1 kilometer downwind of the proposed site (with the wind blowing from the cluster to the proposed site) was considered the background level for the cluster. The highest value obtained for any cluster for each pollutant was considered the background level.

3. Results

The results of the dispersion analyses performed on the SGCF and its ancillary facilities are presented in table F-5. As can be seen in this table, the predicted maximum ground-level concentrations of the various regulated pollutants are within the PSD Class II increments.

The results of the dispersion analysis performed to estimate the background pollutant levels are presented in table F-6. As can be seen in this table, the maximum background levels do not exceed primary Alaska Ambient Air Quality Standards.

TABLE F-5

COMPARISON OF PREVENTION OF SIGNIFICANT DETERIORATION INCREMENTS TO THE MODELING RESULTS

	Maximum Allowable Increase (ug/m^3)	Maximum Predicted Increase (ug/m^3)
Class II Area		
Particulate matter		
Annual geometric mean	19	0.7[a]
24-hour maximum	37	8.3[c]
1-hour maximum	--	14.2[b]
Sulfur Dioxide		
Annual arithmetic mean	20	0.27[a]
24-hour maximum	91	3.3[c]
3-hour maximum	512	4.7[c]
1-hour maximum	--	5.7[b]
Nitrogen Dioxide		
Annual	--	19.6[a]
1-hour	--	383.0[b]

[a] Annual levels were predicted using the EPA VALLEY computer program. Maximum levels were predicted to occur 5 km. west of the proposed facilities.

[b] One-hour levels were predicted using the EPA PTMTP computer program. Maximum levels were predicted to occur 1 km. from the proposed facilities during C stability conditions with a wind speed of 10 meters per second.

[c] Turner's power law equation was used to correct the 1-hour predicted values to 3-hour and 24-hour values.

TABLE F-6

MAXIMUM PREDICTED BACKGROUND POLLUTANT LEVELS AND NATIONAL AMBIENT AIR QUALITY STANDARDS
(Values are $\mu g/m^3$)

Pollutant	Averaging Time	Background Level[a]	Alaska Ambient Air Quality Standard
TSP	Annual	1.5	60
	24-hour	21.8[b]	150
	1-hour	37.4	-
SO_2	Annual	0.6	60
	24-hour	19.3[b]	260
	3-hour	27.5[b]	1,300
	1-hour	33.2	-
CO	8-hour	<1[c]	40,000
	1-hour	<1[c]	10,000
NO_2	Annual	24	100

[a] These levels represent ground level concentrations calculated using emissions from the major and approved existing sources in the area. Maximum levels were predicted to occur 1.0 km downwind from the proposed facilities, with the exception of NO_2 which was reported at 2.0 km downwind.

[b] Turner's - 0.17 power law equation was used to correct the 1-hour predicted values to 3-hour and 24-hour values.

[c] Based on the low CO emission rates from the major point sources and the small amount of vehicular traffic in the area.

Several assumptions were designed into both dispersion analyses to assure conservative results. They include:

All nitrogen oxide emissions were assumed to be NO_2.

No reduction in NO_x emissions was assumed, although a lower combustion temperature resulting from exhausting waste CO_2 through the gas turbine unit would reduce NO_x emissions.

Exit velocities used for the turbines were multiplied by 0.24 to reduce the plume rise by at least 30 percent for all stability conditions.

The three turbine units were assumed to be operating at 100-percent load 100 percent of the time, although only two units would run while the third would be kept in reserve.

The space and process heaters were assumed to be operating at 100-percent load 100 percent of the time, although two of the process heaters and one space heater would be kept in reserve.

A worst-case mixing height of 900 meters was used to prevent the plume from rising above the mixing boundary layer.

The staff recommends that further analysis be performed when more project and site-specific data are available. The gas turbine data was a conservative approximation of a 32,500-hp unit burning conventional high Btu gas. Emissions data were unavailable for a unit burning a low Btu-high CO_2 gas. It is expected that such a unit would have lower NO_2 emissions. The space and process heater data were obtained from a vendor and were based on the use of diesel fuel, whereas cleaner local natural gas may be used. The meteorological data were obtained from Barter Island, which can be considered generally characteristic of the area, but site-specific differences such as wind direction frequencies are probable. Based on this analysis, the staff believes that further analysis based on site-and project-specific data may affect the level of review required for PSD approval.

APPENDIX G

FERC STAFF
BIOLOGICAL ASSESSMENT
AND
NMFS CONSULTATION

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

In Reply Refer to:

OPPR-DPC/EEB
Docket No. CP78-123 et al.
Alaska Natural Gas
Transportation System-
Prudhoe Bay Project

Mr. Terry L. Leitzell
Assistant Administrator for Fisheries
National Marine Fisheries Service
3300 Whitehaven Street, NW
Washington, D.C. 20235

AUG 7 1979

Dear Mr. Leitzell:

In accordance with the Endangered Species Act of 1973 (Act), as amended, the Federal Energy Regulatory Commission (FERC) is submitting a biological assessment for the Alaska Natural Gas Transportation System (ANGTS), including the construction and operation of a proposed sales gas conditioning facility (SGCF) at Prudhoe Bay, Alaska. The enclosed assessment discusses the species that may occur within the project area listed by the National Marine Fisheries Service (NMFS) in a letter to the FERC dated May 23, 1979.

As a result of the biological assessment, the FERC staff has concluded that the gray whale and the bowhead whale may be affected by the proposed action. Therefore, we are requesting consultation with the NMFS under Section 7 of the amended Act.

The Commission staff evaluated the environmental impact of the pipeline route eventually selected in a 1976 supplement to its final environmental impact statement (FEIS), Alaska Natural Gas Transportation Systems: Alcan Pipeline Project. The Commission staff believes that no further consideration of the pipeline route, which the President recommended to Congress on September 22, 1977, is necessary. However, the staff has determined that the FEIS did not assess the environmental impact of the facilities which will be necessary to condition and process Prudhoe Bay gas prior to pipeline transmission. Therefore, the FERC has assumed the responsibility as lead agency in preparing an assessment of the environmental impact of the SGCF. Accordingly, on July 27, 1979, copies of a draft environmental impact statement (DEIS), Prudhoe Bay Project, were transmitted to interested parties. A copy of this DEIS is attached to the biological assessment.

In preparing this biological assessment, the FERC staff has reviewed numerous reports and publications on these two endangered species and, in addition, has telephoned experts having knowledge of these species.

If you require additional information, please contact Mr. George Taylor of the Environmental Evaluation Branch by telephoning (202) 275-4564.

Sincerely,

Michael J. Sotak, Acting Chief
Environmental Evaluation Branch

Enclosure

ENCLOSURE

BIOLOGICAL ASSESSMENT

A complete description of the proposed pipeline project may be found in the Commission's 1976 supplement to its FEIS, Alaska Natural Gas Transportation Systems: Alcan Pipeline Project. A description of all activities involved in the construction of the proposed SGCF appears in the 1979 DEIS, Prudhoe Bay Project.

The major construction involved in this proposal would be onshore facilities, but some nearshore construction may also be necessary. The nearshore construction would require either widening an existing docking facility or construction of a new causeway and dock. The existing causeway is 2,864 meters long and is located on the western side of Prudhoe Bay just east of Simpson Lagoon. The water at the farthest offshore dockhead is 2 meters deep. Impacts that may occur as a result of any dock construction are discussed on pages 89 through 94 and pages 106 through 110 in the DEIS for the Prudhoe Bay Project.

Construction of both the SGCF and the ANGTS would require increased barge traffic tc transport materials to Prudhoe Bay. The number of barge trips to Prudhoe Bay to deliver materials for the SGCF could range from 2 to 25 over a 2- to 3-year period. Present information indicates that up to an additional 16 barge trips would be necessary to transport pipe for the ANGTS. Additional barge trips may be required during ANGTS construction for compressor station materials and other construction materials; however, these numbers are not presently known.

The following biological assessment discusses the two endangered species which the NMFS has identified within the project area.

BOWHEAD WHALE (Balaena mysticetus)--Endangered

The bowhead whale migrates along the North Slope of Alaska and may occur in the offshore area of Prudhoe Bay. Bowhead whales migrate from the Bering Sea into the Chukchi and Beaufort Seas from March through June. Eskimos have observed whales within 91 to 182 meters of shorefast ice. The bowhead returns to the Bering Sea in its southern migration from September to December.

Shipment of material and equipment through the Bering Sea to the arctic coast is possible an average of only 6 weeks a year. This period, which usually ranges from the last week in July to the first weeks in September, varies from year to year according to ice conditions. Generally, most barge traffic would probably not be moving through this area during peak bowhead migration. Early fall migrants may be most affected by barge movement when bowheads are speculated to migrate closer to shore.

Pages 67 and 68 of the Prudhoe Bay Project DEIS present additional information concerning the bowhead whale; pages 106 and 107 indicate possible impacts as a result of the proposed actions that may affect bowheads.

We request that the NMFS provide our staff with its biological opinion on the effect that these possible impacts may have on bowhead whale populations.

References: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19.

GRAY WHALE (*Eschrichtius robustus*)--Endangered

The eastern Pacific population of gray whales migrates between Baja California and the Bering, Chukchi, and Beaufort Seas. This stock begins its northward migration from its Gulf of California wintering grounds in late February, and it continues through June. From late May through October, gray whales occupy the shallow waters of the northern and western Bering, Chukchi, and occasionally the western Beaufort Sea. They are more frequently found along the arctic coast of Alaska, ranging from Cape Thompson to Point Barrow. However, Eskimos have reported a few whales along the shores of the Beaufort Sea as far east as Barter Island. Gray whales migrate southward from these arctic regions from October to January. The gray whale calves and mates in its wintering grounds during its most southern distribution.

The principal barge route to Prudhoe Bay from a proposed west coast fabrication site would use the inland passage across the Gulf of Alaska/Pacific Ocean, through the Aleutian Islands, northward into the Bering Sea, skirting the Seward Peninsula and entering the Arctic Ocean to Prudhoe Bay. Barge traffic would utilize access routes similar to gray whale migration patterns. The greatest overlap would occur from late July to early September. During this time, most gray whales would have already arrived in their summering grounds in the Bering, Chukchi, and western Beaufort Seas where they are reported to do most of their feeding.

The effects of barge traffic on gray whales summering in the area would be similar to those described in the Prudhoe Bay DEIS.

The FERC staff again requests that the NMFS provide us with its biological opinion on the effect of the proposed project on this endangered whale species.

References: 10, 11, 12, 13, 17, 18, 20, 21.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Box 1668, Juneau, Alaska 99802

November 13, 1979

RECEIVED BY
NO 1 1
M. J. S.

Mr. Michael J. Sotak, Acting Chief
Environmental Evaluation Branch
Federal Energy Regulation Commission
Washington, D. C. 20426

Dear Mr. Sotak:

Staff members at the National Marine Mammal Laboratory, Northwest and Alaska Fisheries Center, NMFS, Seattle, Washington have reviewed the FEIS, Alaska Natural Gas Transportation System, Project Prudhoe Bay as per your request to Mr. Terry L. Leitzell, Assistant Administrator for Fisheries for a Section 7 of the Endangered Species Act consultation. The following information is a result of their examination of the FEIS and a review of the enclosure "Biological Assessment" which was included with your request to Mr. Leitzell.

If deleterious effects of construction and operation of a Sales Gas Conditioning Facility (SGCF) at Prudhoe, Alaska, on bowhead and gray whales were to occur, we would expect them to result from interactions with marine vessel traffic during the construction phase of the SGCF. However, there are no scientific data which will allow us to conclude that vessel harassment problems will result such as were observed for gray whales near California and Mexico or for humpback whales in Alaska and Hawaii. The arctic environment, with its precipitous conditions of shifting ice or ice confinement, is dramatically dissimilar to the temperate and sub-tropical waters described above.

No indirect effects on bowhead or gray whales are expected as a result of changes in the local biotic community near the mouth of the Put River if the Put River is used as a source of water and/or gravel during the construction and operation of the SGCF. Trophic studies of the interrelationship of bowheads to the rest of the arctic marine community, however, have not been done.

Finally, we note that all concerns are mitigated, presumably, if the SGCF were located in Fairbanks, Alaska, as was proposed in the FEIS as an alternate site.

In addition, we note the following problems in the FEIS:

P. 67, Para. 2. The comment "...gray whales [are] more commonly found nearer shore or in open water" is misleading. First, grays are not commonly found in the Beaufort Sea (which the quote implies, although does not really state); secondly, they are a nearshore species but not found in the ice. The wording nearshore and open water can imply both close to shore and offshore, i.e. "open water" is sometimes analogous to pelagic.

P. 67, Para. 3. It is incorrect to assume that white whales (belugas) "prefer" the pack ice edge, especially in the spring (as implied). They can be found throughout the pack ice, and are not likely to be near the "pack edge" in spring, but rather in late summer and fall.

P. 67, Para. 4. The size estimate of the bowhead population is 1,700-2,800 (mean 2,264). See Braham et al. (1979) Rep. Inter. Whal. Commn., 29:291-306.

P. 68, Para. 1. Bowheads occur in Amundsen Gulf for the summer (feeding) and later (fall, August-September) off the MacKenzie Delta during their westwardly fall migration.

P. 68, Para. 1. Add here, as you did on page 66, that Thysanoessa spp. (especially raschii) is the prey species most likely taken by bowheads.

P. 68, Para. 2. The statement is made that gray whales are found more frequently from Cape Thompson to Point Barrow. More frequently than where? Gray whales are generally absent from the Beaufort Sea. We do not presently believe that OCS activities near Prudhoe Bay represent a threat to their species.

P. 68, Para 3. Harbor seals (Phoca vitulina) are not found in the Beaufort Sea; they are spotted seals (Phoca largha), a different species.

P. 107, Para. 2. There is no biological basis for stating for any species, that "death of one juvenile can be more serious than death of a few adults". This might be true if juvenile mortality is nil; but mortality in bowheads, especially, is unknown. Given that the age difference is great between the death of a few adults and a juvenile (i.e., if a few very old adults die versus one juvenile, especially if female) then one might argue favorably that the one juvenile female has a greater reproductive potential than the few older animals.

If you desire additional information, please contact Dr. Michael Tillman, Director, National Marine Mammal Laboratory, telephone (206)442-4711 or FTS 399-4711.

Sincerely yours,

Frederick V. Thorsteinson
for Harry L. Rietze
Director, Alaska Region
National Marine Fisheries Service

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Washington, D. C. 20235

F/MM:WA

DEC 26 1979

Mr. Michael J. Sotak
Acting Chief
Environmental Evaluation Branch
Federal Energy Regulatory Commission
Washington, D. C. 20426

Dear Mr. Sotak:

This is in further response to your request for consultation with the National Marine Fisheries Service under Section 7 of the Endangered Species Act (ESA) in connection with the Alaska Natural Gas Transportation System and proposed construction and operation of a sales gas conditioning plant at Prudhoe Bay, Alaska. On November 13, 1979, a letter was sent to you by Mr. Rietze, Director of our Alaska Region, conveying the results of a National Marine Mammal Laboratory review of the FEIS and Biological Assessment as you had earlier suggested. The intent of that letter was to state our conclusion that the proposed activities would not adversely impact either gray or bowhead whales. Our conclusion, however, was not cast in terminology most commonly identified with ESA requirements. To clarify, we believe that the proposed activities are unlikely to jeopardize the continued existence of gray or bowhead whales or their habitat. We therefore conclude that further consultation is unnecessary unless new information is developed.

Sincerely yours,

for Terry L. Leitzell
Assistant Administrator
for Fisheries

STATE OF ALASKA

JAY S. HAMMOND, Governor

OFFICE OF THE GOVERNOR

DIVISION OF POLICY DEVELOPMENT AND PLANNING

POUCH AP
JUNEAU, ALASKA 99811
(907) 465-3541 OR 465-3574

January 30, 1980

Mr. Robert Arvedlund
Project Manager
Federal Energy Regulatory Commission
825 N. Capital St. 7th Floor
Washington, D.C. 20426

Subject: Clarification of Consistency Comments on DEIS for Construction and Operation of a Sales Gas Conditioning Facility at Prudhoe Bay, Alaska. (State I.D. No. 79073003)

On October 4, 1979, the Prudhoe Bay Project Draft Environmental Impact Statement (DEIS) was declared to be conditionally consistent with the Alaska Coastal Management Program (ACMP). A copy of that letter (Attachment A) is enclosed. It was declared to be consistent on the condition that the project comply with various Use and Resource Standards contained in the ACMP.

Subsequent to the Division of Policy Development and Planning (DPDP) consistency review, Mr. George Taylor of your office requested in various telephone conversations with DPDP staff that a clarification of the comments contained in that review be made to you. Because certain portions of the review were not received by you until late November 1979, the State Clearinghouse forwarded comments made by the Alaska Department of Fish and Game and Environmental Conservation on the Prudhoe Bay Project DEIS. The comments contained in the October 4, 1979 letter addressed many concerns but did not specifically identify those that pertain to the Use and Resource Standards of the ACMP, that is, consistency.

Therefore, in an attempt to assist you and your agency in identifying those areas of State concern pertaining to consistency with the ACMP, I have segregated out those state agency comments originally submitted to you that affect only the Use and Resource Standards contained in the ACMP and grouped them with the appropriate standards (Attachment B). You will notice that, for the sake of congruity, the original comments submitted by both departments are quoted verbatim. Only those comments not pertaining to consistency with the ACMP were deleted. All references to tables, charts, page numbers, etc., pertain to those made in the original comments already submitted to you. The same numbering system utilized by the Department of Environmental Conservation in making its comments is employed. Since the Department of Fish and Game submitted it's comments in paragraph form only, and not numbered, that system is also employed.

ACMP spells out a series of standards and guidelines , a copy of which is enclosed, which relate to a variety of coastal use concerns including standards and priorities for siting and approval of coastal uses, geophysical hazards, recreation, energy facilities, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing and subsistence. Additionally, the program describes a number of resource and habitat standards covering air, land and water quality, historic, pre-historic, and archeological resources, protection of coastal habitats including offshore areas, estuaries, wetlands, tideflats, rocky islands, etc. Copies of the federal and state laws and relevant regulations are attached as well as further information contained in the State of Alaska's Coastal Management Program's final Environmental Impact Statement and should be consulted for more detailed information.

You will notice that almost every standard contained in the ACMP is addressed. Of particular concern to DPDP is that of alternatives. As you are aware, the National Evironmental Protection Act (NEPA) regulations lay particular significance upon alternatives and the importance they have in determining such things as site location, method of operation in Environmental Assessments (EA) and Environmental Impact Statements (EIS). It is imperative that every and all alternatives be discussed and adequately presented in the FEIS for a proper consistency review to be completed by DPDP.

Additionally, it is very understanding that as of this date there is no applicant for the construction and/or operation of the Gas Sales Conditioning Facility. It is also my understanding that it is the intent of FERC that when an application is recieved any stipulations included as part of the consistency determination would have to be accepted by the applicant before any FERC license(s) or permit(s) would be issued.

If you have any further questions, please do not hesitate to call me at 465-3540.

Sincerely,

Tom Barnes
Federal Agency Liaison

cc: John Halterman, DPDP
Bob Waldrop, Office of The Governor
Bill Ross, DPDP
Murray Walsh, OCM
George Taylor, FERC

October 4, 1979

Federal Energy Reulatory Commission
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

Attention: Lois D. Cashell, Secretary

Subject: Prudhoe Bay Project DEIS: Construction and Operation of Sales Gas Conditions Facility State I.D. No. 79073003

Dear Ms. Cashell:

The Division of Policy Development and Planning in accordance with Public Law 92-583 and 94-370 and Alaska Statutes 46.40.010, has completed review of the consistency of the subject proposal with the Alaska Coastal Management Program (ACMP).

As currently planned, we have found the proposal to be conditionally consistent. It will be consistent with the ACMP provided that the attached conditions are met. We request that you inform us in writing at your earliest convenience whether or not these conditions are acceptable to you. Your notification to us of the acceptance of the conditions is required to complete issuance of the state's concurrence regarding the consistency of your project with ACMP.

Additionally, if the project is substantially amended during its implementation such that it affects the coastal zone differently than as represented in the proposal we reviewed and have conditionally approved; we ask that you contact the State Clearinghouse to determine if an ACMP review of the revision is required.

We attempted to contact your Washington, D.C. office and Lois Cashell in particular, on Monday about this determination. If you have questions, please contact us at (907) 465-3577.

Sincerely,

Frances A. Ulmer
Director

Attachment
FAU:DH:cl

cc: Tom Barnes, Office of Coastal Management
Commissioner McAnerney, DC&RA
Commissioner Mueller, DEC
Richard Logan, DF&G
Robert Loeffler, Law Firm of Morrison and Foerster, Washington, D.C.

bcc: John Halterman

date: Sept. 27, 1979

to: Jerry L. Madden
A-95 Clearinghouse

re: Sales Gas Conditioning Facility
State I.D. No. 79073003

from: Murray Walsh
Coordinator
Office of Coastal Management
State of Alaska

If the Sales Gas Conditioning Facility were to be located at Prudhoe Bay, the plan would have to be consistent with a number of coastal management Use and Resource Standards.* Among these are those which seem most pertinent to this project:

CZM Standards

6 AAC 80.070	Energy Facilities Siting
6 AAC 80.080	Transportation and Utilities
6 AAC 80.040	Coastal Development
6 AAC 80.120	Subsistence
6 AAC 80.130	Habitats
6 AAC 80.140	Air, Land, and Water Quality

Analysis of potential environmental impacts as they relate to the Alaska Coastal Management Act of 1977 and its regulations are altogether lacking in the DEIS. The Sales Gas Conditioning facility must be consistent with the Alaska Coastal Management Program (ACMP).

Review comments prepared by the Alaska Departments of Fish and Game and Environmental Conservation indicate that there may be several potential inconsistencies with the ACMP. Our own review of the document concludes that there will be serious impacts if they occur as described and would urge that the project sponsors give serious reconsideration of alternative sites. At minimum, the FEIS should contain a more comprehensive evaluation of alternative sites vis a vis ACMP Use and Resource Standards so that decisions on trade-offs could be facilitated.

*Copy attached

Consistency Comments Related to Sales Gas Conditioning Facility at Prudhoe Bay. State I.D. No. 79073003.

6 AAC 80.070 Energy Facilities

Environmental Conservation

"1. This Department advocates expansion of the existing dock facilities at Prudhoe Bay to accommodate increased barge traffic, rather than construction of a new, separate causeway. The design of an expanded dock and causeway should consider the requirements of possible future facilities in Prudhoe Bay, including marine pipeline corridors to the proposed onshore water reinjection plants and oil production gathering lines from offshore Beaufort Sea lease areas. ARCO and the State of Alaska have informally discussed breaching of the causeway to allow improved east to west transport of Put and Sag River water along the coast. It appears that the existing causeway is presently deflecting estuarine surface waters northward along the causeway, altering the marine environment on the western, nearshore side of the causeway. The possibility of breaching should be acknowledged at the DEIS stage, early enough so that due consideration is given to the alternatives. Breaching subsequent to widening the causeway would be a much more costly venture."

"The scenario in the impact section discussing the long term effects of the construction of a new causeway and dock should include the possibility of adverse cumulative effects resulting from two stuctures. The magnitude of such effects would largely be a function of the location, size and configuration of any new causeway/-dock structure. Based on our review of the ARCO causeway research over the last three years, we concur with the statement on page 94 that, of the alternatives considered, 'construction of a new causeway would have the most significant impacts on the bay."

"2. We understand that exact abandonment procedures for the proposed sales gas conditioning facilities are difficult to formulate at this stage. However, the DEIS should not dodge this issue, one which caused a great deal of controversy (and which involved this department for several years) after completion of construction of the TransAlaska pipeline. It is likely that an 'abandonment and restoration' stipulation be included in the text."

Fish and Game

"The document is entitled Prudhoe Bay Project: Draft Environmental Impact Statement. This indicates to us that FERC had already predetermined the location of the plant and did not intend to give serious considerations to other potential sites, despite the wishes of the State of Alaska. This was borne out by the cursory treatment of both the North Pole and Yukon River potential sites later in the document. In fact, it appears that the recommendation of FERC were not based on environmental considerations. Their conclusion was that '...the proposed Prudhoe Bay site is acceptable. While the staff considers the North Slope alternative site to be acceptable as well, it believes that the site is not sufficiently superior to the Prudhoe Bay site to warrant its selection.' We suggest that the converse is also true: That the North Pole site is not sufficiently inferior to warrant its disqualification, notwithstanding engineering constraints. Table 1 presents a listing of fourteen environmental factors. Based on FERC's own discussion, it can be seen that the Prudhoe Bay site will have problems with 12 of the 14. The North Pole and Yukon River sites will experience conflicts with 3 and 7 respectively. It is obvious then that the recommendations in the environmental impact statement were made on other than environmental grounds."

"A major concern with the Prudhoe Bay site is the possibility of construction of a new causeway and dock. The existing ARCO dock was the subject of extensive review and controversy. Another dock would require substantial amounts of gravel, may cause changes in water circulation, nearshore salinity, and local ice conditions and may adversely affect fish and marine mammal migrations and freshwater discharge from the Sagavanirktok River. Therefore, ADF&G does not favor additional docking facilities at Prudhoe Bay."

" The docking facilities would be needed for off-loading modular units barged to the Prudhoe Bay site. It is proposed to use modular construction in order to: 'Minimize the impacts of the process plant on the permafrost, to minimize the plant's acreage layout and to facilitate the ease of construction at the construction site.' We grant that these may be valid reasons for considering modular construction at Prudhoe Bay (although how modular construction will minimize the acreage occupied by the plant is not explained). However, the DEIS rejects the North Pole site partially on the grounds that modular units could not be transported to it overland. We suggest that modular construction would not be necessary at the North Pole site 'because of the general absence of permafrost on the site', as stated in the DEIS, and because the construction season is longer and more clement in the Fairbanks area then at Prudhoe Bay. Construction of large facilities without the modular approach has taken place for decades in Fairbanks."

"The gravel requirements of the Prudhoe Bay site are tremendous; if the figures presented in various parts of the document are summed, the total is nearly 5 million cubic yards. Yet the DEIS states that gravel will be gotten from the Putuligayuk River. Gravel on the North Slope is scarce. The Putuligayuk River site has been nearly depleted. The scarcity of gravel is a major consideration in choosing a route for the natural gas pipeline. To put the matter in perspective, and using approximate figures, Alyeska Pipeline Service Company used 62 million cubic yards of gravel to build the oil line pad, haul road and related facilities pads. The gravel came from 400 material sites of an average size of 155,000 cubic yards. It will then take 32 APSC average-sized material sites to supply the SGCF, dock and causeway with gravel. The problem of attaining gravel, therefore, becomes a major environmental concern and one which must be addressed in detail in the final EIS."

"The existing data for fish and wildlife species of importance have not been examined thoroughly. For example, the caribou is an extremely important mammal on the North Slope. Yet no data from ADF&G studies has been included in the reference material. We invite FERC to avail themselves of the information gathered by our biologists and we hope that the caribou will not be treated so casually in the final EIS. The invitation to examine ADF&G literature extends, of course, to other Alaskan species besides the caribou."

"It appears that very little direct knowledge of Alaska was used in writing the DEIS. For example, the Yukon River site is considered to have impact on the peregrine falcon which 'nests in the steep cliffs and canyon areas of the Yukon River near the Canadian border and also at Franklin Bluffs.' It should be pointed out that the proposed Yukon River site for SGCF is at least 400 miles away from either of these locations and, further, that Franklin Bluffs is not even on the Yukon River, but rather on the Sagavanirktok River."

"The DEIS states that to build the Yukon River facility, moose habitat would be destroyed and the operation of the facility could cause moose to shift to 'less desirable range.' This insinuates that the proposed location is prime moose habitat and that it is the only prime moose habitat in the area. There is no data presented to support these contentions. Although we would agree that destruction of any moose habitat is undesirable, it is not an occurence which cannot either be mitigated or compensated. This would be true especially if the habitat is neither prime nor scarce. Without a more thorough examination of the facts, a proposed location cannot be rejected because it would destroy moose habitat of an undefined quality or availability."

Comment: The Department of Fish and Games' comment, while identified here under the Energy Facilities standard also applies to Subsistence (6 AAC 80.120), Habitats (6 AAC 80.130), Coastal Development (6 AAC 80.040) and Transportation and Utilities (6 AAC 80.080) standards and should therefore be appropriately considered.

Additionally, the Department of Environmental Conservation comments 1 and 2 should also be considered to apply under the Transportation and Utilities Standard (6 AAC 80.080).

6 AAC 80.080 Transporation and Utilities

Environmental Conservation
See comment under Energy Facilities 6 AAC 80.070

Fish and Game
See comment under Energy Facilities 6 AAC 80.070

6 AAC 80.040 Coastal Developemnt

Environmental Conservation

"3. The capability and availability of material sources to supply the massive gravel requirements of this project, the gasline, water reinjection facilities, and possibly numerous additional facilities in the Prudhoe Bay area, remain a key issue. A locational map of gravel sources and access roads should be included, along with estimates of volumes the Put River and other resources are likely to be able to provide. Alternatives to the Put River should be discussed. The impact discussion relating to soils and road construction is inadequate and requires expansion. It is presently too general.

Fish and Game

See comment under Energy Facilities 6 AAC 80.070

6 AAC 80.120 Subsistence

Environmental Conservation

"4. Under mitigating measures, the DEIS should include measures necessary to minimize siltation effects from gravel removal and road construction."

"11. In the discussion of extraction and placement of gravel (pages 96-98), there is no mention of the applicability of Prevention of Significant Deterioration regulations to this aspect of the project, or whether certain exemptions from PSD review may apply."

"17. A reference should be included for the statement that damage to lichens would result from exposure to SO_2 concentrations of 775 ug/m^3."

"25. The section on hydrology impacts (page 86) states that gravel extraction can affect a number of physical factors in streams, but does not mention sedimentation (mentioned, however, under the topography, geology, and soils section). To be meaningful, the document should discuss water bodies likely to be affected and their known sensitive aspects."

Fish and Game

"A related issue is that of the water injection system. This was discussed briefly in various places throughout the DEIS. However, it is unclear whether or not the present DEIS is meant to suffice for both the SGCF and the water injection system."

Comment: Both Fish and Games' comment and Environmental Conservations' Comment No. 25 should be considered applicable under the Air, Land and Water Quality Standard (6 AAC 80.140) as well.

Environmental Conservation

"5. In the conclusions and recommendations section, the listing of procedures to mitigate effectively the potential environmental impacts from the proposal provides a good starting point for drafting more specific measures. Oil Spill Contingency and SPCC planning should be added to the list of concerns. We hope the process exists for translating these generic concerns to specific, stipulatory language. For example, mitigating measures 10 and 11 specify 'biologically sensitive areas during sensitive periods' and 'areas sensitive to wildlife disturbance.' These references are not effective as stipulations unless accompanied by a detailed listing by resource agencies of areas and times when resources are sensitive to disturbance."

"6. The SELEXOL process description (pages 1-7) states that H_2S, COS, and mercaptans are removed from the gas, flashed off, and vented or sent to a sulfur recovery unit. We request that the document state the quantities of these odorous and highly toxic compounds and other significant emissions that are anticipated. The impact section includes only a table of predicted increases in ground level concentrations, of the standard air pollutants--SO_2, NO_x, PM, etc.

"7. Description of facilities such as generators, flares and incinerators (page 11) should be accompanied by type and size of unit and quantity of emissions. Reference should be made to Appendix F.1."

"9. The description of the staff air dispersion analysis is not adequate. Procedures for determining plume height are not indicated, 'worst case' meteorological contributions are not identified, and the assumption that background concentrations are insignificant is not justified."

"10. Table 10, titled 'Maximum Predicted Ambient Air Quality Background Levels and NAAQS,' is misleading at best. Procedures for estimating the values presented are not indicated. The interpretation of background is wrong--new ARCO and SOHIO PSD sources are <u>not</u> included in the definition of background. There is no justification given for excluding EPA's suggested 'natural background' values given in EPA-450/2-78-019. The Alaska Air Quality Standards, which are in some instances more stringent than the NAAQS, should be used for comparison."

"Footnote 'a' says predicted maxima are downwind from the proposed site without giving the wind direction--this is not a meaningful concept for annual values. The ambient air quality data being collected for ARCO-SOHIO should be used in rewriting the air quality section and in preparing the table."

"12. Table 15, 'Comparison of NAAQ Standards Maximum Downwind Ground-Level Increases in Pollutant Concentrations Resulting From Construction Equipment' is incomplete and misleading. The table does not indicate whether it includes the impact of construction equipment only, or whether the equipment only, or whether the equipment at the construction camp or fugitive dust is included. There is no list of the emitting sources, quantities, and types of emissions, nor comparison with State Air Quality Standards of PSD increments. To what column(s) does footnote 'a' apply? Footnote 'c' is erroneous, the lead standard is a quarterly arithmetic mean of 1.5 ug/m^3, without reference to daily values, and one which is never to be exceeded. There is no footnote 'e' as indicated in column '1' at the entry 'Lead (Pb^{+2})e.'"

"13. The discussion of impacts from operating the facility is incomplete. There is no list of equipment, types and quantities of emissions, nor is there a description of the modeling procedures. the comparison of calculated increases with minimum significance levels is inappropriate since Prudhow Bay is not an nonattainment area. The State Ambient Air Quality Standards are not listed.

"The list of assumptions used in the dispersion analysis is good, but there is no explanation of why the turbine plume rise was reduced nor is there justification for stating that 900 meter mixing height is 'worst case'--a plume, for example, trapped below a 300 meter strong inversion layer would cause worse ground level concentrations.

"16. The conclusion to the air quality impact section states that aesthetic impacts would be minimal. Visibility of the plume should be included in this consideration."

"19. The discussion of air quality impacts at the North Pole alternative site (pages 151-153) suggests the CO emissions will occur primarily from construction equipment and stationary turbines. In fact the use of vehicles by 1000 construction workers and 200 permanent employees and their families could be the most significant concern. Since the area is nonattainment for CO, measures to mitigate these CO emissions must be described."

"The document also states (page 200) that costly reduction of emissions produced by other facilities would be required before the SGCF could be placed in operation. This is highly misleading since most CO emissions are generated by vehicles."

"20. Appendix E, 'Ambient ground-level concentrations from construction of the SGCF and anciliary facilities', presents much of the information which we feel should be clearly described and summarized in the main text of the DEIS. However, we have some serious concerns regarding this discusssion."

"On page 241, the description of the box model is unclear and the results are probably much too low. The model apparently causes a uniform distribution of contaminant in a flat vertical space with dimensions of 500 meters by 4+ miles x 1 second. This volume does not expand with time or distance so an infinitely long rectangular tube is constructed with uniform concentration."

"The short-term/long-term calculation is inappropriate since the original calculation yields a 'steady state' situation. The wind merely moves these 'plates' of contaminated air along, and doesn't contribute to additional dispersion."

"Dividing by a wind speed as high as 12.2 miles/hour gives much lower concentration estimates than would be obtained using a 'worst case' speed of 1-2 knots."

"The sample calculation (page 241) derives short-term (24 hour) concentration from long term, the reverse of the normal procedures. The result, 49.67 ug/m^3, apparently is reported in Table E-7 as a 1-hour figure, and the calculated annual figure, 2.6 ug/m^3, is apparently shown in the table as the 8-hour figure. This situation is very confusing, and throws doubt on the validity of the table."

"The term 'downwind' in the title E-7 is meaningless since direction is a concept, not an input."

"There is no estimate of TSP from the gravel operations included in Table E-3, only emissions form the equipment.

"The estimated change in pollutant concentrations is not compared with State Air Quality Standards of PSD increments."

"Background concentrations are not included with the increased pollutant levels for comparison with the primary/secondary standard."

"The footnotes to Table E-7 regarding lead ('c' and 'e') are erroneous, as noted in comment 12."

"21. In appendix F, page 245, we feel interpretation of 'background' is wrong. The new ARCO and SOHIO facilities also consume increment. There is now discussion of actual ambient air quality data and its possible use to determine background. There is no comment about the applicability of SPA's 'natural background levels' published in EPA-450/2-78-014. There is no justification for making the assumption that meteorological data from Barter Island is the same as in Prudhoe Bay. Barter Island's exposure to the Arctic Ocean causes a different distribution of wind directions, but it can be argued that the difference is not sufficient to change the results of the dispersion analysis."

"In sections 2 and 3 of Appendix F, we see similar concerns. The description of PTMTP is insufficient since it is not one of the so called EPA guideline models listed in OAQPS 1.2-080. The interpretation of background is wrong; the ARCO and SOHIO facilities consume increment; and the increased should be compared with NAAQS (and state standards), not just the 'background.' The increases due to operation of SGCF should be compared with remaining increment for Class II areas, not the offset policy minimum significance levels. The discussion of treating emissions from clusters of sources is unclear. The intent of treating multiple sources as though they were one or more single sources upwind from the new facility is apparent, but the treatment of the emissions when calculating maximum concentrations is not at all clear."

"22. The discussion of solid waste disposal is inadequate. Solid waste presents a major environmental concern on the North Slope because of the huge quantities of debris that have been improperly disposed of and abandoned in the past. Regardless of existing facilities, the developer must take responsibiltiy for all facets of solid waste management. An incinerator and landfill (page 16) are only one aspect of the required solid waste system. The solid waste stream must be broken into components, with quantative estimates, suitable for various types of disposal. Alternative disposal methods, such as a sea-lift of waste materials or use of the North Star Borough (Fairbanks) solid waste baler, should be investigated. An analysis of potential markets should be done for materials that must be back-hauled."

"Contrary to the expression in the document (page 73), we feel that wintertime covering of refuse is feasible at the Arco landfill, except perhaps in periods of extreme cold. The dry cover material allows working at subzero temperatures. It should also be noted that burial of biodegradable wastes does not depend on available cover--biodegradables cannot be buried at any time."

"The attached solid waste guidelines for arctic and sub-arctic development indicate present policy of the Department."

"23. The nature of the waste product disposal system (page 11) should be described. It is not clear whether this refers to the solid waste, wastewater, or process waste system."

"24. Disposal of material excavated from the water storage reservoir must be addressed (page 12 and 123). Salt water intrusion into the storage reservoir is a possibility that should be recognized."

"26. The section on mitigation measures indicates (page 124) that sanitary wastes would be trucked to a sanitary landfill. These wastes, of course, must receive treatment in an approved wastewater treatment facility, presumably that described on page 15."

Fish and Game

"Waste disposal is another problem area. In construction of the water reservoirs at Prudhoe Bay, somewhere between 300,000 and 400,000 cubic yards of spoil will be excavated. However, there is no indication of where this material will be wasted. This could be a significant environmental concern. The DEIS also states that it is unkown how much hazardous waste will be generated and that it is assumed that the ARCO disposal site will be available. We suggest that before environmental impact can be assessed, we must know exactly how much and what kind of hazardous waste will be generated and exactly where it will be placed.

Department of Fish and Game is concerned about such aspects of the project as : 1) possible discharge of toxic chlorinated waste water into Prudhoe Bay, 2) discharge of large quantities of silt and organic material into Prudhoe Bay, 3) potential entrainment and impingement of marine organisms during water withdrawl, 4) discharge of toxic water and water with high BOD into Prudhoe Bay under winter ice when there is little current movement to cause dilution and when organisms are already under stress from low temperatures, low oxygen levels and high salinities. It is our contention that the water injection system is a project of such potential environmental impact that it will require its own EIS. That EIS should be forthcoming in the near future."

Comment: The Department of Environmental Conservation Comment No. 25 and the Department of Fish and Game comment contained in the Subsistence (6 AAC 80.120) section also pertains to the Air, Land and Water Quality standard as well.

AGENCIES AND THEIR JURISDICTIONS

Agency	Jurisdiction, Statutes, Codes
Federal	
Army Corps of Engineers	-Approves construction of dock facilities, dredging, and pipeline crossings of navigable waters. (Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act of 1977.)
	-Receives required certification from states to insure compliance with state plans for land and water use programs for coastal waters and shorelines.
Department of Labor Occupational Safety and Health Administration	-Approves facility if in compliance with OSHA regulations.
Department of Transportation Office of Pipeline Safety	-Approves design and operations of gas pipelines.
Coast Guard	-Approves design and operations of dock facilities; approves vessel operations; regulates safe shipping practices. Issues permits for pipeline crossings of navigable waters; approves design and operations of private aids to navigation; regulates safe shipping practices.
Environmental Protection Agency	-Issues permits for wastewater discharges (NPDES permits) and prevention of significant air quality deterioration.
	-Reviews project impact on environment, with special attention on air, water, noise, and solid waste impacts.
	-Reviews New Source Performance Standards applications.
Federal Aviation Administration	-Reviews facility designs to determine if hazard to aviation would be created.

Agency	Jurisdiction, Statutes, Codes
Federal (cont.)	
Federal Communications Commission	-Certifies all communications equipment. Issues permits for radio towers.
Federal Energy Regulatory Commission	-Approves construction or operation of any pipeline or related facility for the transportation of natural gas in interstate commerce.
State of Alaska	
Department of Commerce Division of Occupational Licensing	-Issues electrical licenses and welding certificates.
Department of Environmental Conservation Division of Water and Air Quality Control	-Issues permits for air emissions, open burning, wastewater discharges, road oiling, and solid waste management.
Department of Health and Social Services Division of Public Health	-Issues food service permits.
Department of Natural Resources Division of Land	-Issues permits for lease operations, gravel removal, water appropriations, miscellaneous land use, and special land use.
Department of Public Safety Division of Fire Prevention	-Approves plans.

STANDARDS APPLICABLE TO THE CONSTRUCTION AND OPERATION OF THE PROPOSED SALES GAS CONDITIONING FACILITIES

Alaska Administrative Codes 18, 50, 60, 70

American Concrete Institute (ACI) Standards 318-71 and 347

American Institute of Steel Construction, Inc., Part 5, Section 1.23

American National Standards Institute (ANSI) S1.4-1971, S1.6-1967, S1.11-1966, S.1.20-1962, B31.3, B31.8

American Petroleum Institute (API) Bulletin 1105

API Standards 5LX, 610, 613, 616, 617, 660, 661, 1104

American Society for Testing and Materials (ASTM) Standards C33, C150, A252, C109, C190, C531, E23

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Guide

American Society of Mechanical Engineers (ASME) Section VIII, Div. 1 and 2, Section IX and E-165

American Welding Society

National Ambient Air Quality Standards (NAAQS)

National Electrical Code

National Fire Protection Association (NFPA)

National Plumbing Code

OSHA (Title 29 of CFR)

Tubular Exchanger Manufacturers' Association (TEMA)

Uniform Building Code

APPENDIX K

FAIRBANKS NORTH STAR BOROUGH

P. O. Box 1267 — Fairbanks, Alaska 99707

M E M O R A N D U M

TO: Philip R. Berrian, Planning Director
FROM: Allen R. Cronk, Land Management Officer
SUBJECT: Potential Conditioning Plant Sites
DATE: August 28, 1979

Attached are very brief summaries of six (6) sites which are potentially available for a gas conditioning plant. Since I am unaware of all the features desired for such a plant site, only the most obvious features are addressed. There are many more sites potentially available in both public and private hands which should be considered once the pipeline route becomes final. Minor reroutes or loops could make even more sites available.

The six sites aggregate 32,400 acres which could be developed, at a reasonable cost and only minor environmental impact. All areas are currently zoned Unrestricted Use and would require no further action to allow plant construction.

Allen R. Cronk

ARC/kea

STAFF REPORT
POTENTIAL CONDITIONING PLANT SITES

Name:	Peede Road Site
Legal Description:	T. 1 S., R. 2 E., F.M. sec. 16, 21, 26, 27 and 28
Selection:	Borough or CIRI selected
Acreage:	3,200
Average Elevation:	450 feet above MSL
Road Access:	Excellent - Badger, Peede, Brock Roads, Richardson Highway
Rail Access:	Available upon construction of 2.5 miles of Spur line.
Water:	Virtually unlimited based on well tests on Fort Wainwright and Eielson Air Force Base.
Power:	Available
Gravel:	Available on site
Seismic:	A fault is known to exist in the area.
Ice Fog:	Excessive emissions could cause a problem. A tall stack is desirable.
Pipeline:	On-site (Alyeska)

REMARKS:

Lying between Fairbanks and North Pole, the site is centrally located within easy commuting distance of existing housing and other necessary ancillary facilities.

ARC/kea
8/28/79

STAFF REPORT
POTENTIAL CONDITIONING PLANT SITES

Name:	Elliot Highway Site
Legal Description:	T. 3 N., R. 1 W., F.M. secs. 5, 6, 7 and 18 T. 3 N., R. 2 W., F. M. secs. 1, 2, 3, 9, 10, 11, 12, 13, 14, 15, 16, 21 and 24
Selection:	Borough selected and State Land
Acreage:	10,880
Average Elevation:	1,000 feet above MSL
Road Access:	Good - Elliot Highway and Alyeska access roads.
Rail Access:	Appears to be feasible by utilizing the old Chatanika Railroad grade and tunnel (about 35 miles).
Water:	Virtually unlimited but may require the construction of 1 to 3 miles of water main.
Power:	Proposed new 69 kv line from waste heat generation at Alyeska pump station will cross this site in an estimated 2 years.
Gravel:	Little needed but available within economic haul.
Seismic:	No known faults
Ice Fog:	No problem considering height of land
Pipeline:	On-site (Alyeska)

REMARKS:

No legal population known within impact area but low density recreation use throughout area.

ARC/kea
8/28/79

STAFF REPORT
POTENTIAL CONDITIONING PLANT SITES

Name:	Old Murphy Dome Road Site
Legal Description:	T. 3 N., R. 1 W., F.M. secs. 32, 33 T. 2 N., R. 1 W., F.M. secs. 3, (W½), 4
Selection:	Borough selected and State Land
Acreage:	2,240
Average Elevation:	1,000 feet above MSL
Road Access:	Require construction of 4 to 5 miles of road.
Rail Access:	Appears to be feasible by utilizing the old Chatanika Railroad grade and tunnel (about 25 miles).
Water:	Virtually unlimited but may require construction of 1 to 2 miles of water main.
Power:	Proposed new 69 kv line from waste heat generator at Alyeska pump station will cross this site in an estimated 2 years.
Gravel:	Little needed but available within economic haul.
Seismic:	No known faults
Ice Fog:	No problem considering the height of land.
Pipeline:	On-site (Alyeska)

REMARKS:

No legal population known within impact area but recreation use (summer and fall) within 1 mile of site.

ARC/lls
8/28/79

STAFF REPORT
POTENTIAL CONDITIONING PLANT SITES

Name:	Johnson Road Site
Legal Description:	T. 4 S., R. 5 E., F.M. Portions of secs. 7, 17, 18, 19, 20, 21, 22, 27, 28, 29, 30
Selection:	Borough Selected
Acreage:	5,680
Average Elevation:	1,250 above MSL
Road Access:	Good
Rail Access:	Available upon construction of 10 miles of spur line.
Water:	Virtually unlimited but may require construction of 2 or more miles of water main.
Power:	Available along road
Gravel:	Little needed but available within economic haul.
Seismic:	No known faults
Ice Fog:	No problem considering height of land
Pipeline:	On-site (Alyeska)

REMARKS:

Pump Station 8 is on this tract.

Very low population density within impact area.

Remote from settlement, temporary construction facilities are likely to be required unless excess billoting space is available at Eielson AFB and it is made available for private use.

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8/28/79

STAFF REPORT
POTENTIAL CONDITIONING PLANT SITES

Name:	Vault Creek Site
Legal Description:	T. 2 N., R. 1 W., F.M. secs. 11 & 12
Selection:	Borough Selected
Acreage:	1,200
Average Elevation:	1,000 feet above MSL
Road Access:	Good - Elliot Highway & Old Murphy Dome Roads
Rail Access:	Appears feasible by utilizing the Old Chatanika Railroad grade and tunnel (about 20 miles).
Water:	Virtually unlimited but may require construction of 4 miles of water main.
Power:	Proposed 69 kv line from waste heat generator at Alyeska Pump Station will cross this site in estimated 2 years.
Gravel:	Little needed but available within economic haul.
Seismic:	Considering the mineralization with area, faults are likely on this site.
Ice Fog:	No problem considering height of land
Pipeline:	On-site (Alyeska)

REMARKS:

No legal population is known within this impact area but mining interest surrounds the tract.

ARC/lls
8/28/79

STAFF REPORT
POTENTIAL CONDITIONING PLANT SITES

Name:	French Creek Flats Site
Legal Description:	T. 4 S., R. 4 E., F.M. secs. 6, 7 and 18 (Borough Selected) Portions of secs. 1, 2, 4, 5, 9, 10, 11, 12, 13, 14, 15, 23 and 24 (State Land)
Selection:	Borough Selection and State Land respectively
Acreage:	9,200
Average Elevation:	700 feet above MSL
Road Access:	Richardson Highway, spur road construction
Rail Access:	Approximately 6 miles of spur line construction
Water:	Based on Eielson well tests, virtually unlimited.
Power:	Available along the Highway.
Gravel:	Available on-site
Seismic:	No known faults
Ice Fog:	Excessive emissions could impact Eielson AFB
Pipeline:	On-site (Alyeska)

REMARKS:

The western portion of the tract lies within Eielson approach path hense would require heighth limits and would be subjected to a crash hazard.

Remote from settlement, temporary construction facilities are likely to be required unless excess billoting space is available at Eielson AFB and it is made available for private use.

Very low population density within impact area.

ARC/kea
8/28/79

POLUTION CONTROL TECHNIQUES

Particulate Control Technology

Particulate matter from the combustion of coal occurs mostly in the form of fly ash. Uncontrolled particulate loadings in the flue gas leaving a boiler can range from 2 to 13 gr/SCF of dry gas. Removal efficiency for particulate matter depends upon many influences but particle size is usually the controlling factor. Fly ash is the major contributor to stack gas opacity. It it is not removed, a visible plume occurs which may produce dust "fall out" on the surrounding area. Collected particulate matter can be combined with bottom ash and used as landfill, road base material, granular material for roofing, aggregate in concrete blocks and preformed concrete, asphalt mix material, cinders for icy road, insulation, and grit for sand blasting. Improper handling of collected ash may create environmental problems from fugitive ash emissions and leachate from ash storage and landfills.

There are several types of equipment which can be used to control particulate matter: mechanical collectors, electrostatic precipitators, fabric filters, and wet scrubbers. The plant design for Fairbanks dictates cartridge-type fabric filter inserts, which use tublar fabric bags to filter out particulate matter in the flue gas. Filtration is efficient, normally removing more than 99 percent of the particulates. The efficiency of each individual bag, (cartridge insert) however varies with time and dust accumulation on the bag surface. After a fixed period of time, a section of the baghouse, (cartridge insert) containing a number of individual bags, is isolated from the gas stream. Each bag is cleaned by one of various methods. When cleaning is complete, the section is returned to service and another section is removed for cleaning.

Sulfur Dioxide Control Technology

Sulfur dioxide (SO_2) is generated when the sulfur in coal is burned. Two general types of control which have been used over the past 15 years in the petrochemical industry are wet and dry flue gas desulfurization (FGD) processes. The dry processes consist of a gas/solid contacting system which absorb SO_2 into the solid matter. Dry lime/limestone injection and absorption on activated carbon, finely ground charcoal, coke, and silica gel have all been tested and applied to boilers in varying degrees. The lime/limestone injection process has been applied to a small number of utility boilers but the process created major operational problems and has been dropped in favor of a wet process. The dry absorption processes are currently being developed for coal-burning utility plants and are not currently available for commercial application.

The wet FGD processes have had by far the greatest success in utility boiler applications. In these processes, SO_2 is absorbed (within the scrubber) into a water slurry or solution and reacts to form sulfurous acid, which in turn is neutralized by an alkali contained in the system. All processes are classified as either throwaway or regenerable. Throwaway processes generate a sulfite/sulfate waste product which must be disposed of. The regenerable processes regenerate the alkali and produce one of the many byproduct sulfur compounds which can be marketed. No exact engineering designs for SO_2 removal at the SGCF have been supplied to the FERC.

Nitrogen Oxide Control For Coal-Fired Steam Plants

Oxides of nitrogen are a major contributor to the total air pollution problem existing in industrial areas. Generally referred to as NO_x, this gaseous pollutant includes both nitric oxide (NO) and nitrogen dioxide (NO_2).

Oxides of nitrogen react with other compounds in the atmosphere to form nitric acid, nitrates, nitrites, nitro-compounds, aldehydes, ketones, peroxides, acyl-nitrates, and particulates. These compounds, collectively called photochemical smog, all absorb solar radiation and produce free radicals which form new compounds. (i.e., increasing smog formation). Various oxides of nitrogen react with water and acidify precipitation. Gaseous and particulate nitrogen oxides both discolor and attenuate light transmission through the atmosphere, thus reducing visibility.

Nitrogen oxides are produced when fuel-bound nitrogen is released during combustion, as well as from the fixation of atmospheric nitrogen in the combustion air. Not all of the fuel nitrogen is converted to NO_x; typically, only 40 percent to 60 percent is converted, depending upon the coal's fuel nitrogen content, firing conditions, and the structure of the nitrogen-containing molecules within the coal. Under certain conditions, it could be important that the nitrogen-containing molecules were associated with the volatile fraction of the coal rather than with the fixed carbon portion. The chemical oxidation state of the nitrogen species is important because nitrogen that is partially oxidized will be more easily converted to NO. The mechanism of forming "fuel NO_x" is not well understood. There is some evidence to support the belief that lowering the available oxygen in the combustion process will limit the formation of "fuel NO_x."

Atmospheric nitrogen enters the boiler system via the combustion air. At combustion temperatures of 3,500°F. and below, a small portion of this nitrogen is oxidized to form "thermal NO_x." This cannot be completely prevented, but it can be significantly reduced by one of the three general methods: lowering the peak flame temperature, reducing the availability of oxygen in the flame, or altering the residence time/temperature profile in the combustion zone.

Several processes have been developed to control NO_x by removing it from the flue gas or reducing it to elemental nitrogen. These processes are not as economical as the combustion modifications, but in some applications they may be necessary.

COMMENTS ON THE DEIS

Advisory Council On Historic Preservation

1522 K Street N.W.
Washington D.C.
20005

Reply to: P. O. Box 25085
Denver, Colorado 80225

REGULATORY COMMISSION

RECEIVED BY
AUG 15 1979
M. J. S.

August 6, 1979

Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Dear Sir:

This is to acknowledge receipt of the draft environmental statement for the construction and operation of a sales gas conditioning facility at Prudhoe Bay, Alaska, on August 4, 1979. We regret that we will be unable to review and comment on this document in a timely manner pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969.

Nevertheless, the Federal Energy Regulatory Commission is reminded that, if the proposed undertaking will affect properties included in or eligible for inclusion in the National Register of Historic Places, it is required by Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) to afford the Council an opportunity to comment on the undertaking prior to the approval of the expenditure of any Federal funds or prior to the issuance of any license. The Council's regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800.4) detail the steps an agency is to follow in requesting Council comment.

Comment reflected in the staff's recommendation in section I of the FEIS.

Generally, the Council considers environmental evaluations to be adequate when they contain evidence of compliance with Section 106 of the National Historic Preservation Act, as amended. The environmental documentation must demonstrate that either of the following conditions exists:

Ibid.

1. No properties included in or that may be eligible for inclusion in the National Register are located within the area of environmental impact, and the undertaking will not affect any such property. In making this determination, the Council requires:

--evidence that the agency has consulted the latest edition of the National Register (Federal Register, February 6, 1979, and its monthly supplements);

--evidence of an effort to ensure the identification of properties eligible for inclusion in the National Register, including evidence of contact with the State Historic Preservation Officer, whose comments should be included in the final environmental statement.

2. Properties included in or that may be eligible for inclusion in the National Register are located within the area of environmental impact, and the undertaking will or will not affect any such property. In cases where there will be an effect, the final environmental statement should contain evidence of compliance with Section 106 of the National Historic Preservation Act through the Council's regulations, "Protection of Historic and Cultural Properties".

Should you have any questions, please call Jane King at (303) 234-4946, an FTS number.

Sincerely,

Louis S. Wall
Chief, Western Division
of Project Review

September 27, 1979

RECEIVED BY

L. J. S.

Federal Energy Regulatory Commission
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

Attention: Lois D. Cashell, Secretary

Subject: **Alaska State Clearinghouse Review Closeout on Draft Environmental Impact Statement for Construction and Operation of Gas Conditioning Plant at Prudhoe Bay, State I.D. No. 79073003**

Dear Ms. Cashell:

The Alaska State Clearinghouse has completed review on the subject DEIS. These review results constitute the response of the Office of the Governor to the FERC's request for comment.

The following agencies commented:

The Alaska Department of Fish and Game said:

> "The Alaska Department of Fish and Game has reviewed the draft Environmental Impact Statement prepared for the Sales Gas Conditioning Facility. We have significant problems with the document and would like to take the opportunity to enumerate them.
>
> "The document is entitled Prudhoe Bay Project: Draft Environmental Impact Statement. This indicates to us that FERC had already predetermined the location of the plant and did not intend to give serious considerations to other potential sites, despite the wishes of the State of Alaska. This was borne out by the cursory treatment of both the North Pole and Yukon River potential sites later in the document. In fact, it appears that the recommendations of FERC were not based on environmental considerations. Their conclusion was that '...the proposed Prudhoe Bay site is acceptable. While the staff considers the North Pole alternative site to be acceptable as well, it believes that the site is not sufficiently superior to the Prudhoe Bay site to warrant its selection.' We suggest that the converse is also true: that the North Pole site is not sufficiently inferior to warrant its disqualification, notwithstanding engineering constraints. Table 1 presents a listing of fourteen

As stated on page 134 of the DEIS, the state of Alaska specifically requested that the Yukon River and Fairbanks sites be examined. The staff has since examined six additional sites in the Fairbanks area, as requested by the Fairbanks North Star Borough, and examined one of these six in greater detail in the FEIS. The staff further agrees that the North Pole site is not sufficiently inferior to warrant its disqualification and did not mean to imply that. The conclusion section of the DEIS has since been modified. Table 1 should be expanded to include <u>all</u> of the staff's criteria rather than selected factors.

environmental factors. Based on FERC's own discussion, it can be seen that the Prudhoe Bay site will have problems with 12 of the 14. The North Pole and Yukon River sites will experience conflicts with 3 and 7 respectively. It is obvious then that the recommendations in this environmental impact statement were made on other than environmental grounds.

"A major concern with the Prudhoe Bay site is the possibility of construction of a new causeway and dock. The existing ARCO dock was the subject of extensive review and controversy. Another dock would require substantial amounts of gravel, may cause changes in water circulation, nearshore salinity, and local ice conditions and may adversely affect fish and marine mammal migrations and freshwater discharge from the Sagavanirktok River. Therefore, ADF&G does not favor additional docking facilities at Prudhoe Bay.

Comment reflected in section C.3 of the FEIS.

"The docking facilities would be needed for off-loading modular units barged to the Prudhoe Bay site. It is proposed to use modular construction in order to: 'Minimize the impacts of the process plant on the permafrost, to minimize the plant's acreage layout and to facilitate the ease of construction at the construction site.' We grant that these may be valid reasons for considering modular construction at Prudhoe Bay (although how modular construction will minimize the acreage occupied by the plant is not explained). However, the DEIS rejects the North Pole site partially on the grounds that modular units could not be transported to it overland. We suggest that modular construction would not be necessary at the North Pole site 'because of the general absence of permafrost on the site', as stated in the DEIS, and because the construction season is longer and more clement in the Fairbanks area than at Prudhoe Bay. Construction of large facilities without the modular approach has taken place for decades in Fairbanks.

Comment noted.

"The gravel requirements of the Prudhoe Bay site are tremendous; if the figures presented in various parts of the document are summed, the total is nearly 5 million cubic yards. Yet the DEIS states that gravel will be gotten from the Putuligayuk River. Gravel on the North Slope is scarce. The Putuligayuk River site has been nearly depleted. The scarcity of gravel is a major consideration in choosing a route for the natural gas pipeline. To put the matter in perspective, and using approximate figures, Alyeska Pipeline Service Company used 62 million cubic yards of gravel to build the oil line pad, haul road and related facilities pads. The gravel came from 400 material sites of an average size of 155,000 cubic yards. It will then take 32 APSC average-sized material sites to supply the SGCF, dock and causeway with gravel. The problem of attaining gravel, therefore, becomes a major environmental concern and one which must be addressed in detail in the final EIS.

Comment reflected in section C.3 of the FEIS.

"The existing data for fish and wildlife species of importance have not been examined thoroughly. For example, the caribou is an extremely important mammal on the North Slope. Yet no data from ADF&G studies has been included in the reference material. We invite FERC to avail themselves of the information gathered by our biologists and we hope that the caribou will not be treated so casually in the final EIS. The invitation to examine ADF&G literature extends, of course, to other Alaskan species besides the caribou.

See reference section of FEIS for ADF&G studies that were used but not cited in the DEIS. Also, see section B.6 of the FEIS.

"It appears that very little direct knowledge of Alaska was used in writing the DEIS. For example, the Yukon River site is considered to have impact on the peregrine falcon which 'nests in the steep cliffs and canyon areas of the Yukon River near the Canadian border and also at Franklin Bluffs.' It should be pointed out that the proposed Yukon River site for SGCF is at least 400 miles away from either of these locations and, further, that Franklin Bluffs is not even on the Yukon River, but rather on the Sagavanirktok River.

Comment reflected in section H.3 of the FEIS.

"The DEIS states that to build the Yukon River facility, moose habitat would be destroyed and the operation of the facility could cause moose to shift to 'less desirable range.' This insinuates that the proposed location is prime moose habitat and that it is the only prime moose habitat in the area. There is no data presented to support these contentions. Altough we would agree that destruction of any moose habitat is undesirable, it is not an occurence which cannot either be mitigated or compensated. This would be true especially if the habitat is neither prime nor scarce. Without a more thorough examination of the facts, a proposed location cannot be rejected because it would destroy moose habitat of an undefined quality or availability.

Comment reflected in section H.3 of the FEIS. Rejection of the Yukon River alternative site was not based solely on impact to moose population in the area. The staff notes that this impact is not considered in table 1 of this comment.

"Waste disposal is another problem area. In construction of the water reservoirs at Prudhoe Bay, somewhere between 300,000 and 400,000 cubic yards of spoil will be excavated. However, there is no indication of where this material will be wasted. This could be a significant environmental concern. The DEIS also states that it is unknown how much hazardous waste will be generated and that it is assumed that the ARCO disposal site will be available. We suggest that before environmental impact can be assessed, we must know exactly how much and what kind of hazardous waste will be generated and exactly where it will be placed.

The first part of the comment is reflected in section C.3 of the FEIS. No hazardous wastes are expected to be generated at the proposed project.

"The DEIS has failed to indicate whether the State of Alaska coastal zone management program has been considered and if the construction of the SGCF is consistent with it. Recent Federal regulations dictate that all Federal actions will be in compliance with approved State coastal zone management plans. A consistency ruling must be obtained from the Alaska Coastal Management Program office before the planning for construction of the SGCF can proceed further.

Comment reflected in sections B.8 and C.8 of the FEIS.

"A related issue is that of the water injection system. This was discussed briefly in various places throughout the DEIS. However, it is unclear whether or not the present DEIS is meant to suffice for both the SGCF and the water injection system. The Alaska

Department of Fish and Game is concerned about such aspects of the project as: 1) possible discharge of toxic chlorinated waste water into Prudhoe Bay, 2) discharge of large quantities of silt and organic material into Prudhoe Bay, 3) potential entrainment and impingement of marine organisms during water withdrawl, 4) discharge of toxic water and water with high BOD into Prudhoe Bay under winter ice when there is little current movement to cause dilution and when organisms are already under stress from low temperatures, low oxygen levels and high salinities. It is our contention that the water injection system is a project of such potential environmental impact that it will require its own EIS. That EIS should be forthcoming in the near future.

Comment reflected in sections A.6 and C.12 of the FEIS.

"The Department could take issue with other details of the DEIS, but we feel that we have identified many of the major concerns. This should be sufficient to demonstrate that the DEIS is lacking in critical areas and must be reworked before it can be considered final.

TABLE 1

Comparison of Environmental Aspects of Proposed SGCF Sites

Environmental Considerations	Prudhoe Bay	North Pole	Yukon River
1. Permafrost present	X	—	X
2. Build new dock	X	—	X[c]
3. Ice fog significantly increased	X	X	X
4. Carbon monoxide significantly increased	X	X	X
5. Conflicts with endangered species			
a. peregrine falcons	—	—	—
b. bowhead whales	X	—	—
6. Significant conflicts with big game animals			
a. moose	—	—	—
b. caribou	X	—	—
c. brown bear	—	—	—
d. black bear	—	—	—
7. Conflicts with waterfowl and shorebirds	X	—	X
8. Impacts on fish and aquatic communities			
a. salt water	X	—	—
b. freshwater	X	X	X

9. Conflicts with marine mammals	X	—	—
10. Inadequate domestic water source	X	—	—
11. Problems with solid waste disposal	X[a]	a	—
12. Problems with sewage disposal	b	—	—
13. Adequate gravel not readily available	X	—	—
14. High hydraulic erosion potential	—	—	X"

The Alaska Department of Environmental Conservation said:

"The Department of Environmental Conservation has reviewed the DEIS for the proposed sales gas conditioning facility at Prudhoe Bay. Serious concerns exist, primarily regarding the air quality sections. For this reason we feel the document is inadequate as written. Our comments follow.

"1. This Department advocates expansion of the existing dock facilities at Prudhoe Bay to accommodate increased barge traffic, rather than construction of a new, separate causeway. The design of an expanded dock and causeway should consider the requirements of possible future facilities in Prudhoe Bay, including marine pipeline corridors to the proposed onshore water reinjection plants and oil production gathering lines from offshore Beaufort Sea lease areas. ARCO and the State of Alaska have informally discussed breaching of the causeway to allow improved east to west transport of Put and Sag River water along the coast. It appears that the existing causeway is presently deflecting estuarine surface waters northward along the causeway, altering the marine environment on the western, nearshore side of the causeway. The possibility of breaching should be acknowledged at the DEIS stage, early enough so that due consideration is given to the alternatives. Breaching subsequent to widening the causeway would be a much more costly venture.

Comment reflected in section C.3 of the FEIS.

"The scenario in the impact section discussing the long term effects of the construction of a new causeway and dock should include the possibility of adverse cumulative effects resulting from two structures. The magnitude of such effects would largely be a function of the location, size and configuration of any new causeway/dock structure. Based on our review of the ARCO causeway research over the last three years, we concur with the statement on page 94 that, of the alternatives considered, 'construction of a new causeway would have the most significant impacts on the bay.'

Comment reflected in sections A-6 and C-12 of the FEIS.

"2. We understand that exact abandonment procedures for the proposed sales gas conditioning facilities are difficult to formulate at this stage. However, the DEIS should not dodge this issue, one which caused a great deal of controversy (and which involved this department for several years) after completion of construction of the TransAlaska pipeline. It is likely that an 'abandonment and restoration' stipulation be included in the text.

"3. The capability and availability of material sources to supply the massive gravel requirements of this project, the gasline, water reinjection facilities, and possibly numerous additional facilities in the Prudhoe Bay area, remain a key issue. A locational map of gravel sources and access roads should be included, along with estimates of volumes the Put River and other sources are likely to be able to provide. Alternatives to the Put River should be discussed. The impact discussion relating to soils and road construction is inadequate and requires expansion. It is presently too general.

"4. Under mitigating measures, the DEIS should include measures necessary to minimize siltation effects from gravel removal and road construction. Reference to the U.S. Fish and Wildlife Service guidelines for gravel extraction and rehabilitation practices on the North Slope would be a useful addition to this section, or to the conclusions and recommendations on pages 201-202.

"5. In the conclusions and recommendations section, the listing of procedures to mitigate effectively the potential environmental impacts from the proposal provides a good starting point for drafting more specific measures. Oil Spill Contingency and SPCC planning should be added to the list of concerns. We hope the process exists for translating these generic concerns to specific, stipulatory language. For example, mitigating measures 10 and 11 specify 'biologically sensitive areas during sensitive periods' and 'areas sensitive to wildlife disturbance.' These references are not effective as stipulations unless accompanied by a detailed listing by resource agencies of areas and times when resources are sensitive to disturbance.

"6. The SELEXOL process description (pages 1-7) states that H_2S, COS, and mercaptans are removed from the gas, flashed off, and vented or sent to a sulfur recovery unit. We request that the document state the quantities of these odorous and highly toxic compounds and other significant emissions that are anticipated. The impact section includes only a table of predicted increases in ground level concentrations, of the standard air pollutants--SO_2, NO_x, PM, etc.

"7. Description of facilities such as generators, flares and incinerators (page 11) should be accompanied by type and size of unit and quantity of emissions. Reference should be made to Appendix F.1.

The DEIS does not dodge the issue. It simply recognizes that it would be pure speculation to address an event 25 or more years in the future.

A general map of the area is provided in figure 1. Comment is also reflected in section C.3 of the FEIS.

Previously addressed by recommendations 7 through 11 of the DEIS.

Comment reflected in section I of the FEIS. Also see the staff's response to the North Slope Borough's comment concerning Alaska Department of Fish and Wildlife approval of more specific wildlife protection plans.

This information is not known at this time. Page 121 of the DEIS identifies the known emissions.

When it is available, this type of information has been considered.

"8. The description of air quality (page 55) states that there are no air quality data suitable for analysis. We are aware of a study done for ARCO entitled, 'Air Quality and Meteorological Baseline Study for Prudhoe Bay, Alaska, June 1974 - June 1975,' Technical Report No. 217, by Metronics Assoc., Inc., dated January 12, 1976. In addition, Radian Corporation is currently conducting an air quality monitoring program for ARCO in support of a Prevention of Significant Deterioration application.

Comment reflected in sections B.4 and C.4 of the FEIS.

"9. The description of the staff air dispersion analysis is not adequate. Procedures for determining plume height are not indicated, 'worst case' meteorological conditions are not identified, and the assumption that background concentrations are insignificant is not justified.

A detailed discussion was deemed inappropriate. This modeling was undertaken to approximate the contribution of air pollutants from existing and EPA PSD-approved facilities.

"10. Table 10, titled 'Maximum Predicted Ambient Air Quality Background Levels and NAAQS,' is misleading at best. Procedures for estimating the values presented are not indicated. The interpretation of background is wrong—new ARCO and SOHIO PSD sources are not included in the definition of background. There is no justification given for excluding EPA's suggested 'natural background' values given in EPA-450/2-78-019. The Alaska Air Quality Standards, which are in some instances more stringent than the NAAQS, should be used for comparison.

"Footnote 'a' says predicted maxima are downwind from the proposed site without giving the wind direction—this is not a meaningful concept for annual values. The ambient air quality data being collected for ARCO-SOHIO should be used in rewriting the air quality section and in preparing the table.

Table 10 has been updated to reflect the Alaska standards. Also see previous response.

"11. In the discussion of extraction and placement of gravel (pages 96-98), there is no mention of the applicability of Prevention of Significant Deterioration regulations to this aspect of the project, or whether certain exemptions from PSD review may apply.

The extraction and placement of gravel is not associated with PSD requirements.

"12. Table 15, 'Comparison of NAAQ Standards and Maximum Downwind Ground-Level Increases in Pollutant Concentrations Resulting From Construction Equipment' is incomplete and misleading. The table does not indicate whether it includes the impact of construction equipment only, or whether the equipment at the construction camp or fugitive dust is included. There is no list of the emitting sources, quantities, and types of emissions, nor comparison with State Air Quality Standards of PSD increments. To what column(s) does footnote 'a' apply? Footnote 'c' is erroneous, the lead standard is a quarterly arithmetic mean of 1.5 ug/m^3, without reference to daily values, and one which is never to be exceeded. There is no footnote 'e' as indicated in column '1' at the entry 'Lead (Pb^{+2})e.'

Table 15 has been changed to reflect only short-term concentrations. All other comments were addressed or appropriate responses already appear in the text.

"13. The discussion of impacts from operating the facility is incomplete. There is no list of equipment, types and quantities of emissions, nor is there a description of the modeling procedures. The comparison of calculated increases with minimum significance levels is inappropriate since Prudhoe Bay is not a nonattainment area. The State Ambient Air Quality Standards are not listed.

There is a discussion of the modeling procedures in appendix F. The calculated increases and the minimum standards were included for comparison. The Alaska standards are now listed.

"The list of assumptions used in the dispersion analysis is good, but there is no explanation of why the turbine plume rise was reduced nor is there justification for stating that a 900 meter mixing height is 'worst case'—a plume, for example, trapped below a 300 meter strong inversion layer would cause worse ground level concentrations.

The turbine plume was reduced because that is EPA's standard procedure for modeling gas turbines. Various mixing heights were modeled. With a very low mixing height, the plume protrudes through the mixing layer, producing no ground-level concentration for purposes of the analysis.

"14. Table 17 is misleading—the increments are partially 'consumed' by the ARCO-SOHIO projects, which should be included in this comparison in addition to the SGCF impacts.

Table 17 was included only as a reference.

"15. The table also shows Class I increments, although no Class I areas are identified, and there is no mention of the distance to any Class I area. The report also does not identify the PSD designation of the Prudhoe Bay area (Class II).

Class I increments have been dropped from the text and table 15.

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"16. The conclusion to the air quality impact section states that aesthetic impacts would be minimal. Visibility of the plume should be included in this consideration.

Comment reflected in section C.4 of the FEIS.

"17. A reference should be included for the statement that damage to lichens would result from exposure to SO_2 concentrations of 775 ug/m^3.

There are four references concerning lichens listed in the reference section of the DEIS.

"18. The discussion of fire protection, vent and flare systems, electrical power, and operation is closer to project description than to mitigative measures.

Comment noted.

"19. The discussion of air quality impacts at the North Pole alternative site (pages 151-153) suggests that CO emissions will occur primarily from construction equipment and stationary turbines. In fact the use of vehicles by 1000 construction workers and 200 permanent employees and their families could be the most significant concern. Since the area is nonattainment for CO, measures to mitigate these CO emissions must be described.

Comment considered. Abating CO emissions can be accomplished by methods other than transportation-related methods, but the economic and socioeconomic costs could create a greater impact.

"The document also states (page 200) that costly reduction of emissions produced by other facilities would be required before the SGCF could be placed in operation. This is highly misleading since most CO emissions are generated by vehicles.

The statement is accurate.

"20. Appendix E, 'Ambient ground-level concentrations from construction of the SGCF and ancillary facilities,' presents much of the information which we feel should be clearly described and summarized in the main text of the DEIS. However, we have some serious concerns regarding this discussion.

"On page 241, the description of the box model is unclear and the results are probably much too low. The model apparently causes a uniform distribution of contaminant in a flat vertical space with dimensions of 500 meters by 4+ miles x 1 second. This volume does not expand with time or distance so an infinitely long retangular tube is constructed with uniform concentration.

"The short-term/long-term calculation is inappropriate since the original calculation yields a 'steady state' situation. The wind merely moves these 'plates' of contaminated air along, and doesn't contribute to additional dispersion.

"Dividing by a wind speed as high as 12.2 miles/hour gives much lower concentration estimates than would be obtained using a 'worst case' speed of 1-2 knots.

"The sample calculation (page 241) derives short-term (24 hour) concentration from long term, the reverse of the normal procedure. The result, 49.67 ug/m^3, apparently is reported in Table E-7 as a 1-hour figure, and the calculated annual figure, 2.6 ug/m^3, is apparently shown in the table as the 8-hour figure. This situation is very confusing, and throws doubt on the validity of the table.

"The term 'downwind' in the title of Table E-7 is meaningless since direction is a concept, not an input.

"There is no estimate of TSP from the gravel operations included in Table E-3, only emissions from the equipment.

"The estimated change in pollutant concentrations is not compared with State Air Quality Standards of PSD increments.

"Background concentrations are not included with the increased pollutant levels for comparison with the primary/secondary standard.

"The footnotes to Table E-7 regarding lead ('c' and 'e') are erroneous, as noted in comment 12.

Comments considered and appropriate changes made in the text.

"21. In appendix F, page 245, we feel interpretation of 'background' is wrong. The new ARCO and SOHIO facilities also consume increment. There is no discussion of actual ambient air quality data and its possible use to determine background. There is no comment about the applicability of SPA's 'natural background levels' published in EPA-450/2-78-014. There is no justification for making the assumption that meteorological data from Barter Island is the same as in Prudhoe Bay. Barters Island's exposure to the Arctic Ocean causes a different distribution of wind directions, but it can be argued that the difference is not sufficient to change the results of the dispersion analysis.

Comment considered. Refer to the response to comment 9.

"In sections 2 and 3 of Appendix F, we see similar concerns. The description of PTMTP is insufficient since it is not one of the so-called EPA guideline models listed in OAQPS 1.2-080. The interpretation of background is wrong; the ARCO and SOHIO facilities consume increment; and the increases should be compared with NAAQS (and state standards), not just the 'background.' The increases due to operation of SGCF should be compared with remaining increment for Class II areas, not the offset policy minimum significance levels. The discussion of treating emissions from clusters of sources is unclear. The intent of treating multiple sources as though they were one or more single sources upwind from the new facility is apparent, but the treatment of the emissions when calculating maximum concentrations is not at all clear.

EPA still recognizes the PTMTP model as a valid air pollution dispersion model for certain modeling situations. To attest to this fact, PTMTP is still obtainable as a standard model in the UNIMAP package and in fact was suggested for use by EPA Region X for this instance. The increases from the operation of the proposed facility were compared to the minimum significance levels to demonstrate their relationship to them. It is more appropriate to compare the expected increases to the minimum significance levels because these levels are more stringent than the Class II PSD increments. Analyzing clustered omissions is a standard modeling procedure.

"22. The discussion of solid waste disposal is inadequate. Solid waste presents a major environmental concern on the North Slope because of the huge quantities of debris that have been improperly disposed of and abandoned in the past. Regardless of existing facilities, the developer must take responsibility for all facets of solid waste management. An incinerator and landfill (page 16) are only one aspect of the required solid waste disposal system. The solid waste stream must be broken into components, with quantative estimates, suitable for various types of disposal. Alternative disposal methods, such as a sea-lift of waste materials or use of the North Star Borough (Fairbanks) solid waste baler, should be investigated. An analysis of potential markets should be done for materials that must be back-hauled.

The staff agrees that the developer must take responsibility for all facets of solid waste management so as to avoid the improper handling of debris that has occurred along the North Slope. The state may require that the developer backhaul certain materials (See section B.8 of the FEIS.), but an analysis of potential markets for these materials is beyond the scope of this EIS.

"Contrary to the expression in the document (page 73), we feel that wintertime covering of refuse is feasible at the Arco landfill, except perhaps in periods of extreme cold. The dry cover material allows working at subzero temperatures. It should also be noted that burial of biodegradable wastes does not depend on available cover—biodegradables cannot be buried at any time.

Comment reflected in section B.8 of the FEIS.

"The attached solid waste guidelines for arctic and sub-arctic development indicate present policy of this Department.

Guidelines were not attached to submittal.

"23. The nature of the waste product disposal system (page 11) should be described. It is not clear whether this refers to the solid waste, wastewater, or process waste system.

Comment reflected in section A of the FEIS. The system need not be described in detail in this EIS.

"24. Disposal of material excavated from the water storage resevoir must be addressed (pages 12 and 123). Salt water intrusion into the storage resevoir is a possibility that should be recognized.

No information concerning disposal sites is currently available. The staff does not agree that saltwater intrusion is a real possibility.

"25. The section on hydrology impacts (page 86) states that gravel extraction can affect a number of physical factors in streams, but does not mention sedimentation (mentioned, however, under the topography, geology, and soils section). To be meaningful, the document should discuss water bodies likely to be affected and their known sensitive aspects.

Comment reflected in section C.3 of the FEIS.

"26. The section on mitigation measures indicates (page 124) that sanitary wastes would be trucked to a sanitary landfill. These wastes, of course, must receive treatment in an approved wastewater treatment facility, presumably that described on page 15.

Comment noted.

"27. Discussion of the SGCF is mingled in the document with discussion of the Waterflood project (e.g., page 12), causing considerable confusion. Any discussion of the Waterflood should be entirely separate, except when discussing cumulative requirements of impacts.

Comment reflected in sections A.6 and C.12 of the FEIS.

"28. We would be pleased to provide additional in-depth comment on these concerns. Further, we would appreciate the opportunity to work with FERC/EPA in completion of this document so that it becomes a good EIS."

No response required.

The Alaska Department of Community and Regional Affairs said:

"The project site appears to be located within the coastal area, as defined in 6 AAC 85.040. The North Slope Borough is currently preparing a district coastal management program for the 'Mid-Beaufort' area, which extends between National Petroleum Reserve-Alaska and the Arctic National Wildlife Range. The Borough expects to take action locally on its program in the near future. Thus, construction and/or operation of the facility might be subject to the Borough program, depending upon timing actually realized. We, therefore, encourage consideration of the Borough's evolving program in evaluation of this project."

Based upon the concensus of these comments, the Clearinghouse determines that the subject document is inadequate in various areas and, as written, is unacceptable in depth, scope and data necessary to support conclusions of such issues as site selection.

Sincerely,

Jerry L. Madden
State-Federal Coordinator

JLM:cl

cc: Frances A. Ulmer, Director, Division of Policy Development and Planning
Lee McAnerney, Commissioner, Department of Community and Regional Affairs
Ernest Mueller, Commissioner, Department of Environmental Conservation
Richard Logan, Chief, Habitat Section, Department of Fish and Game
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September 24, 1979

Mr. Charles B. Curtis, Chairman
Federal Energy Regulatory Commission
Washington
D.C.
20426

Subject: Comments on FERC Alaska natural gas rulings, policy issues, and the DEIS for a "Prudhoe Bay Project" for the construction and operation of a "sales gas conditioning facility" (SGCF).

References: (1) FERC EIS 0009 D. July, 1979 document.
(2) Northwest Alaskan Natural Gas Transportation Company Docket No. CP78-123 et.al.
(3) Docket No. RM79-19.

Enclosure: (1) Analysis of the issue of the "proposed" SGCF and its alternatives at Prudhoe Bay.

Dear Mr. Chairman:

The various references, and others cited in Enclosures (1) to this letter, suggest a pattern of effort on the part of the FERC to sidestep some very important issues with regard to the wet gas which comes out of the ground along with crude oil at Prudhoe Bay, Alaska. We hope that the FERC under your able chairmanship will consider the national energy implications in the spirit of NEPA and not simply address narrowly circumscribed regulated natural gas questions to which narrowly circumscribed answers will inevitably be provided. FERC is part of DOE and broad gauge objectivity is the appropriate mode, we respectfully suggest.

Please examine and review the enclosed analysis and let us know, as soon as possible, your reactions to the five questions we have asked. Thank you.

Very truly yours,

William H. Kumm

William H. Kumm
President

Enclosure
WHK:jcoc

Enclosure (1) to Arctic Enterprises Inc. letter to Chairman Charles B, Curtis, FERC, September 21, 1979.

ANALYSIS OF THE ISSUE OF THE "PROPOSED" SGCF AND ITS ALTERNATIVES AT PRUDHOE BAY.

1. The July 1979 Draft Environmental Impact Statement (DEIS) FERC/EIS 0009D on the so called "Prudhoe Bay Project" for the construction and operation of a "sales gas conditioning facility" (SGCF) say as follows on page iii of the Foreword:

   (A) *"However both the Decision and the FEIS appear to have considered the transportation system to start at the discharge side of such conditioning and processing facilities."*

   On the same subject it further goes on to say on page iv:

   (B) *"This DEIS is unusual in a number of other aspects. The FERC staff has prepared this EIS even though an application for the necessary processing and conditioning facility has not been filed before the FERC."*

   The combined effect of the Foreword of the DEIS as cited here in (A) and (B) is to say, in effect: "The SGCF is outside of the FERC jurisdiction. However, if we want to look at it, rule on it, write EIS's about it, we will, even if nobody has applied to build one."

2. The DEIS then goes on to acknowledge that at least 10% of the 2.4 BCFD of wet natural gas feedstock at Prudhoe Bay is Carbon Dioxide (CO_2), and that it would be vented to the atmosphere. Thus, some 240 million cubic feet per day of CO_2 will be thrown away, i.e. dumped to the atmosphere, by an SGCF if built and operated at this Arctic site.

   The FERC Docket No. RM79-19 appears to be trying to address the question of the value to be assigned to the processing facility function of making dry pipeline quality natural gas, i.e. with no more than 1% CO_2, from wet oil-associated gas. This would involve the removal of the "unwanted CO_2" and NGLs. If FERC is prepared to assign an economic value to the dry gas at the gas discharge side of a postulated gas conditioning facility, what is the economic value of the CO_2 at its

The foreword does not conclude all the statements made in this comment. It is a fact that the SGCF would be exempt under section 1(b) of the Natural Gas Act. Since no application will be filed with the Commission to construct the conditioning plant, the Commission will have no occasion to take any action on the staff's EIS. However, the staff recognized its responsibility to provide this Commission and other Federal agencies with information not previously published on the SGCF.

The economic value of CO_2 is well beyond the scope of the EIS.

discharge point? That is, what is the value of the CO_2 which the SGCF would throw away, and which is therefore chargeable to the so called "sales gas"? These are questions 1) and 2).

3. On page 131 of the DEIS the first paragraph of the section which is supposed to deal with the Alternatives to the Proposed Action, under the operative NEPA proceedures says:

(C) *"This section discusses alternative siting of the SGCF, alternative pipeline pressure and alternative process design."*

The section does not address alternatives to the "proposed action". It assumes that the "proposed action"; (for which, as has been admitted under (B) there actually is no proposal and therefore no proposed action,) there will be an SGCF, and then goes on to discuss variants on the SGCF.

Furthermore, this same paragraph of the DEIS on page 131 goes on as follows:

(D) *"Other considerations such as (1) alternative pipeline routes, ,2) alternative gas transportation modes and systems, (3) alternative sources of energy, (4) energy conservation, and (5) alternatives of no action were previously addressed in the FEIS's prepared by the Federal Power Commission and the U.S. Department of Interior in April 1976 and March 1976 respectively; they are adopted by reference."*

The difficulty with the logic of (D) in trying to cite the previous FEIS's in the subject EIS on the SGCF is that, as admitted under (A), the SGCF was not covered by these prior FEIS's. It would be just as relevant to cite a prior EIS on a hydrelectric dam for example.

Citing any prior EIS's does not discharge the FERC under this EIS activity from covering all of the alternatives to this "proposed action."

The proposed action is the SGCF, not the construction and operation of the pipeline, which has already been approved. The alternatives cited in the comment and the DEIS are germane in this case and can indeed be referenced rather than reprinted.

4. One other further example of FPC/FERC effort to sidestep an issue directly related to the subject of Prudhoe Bay wet gas processing is cited here.

In 1976 the then Chairman of the FPC, Mr. Richard L. Dunham said in testimony at a Senate hearing as follows, as reported in the Joint hearing record on the issue of the Transportation of Alaskan Natural Gas, Serial 94-72 (Commerce), March 25 and 26, 1976, Page 1835: (Emphasis added).

> *"Senator STEVENSON. How does this (FPC) procedure give adequate consideration to options which are not embodied in applications before the FPC such as the methanol option or the Alcan Highway option?*
>
> *Mr. DUNHAM. Well the methanol and the Alcan Highway and other alternatives have, as I understand it, already been introduced as possibilities in our proceedings.*
>
> *Now there is nothing in existing law which mandates that we issue a final certificate and license on only those two applications (Arctic Gas and El Paso).*
>
> *There is no real limitation on the matter. We could not issue a license on the methanol alternative, as I understand it, because that is not under our jurisdiction."*

(E)

The result of the FPC/FERC not having jurisdiction over methanol then was to ignore it as an alternative. However the intent of NEPA is not to ignore alternatives but to examine them, in a specific section of EIS documents called the section on "Alternatives to the Proposed Action".

Having shown above that the DEIS is not consistent with itself and generically incomplete in the section supposed to deal with the alternatives to the SGCF, what is the FERC going to do about beefing up the DEIS document? This is question 3.

The methanol alternative was addressed in the previous DOI and FPC FEIS's.

The FERC cannot argue that the projected Prudhoe Bay SGCF is sometimes outside and sometimes inside its jurisdiction, but a methanol synthesis plant is always outside, and therefore does not need to be considered as an alternative to the SGCF "proposed action."

Furthermore, the FERC cannot argue that there is an applicant for the SGCF and there is none for a methanol synthesis facility, an ammonia synthesis, a urea synthesis, or a synthetic protein synthesis facility, because as the FERC has admitted, in (B) there is no applicant for an SGCF.

Generating EIS data in an hypothetical "no applicant" situation requires that all hypotheses receive equal treatment.

What revised procedure is FERC now going to institute? This is question 4.

5. There is a large body of data which exists on the subject of the conversion of wet gas to fuel grade methanol. Because the chemical process is carbon-shy, all of the CO_2 at Prudhoe Bay would be used. All of the NGL's would be used. All of the methane would be used.

See the staff's previous response.

Furthermore, because of the unique case at Prudhoe Bay, that a pipeline already exixts which can carry all the fuel grade methanol that could be produced at this site, there never was, nor is there now, any need for an FPC/FERC regulated commodity proceeding based on applications to build a new gas pipeline.

When is the FERC going to start operating with a policy of a national department of energy instead of persisting in endeavors, proceedings, litigations, rulings, etc.

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related to arbitrary energy commodity forms regulated from the point of market end custody transfer backwards to the source? This is question 5. When you ask a natural gas question you tend to get a natural gas answer, not necessarily an energy, or social utility answer.

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BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF PIPELINE AND PRODUCER REGULATION

Washington, D.C. 20426

PRUDHOE BAY PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT, CONSTRUCTION AND OPERATION OF A SALES GAS CONDITIONING FACILITY AT PRUDHOE BAY, ALASKA JULY, 1979	NORTHWEST ALASKAN GAS TRANSPORTATION COMPANY Docket No. CP 78-123, et al

Comments of Atlantic Richfield Company

I

Atlantic Richfield Company (ARCO) concurs with the general conclusion reached by the staff, at pages ii-iv, that the assessment of environmental impact presented in this docket would not be necessary but for the fact that the final environmental impact statement (FEIS) for the Alaska Natural Gas Transportation System (ANGTS) failed to "fully assess the environmental impact of the facilities which will be necessary to condition and process Prudhoe Bay gas prior to pipeline transmission." Although ARCO is not now and does not intend to become an applicant for a permit to construct or operate such facilities, in light of the particular circumstances surrounding the adoption of the Alaska Natural Gas Transportation Act (ANGTA) and the interaction with the Commission's interpretation of the Natural Gas Act (NGA), ARCO believes it appropriate to submit comments in this matter.

No response required.

As a preliminary matter, it is noted that the DEIS is overly long and suffers from the inability to distill pertinent material from that which is irrelevant. For whatever cause, the DEIS does not conform to the Council of Environmental Quality's Guidelines, 40 CFR Part 1502 (particularly §§1502.7, 1502.10 and 1502.17). See also the D.O.E.'s Proposed Guidelines for Compliance with NEPA (except for FERC) at 44 FR 42136, July 18, 1979. FERC's most recent policy statement with respect to NEPA does not evidence an intent to do less than that required by CEQ. See 18 CFR §§2.80, 2.82. Also, see 43 FR 55978, November 29, 1978 which became effective for all governmental agencies effective July 30, 1979. We assume these technical difficulties will be remedied in the Final EIS.

The DEIS was published before the Commission's proposed rulemaking, "Regulations Implementing the National Environmental Policy Act of 1969," was issued on August 20, 1979. For consistency between documents, the FEIS has maintained the previous format.

II

We turn now to specific comments on the statement.

1. At various points throughout the DEIS, in descriptions of the gas conditioning facilities (e.g. page ii, mid-paragraph; page 3, paragraphs 2 and 4, etc.) there is reference to the dehydration function. While certain dehydration facilities presently exist at Prudhoe Bay to enable the produced gas handling and the current sale of fuel gas to the owners of the Alyeska Pipeline without CO_2 removal, additional dehydration facilities may be required to meet gas pipeline transmission specifications, even beyond that dehydration furnished as a side effect of the Selexol process base case.

This information updates page 2-2 of volume I of the Parson's Report, which states that because water dewpoint control is accomplished by existing dehydration equipment it was assumed that no further process equipment was required in the SGCF for water dewpoint control. A footnote on this matter has been included in section A of FEIS.

2. On page 1, in the last sentence of the first paragraph, the figure 2 billion cubic feet per day is described as the feed gas stream. The inlet stream to the SGCF is 2.7 billion cfd. The outlet stream is 2.0 billion cfd.

Comment reflected in section A of the FEIS.

3. On page 2, numbered paragraph 2, second paragraph, there is an incorrect statement of what the alternate case was which was evaluated by the Ralph M. Parsons Company. The alternative design has no provision for new dehydration facilities.

Ibid.

4. On page 7, the only full paragraph, the description of the process for removal of CO_2 and NGL fractions is a correct general description of a Selexol system. Unfortunately, the description does not fit the specific process selected by the Parsons' study and evaluation. The descriptions on page 220 and 221 are accurate and should be substituted for the discussion that appears on page 7.

No change required. The paragraph on page 7 of the DEIS was a general description. Specific details appear in appendix C.

5. Page 10, the last full paragraph, in paragraph (a) describing the evaluation of the selection process, it is stated that "... Parsons determined that Latepro, Lurgi, and Open-art DEA did not have adequate commercial experience." This statement is not correct. All of the processes described are commercially available. Parsons determined that the named processes were not economically feasible, given the gas composition and design considerations of the pipeline.

Comment reflected in section A of the FEIS.

6. On page 11, the first paragraph describes various process support facilities, including "an emergency diesel-driven power generator." On page 122, the third full paragraph, there

Comment reflected in sections A and D of the FEIS.

is a description that indicates the emergency generators also may be operated with field fuel gas. The inconsistency should be eliminated.

7. Commencing at page 11, paragraph i. Water Reservoir and Treatment Facilities and continuing through page 16, there is a amalgam of information dealing with intake structures, proposed usage of water which would come from the Put River (presumably to be used in the construction camp for potable water) and waste water treatment facilities. However, commencing on page 12, the second full paragraph, a discussion is interjected dealing with radically different quantities; with usage reflecting withdrawal of water from Beaufort Sea and injection of water into wells. This information relates to a potential waterflood project, however, the data is not accurate for any figures that are now being considered for that project. The last two paragraphs on page 12 should be revised and combined with other discussions relating to waterflood matters in one location of the DEIS.

Comment reflected in section A.6 of the FEIS.

On pages 14, 15, and 16 there is extensive discussion of fresh (potable) water, process water, and waste water treatment plans. Rather than such detail, it should suffice to conclude after presentation of total capabilities that the sources of water and expected usage would have minimal environmental impact and that the treatment facilities described would be able to bring the effluent into compliance with EPA standards expected for not only secondary treatment, but what could be expected from tertiary treatment.

Such detail, when available, is warranted for public review.

8. On page 16, paragraph ii. Solid Waste Disposal Facilities, there is no discussion of the present regulatory difficulties with the State and North Slope Borough in siting of solid waste facilities, particularly the present landfill immediately adjacent to the Sagavanirktok River, or the proposed landfill in the Put River/Oxbow. Since description of the facilities probably implies their availability, some mention should be made of the regulatory restrictions that may inhibit landfill use by the SGCF. Also, in the first paragraph of page 17, the reference to "Parsons" in the phrase "Parsons construction camp" should be deleted. Parsons' role as managing contractor during the construction phase of existing Prudhoe facilities on the ARCO side of the field is at an end, and Parsons has no relation to the construction camp.

Comment reflected in section A of the FEIS.

9. On page 17, under the heading 4. Construction Procedures, the description of the time table for three sealifts of material for the SGCF shows commencement in 1980. Although those dates were realistic when the Parsons report was issued, based upon what was then perceived as the most likely track for regulatory approvals and financing of the natural gas transmission line, the current appraisal is that the time table is highly optimistic.

Ibid.

10. On page 18, the second full paragraph, the last three sentences imply that there is no current capability to use pneumatic, rubber tired vehicles (RTV's) in offloading barges. That is not a correct assumption.

The paragraph implies no such assumption.

11. Page 21, paragraph 6. Future Plans and Abandonment, Footnote 1/ suggests that the environmental impact of water injection facilities will be discussed only peripherally or by occasional references. As noted above all such references should be combined in one place, rather than having such occasional references intertwined with a discussion of the SGCF required to meet gas pipeline specifications.

Comment reflected in section A of the FEIS.

12. On page 21, in the same paragraph 6 a), the statement is made that, "... the SGCF could increase its output by 50 percent without any major modifications to the proposed plant's process equipment." The process recommended in the Parsons' study was selected upon design considerations for handling the chemical composition and volumes of gas to be produced from the Prudhoe Bay Unit. Any significant increase in capacity of the SGCF would necessitate the installation of additional processing trains. In addition, it should be noted that the expansibility of the SGCF was designed to handle possible increases in volumes produced from the Prudhoe Bay Unit. As other gas fields are developed on the North Slope other field gas conditioning facilities will be required to prepare such gas for transportation to the ANGTS.

Ibid.

13. Paragraph b) Water Injection Facilities, on page 22 states in part that, "Adverse environmental effects from water injection could arise from withdrawals from subterranean reservoirs, withdrawal from rivers, spills, seawater if utilized, and from leaks to different formations" in injection wells, as well as

damage to marine life by velocity into intake facilities. At no time has there been a serious proposal for water to be withdrawn from rivers for water injection purposes. "Spills" presumably refers to oil spills onto tundra or navigable waters and is not a realistic consequence of the water injection project. Finally, the assertions related to "withdrawals" and "leaks" from formations is in conflict with other language later on in the EIS which correctly recognizes that in permafrost areas, little or no communication takes place between various formations and subsidence due to withdrawal of water from an aquifer is not likely. The entire paragraph is replete with speculation as to possible phenomena and should be limited to realistic concerns.

The paragraph has been deleted. Also see section C.12 of the FEIS.

14. In the last paragraph on page 22, there is a statement that says "Water injection is not planned for several years after initiation of gas sales." That is inaccurate. Currently the SGCF is projected to be completed in 1985 or 1986. Projected waterflood startup of a limited nature is approximately 1984. Applications for permits to all federal and state agencies involved and a request for an EIS to be prepared by the Army Corps of Engineers on the Waterflood Project were submitted by the co-operators of the Prudhoe Bay Unit on August 3, 1979.

Paragraph has been deleted.

15. On page 43, Colleen Lake is listed as a NANA distribution center to service companies for water usage. That reference should be corrected to read "North Slope Borough distribution to service companies ..."

Comment reflected in section B.3 of the FEIS.

16. Also on page 43, with respect to the discussion on the Sagavanirktok River; Atlantic Richfield Company's Prudhoe Bay Operations Center obtains water from the Sag for its water usage, but so also does the North Slope Borough. Perhaps as a qualification as to the effect upon the Sag River of Atlantic Richfield's use, reference should be made to Webster Lake. Atlantic Richfield stores potable water in a dredged reservoir called Webster Lake. Withdrawals from the river are made during summer high-stream flow seasons and stored in Webster lake for use in winter when winter flows are very low.

The paragraph does not discuss the effects of Atlantic Richfield's use upon the Sag River. Webster Lake is discussed in the first paragraph.

17. On the bottom of page 43, the last sentence states that "A smaller, infrequently used causeway is located on the east side of the bay." This dock, known as Dock No. 1, is still frequently used although not as heavily as the North (or West) Dock (Dock 2) and its extension (Dock 3). Large amounts of general cargo which is either lightered from barges or arrives on shallow draft barges is the type of cargo normally going over the Dock No. 1. The North Dock (Dock 2) and its extension (Dock 3) are used primarily for deeper draft barges.

Comment reflected in section B.3 of the FEIS.

18. At page 53, paragraph 4. Air Quality, it is stated that, "There are no ambient air quality data for the Prudhoe Bay site that are suitable for analyses." There is information available on the air quality in the Arctic and Prudhoe Bay. In 1974 Metronics did an air quality study which indicates that the air quality at Prudhoe Bay is excellent. Currently there is a program being conducted under a contract with Radion Corporation

Comment reflected in section B.4 of the FEIS.

to do a very detailed air quality and meteorology analysis of the air in the Prudhoe Bay area. There exist monthly reports from Radion Corporation for data which was collected beginning March 15, 1979 and continuing to date (with plans to collect for approximately one full year). Such preliminary information can be made available, although complete summaries typically submitted for PSD reviews will not be available in time for the Final EIS.

19. On page 56, the statement is made that "The major noise sources in the Prudhoe Bay field were the central compressor plant, the central power plant, and the drilling sites." By comparing this result with the locations of noise sampling depicted on Figure 14, page 57, one can readily discern how this conclusion was reached. Independent sampling by the operators reveals that the major noise sources are the flow stations and gathering centers rather than the sources listed.

Comment reflected in section B.4 of the FEIS.

20. On page 62, the statement in the first full paragraph that, "The movements of juvenile fish along the coastline are restricted to less saline, protected waters of major river deltas and lagoons." is incorrect. Juvenile fish are found in other locations even if they may be predominant in the Sag, Kuparuk and other major river mouths. Juvenile fish may use these as staging areas or find them to be extremely prolific feeding grounds. It is unknown what percentage of juveniles are found in other areas.

Comment reflected in section B.7 of the FEIS.

21. On pages 67 and 68, in a discussion of the populations of Bowhead whales in the Beaufort Sea, the number of 1,700 is used as an estimate of maximum quantities. It is not indicated where the author of the EIS obtained this information. Estimates ranging upward of 2,500 representing the maximum number of Bowhead which may use the Beaufort Sea for feeding grounds/breeding grounds/migration routes are available in literature and from whale experts.

Comment reflected in section B.7 of the FEIS.

22. The discussion concerning solid waste on page 74 covers plans and approvals to bury metals, incinerator ash, and other items that under some circumstances might be economically recoverable under RCRA. The assurance of approval appears to be inconsistent with the position recently asserted by the State, that there are so-called "nonburyable" items, which must be backhauled to Fairbanks or Anchorage or the lower 48 for reuse and recovery if there is a market for such items, notwithstanding the economics of such recovery. The methods which will be employed for solid waste disposal are not as certain as is indicated.

Comment reflected in section B.8 of the FEIS.

23. On page 77, Recreation and Aesthetics, there is a statement that the Sag River is being studied for possible designation as a "Wild and Scenic River." If the statement is true and the designation is made, any builder of the SGCF may have significant new difficulties with permitting activities. Also in the last portion of paragraph 10, page 77, there is a notation that the Parks Service has identified 16 geographic locations within the Prudhoe Bay area (however defined) as

Comment reflected in section B.10 of the FEIS.

appropriate for nomination as National Landmarks. ARCO questions whether this actually has occurred, and, if so, the appropriateness of such a designation. The closest to confirmation of this statement is Graphic No. 10, Volume 3 of the Beaufort Sea Final EIS, Proposed Federal/State Oil and Gas Lease Sale, describing various locations eligible for inclusion in the National Register of Historic Places. Also under the same paragraph 10, there is a statement that there is considerable potential for recreational and tourist use of North Slope and Prudhoe Bay coastal area. It is ARCO's position, (and that of the State, North Slope Borough and others) that such uses should not be permitted in the Prudhoe Bay area in order to prevent significant impact upon subsistence lifestyles. Such a change in use would also disrupt the existing sensitive balance between traditional lifestyles and industrial developments. In this regard, the previous statement under paragraph 9. that speaks to the threat to traditional lifestyles posed by continued natural resource development is somewhat overplayed. The native lifestyle has undergone significant change in the past 50 years. Whether or not an equilibrium has been reached is difficult to say, but no doubt continued change will be evident and is inevitable.

24. On page 78 the paragraph regarding archaeological and historical resources states that "... very early Eskimo occupation was found and excavated nearby." The term "very early" is probably inappropriate and should be "historic Eskimo occupation".

Comment reflected in section B.10 of the FEIS.

Comment noted.

See the staff's response to comment 39.

Reference to the site has been deleted in the FEIS since it is not as near the SGCF as originally thought and since it has been excavated.

25. On pages 85 and 86, it is noted that substantial quantities of gravel will be necessary for construction of water injection facilities. Here again we suggest that all comments relating to water injection facilities be collected in one place. In any event, obtaining such gravel from river beds and channels could affect surface drainage patterns. Disregarding any effect which might result from the necessity of constructing an extension to, or expansion of, the North Dock for other projects such as the Gas Conditioning Plant, development of the Lisburn, Kuparuk, and other North Slope reservoirs, we question whether the discussion of this gravel use for water injection facilities is appropriate in this EIS. If the waterflood gravel usage were discussed in the context of the cumulative effect of gravel use by all projects upon surface drainage, then such a discussion might be appropriate, but in this context it is not.

Comment reflected in sections A.6 and C.12 of the FEIS.

26. On page 88, in the second full paragraph dealing with water resources and withdrawal systems, there is a statement that BP Alaska (which for consistency should read Sohio Petroleum Company) has extracted gravel from an Oxbow lake adjacent to the Put River and used the deepened lake as a reservoir. That reference should be to the Kuparuk River. Indeed, Sohio Petroleum Company has excavated gravel from the Put River, but their current water reservoir is the Kuparuk River.

A February 28, 1977, letter from BP Alaska refers to the Put River as its source of gravel. Also see section C.3 of the FEIS.

27. In the last full paragraph on page 88, the staff recommends that water withdrawal for water supply reservoir replenishment and daily usage be limited to the months of June

and July because of limited stream flow. This recommendation is merely a result of averaging numbers and has no relation to actual usage of the river nor its biological value. As noted elsewhere in the EIS, there are few, if any game fish in the Put River. Diversion from the river would have little effect upon biological populations. The river does not flow except for a very few months because of its local drainage area, which is not derived from the headwaters in the Brooks Range, as are the Kuparuk and Sagavanirktok.

Comment reflected in section C.3 of the FEIS.

28. Throughout the entire discussion on pages 86 - 89, there was an assumption by the staff that the Put River would be a major source of water for operations in support of the Gas Conditioning Plant. This discussion of water source is probably appropriate under certain circumstances. However, if there is utilization of existing ARCO PBOC housing facilities or of Sohio Operations Camp facilities, existing sources of water in the Kuparuk or Sagavanirktok, rather than the Put River, are more nearly likely to support the SGCF.

No response required.

29. On page 89, paragraph c) Docking Facilities, under the first bullet, there is a statement that increased turbidity as a result of the construction operation of the Causeway will decrease the amount of light available for algal growth. Also under the same construction phase, the last bullet, there is a discussion that states that reentry of nutrients into the water column may stimulate <u>additional</u> algal growth. These two statements appear to be diametrically opposed and should be resolved.

Comment reflected in section C.3 of the FEIS.

30. On page 90 under "Long-term effects," the third bullet discusses gyres, stating that they "would impede further the mixing of marine and estuarine waters." This is not correct. Gyres usually encourage mixing activities.

Arco has updated information on the use of the existing causeway; therefore, the discussion on gyres has been deleted.

31. On page 91, there is a discussion of a potential new causeway and dock, or including an additional new arm on the existing causeway. To ARCO's knowledge, none of these kinds of facilities are planned either with this project or in conjunction with any other project. The notion under bullet three on page 91 that a "A new causeway would reflect waves." would depend a great deal on the alignment of that causeway from the shore. The notion under bullet four regarding ice movement during breakup and effects is total hypothecation.

This contradicts the data Arco has submitted to the U.S. Army Corps of Engineers. See sections A.6, C.3, and C.12 of the FEIS.

32. On page 93, in the first full paragraph, it is stated, "A major new structure, such as a long causeway, could have significant effects on waves during both mild and stormy weather, ..." That is the case, but since as noted above, there is no intention to build a new causeway the rest of the paragraph is totally speculative. Rather than go on about the design of a phantom dock which is not planned, we suggest the discussion be deleted as irrelevant.

Ibid.

33. On page 93, second full paragraph, in a discussion of sediment deposition, it is stated that "Approximately 1,999 cubic meters per year of sediment have been deposited" at the base of the original West Causeway. That number is incorrect. It should read approximately 1,000 cubic meters.

Comment reflected in section C.3 of the FEIS.

34. On page 93, last paragraph, it is stated, "Tidal currents under the winter ice may cause scouring of the bottom." Recent winter under-ice current data indicates there is virtually no current in the winter time in the nearshore area.

Comment reflected in section C.3 of the FEIS.

35. On page 94, subparagraph d) there is again a discussion of water injection facilities. Again, this discussion should be consolidated with all other waterflood related matters at one location in the DEIS.

Comment reflected in sections A.6 and C.12 of the FEIS.

36. On page 96, reference is made to a "pumping station" to be located in the active flood channel of the Put River for receipt of potable water. Insofar as is known to ARCO, no such pumping station is contemplated in connection with the SGCF.

Comment reflected in section C.3 of the FEIS.

37. On pages 96 through 102 (Section C.4. dealing with Air Quality) the air emissions analysis appears to address only the electric power generation units and has omitted the data related to all gas turbines associated with the process facilities. Review of Appendix F, "Report on the Air Pollution Dispersion Analysis for the Sales Gas Conditioning Facility and its Auxillary Facilities" also found these units to be missing the analysis.

Comment reflected in section C.4 of the FEIS and appendices.

The units which should have been included are fully described in various sections of Volume II of the Parsons Report. Design data sheets are also presented in Volume V. Briefly, these units are as follows:

Ibid.

Quantity	Description	HP - Each	Total HP
4	Stripper Overhead Turbine/ Compressors	14,630	58,520
5	Refrigeration Turbine/ Compressors	26,334	131,670
2	Field Fuel Gas Turbine/ Compressors	28,920	57,840
2	CO_2 Injection Turbine/ Compressors	11,400	22,800
6	Sales Gas Turbine/ Compressor Units (Alt. design case)	29,459	176,754
Total			447,584

Inclusion of these units into this analysis will up the horsepower total from approximately 75,000 HP to 447,600 HP.

A cursory evaluation of the probable emission from these units was done and is presented in Volume II, Section 3 of the SGCF Report.

38. Under paragraph 7. Aquatic Communities, on page 108, there is a discussion in the last full paragraph and also the first, second and third full paragraphs on page 109 which address possible effects of waterflood activities. Since intake of Beaufort Sea water has never been contemplated for support facilities for the Gas Conditioning Facility, this whole discussion should be consolidated in one location dealing with water injection.

The staff has consolidated this information in section C.12 of the FEIS.

39. On page 110, paragraph 8 a, the proposition that "the development of oil and gas resources in the Prudhoe Bay area on the North Slope of Alaska has caused subsistence land use by

Alaskan Natives which existed 10 years ago to suffer" is wrong. While we do not dispute the impact upon expectations and life-style of Natives over the past several decades, (i.e. they are no longer dependant entirely upon subsistence resources for their food, clothing and transportation systems), all available data shows no significant impact upon fish and wildlife populations available for taking in the Prudhoe area. The only real impact is the social crumbling caused by the juxtaposition of a Native subsistence lifestyle and modern activities. The conflicts that are exposed by such coincidence are in the nature of a sociological change but is not a degradation of land use or of the fish and wildlife populations.

The staff disagrees. The changes in Native lifestyle have intensified over the last 10 years, and the oil and gas development in the North Slope during this time has been the catalyst for it. Construction and operation of facilities in the area changed the immediate land use from potential subsistence to industry use. In this way, the subsistence use of this land has suffered. See section C of the FEIS, which describes the impact to wildlife populations (i.e., caribou, seals, fish, waterfowl) that could result from the proposed project and the effect of this impact on subsistence land use in the area.

On the other hand, as is contended in the same section, the opening of the haul road for public use beyond the limited use of support of existing and planned industrial facilities does present the danger of subjecting the wildlife resources to new demands. The general public is not subject to the same controls as are employees of operators and contractors within the industrial area.

40. On page 112, under paragraph 9, Socioeconomic Considerations, there is speculation that there may be substantial industrial expansion outside the immediate confines of the Prudhoe Bay complex which then could affect subsistence hunting and fishing areas. That is not likely if the North Slope Borough passes its Coastal Zone Management Plan in anything like its present form. In any event, there is considerable economic incentive to locate

Comment noted.

most support activities in the immediate vicinity of the existing service base located at Deadhorse.

41. On Page 117, while describing the design and construction aspects of the SGCF, the assumption is made that piles on which the facility would be constructed will be of wood. This is not appropriate. Normally, thermal piles are composed of steel and concrete. See Volume II, Section 1.2 of Parsons' Report. In the second full paragraph an assumption is made that the gravel pad must bear the load of the SGCF. There is no direct contact between the modules and the gravel pad. The facility is pile supported.

Comment reflected in section D of the FEIS.

42. On page 118, under the heading Safety and Fire Protection, the second full paragraph, there is a criticism of the design of the hydrocarbon gas detection systems, one calibrated for methane and the other for propane and heavier hydrocarbons, without the capability to detect ethane. Such an engineering approach is not remiss, since methane is present in much larger quantities than ethane, even though they are found in conjunction. Being a lighter gas, methane would be detectible first in upper portions of modules or compartments, whereas propane and heavier hydrocarbon vapors would be detected in the bottom portions of compartments. The presence of either at close to explosive levels would trigger the alarms and ventilation measures discussed without the necessity to detect separately the existence of ethane vapors. If the ventilation measure did not immediately reduce the concentration to well below the Lower Explosive Limit

The staff agrees that the engineering approach is not remiss. The paragraph was not intended to criticize the design; the suggestive sentence has been removed.

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(LEL) while troubleshooting for the source of the vapors, appropriate shutdown measures would be activated. These, of course, would be described in detail by the operational manuals developed contemporaneously with final design of the detection and inerting systems.

43. The first paragraph on page 124 discusses how utility water from drums may be periodically trucked away to sanitary landfill near the Sag River. This assumption is not correct. The utility water is treated through a waste water system and is not disposed of by landfilling, but rather by discharge to lagoons.

Comment reflected in section D of the FEIS.

44. On page 129, in a discussion of <u>Irreversible and Irretrievable Commitments of Resources</u>, there is a statement that the fossil fuel resources (which are the focus of the facility being evaluated herein) would be irretrievably "lost". We suggest that the word "expended" is more appropriate, since exploitation of the gas reserves and ultimate delivery to consumers in the lower 48 is not a loss of a resource. If the "lost" referred to is in reference to other liquid hydrocarbons, it is ARCO's position that production of the gas will not affect ultimate recovery of liquid hydrocarbons.

Comment reflected in section G of the FEIS.

45. Page 133, subparagraph (d), Climatic Conditions. The statement is made that reduced visibility from ice fog would reduce the efficiency of plant operations. Other than the effect upon ability to move from residential compounds to the operations area of the SGCF, no known effect upon efficiency of the plant is expected, and we question the reasoning behind this statement.

Comment reflected in section H of the FEIS.

46. On page 178, in a discussion of Noise Quality, there is a marked difference in numerical assumptions of the incremental effect of construction and operations activity and also the ambient noise levels between the three locations at Yukon, Prudhoe Bay and North Pole. These differences seem inconsistent with the statement that "the noise impacts which would result from construction would not differ significantly from construction impacts to the Prudhoe Bay site."

Section B.5 of the DEIS identified the background noise level of Prudhoe Bay as 32 dB(A) at the Beaufort Sea, the level to which the wildlife in the area are accustomed. A 30-dB(A) estimate was made for the Yukon River site. Thus, the impacts for these two sites should be similar. Page 178 makes no comparison with the North Pole site.

47. On page 188 and 189, there are summaries of what are supposedly ARCO's, Sohio's and Exxon's positions. ARCO considers the summary for itself to be a fair representation, except that it fails to specify that the ranges given for percent of butanes transportable relate to the selection of chemical or physical solvent CO_2 extraction process.

Sohio and Exxon may differ with the characterization of their own positions; however, we feel the discussion which follows, an elaboration on only ARCO's position, is necessary in order to make the summary on Alternate Pipeline Pressure Design Considerations meaningful.

Comment reflected in section H.4 of the FEIS.

The combined produced gas from the Prudhoe Bay Field could be transported in a 1680 psig pipeline, but only if such pipeline was specially designed for such purpose. Our position assumed a 1680 psig pipeline design such as those proposed by CAGSL and El Paso before the FERC. ARCO calculations and test data taken in December 1977 on actual combined field production at the central injection compressor plant indicate the dewpoint pressure of the produced gas at about +20 to +30°F is approximately

1480 psig. The calculations on the expected future combined field gas indicate a slightly lower but similar dewpoint at the time of gas sales.

To operate a pipeline with a dewpoint gas as this would require a minimum suction pressure at each compressor station of no less than 1500 psig to avoid two-phase flow. Such a pipeline would require a different operation than that designed by CAGSL or El Paso for 1680 psig systems. This special pipeline would require a significant increase in number of compressor stations. In addition, standby compressors at each station would be required to avoid compressor outage with the subsequent greater pressure drop prior to reaching the next compressor station. ARCO calculations indicate the number of compressor stations would at least double over that indicated in other 1680 psig pipeline designs.

347 Therefore, based on this data, we submit that while it might be technically possible to operate a 1680 psig pipeline without removing any heavy hydrocarbons from the produced Prudhoe Bay gas, it would not be economically feasible.

If such a special 1680 psig pipeline were designed and operated through Alaska, the heavy hydrocarbons would have to be removed prior to entering the Canadian portion of the pipeline which operates at 1080 psig. Calculations and tests indicate the gas would always be in a two-phase region at these pressures and temperatures.

48. On page 190, under the heading, d) Additional Design Considerations, the last paragraph, there is a discussion of

Comment reflected in section H.4 of the FEIS.

possible difficulties in the interface between a 1680 PSIG Alaskan Pipeline transporting not only C1, C2 but some heavier hydrocarbons, and a Canadian design of 1,080 PSIG operation. To make these sentences correct they should be revised to read: "If a 1,680 PSIG Alaskan Pipeline were constructed and the heavier hydrocarbons (Pentanes plus) not removed at Prudhoe Bay, difficulties would be encountered where the higher pressure operation joined the lower pressure operation and also at the highest crossing in the Canadian mountain range. These problems would necessitate the removal of the heavier hydrocarbons prior to the Canadian segment." (emphasis added, see the discussion in our numbered paragraph 47 above.)

Comment reflected in section H.4 of the FEIS.

49. On page 191, the fifth line, the last word "dissolves" should be changed to the word "absorbs". Also on page 191, under the heading Chemical Absorbent Processes, the fourth dashed paragraph should be revised to read: "There is little absorption of hydrocarbons, and further treatment will be required to meet the hydrocarbon dew point specification." Finally, a new sixth dashed paragraph should be added, reading: "Gas must be dehydrated because solutions are water based."

Comment reflected in section H.5 of the FEIS.

50. On page 194, in the discussion of Waste Liquid Discharges, there is an assertion that none of the processes would require a waste water discharge. This is not technically correct, since in the Sulfinol process there is a need for water in the process and there would necessarily be a waste water discharge to some location. However, since the Selexol process was selected, the

Ibid.

conclusion reached, i.e., that there will be no waste liquid discharge from the process, is correct.

51. Under the topic "Waste Hydrocarbon Discharges" on page 194, there is an assumption that in the Sulfinol process a waste stream of 98% + CO_2 (and the remainder hydrocarbon gases) could be discharged to the atmosphere. Nowhere during the evaluation process was it assumed that hydrocarbons could be vented to the atmosphere. In all instances where not injected, such a stream of waste gas would be fed to boilers, heaters, and turbines, a part of the field fuel gas system, or where hydrocarbons were minimal, the waste gas stream would be incinerated before being vented to the atmosphere.

Comment reflected in section H.5 of the FEIS.

52. On page 197, in the first paragraph, the last sentence, there is a statement that "The Parsons Report indicates that it may be possible to add almost the entire butane fraction to the sales gas." The quoted statement is accurate if the design of the pipeline were for transportation at 1,440 PSIG. However, that statement is not true at 1,260 PSIG. Only about 88% of the butanes could be transported at that operating pressure per Parsons' CO_2 specification study, pages 4 through 16, base case. Also on page 197, in the second paragraph, the second sentence asserts that the Sulfinol process affords an alternate disposal of butane fractions, or at least 87,000 pounds/hr for heater fuel. That figure was derived from the product distribution available using the Selexol process. Product distribution under the Sulfinol process would be significantly different.

Ibid.

53. On page 201, the Environmental Staff attempts to impose certain mitigating measures, some of which do not appear to be appropriate:

Number 1 would impose "Local Hire" provisions for local and native Alaskans, which go considerably beyond the Alaskan provisions struck down by the U.S. Supreme Court in Hicklin v Orbeck. Nor would such provisions appear to be protected by the recent Weber decision.

The staff believes that this recommendation is still desirable and strongly encourages any SGCF developer to implement these actions.

Number 2 urges use of existing module fabrication sites. If the builder of the SGCF is able to find alternate sites which will result in a less expensive end product with adequate engineering design, no environmental effect is served by such a stipulation.

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Use of existing sites rather than new sites certainly serves environmental mitigation in most cases. The recommendation stands.

Number 3 urges use of existing facilities at Prudhoe Bay. Allocation of the costs of SGCF support facilities and utilization of existing facilities may involve contractual and legal difficulties.

The recommendation stands.

Number 4 requires submittal of a study analyzing waste heat utilization. Despite the independent requirements that may exist in various other statutes, such as the Powerplant and Industrial Fuel Use Act of 1978, (PIFUA) the Energy Supply and Environmental Coordination Act (ESECA) of 1976, et al., any requirement for submittals of studies to the Staff is overreaching beyond environmental effects. In any event, a stipulation should be expressed as a performance standard and not a requirement.

A submittal of such a study is certainly not overreaching. The recommendation encourages a developer to study and exercise energy conservation by utilizing waste heat where possible. The recommendation stands.

Number 5 is objectionable for the same reasons as 4 and in any event, the environmental effects have been evaluated continuously by numerous state and federal agencies.

Number 6 is unreasonable, as noted previously.

Recommendations 5 and 6 have been deleted.

54. As a final comment on the form of the DEIS, ARCO notes that the F.E.R.C., by proposed rulemaking which appeared in the Federal Register on Thursday, August 23, 1979, 44 FR 49466, intends to implement Executive Orders 11988 and 11990, Floodplain Management and Protection of Wetlands, respectively, in their own regulations. The Army Corps of Engineers on January 12, 1979 has declared the majority of the Prudhoe Bay area (including the proposed site for the SGCF) to be wetlands, rather than merely wet uplands tundra as is discussed on page 31 and elsewhere within the DEIS. Disregarding the correctness of the Corps assertion, a discussion of the siting considerations in the context of the wetlands E.O. would be prudent.

While the staff has not referenced the wetlands executive order _per se_, it has identified the unique nature of the terrestrial ecosystem and discussed the expected environmental impacts.

55. Appendix A, _Properties of Oil Formations_ had certain deficiencies from a reservoir engineering viewpoint. To more nearly reflect what we understand to be the operating mechanisms, ARCO has provided a substitute Appendix A.

Substitute appendix A adopted.

56. Appendix B contains economic calculations which are subject to considerable second guessing and modifications based upon differing regulatory treatment or price projections. For example, staff calculates that "additional fuel and NGL savings could be realized by heating fractionater (sic) reboilers with waste heat from turbine exhaust." Such a calculation is

All numbers in appendix B were taken directly from the Parson's report.

highly dependant upon the price used for fuel. In fact, such a design was considered, but rejected in favor of <u>regenerative</u> gas turbines which do make use of otherwise waste heat.

57. On page 219, the third paragraph, the third sentence, delete the words: "through a feed stream in the low temperature separator and would be pumped."

Comment reflected in appendix C of the FEIS.

58. On page 220, numbered paragraph 3. <u>CO_2 Removal</u>, the last sentence should be revised to read: "The conditioned absorber overhead gas would be warmed by heat exchanges with feed gas, then chilled and finally routed to the pipeline gas compressors."

Ibid.

59. On page 220, numbered paragraph 4. <u>Pipeline Gas Compression and Chilling</u>, the first sentence should be revised to read: "The conditioned gas streams from the four NGL extraction/CO_2 removal trains would be combined prior to compression."

Ibid.

60. Appendix F needs to be revised to take into account emissions from process gas turbines, as noted previously.

Comment reflected in appendix F of the FEIS.

III

<u>Conclusion</u>

In summary, ARCO considers the conclusion reached in the DEIS, that the impact of the SGCF will be minimal upon the human environment, to be correct. Those minor deficiencies in form noted herein and by other commenters can be easily remedied by the Staff in the Final Environmental Impact Statement.

No response required.

Respectfully submitted this 31st day of August, 1979, at Anchorage, Alaska by its attorneys,

ATLANTIC RICHFIELD COMPANY

Edward J. Kremer

William J. Bonner

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APPENDIX A

PROPERTIES OF OIL FORMATIONS

Oil reservoirs are complicated systems whose physical properties, fluid contents, and latent energies within the reservoir fluids dictate the degree of ease or difficulty which the producer will experience in tapping the hydrocarbons trapped below the surface of the ground.

A petroleum reservoir consists of a porous stratum of rock which is capped with an impervious layer of rock. The shape of the structure must be such that the oil (or gas) can accumulate in the porous zone. The cap rock prevents further upward migration of the contents. The most common type of reservoir is a dome-shaped structure or "anticline." In some instances, the dome may be almost hemispherical; in other cases, it may be narrow and elongated.

Porous rocks normally contain three fluids within their pores -- oil, gas, and water. Since the fluids have different densities, the force of gravity tends to cause the fluids to segregate, with any gas, being lightest, on top, oil and water on the bottom. Where the rock stratum is flat, any gas or oil present will flow to the top of the porous rock formation. When the porous formation is tilted, gravity will cause the oil or gas to move in an updip direction until they meet some restriction, such as a fold in the formation. When oil is trapped in an anticline or other type trap, water will commonly exist downdip on the flanks of the structure. If the porous formation is quite thick, water may also exist directly underneath the oil.

The nature of reservoir rock is extremely important, because the oil is stored in the small spaces or pores which separate the individual rock grains. The porosity of a rock is the volume of all the pores and openings expressed as a percentage of the total volume of reservoir rock. If the oil is to enter or leave the rock, there must be a free connection between one port and the next. The ability of the rock to allow passage of fluids through interstices depends on the size of the connecting channels which exist between one pore space and the next (permeability).

For oil to move through the pores of the reservoir rock and into the bottom of a well, the pressure under which the oil exists in the reservoir must be greater than the pressure

at the bottom of the well. As long as this differential pressure can be maintained, the oil and its associated dissolved gas will continue to flow into the producing well.

The following paragraphs summarize natural production mechanisms.

1. Water drive: When a porous formation covers an area much larger than the area of the entrapped oil, the reduction in the reservoir pressure causes the water under pressure in the porous formation (called an aquifer) to flow into the oil reservoir. The amount of energy obtained from expansion of a barrel of water under pressure as the pressure is reduced is quite small. However, in a large aquifer, the amount of water may greatly exceed the amount of oil trapped within local areas of the aquifer. If the aquifer is large enough and has a high enough permeability, the energy provided by expansion of water in the aquifer may be sufficient to cause water to move into the oil reservoir to replace all oil withdrawn. Such an oil reservoir would be said to possess an "active water drive."

If the aquifer is smaller relative to the oil reservoir or if the permeability isn't high enough to allow water to flow up to the oil reservoir fast enough to replace the oil withdrawn, a field may have a "partial water drive." This provides little of the energy necessary to produce the oil or a large portion of it. A field with a partial water drive at one producing rate might have an active water drive at a lower rate.

Under some conditions, a water drive may be the most effective mechanism to recover oil. In order to utilize the energy from a water drive most effectively, it may be necessary to limit the rate of oil production so that the aquifer water can enter the vacated section of the oil-bearing zone as the oil is extracted. If the oil production rate exceeds the rate of water entering the reservoir, pressure will decline and consequently reduce the energy available for oil production.

2. Solution gas drive: Gas is soluble in oil. In most reservoirs, considerable gas is dissolved in the oil under pressure. As oil is produced and the pressure declines, gas is released from solution in the oil. The gas, having a high expansion ability, expands to replace the oil.

In the absence of a water drive that maintains the reservoir pressure use at a high level, a portion of the energy required to produce the oil will be provided by expansion of the released solution gas. In reservoirs with no water drive, essentially all the energy may be provided by expanding gas. Far more energy is available in the gas than is required to move all the oil to the well bore in most reservoirs. Unfortunately, gas is much more mobile than oil, and as its saturation builds, it flows to the well bore in increasing amounts and is produced with the oil. Thus, much of the energy needed to produce the oil is dissipated. Consequently, a solution gas drive is generally less efficient than other recovery mechanisms.

3. Gas cap drive: When more gas is present than can be dissolved in the oil at the reservoir pressure, the free gas will collect at the highest portion of the structure (trap) above the oil. As oil is withdrawn and the reservoir pressure declines, the gas in the gas cap will expand to displace the oil and maintain reservoir pressure. A gas cap drive may be extremely efficient, exceeding the potential recovery from water drive reservoirs, or extremely inefficient, approaching recovery from a solution gas drive reservoir. The problem is that the gas cap gas, because of its high mobility, tends to finger through the oil rather than displace it or overrun the oil along the top of the reservoir and come into the producing oil wells. Thus, it is often difficult to prevent producing the gas cap gas and dissipating its energy. In reservoirs with steep dips or thick oil columns, it is sometimes possible to minimize gas cap production, and oil recoveries may be quite high.

4. Gravity drainage or gravity segregation: The force of gravity may also help in the recovery of oil. Gravity represents an inexhaustable source of energy. The problem is that the force is weak. Consequently, unless the porous rock has a high permeability, allowing oil to flow with a low energy expenditure, gravity may provide only a small fraction of the energy required. However, in reservoirs with a necessary combination of steep formation dips, thick oil columns, and high permeability, the forces of gravity may be utilized to yeild extremely high recoveries. As an example, the force of gravity opposes those forces which tend to cause gas cap gas to finger through the oil or overrun the oil and cone into producing oil wells. In reservoirs with high permeabilities where pressure drops into producing well bores is low (or where producing rates are low), gravity may minimize dissipation of the gas cap gas and allow high oil recoveries.

Even in reservoirs with no gas cap, gravity may be important. If the permeability is high enough to produce low pressure gradients, gravity will cause much of the gas

to flow to the top of the trap and form a secondary gas cap (a secondary gas cap is formed from solution gas after oil production starts). This allows the energy present in the solution gas to be conserved rather than dissipated, as in most solution gas drive reservoirs, and can allow high oil recoveries.

The Sadlerochit reservoir at Prudhoe Bay has a large primary gas cap, a thick oil column, a high permeability, and a large aquifer to the south and west. The large aquifer would suggest the possibility of an active water drive. However, the permeability of the aquifer decreases away from the reservoir, and as a consequence, most reservoir engineers and geologists expect only limited water influx into the reservoir.

The thick oil column and relatively high permeability suggest that gravity forces will be useful in oil recovery. The operators plan to allow the primary gas cap to expand to displace oil. Producing rates and oil withdrawal points will be controlled to minimize gas fingering. The long producing life of the field and the high permeability will allow the weak gravity forces to displace large volumes of oil into the producing wells. This will result in good gravity drainage recovery.

VERIFICATION

STATE OF ALASKA)
) ss
THIRD JUDICIAL DISTRICT)

William J. Bonner, being duly sworn, deposes and says that he is a senior attorney for Atlantic Richfield Company, that he is authorized to verify and file this document, that he has examined the statements contained therein and that all such statements are true and correct to the best of his knowledge, information and belief.

William J. Bonner

Sworn to and subscribed before me this 31st day of August, 1979.

Notary Public in and for Alaska
My Commission expires: 9-10-82

CERTIFICATE

OF

SERVICE

I hereby certify that I have this day served the foregoing document upon all parties of record in these proceedings in accordance with the requirements of Section 1.17 and 10 copies of the document upon the Council on Environmental Quality in accordance with Section 2.82 of the FERC's Rules of Practice and Procedure.

Dated at Anchorage, Alaska, this 31st day of August, 1979.

William J. Bonner
Senior Attorney
for Atlantic Richfield
Company

VERIFICATION

STATE OF ALASKA)
) ss
THIRD JUDICIAL DISTRICT)

William J. Bonner, being duly sworn, deposes and says that he is a senior attorney for Atlantic Richfield Company, that he is authorized to verify and file this document, that he has examined the statements contained therein and that all such statements are true and correct to the best of his knowledge, information and belief.

William J. Bonner

Sworn to and subscribed before me this 31st day of August, 1979.

Notary Public in and for Alaska
My Commission expires: 9-10-82

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Dated at Anchorage, Alaska, this 31st day of August, 1979.

William J. Bonner
Senior Attorney
for Atlantic Richfield
Company

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, CORPS OF ENGINEERS
P.O. BOX 7002
ANCHORAGE, ALASKA 99510

RECEIVED BY
OCT
M. J. S.

REPLY TO
ATTENTION OF:

NPAEN-PL-EN

10 OCT 1979

Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Gentlemen:

The accompanying review comments regarding the Draft Environmental Impact Statement (DEIS) for the Prudhoe Bay Project (FERC/EIS 0009D) are submitted in response to your request for comments.

The nature of the project, the sensitivity of the impacted environment, and the extent of activities that are under Corps of Engineers authority require that the Corps of Engineers produce or adopt an EIS for the project. The FERC DEIS does not incorporate the data necessary for Corps of Engineers permit authority decisions and cannot be adopted by the Corps of Engineers until additional data are provided.

It is apparent from the DEIS that the information available to the FERC staff for the description of the project location, material sources, and disposal sites was inadequate. The applicant must provide project data and list possible alternatives early in the EIS process, otherwise, the applicant risks delay of the EIS process and permit issuance. It is essential that accurate project data be made available to FERC by the applicant before the EIS process is continued.

Biological and physical data regarding the project site and the affected environment were inadequate for impact assessment under the authorities of the Corps of Engineers. Before the Final EIS is written, adequate data should be synthesized from existing data, or field studies should be conducted in the project area to collect the data. The data base for the Final EIS should include site-specific and project-area-specific data including: 1) soil and vegetation mapping; 2) hydrological data; 3) nesting bird surveys; 4) fish population data; 5) resident and transient animal censuses; and 6) topographic mapping and landform description.

The data presentation should be quantitative whenever possible and should be site-specific when used for the assessment of specific impacts.

The comments allude to the assumption that the DEIS should have been a joint product by the FERC and the Corps and that the DEIS should be suitable for adoption by the Corps. Such a position implies that the Corps was never asked to participate in the preparation process. The Corps (as well as EPA, DOI, DOT, and the state of Alaska) was invited as early as October 1978 to participate not only in the scoping but in the preparation of the DEIS; specifically, Brigadier General Hugh Robinson of the Corps' Washington, D.C. office was invited to scoping sessions. Outlines and revised outlines of the DEIS, assignments for the various agencies, and draft sections of the DEIS were sent to the Corps for its review and comments. A complete preliminary draft of the DEIS was sent to the Corps for comment. The Corps chose not to respond or attend the scoping sessions (as DOI, DOT, DOT, and EPA did), or comment on the preliminary draft of the DEIS. FERC staff cannot be accused of not providing opportunities for Corps participation.

10 OCT 1979

NPAEN-PL-EN
Federal Energy Regulatory Commission

The Alaska District, Corps of Engineers is preparing an environmental impact statement (EIS) for the Prudhoe Bay Waterflood Project. The EIS will address some elements that are discussed in the Prudhoe Bay Project DEIS. FERC comments and participation in the scoping of the Prudhoe Bay Waterflood Project EIS will be invited following publication of the notice of intent.

Sincerely,

LEE R. NUNN
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

After review of the Federal Energy Regulatory Commission (FERC) Draft Environmental Impact Statement (DEIS) for the Prudhoe Bay Project (FERC/EIS 0009D), the following comments are submitted.

General Comments

The Prudhoe Bay Project includes activities which would occur in navigable waters of the United States and in wetlands that are under Department of Army, Corps of Engineers (CoE) permit authority. Specifically, the project would require permits under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act of 1977. Activities which may be within CoE permit authority include land filling for the Sales Gas Conditioning Facility (SGCF) and the construction of docking facilities, roads, reservoirs, river intake structures, sea water intake structures, gravel pads, causeways, conduits, stabilization ponds, landfill sites, and gravel borrow pits.

No response required.

The project would affect sensitive environmental systems and would involve diverse, interacting, large-scale activities that would require CoE permits. Therefore, these activities should be the subject of an Environmental Impact Statement that reflects CoE environmental concerns and that would provide specific data for CoE permit decision-making processes. To meet those requirements, the Prudhoe Bay Project DEIS should have been a joint product that included the CoE along with the U.S. EPA and FERC, and should be suitable for adoption by the CoE.

See staff response to the transmittal letter of these comments.

At a minimum, the DEIS should reflect substantial input from the CoE. The DEIS was developed without substantial CoE input and the data presented are insufficient for the CoE to assess impacts to wetlands and navigable waters in the project area and under CoE authority.

Ibid.

Throughout the SGCF Draft Environmental Impact Statement the data that describe the location and dimensions of the proposed project, existing conditions in the vicinity of the selected site alternative, and the potential impacts of the project were general and qualitative in nature. The information presented was not sufficiently detailed to permit a realistic evaluation of the potential impacts of the project. An adequate impact assessment would require site-specific soils, hydrological, and biological data for the main project site and for each of the associated facilities including roads, borrow pits, reservoirs, waste treatment ponds, and other facilities. The data provided by the applicant (or applicant-to-be) was inadequate to identify the areas that would be impacted and the extent of the impacts. The existing data base is sufficient to describe general conditions and ecological associations in the project area, but is inadequate for the assessment of site specific impacts. Impact assessment for the proposed project requires data that describe quanititatively the conditions at the proposed sites. Acquisition of adequate, site specific data could require field investigations

Ibid. The staff further believes that the available data in the DEIS provides an adequate basis for assessing the environmental impact associated with the construction and operation of the SGCF.

for a minimum of one summer at the site. If such data exists its presentation is required for CoE adoption of the EIS.

Specific Comments

Page	Paragraph ( )	Comment	Response
iii	Footnote 1	The last sentence leads to the erroneous conclusion that the CoE participated in the scoping or preparation of the DEIS. This was not the case, and the statement should be restructured to clarify agency roles.	See staff response to the transmittal letter of these comments.
10-12		Areas, distances, and quantities of materials used to construct the support facilities should be defined, preferrably in tabular form. At least the following data should be presented for each facility: 1) exact location (or location alternatives); 2) dimensions; 3) type, depth, volume, and sources of fill material; and 4) amounts of material to be displaced by construction and the disposal location.	This information is not currently available.
15	(3)	The dimensions and location of the waste-water lake should be defined; also, the volume, dimension, source, and type of fill material to be used.	Ibid.
16	(4)	The location and dimensions of the solid waste landfill should be stated.	Ibid.
22		The water injection facilities will be addressed in a separate EIS. Reference should be made to that EIS.	Comment reflected in section A.6 of the FEIS.
23	(1)	At least general abandonment procedures should be formulated and presented. This is important for determination of long-term effects and for the evaluation of mitigation measures.	See staff response to Alaska Department of Environmental Conservation comment 2.
33	(6)	Wetlands that are within CoE jurisdiction should be mapped.	The only agency which has declared the area as wetlands is the Corps.
47	(1)	If westerly winds produce easterly currents, and easterly winds produce westerly currents,	Wind direction is based on the direction <u>from</u> which the wind comes; current is based on the direction <u>to</u> which the current goes.

Page	Paragraph	Comment	Response
		perhaps this apparent anomaly should be explained.	
48	(1)	The estimated maximum wave height on page 48 does not agree with data reported on page 46. This apparent inconsistency should be explained.	Page 46 presents actual data, whereas page 48 presents an estimate.
56		Early in the terrestrial community discussion the biological community types in the project area should be identified and the extent and location of those habitats, and the extent of wetlands as defined by U.S. EPA and CoE regulations should be mapped. The identification of wetlands is an essential requirement for the issuance of Section 404 permits and an essential part of the EIS. If there is more than one identifiable community type in the wetland, the extent of each community type should be mapped.	The composition of the biological community in the Prudhoe Bay area is not as varied as the comment suggests. The description provided on page 59 of the DEIS is a general description of the "wet" tundra typical of the Prudhoe Bay-North Slope region. Onsite surveys in the project area have not been conducted at this time.
59-60		Considering the scope of the project, records of actual observations of small mammal, large mammal, and bird populations and useage of the proposed project area should be obtained and appended to the report.	See the reference section (pages 206 and 207 of the DEIS), which contains a number of studies reported by Angus Gavin on these wildlife populations.
61-62		Existing water withdrawals from the Put River under Water Permit No. 890 (cited on page 88 of this DEIS) and additional water withdrawal under operating conditions would remove a substantial and significant portion of the summer river flow. The effect of those withdrawals on fish populations, if any are present, could be important. The apparent lack of data regarding fish populations in the lower Put should be resolved by sampling, by reference to unpublished data on the Put River, and by reference to studies on comparable arctic streams, or should be identified as a potentially important data gap. The incorporation of general information about estuarine fish populations in the Beaufort Sea is not sufficient to define potential impacts at a specific site such as is proposed for the project.	Telephone conversations with the Alaska Department of Fish and Game indicated that the Put River had little or no fishery value. (See reference section, page 207 of the DEIS.)

64-65		Full names of fish should be used or the full names should be on the same page as the abbreviations.	Refer to table 13 of the DEIS for the full names of these species.
66		The comments regarding the fish data also should be applied to the analysis of the other biota of the Put River.	Refer to page 61 of the DEIS, which states that "there is little available information on the existing aquatic flora and fauna of the Put River."
70	(2)	Have polar bears been sighted in the project area?	Yes.
70	(3)	Are there specific marine bird data for the project? Specific data should be presented for the project area or the lack of data should be treated as a data gap during the impact assessment.	The staff believes that the description of the marine birds in the area of the project, as described on page 70 of the DEIS, is adequate.
80		The data presented are inadequate for impact assessment related to gravel borrowing and placement because borrow sources are not identified (except by passing mention of possible sources) and specific data concerning the soils and biological conditions at the borrow and fill sites are not presented. Site-specific information is required for proper impact analysis. Photographs would be helpful.	This information cannot possibly be provided. The project sponsors would be required by state and Federal agencies to use certain specific locations. These agencies have not yet made such determinations.
81	(4)	Erosion is a potential problem near stream banks, particularly if vegetation is disturbed.	This is related to siltation, which is discussed on page 81 of the DEIS.
83	(3)	Erosion is considered no problem on page 81, but is discussed on page 83. This inconsistency should be resolved.	Erosion would not be a "serious problem." The DEIS does not claim it is "no problem."
86	(5)	1.1 meter is not 6 feet.	Comment noted.
89	(1)	On page 61 it is stated that "there is some indication that the lower end of the (Put) river in the delta area of Prudhoe Bay may provide primary summer habitat for freshwater, anadromous and some juvenile saltwater fish species." On page 89 potential impacts of water withdrawal are not addressed, presumably because ". . . the Put River has no known populations of char or grayling, possible flow reductions are not regulated by the State of Alaska." The germane	Comment reflected in section C.3 of the FEIS.

		issue is not the regulatory authority of the State of Alaska, but the potential impact of project operation on fish populations that may be present, as stated on page 61. This discrepancy should be resolved and the issue of potential impacts should be addressed.	
92	(4)	After stating on page 90 that increasing the size of the existing causeway might deflect currents, alter circulation patterns, impede mixing of marine waters, and increase sedimentation in some areas, it is illogical and inconsistent to state (on page 92) that the only long-term effect of the expansion would be the loss of habitat.	Comment reflected in section C.3 of the FEIS.
93		The beginning paragraph includes the statement that ". . . it is unlikely that a new causeway would have a significant environmental impact, unless the anchoring effect of the causeway. . . resulted in increased strudel scour. . . . " This assessment does not reflect the impacts listed on page 91. Those potential impacts should be addressed also.	Comment reflected in section C.3 and C.12 of the FEIS.
94		The water injection facilities represent a major project with potentially significant environmental impacts. Potential impacts from this major project cannot effectively be dealt with by a single-page discussion, particularly when no details of the waterflood plant location or description of the planned facilities are presented. Reference should be made to the Waterflood Project EIS currently being produced by the CoE. Synergistic and cumulative effects resulting from the two projects should be addressed in both EIS's.	Comment reflected in sections A.6 and C.12 of the FEIS.
106	(2)	Paragraph 2 discusses effects of scraping noises on bowhead whales. This probably should not be included in the discussion of <u>terrestrial</u> communities, but should be moved to the <u>aquatic</u> section (which should be labeled Aquatic and Marine).	Comment noted.
106-110		The DEIS does not present sufficient data to evaluate the effects of the project on	

		the biota. For each important species (i.e. important in the food web, endangered species, key species in communities, and important game, commercial, and subsistence species) the DEIS or the appendix should describe or list the importance of the species, the numbers or densities affected, importance of the affected habitat to the species, and potential effects of the project on the species. Gaps in the above data should be identified clearly and the effect of those data gaps on the assessment of impacts should be estimated if possible.	The staff believes that the revised discussions on existing environment and impacts to the environment are adequate for this analysis. An appendix has also been added to the FEIS referencing the staff's consultation on endangered species.
117	(3)	Potential gravel sources should be identified.	Comment reflected in section C.3 of the FEIS.
123	(2)	Dredged material disposal sites should be identified, at least tentatively, or alternatives should be discussed.	This information is not currently available to the staff.
125	(2,4)	Insufficient data has been presented to conclude that impacts would be minimal.	Comment noted.
125-126		The causeway and intake structures should be discussed in the Unavoidable Impacts section.	Offshore facilities are discussed in that section.
138-166		The evaluation of the North Pole alternate site does not clearly state why that alternative is less feasible than the chosen site. The evaluation of the site should be summarized and should be compared with the other alternatives in a concise summary. With the exception of air quality considerations, the North Pole alternative appears to be the best site from an environmental standpoint. The possibility of variances from air quality attainment requirements and alternative solutions to achieve air quality attainment should be explored fully. Many of the socioeconomic problems discussed could be alleviated by tax revenues from the facility or by front-end money from the processor.	Comment reflected in sections H and I of the FEIS.
200	(2)	The boom-bust economy is caused in part by the over-building of infrastructure to support a project. In the case of Fairbanks,	Comment reflected in section I of the FEIS.

much of the community infrastructure necessary for the 3,000 workers is available and under-utilized. The impact of the SGCF construction would be much less than for the TAPS and would leave behind an industry that would be a continuing benefit to the community.

257	(1,2)	The discussion of CoE responsibilities makes no reference to Section 404 jurisdiction and permit authority. Reference to Section 404 should be added because the SGCF and ancillary structures probably would be built on wetlands under CoE Section 404 jurisdiction.	Comment reflected in Appendix I of the FEIS.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

September 11, 1979

Federal Energy Regulatory Commission
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

Gentlemen:

We have reviewed the Prudhoe Bay Project Draft Environmental Impact Statement, Construction and Operation of a Sales Gas Conditioning Facility at Prudhoe Bay, Alaska. We are responding on behalf of the Public Health Service.

It is noted on page 12 that during peak runoff during the summer, 60 tons per day of solids could be discharged from the backwash effluent. The final statement should indicate if this potential discharge would meet the EPA Best Conventional Pollution Control Technology (BCT) guidelines. Also, there appears to be an inconsistency regarding the disposition of treatment plant filter backwash and sediment. On page 12 it is stated that backwash would be discharged into Prudhoe Bay, and on page 86 it is noted that filter backwash and sediment would be conveyed to the sewage treatment facility. This should be clarified in the final statement.

The reference on page 12 is to the water injection facilities, whereas the reference on page 86 is to the SGCF utility water facilities. Also see section A.6 of the FEIS.

It is stated on page 95 that if the proposed wastewater treatment facilities are designed and operated similarly to the existing Atlantic Richfield Company (ARCO) plant, the environmental impacts would be minimal. However, since "monitoring data are sparse, and the ultimate fate of the effluent is unknown," we recommend that routine follow-up monitoring efforts be planned and conducted following project completion to ensure the detection of possible adverse impacts relating to the disposal pond.

Monitoring programs--e.g., the perculation program identified on page 176 of the DEIS--would be the responsibility of the Alaska Department of Environmental Conservation.

The Operation, Maintenance and Emergency Procedures section does not address emergency medical needs of employees, hazardous pollutant emergency procedures other than built-in controls, or general disaster procedures for any potential disaster occurrence. We recommend that these additional procedures be addressed in the final statement.

Comment reflected in section A.5 of the FEIS.

This draft statement has addressed the issue of potential effects on public health from pollutants emitted during construction, and has indicated that the risks would be minimal because of short-term exposure and an unlikely concentration of pullutants due to a constant wind and scattered construction. In addition to monitoring efforts, we recommend that workers that may be exposed to toxicants or any other health or safety hazard be trained in early detection of potential hazards and appropriate emergency procedures to protect personal health. A fire

Ibid.

safety training program is alluded to on page 120, but it is stated that no information has been submitted. The final statement also should note that each construction contract conform to requirements for safety and health according to the Federal Construction Act of 1969 (P.L. 91-54).

An assumption is made on page 111 regarding a disposal system for the types or quantities of hazardous wastes that may be generated at the proposed project. Since inadequate information is available regarding hazardous wastes and the uncertainty regarding the use of the multiple disposal system now available at ARCO, we recommend that this issue be clarified in the final EIS.

At the present time, no hazardous wastes are expected to be generated at the project site. Comment reflected in section C.8.6 of the FEIS.

Since it is unknown if any cultural resources exist at the Prudhoe Bay industrial complex or on the immediate site of the proposed project (page 114), we recommend that a thorough historical and archaeological survey of the site be conducted and any finds retrieved before construction is allowed. This endeavor is especially important because the land in the Prudhoe Bay area is known to be the site of numerous temporary settlements and seasonal hunting and fishing camps of Alaskan natives.

Comment reflected in staff recommendation in section I of the FEIS.

We agree with the premise that the specific facilities proposed would do little to augment the impact which has already occurred on the North Slope to the native socioeconomic and cultural framework and general land use. However, we are generally concerned with the cumulative effect of additional industrial facilities that would probably increase with enhanced oil or gas development. With the many unfamiliar and unpredictable events at the village level, quantitative impact projections cannot be made with a high degree of accuracy as noted on page 113. Therefore, as energy technologic developments occur in Alaska, we highly recommend that sponsors remain cognizant of possible long-term effects upon the native populations as well as the environment. Through liaison with village councils, the North Slope Borough, and the State of Alaska attempts could be made to mitigate any action that may have detrimental effects.

No response required.

We appreciate the opportunity of reviewing this draft statement. We would appreciate receiving a copy of the final EIS when it becomes available.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
ARCADE PLAZA BUILDING, 1321 SECOND AVENUE
SEATTLE, WASHINGTON 98101

September 12, 1979

REGION X
Office of Community Planning
& Development

IN REPLY REFER TO:
10C

Federal Energy Regulatory Commission
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

Gentlemen:

Re: Prudhoe Bay Project Draft Environmental Impact Statement

We have reviewed the statement submitted to us through our Headquarters Office.

We find no significant impact in our areas of concern. Our Anchorage Office had some minor comments in the two socioeconomic sections of your statement. They are as follows:

Page 75, Paragraph 2. In late 1978 the Alaska Department of Labor issued revised employment data for each of the 29 Census Divisions in Alaska for the four years of 1974 through 1977. The unemployment rate for the Barrow-North Slope Division averaged 8.0 percent in 1976 (not 3.7 percent) and 9.2 percent in 1977. There were several Census Divisions with lower unemployment rates, so the Barrow-North Slope Division was not the lowest.

More recent 1980 data has since been acquired, reflected in section B.9 of the FEIS.

Page 161, Paragraph 2. The first sentence in this paragraph concerning Fairbanks and North Pole having historically experienced critical shortages in housing would be more accurate if the following phrase were added at the end of the sentence: "at times of rapid economic growth."

Comment reflected in section B.9 of the FEIS.

Page 162, Paragraph 1. At the end of the first line the December 1978 unemployment rate was 16.4 percent (not 16.2). For the full year of 1978 the rate averaged 17.9 percent.

Ibid.

Thank you for the opportunity to comment.

Sincerely,

Robert C. Scalia
Director, Regional Office
of CPD

COST COMPARISONS
Prudhoe Bay vs. Interior
as
Gas Conditioning Site

Written Comment on the Draft Environmental Statement
Prudhoe Bay Project/Construction & Operation of a
Sales Gas Conditioning Facility at Prudhoe Bay, AK
July, 1979

Prepared By:
Economic Development Division
Greater Fairbanks Chamber of Commerce
October 10, 1979

Because the Fairbanks' comments are extensive, the entire document will not be reprinted in this FEIS. The pertinent comments--e.g., the six introductory pages and particularly pages 40-53--are reproduced and discussed in this FEIS. Copies of the Fairbanks' comments are available for public review in (1) the Commission's Office of Public Information, Room 1000, 825 North Capitol Street, N.E., Washington, D.C. 20426; (2) the Commission's regional office at 333 Market Street, sixth floor, San Francisco, California 94105; (3) EPA's Region X office library, 11th floor, 1200 Sixth Avenue, Seattle, Washington 98101; (4) EPA's Alaska Operations Office, room E535, 701 C Street, Anchorage, Alaska 99513; and at the Fairbanks North Star Borough Building, Fairbanks, Alaska 99706.

The community of Fairbanks appreciates the opportunity to offer further comment on the Federal Energy Regulatory Commission's Draft Environmental Impact Statement regarding Prudhoe Bay as a gas conditioning site. While we realize the extensive work that went into the preparation of that statement, we feel compelled to point out gaps in information, errors of fact and unfounded assumptions. The extension of the period for written comment has afforded us the opportunity to gather data we feel is necessary in your deliberations and decision making -- data that has not been available heretofore.

In considering the relative merits of one site over another, we ask you to keep the following points in mind:

The President's mandate to use coal as a fuel whenever possible;

The need of the United States for petrochemicals as feedstocks for industry;

The necessity to deliver Alaskan natural gas to the consumer as expediently as possible,

And most importantly, the ultimate costs of energy to the consumer at the delivery end of that gas.

We submit to you that not only is the Prudhoe Bay site "not significantly superior" to an Interior site for a gas conditioning facility, it is significantly inferior.

The Prudhoe design evaluated in the DEIS would burn as fuel some 65% of valuable gas liquids. An Interior site would use coal as a fuel, thereby delivering the maximum BTU's to the consumer in the Midwest and at the same time utilizing

The comments on the following 5 pages which support these four items are all reflected in section H of the FEIS.

all available liquids as feedstocks for much needed petrochemical manufacture. Further, that design was imposed on an Interior location without consideration of other alternatives. In actuality, the concept model postulated for the Interior is significantly different.

Not only is the model different, it is less expensive: transportation, construction and operating costs all can be proven significantly lower in the Interior.

Transportation costs for the building and operation of a facility at Prudhoe Bay compared to one at Fairbanks can be summed up by a simple observation: the distance from Seattle to Prudhoe is twice that from Seattle to Fairbanks. It is obvious and it is documented that the costs are more than double for transportation to a Prudhoe Bay site.

The projected 1980 shipping rates to the Interior by water and highway are $130 a ton for oil field-related equipment. The comparable projection to Prudhoe is $288 a ton. Barge shipping rates are estimated at $300 a ton to the beach, not the conditioning plant site. Shipment to the site would cost an additional $27.5 million or 25 percent of the total transportation cost.

In considering the exorbitant cost of moving modules and other equipment by barge to Prudhoe, one must also consider the ominous but ever-present possibility that the barges might not make it to Prudhoe because of unpredictable ice conditions and that the barges could be frozen in over the winter along with tugs.

The attached historical account of the 1975 sealift to Prudhoe Bay underscores that reality and its attendant costs. When the ice locked in the 25 of 47 barges that managed to make it to the bay that October, the oil companies wrote an $80,000 check for each day the barges were detained in the Arctic that winter. Another $20 million was spent rerouting the material overland from the barges that never made it north. The 1980 price for demurrage at Prudhoe is even greater. A tug will cost $10,000 to $13,000 a day. In 1975, two tugs were frozen in the bay. Large barges in 1980 would cost $4,000 a day.

When and if materials arrive at Prudhoe Bay, comparisons of a Prudhoe versus Interior site must take construction detail into consideration. The DEIS is misleading in that it glosses over several considerations of construction in the arctic environment: availability of gravel, special construction methods required to deal with frozen tundra and permafrost and extensive permitting required in any disruptions to the fragile environment.

New state regulations regarding mining of gravel from active riverbeds renders inadequate the DEIS assumptions that there is sufficient gravel on the North Slope. There was no consideration given in the DEIS to accept construction methods in the Arctic which require massive quantities of gravel to serve as insulation over tundra, nor to a piling method of construction that adds $3 to $5 per square foot over and above cost of structures in non-permafrost areas. There was also no consideration given to the fact that an additional 3 million cubic yards of gravel will be needed for a water injection project which will <u>preceed</u> the construction of the conditioning plant.

In short, there is <u>not</u> an adequate supply of gravel on the North Slope for a project of this size. Costs of getting to the gravel that exists may be prohibitive. Gravel fill for site preparation at Prudhoe would require 3.2 million cubic yards at $25 per yard for a total of $80 million, in comparison to an Interior site, which would require .25 million cubic yards at a cost of $4.50 per yard for a total of $1,250,000. Building construction at Prudhoe would be $25 per square foot higher than in an Interior site because of piling and structural slab costs. Extra

construction details to design against wind, snow and erosion problems at Prudhoe further escalate North Slope costs.

Should construction problems and costs be ignored, the choice of Fairbanks over Prudhoe Bay is again a no contest competition in terms of maintenance and operation expenses. The consulting firm of Mark Fryer & Associates of Anchorage identified a conservative $9 million annual operating differential related to labor and an additional $12 million related to energy at the Prudhoe site.

Four specific costs related to labor force operations at Prudhoe Bay were found to exceed those for similar work in Fairbanks. A review of the basic pay scale at Prudhoe Bay revealed that wages are 15% higher than Fairbanks, averaging $21 per hour for skilled journeymen. Premium pay for overtime hours worked at Prudhoe Bay amounts to a direct salary cost of 65% above the straight time salary rate. Fryer & Associates places costs for housing and transporting personnel as equivalent to 32 to 40 man hours. Considering only the first three specific costs, the expense of employing workers at Prudhoe Bay is two and one half times the rate paid for similar plant activities performed in Fairbanks.

A fourth specific cost associated with labor relates to reduced efficiency. Fryer & Associates reports that when workers are required to work long hours, working efficiency decreases and safety suffers. An 84-hour work week will produce a production efficiency of from 70 to 78%. Additional considerations are the effects of sensory deprivation and emotional stress evoked by the remote living situation. Based on the body of literature describing the psychological aspects of remote living, the firm reports worker efficiency at Prudhoe Bay will not exceed 75% of the traditional 40-hour work week.

Fuel inefficiency is another aspect targeted by the consultants in contrasting costs of operating at Prudhoe Bay and Fairbanks. For every 1% of value differential that gas liquids have over pipeline quality natural gas, $12 million annually may be wasted by the currently proposed conditioning facility configuration and location. Currently the cost of unconditioned natural gas at Prudhoe Bay is $1.75 per million BTU which compares to the cost of coal FOB Fairbanks of $1.05 per million BTU. While natural gas is a more appropriate fuel for many of the requirements of the plant, a coal-fired cogeneration plant in Fairbanks that would produce approximately 50 megawatts required by the facility would also supply 340 million BTUs of thermal energy per hour. As much as 400 million BTUs per hour of proposed natural gas consumption could be supplanted with coal. This could provide $2.5 million per year to offset added capital investment and maintenance costs of the coal-fired facility.

Fryer & Associates also identified a reduction in the capital cost of the proposed project by $20 million if it is located in the Interior. This would be realized because support facilities are already in place in Fairbanks. In terms of maintenance and operation costs, the savings per year could average $150,000 to $200,000. The consulting firm concludes that these considerations added to the others listed support an annual savings of $9.3 to $10.3 million if the gas conditioning plant is located in Fairbanks. These savings are believed to be understated and do not even address the potential energy and social concerns.

A final rebuttal of the Fairbanks' response addresses the DEIS concern with introducing an economic upheaval. While it is true that Interior Alaska traditionally has suffered the impacts of a boom and bust economy that rose and fell with the latest major construction project, the case cannot be made with regard to location of a gas conditioning plant at an Interior site.

On the contrary, unlike pipeline, DEWline, or military supply line construction, a project like a gas conditioning plant leaves behind it stable, ongoing

jobs and the basis of spin-off industry. An analysis of the private sector, completely discounting tertiary income multipliers or accrued benefits of satellite industry, shows a net gain of $11,252,700 per year to the Fairbanks economy. An analysis of municipal government costs and benefits associated with construction of a conditioning plant shows net benefits to the Fairbanks North Star Borough of $10,980,888, for a total benefit to the community of $22,233,588 per year.

In addition to the positive economic impact on the Fairbanks economy, an Interior site creates development opportunities and benefits for the rest of the State of Alaska as well as a benefit to the consumer in the contiguous states: rather than burning valuable petrochemicals as fuel, they will be used as the building blocks for industry from packaging to pharmaceuticals to fuel extenders to fertilizers. This approach maximizes the return from a valuable and non-renewable resource, and at the same time delivers the maximum BTUs to the energy-hungry consumer in the Midwest.

DALLAS ENGINEERING INC.

PETROLEUM ENGINEERING

ga, North Dakota | 907/479-3365 | *Fairbanks, Alaska*

S.R. Box 30140
Fairbanks, Alaska 99701

October 8, 1979

Mr. Robert H. Dempsey, Chairman
Economic Development Committee
Greater Fairbanks Chamber of Commerce
550 First Avenue
Fairbanks, Alaska 99701

Dear Mr. Dempsey,

It is my understanding that you are preparing a review of the Draft Evnironmental Impact Statement, prepared by the Federal Energy Regulatory Commission for the Prudhoe Bay Project. This statement is dated July 1979.

Would you please include a copy of this letter as a supplement to your report.

It is obvious from reading the forward to the DEIS that its author(s) is (are) not only not familiar with "Production, Separation, Dehydration, Conditioning and Processing" at Prudhoe Bay, but he/she (they) is (are) not familiar with those terms as they are used in the industry. I would like to make reference to a couple of the more obvious examples.

FIRST: On page ii in the middle of the second paragraph, in parenthesis, you will find the following statement: (Briefly, gas conditioning includes dehydration 2/ and removal of carbon dioxide (CO2), while gas processing includes removal, fractionation and possible partial reinjection of natural gas liquids.). The key word here is "reinjection". It could mean reinjecting these natural gas liquids into the reservoir which would be a proper use of the word since these liquids did come out of the reservoir. If the word refers to the oil pipeline (which is probably the case) then it should be "injection" not "reinjection" since these liquids have never been in the oil pipeline.

SECOND: The footnote (No.2) on page ii is as follows:

> It is recognized here that dehydration facilities presently exist at Prudhoe Bay for the oil recovery process.

Water separation (or removal) from the oil does not "Dehydrate the Gas". The process is entirely different. No gas dehydration is necessary for the oil recovery process.

THIRD: The phrase "Wellhead Gas Price" starts at the bottom of page ii and is continued at the top of page iii. The Natural Gas Policy Act of 1978 does allow the Commission to "Add To" the wellhead gas price; see section 110 (a) (2).

> (2) any costs of compressing, gathering, processing, treating, liquefying, or transporting such natural gas, or other similar costs, borne by the seller and allowed for, by rule or order, by the Commission.

The sentence refers to the gas process, not the oil process.

Comment reflected in the foreword and section A of the FEIS.

This is a legal issue beyond the scope of the FEIS.

It does not allow the Commission to "Include In" the wellhead gas price any such costs which occur after the point of first sale by a producer.

These are very serious errors. Since they are contained in the forward to the document the entire document thus becomes suspect. Further, since no application for a permit to construct or operate a gas Conditioning/Processing facility at Prudhoe Bay is now in existence, it seems inappropriate that a DEIS is even being considered. It appears "Clear and Simple" to be another Regulatory, Bureaucratic Boondoggle!

Sincerely,

Dois D. Dallas, Petroleum Engineer

No response required.

COMMENTS CONCERNING DEIS

1) Pg. 22, last paragraph: The statement that water injection for pressure control is "not planned for several years" may have been correct when the DEIS was prepared but is obviously incorrect now. A decision to proceed with injection may come as early as 1980, with the project actually preceeding construction of the gas conditioning plant. As currently planned, the injection plant will require 3,000,000 cubic yards of the dwindling gravel resource in the Prudhoe area. The DEIS ignores this most dominating siting consideration.

Comment reflected in section A of the FEIS.

2) Pg. 23: Why are abandonment procedures for the SGCF not important when the site is on the North Slope, but sufficiently important to warrant comment in the all too brief analysis of the North Pole alternative site? Reuse of property and/or success in returning developed sites back to nature have been extremely difficult if not completely unsuccessful on the North Slope (judged from previous examples). On the other hand, there exists a long list of successful conversions at sites in and around Fairbanks.

The DEIS does not treat abandonment at each site differently. It simply recognizes that it would be pure speculation to address a situation 25 years or more in the future.

3) Pg. 80, last paragraph: Gravel availability will be discussed later in this communication. The DEIS is unbelievably insensitive to the problems associated with the mining and subsequent use of the limited supply of available gravel in the proposed plant site area. The statements contained in the final paragraph are not outwardly false--they just lack veracity due to glazing over the really important aspect of the consideration. That is, specifically, that gravel supplies "currently being extensively utilized

Comment reflected in sections C.3 and C.12 of the FEIS.

for development of the Prudhoe Bay area; have exhausted available supplies in certain areas (portions of the Sag River) such that prospects of obtaining additional permits for further mining of these relatively cheap, active river channel gravel supplies from the State are dim at best.

4) Pg. 81: Wouldn't it be more accurate to acknowledge that a new dock or causeway will be constructed whether as a part of the SGCF or as a part of another project and write this DEIS on the basis of acknowledging that another 500,000 cubic yards of the limited supply of this geologic resource will have been diminished?

Comment noted in Sections A.6, C.3, and C.12 of the FEIS.

5) Pg. 81, third paragraph: The USGS reports that areas available for future gravel mining (sites not directly in river beds) are faced with the problem of "flooding and erosion in areas near river flood plains." Since the State of Alaska has for all practical purposes stopped the practice of mining in active stream beds, the river upland sites next most economically available would fall within this potential problem area.

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See section C.3 of the FEIS.

6) Pg. 84, second paragraph: Without any knowledge of the disposal mechanism of their current "example", wouldn't it be wise for the "staff" to determine the detrimental effects of a massive disposal problem of this magnitude rather than merely being happy to have Lachenbruch's data to fall back on to determine where the steady state thaw will occur (which is at a point deep within the ground where frozen sides surrounding the thaw bulb would hold the objectionable liquids) and not be concerned with the percolation action that will take place in the active zone within and surrounding the dikes?

See the hydrology discussion for the Yukon River alternate site.

7) Pg. 94: The portion of the "staff" that prepared Subsection (d) recognized the area's "faltering capability for producing required amounts of gravel" when discussing only the relatively small gravel needs for causeway construction associated with the proposed water injection facilities. Why does the rest of the "staff" overlook this major consideration (DEIS, Pg. 80) when they should be commenting on the need for a total of over 5,000,000 cubic yards for just two proposed projects. And even that does not include future needs for gas line construction, additional roads, pads, etc.

Comment reflected in sections C.3 and C.12 of the FEIS.

8) Pg. 95, subsection (e), second paragraph: This paragraph is a perfect example of why the DEIS is unacceptably incomplete. Just because no one could supply "information" on type of excavation, spoil and the disposal consequences is no reason not to investigate the matter and use the data in a proper comparison of available sites. Disposal on the North Slope is an engineering obstable on all projects. It will be a major problem before any design for the gas plant will be approved. Spoil disposal approvals will bring additional government agencies into the approval network and further delay the project. The use of the cover up phrase "ideally, the spoil would be gravel" is inaccurate. Anyone familiar with the area knows that the spoil materials will be the one to three foot organic overburden of frozen silt and tundra that overlays the gravel.

Comment reflected in section C.3 of the FEIS.

9) Pg. 131: The "Alternatives to the Proposed Action" section of the DEIS is obviously an overview at best. Under subparagraph "1" the DEIS states "In an effort to determine the most suitable... conducted a multiphased site selection analysis." A multiphased cursory overview would be a truer

statement. When a staff approaches a task of comparative analysis and lets statements such as "preferred site" slip out (page 140) when referring to a North Slope site in the midst of what should still be an unbiased comparison section of the report, it is rather revealing as to the enthusiasm put into gathering facts for a true "comparison".

The staff is not biased toward one site over another. The "preferred" site is the site "preferred" by the oil producers.

10) Page 132, subsection (b), first paragraph: Excavation into "Bases of mountains", although possibly creating excessively high excavation costs, do not normally necessitate hauling large quantities of spoil material. There are numerous permafrost free sites in the Fairbanks area that would yield good fill material for low areas through excavation from higher terrain in site leveling. This produces a very economical balance of cut and fill. The DEIS dismissed without consideration good sites that very well would have presented an excellent balanced cut/fill site.

In order to investigate alternative sites for production of energy, a set of criteria must first be developed to select a reasonable number of sites for further investigation. The approach proposed here would select sites on the basis of only one criteria. The staff does not agree with this approach.

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11) Pg. 132, subsection (b), third paragraph: With so many good sites available south of the Brooks Range, there is no need to confuse the analysis by discussing potential problems with nondesirable permafrost sites.

Ibid.

12) Pg. 136: A study of this page alone provides ample reason to be able to state that more study on plant siting is essential before a final decision is made. None of the possible sites originally identified by the State of Alaska were investigated with even the hit and miss process used on the staff choice (North Pole) before stating that their "preferred site" would be better.

The staff specifically asked the State of Alaska to select sites to investigate. As page 134 of the DEIS states, Alaska specifically requested the FERC staff to examine the Yukon River and Fairbanks sites. Since the DEIS was issued, the Fairbanks North Star Borough has identified additional sites in the Fairbanks area; the staff has examined these sites in the FEIS.

13) Pg. 138 through Page 165: These pages contain much generalized information on the Fairbanks and North Pole areas that appears to have been cannibalized from numerous documents prepared by other agencies for other reasons than this specific DEIS. The information is correct and in many ways even applicable to the North Pole site. The problem is that it is not used in any specific way and no evaluations are made in a study of the data as it relates to a specific comparison between sites. Again, a reopened study and time to to it properly for the North Pole site as well as other potentially better sites is mandatory.

The key to this comment is that the information in the DEIS is correct and applicable to the North Pole site. This is the precise purpose of an EIS. The staff did, however, use this data to compare alternative sites, as reflected on pages 199-201 of the DEIS.

COMMENTS CONCERNING FOUNDATION DETAILS

1) Prudhoe Bay Area:

a) All potential building sites are underlain with ice rich permafrost soils that are incapable of supporting major structures when the frost melts.

No response required.

b) Massive quantities of gravel (five foot minimum depth) are utilized to cover the tundra with a sufficient insulating blanket to keep the active layer above the frozen tundra material. This blanket serves to preserve the permafrost layer and afford solid surfaces for site movement throughout the project. It serves no useful purpose for support of structures other than preserving the permafrost.

Ibid.

c) Building structures must be supported on pilings set into the preserved permafrost. The piling elevate the structure above the gravel pads in order to negate the efforts of heat transfer from warm buildings into the gravel insulating blanket.

No response required.

d) Elevated structures require costly insulated structural floor slabs which--for processing plants-- would normally be concrete. Concrete slabs are expensive at any location and extremely so in the North Slope area. In addition, the slabs utilize additional critically short supplies of gravel aggregates.

Ibid.

e) As a result of b, c and d above, North Slope project costs are increased significantly over simple slab-on-grade construction practices normally employed in less harsh environments south of the Brooks Range.

Ibid.

f) DEIS statements acknowledge the need for 2.3 million cubic yards of gravel for the conditioning plant. In addition, 3.0 million cubic yards will be needed for the water injection project. Additional yardage will be required for the gas pipeline and for other lesser projects that must be constructed on the North Slope.

Ibid.

g) There is no assurance that upwards of 6 million cubic yards of gravel materials are economically available in or near the proposed project area without causing massive detrimental effects on the environment, the budget for the gas conditioning plant, and other projects that cannot be so easily relocated.

Ibid.

h) Past practice of mining gravel aggregates from the active riverbeds is fast becoming a thing of the past. Future projects of this proposed scale will demand more careful regulation. It is safe to assume that the current State regulatory agencies' policy to not allow more river channel borrow as practiced in the past will become regulation rather than merely policy. When this occurs, a developer will have to get permission to mine specific sites not in active river beds and will have to have a development plan that will require numerous permits before any work can be accomplished. The day of the "cheap" gravel placement operations (currently on the order of $10.00/cubic yard) is gone.

No response required.

i) Near river and upland gravel sites are available. Although the concensus of opinion among persons familiar with the Prudhoe Bay area construction problems is that the meager gravel supplies are nearly exhausted, which is no doubt the reason the DEIS has chosen to gloss over this most important consideration--even to the point of dismissing the strong possibility of a decision to proceed on the water injection project by next year--the fact is that gravel is available. The problem is that mining quantities of this magnitude will be so prohibitively expensive and potential damage to the environment so great that even the oil companies must now start to look at gravel conservation measures. Even if dollar costs are not considered, the damage to the environment and downstream effects on other projects must be considered.

Comment reflected in section C.3 of the FEIS.

j) The USGS has identified several areas that contain gravel not in active stream beds. The useable material is frozen and is overlain with one

Ibid.

to three feet of frozen silt and organic tundra. USGS describes the material as "vegetated gravel commonly mantled with one to three feet of carbonaceous silt with high susceptibility to erosion." In addition they state that the shallow ground water table will limit economic depth of excavation. The gravels are frozen and will have to be thawed before they can be mined with any degree of economy.

Comment reflected in section C.3 of the FEIS.

k) Overburden from submerged gravel deposits will have to be carefully disposed of in a location and manner acceptable to governing agencies. The overburden material will be an economic liability and will have only limited reuse potential. Permits for debris disposal will have to come from the Corps of Engineers since they will have jurisdiction under the Wet Lands classification over disposal of overburden and where the mined materials are placed. The Corps will undoubtedly not permit the "stack it on the tundra and forget it" approach that seems suggested by the DEIS.

Ibid.

l) Paragraphs j & k above refer to removal of the silty overburden and problems associated with the subsequent disposal. USGS cautions against the "carbonaceous silt with high susceptibility to erosion." Sooner or later government agencies are going to have to face up to the increasing problem of soil erosion on the North Slope. Wind blown erosion is exacerbated as more areas are opened to development. A project the scale of the gas conditioning plant warrants attention to this problem. An example of the costs and hazards associated with wind erosion on the North Slope is the recent loss of electrical generating capacity

Ibid.

throughout the oil fields because of "clouds" of wind blown silt.

m) Frozen gravel is normally not capable of economical excavation without first being thawed. This necessity places great constraints on the type of borrow operation that can be established--particularly limiting the number of weeks each year that the mining operation can function. It is conceivable that this point alone could delay the gas plant project one year in order to allow time to do the extensive gravel placement work during the short thawing season in the arctic.

No response required.

n) Based on the previous recorded costs of $10.00 average for river borrow per cubic yard of gravel in place at Prudhoe and adding the cost of escalation, pit stripping and disposal, gravel thawing, delayed progress due to the new requirements for off stream borrow pits, etc., the cost of gravel for a larger scale project of the gas plant magnitude will undoubtedly spiral to the $20 to $30 range. For purposes of comparative planning I would suggest that not less than $25 per cubic yard be used.

Comment reflected in section C.3 of the FEIS.

o) Piling installation is not particularly expensive even on the North Slope. Piling costs are important considerations however since they add another $3 to $5 per square foot of cost over and above what would be required for a slab-on-grade structure in nonpermafrost areas.

No response required.

p) Insulated structural floor slabs (required for ventilation under heated buildings on the North Slope) adds another $20 to $25 per square foot to the structure based on Prudhoe Bay prices.

Ibid.

q) Availability, performance, and reliability of water supplies and waste disposal systems in the frozen arctic are marginal at best.

The staff disagrees. Comment reflected in sections C.3 and H.3 of the FEIS.

2) Interior Construction Sites:

Comments that follow are based on generalities applicable to several possible construction sites in the Fairbanks area.

a) Yardages of materials involved in a cut and fill operation on non-level sites or gravel and non-classified fills on level sites will vary from site to site and are difficult to generalize. Only by means of a detailed study of one or more specific sites can a really intelligent site evaluation be made. Comments that follow are quite specific as they relate to a site such as the North Pole refinery site that was marginally investigated in the DEIS.

No response required.

b) Exact layout of the proposed conditioning plant is not known to the writer. Hence, site requirements (areas) are unknown. However, using the current estimate of 2.3 million yards required for a North Slope site and dividing this quantity by an appropriate factor to convert the massive north slope fill requirement to a modest 1-1/2 foot average requirement for an interior location would suggest that less than 250,000 cubic yards would be needed at North Pole.

Ibid.

c) There are adequate supplies of gravel available for mining from open pits on private and/or public lands as well as from the Tanana River gravel bars. Good gravel supplies are available on or adjacent to the North Pole site. Even the sites suggested by the State that fall in higher terrain than the North Pole site are only a few miles from adequate valley sources of gravel.

No response required.

d) The Corps of Engineers have placed millions of yards of gravel in the flood control project a few miles from North Pole at a cost reported to be averaging $3.25 per cubic yard. Less massive quantities used for roads, parking areas, and building sites would be more expensive due to more restrictive compaction requirements and placement in more restricted areas. In addition escalation will raise prices over the next couple years. Current estimates for the average price of gravel fills for large projects constructed in the North Pole area are from $4.00 to $4.75 per yard compacted in place.

Ibid.

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e) Based on information given under Items m, j and k under Prudhoe Bay considerations and the paragraphs just preceeding this one, the comparative costs of construction of site fill and building foundations are:

Ibid.

Site preparation: gravel fill

Prudhoe Site: 3.2 million yd^3 X $25 = $80,000,000

Fairbanks Site: 0.25 million yd^3 X $4.50 = $1,250,000

In addition to the above, the cost of building construction at Prudhoe would be another $25 more per square foot for piling and structural slab costs. Extra construction details to design against the wind and snow problems at Prudhoe further escalate the North Slope costs.

f) Most construction sites in the Fairbanks area have a minimum of silt materials overlying the quality sands and gravels that are typical of the Tanana Valley. Contrary to implications made in the DEIS, these materials are not undesirable spoil that create disposal problems. Well engineered sites utilize the upper 6" - 8" of material for top-soil in planted areas and the next one to three feet of silt for areas fills for yard grading, road shoulder slopes and similar necessary non-structural fills. There is no "waste" from a well engineered site unless the site is of less quality than most sites and contains an excess of organic overburden.

No response required.

g) In contrast to a North Slope site that requires a minimum of five feet of gravel fill over the higher terrain (which generally equates to an average of 5-1/2' to 6' to cover the undulating surface), interior sites generally require from 1' to 1-1/2' of structural fill (NFS gravel) for roads and parking areas and 1' to 5' of fill (depending only on the depth of overburden and the new finish elevations established for the project) for building construction.

Ibid.

h) Site preparation for a project of the gas conditioning plant scale can easily be accomplished in a single summer construction season.

Ibid.

i) Good construction weather exists in the Interior for from eight to nine months in contrast to about four months on the North Slope. If economy has any part in the FERC study then this equates to potentially millions of dollars saved by constructing in a less harsh climate.

No response required.

j) The DEIS does not adequately address site access problems. A complete study would address these problems and for most interior sites a complete study would reveal that access roads are minimum impact costs on project budgets.

The DEIS does not suggest that access roads to interior sites would have high impact costs on project budgets.

k) Utility costs to provide water supplies and waste disposal are minor portions of the total construction budget at most interior building sites.

No response required.

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CONCLUSIONS

This communication has been written solely for the purpose of encouraging the FERC or the Courts to reopen the considerations of plant siting for this most important construction project. Statements contained herein are not intended to contradict or belittle the efforts expended to date by the personnel who prepared the partial DEIS that is currently under consideration. Information contained herein is intended to point out a few of the many areas not yet studied thoroughly enough for anyone to reach a sound conclusion on the most appropriate plant site.

No response required.

The writer is not qualified to review other areas of the DEIS than those discussed herein. The conclusion is drawn, however, that the necessary haste required in drafting the statement to date probably reflects similar deficiencies throughout the entire report as are found in the foundation, water supply and site sections of the report.

No response required.

There is little doubt in anyone's mind but that the proposed plant can be constructed in the Fairbanks area for a fraction of what it would cost to build on the North Slope. In addition, the impact on the environment in the areas of materials availability and site utilities are substantially less severe in the Interior. Other considerations may present good arguments for plant siting on the North Slope. No one really knows at this point which location should be selected. One thing is for sure. The DEIS does nothing to aid in a sensible evaluation. A proper and thorough analysis must be accomplished before launching into a project of this scale.

No response required.

MAYOR'S [illegible]
EXT. 21[illegible]

ADMINISTRATION AND FINANCE
EXT 210

ASSESSING
EXT 275

PLANNING DEPARTMENT
EXT. 248

PUBLIC SAFETY
EXT. 233

PUBLIC WORKS DEPARTMENT
EXT. 250

HEALTH AGENCY
EXT. 205

NORTH SLOPE BOROUGH
P. O BOX 69
BARROW ALASKA 99723

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CONTROLLER
EXT 260

ACCOUNTING
EXT 239

PURCHASING DEPARTMENT
EXT 214

ENVIRONMENTAL SECURITY
EXT 255

PERSONNEL
EXT 232

PHYSICAL PLANT
EXT 244

HOUSING AGENCY
EXT 204

I. Discussion of potential impacts posed by the proposed Sales Gas Conditioning Facility at Prudhoe Bay

II. Recommendations on Procedures to help prevent potential environmental damage

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I. "Adverse Environmental effects from water injection could arise from withdrawals from subteranenean reservoirs, withdrawals from rivers, spills, seawater if utilized and from leaks to different formations, in water-producing wells or injection wells. If seawater is utilized, intake facilities must be designed to prevent damage to marine life."

Arco has provided information about the water injection facilities (see sections A.6 and C.12) which alter the potential impacts discussed in this paragraph; it has been deleted.

Designs are needed for the intake facilities and How will it prevent any damage to marine life?

While the intake facilities would impact marine biota, the impact from construction and operation of the SGCF would not be cumulative and is therefore not discussed in this document.

It has been stated before that the causeway affects the salinity of nearby waters and that "Changes in these large-scale distribution patterns attributable to the presence and operation of the dock are spatially limited to the area immediately adjacent to the dock at the dockhead." Environmental Studies Associated with Prudhoe Bay Dock, April 1978, Final Report.

Besides enlarging the existing dock facilities, the alternative that was discussed was building a new causeway, an independent new one. Effects were discussed on widening the causeway which included:1) disposition of sediments 2)NO investigation of biology BUT it will be eliminated 3)resuspension of detritus into the water 4)reentry of nutrients and forming algal growth 5)erosion that would alter habitat 6)widening of causeway would change current patterns and form gyres 7)gyres would block the mixing of marine and estuarine waters and 8) modify substrate for benthic community. The effects for a new causeway would be the same as what happened when building the original causeway and would include the above effects. "The only long-term effect of the expansion of the existing causeway would be the LOSS OF HABITAT." These changes will interfere with the functioning of the total ecosystem in Prudhoe Bay. The water injection facility could impact the marine environment in the vicinity of the discharge.

Comment reflected in sections A.6, C.3, and C.12 of the FEIS.

Effects from pollutants, emissions during construction would have adverse effects on public health...cause lung and cardiac dyfunction. " any increase in pollutant concentrations could adversely affect the health of some individuals."

It has been mentioned again and again that the greatest impact would be the loss if habitat of which the extent of damage is unknown. Emissions would adversely affect vegetation, eliminate lemming habitat, fish, seals, arctic fox and polar bears would be impacted more in the winter than summer, migratory species would be affected to a failure of a year's nesting cycle, caribou populations using the area will decline, frightening bowhead whales away and might avoid this area for years. The food of these mammals, fish, birds, caribou will also be destroyed-"...Completed dock facility would affect the availability of food for fish, birds, and others." ...reduced wildlife populations." Furthermore, gravel removal will change stream morphology, block fish passage, freshwater fish would suffer direct and indirect mortality, reduced growth rate, decreased resistance to disease and modification to migration and movements. Dredging would destroy the benthic community. The project would impact erosion, siltation, permafrost. There is mention of extracting gravel from rivers and stream beds-there are no locations specified. Gravel extraction is allowed only where there would NOT be any damage to the river system and its environment and what is in the environment. Other restrictions are to be found in the Alaska Coastal Management Ordinance.

There are a number of biological assessments that must be completed before the start-up of this project, including the bowhead whale study, noise study.

This DEIS discusses the impacts and potential impacts to the marine and environment BUT does NOT discuss how these impacts would be mitigated and how NOT to prevent damage to the environment. How are the facilities and construction to be designed NOT to block fish passage, NOT to degrade fish habitat, birds habitat, mammal environment, all the breeding grounds, molting grounds, spawning grounds, overwintering, calving, and rearing areas? Eventually and gradually, all of the life in the Prudhoe Bay area will be eliminated because of impacts that are mentioned and have been mentioned. What is the rejuvenation plan for the later years after it is gone?

II. Additonal recommendations to mitigate potential environmental impact:

1. The Bowhead Whale study should be completed before startup of project.
   Noise studies must be comleted in association with the bowhead whale.
2. Study of emission of effluents that would affect human life and safety must be completed.
3. Field surveys of archaelogical, historic and cultural sites must be conducted and clearance must be made.
4. Project must have site specific plans to be presented to local government.
5. Mitigating measures must be completed, analyzed; these would include all of the points mentioned above.
6. Rejuvenation plans must be on record.

NOTE: This report prepared by FLOSSIE HOPSON, Resources Research, for the Department of Conservation & Environmental Protection at the Public Hearing, September 6, 1979, Assembly Room - N.S.B., Barrow, AK, presented by Secretary of N.S.B./E.P.O.

The developer of the SGCF has not proposed any mitigation measures to the FERC staff. In both the DEIS and the FEIS, the staff has recommended that the SGCF developer be required to contact the Alaska Department of Fish and Game (ADFG) to seek ADFG approval for more specific wildlife protection plans.

The National Marine Fisheries Service (NMFS) has completed its biological opinion on the endangered bowhead and gray whales. The results of this biological opinion can be found in section C.7 of the FEIS; complete copies of both the FERC biological assessment and the NMFS biological opinion can be found in appendix E. Consultation with the NMFS established that there was no requirement that any ongoing or future whale study be completed for the entire proposed ANGTS project.

Clyde G. Sherman
Special Agent

RECEIVED BY

OCT 1 1979

M. J. S.

Box 1436
527 - 4th Avenue
Fairbanks, AK 99701
Office: 456-4124 Residence: 479-6469
The Prudential Insurance Company of America

Prudential

Mr. Michael Sotak, Chief of
Environmental Assessment Section
825 Capital St.
Washington, D.C. 20426

Sept. 27, 1979

Attn: Dick Holden

Dear Mr. Sotak:

Please pardon my delay in expressing my appreciation for your people taking the time to hold hearings in Fairbanks. I hope your group received a favorable impression and from our economic stand point have concluded that Central, Alaska is the logical area for a gas conditioning plant. Some points I hope you will consider:

1. All future gas discovered will not be north of Prudhoe Bay. If the plant is built on the North slope all gas found, 2-300 miles South and West or East will have to be piped back North to the plant before starting it on its southern journey.

   This is a poor assumption, given pipeline practice in the past.

2. It definitely costs more to construct a plant on the North slope than it would along the railroad and highway system.

   At present, there is no evidence to support or disprove this assumption.

3. In a populated area the great part of the labor force will be living in their own homes. It will relieve the company from the expense of supplying food and shelter to the employees.

   Comment noted.

4. Employees who can live a normal family life are more happy and contented in their work.

   Ibid.

5. The plant located on the railroad will make it possible to market the liquids that are taken from the gas.

   Ibid.

6. In the interior, coal will be used for the extraction rather than the valuable hydrocarbons.

   Ibid.

Page 2
Continued

The development of the separation plant in the interior is the key that can start several other industrial enterprises which will be of value to all states of the Union. Alaska is the most highly mineralized state in the Union. From a national defense stand point the U.S. needs sources of minerals developed on her own soil that can be used if and when it is needed.

Comment noted in section H.3 of the FEIS.

Respectfully submitted,

Clyde G. Sherman

CGS:amg

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Box 1668, Juneau, Alaska 99802

November 13, 1979

RECEIVED BY
NO 1 1
M. J. S.

Mr. Michael J. Sotak, Acting Chief
Environmental Evaluation Branch
Federal Energy Regulation Commission
Washington, D. C. 20426

Dear Mr. Sotak:

Staff members at the National Marine Mammal Laboratory, Northwest and Alaska Fisheries Center, NMFS, Seattle, Washington have reviewed the FEIS, Alaska Natural Gas Transportation System, Project Prudhoe Bay as per your request to Mr. Terry L. Leitzell, Assistant Administrator for Fisheries for a Section 7 of the Endangered Species Act consultation. The following information is a result of their examination of the FEIS and a review of the enclosure "Biological Assessment" which was included with your request to Mr. Leitzell.

If deleterious effects of construction and operation of a Sales Gas Conditioning Facility (SGCF) at Prudhoe, Alaska, on bowhead and gray whales were to occur, we would expect them to result from interactions with marine vessel traffic during the construction phase of the SGCF. However, there are no scientific data which will allow us to conclude that vessel harassment problems will result such as were observed for gray whales near California and Mexico or for humpback whales in Alaska and Hawaii. The arctic environment, with its precipitous conditions of shifting ice or ice confinement, is dramatically dissimilar to the temperate and sub-tropical waters described above.

Comment reflected in section C.7 of the FEIS.

No indirect effects on bowhead or gray whales are expected as a result of changes in the local biotic community near the mouth of the Put River if the Put River is used as a source of water and/or gravel during the construction and operation of the SGCF. Trophic studies of the interrelationship of bowheads to the rest of the arctic marine community, however, have not been done.

Ibid.

Finally, we note that all concerns are mitigated, presumably, if the SGCF were located in Fairbanks, Alaska, as was proposed in the FEIS as an alternate site.

Comment noted.

In addition, we note the following problems in the FEIS:

P. 67, Para. 2. The comment "...gray whales [are] more commonly found nearer shore or in open water" is misleading. First, grays are not commonly found in the Beaufort Sea (which the quote implies,

Comment reflected in section B.7 of the FEIS.

although does not really state); secondly, they are a nearshore species but not found in the ice. The wording nearshore and open water can imply both close to shore and offshore, i.e. "open water" is sometimes analogous to pelagic.

P. 67, Para. 3. It is incorrect to assume that white whales (belugas) "prefer" the pack ice edge, especially in the spring (as implied). They can be found throughout the pack ice, and are not likely to be near the "pack edge" in spring, but rather in late summer and fall.

Comment reflected in section B.7 of the FEIS.

P. 67, Para. 4. The size estimate of the bowhead population is 1,700-2,800 (mean 2,264). See Braham et al. (1979) Rep. Inter. Whal. Commn., 29:291-306.

Ibid.

P. 68, Para. 1. Bowheads occur in Amundsen Gulf for the summer (feeding) and later (fall, August-September) off the MacKenzie Delta during their westwardly fall migration.

Ibid.

P. 68, Para. 1. Add here, as you did on page 66, that *Thysanoessa* spp. (especially *raschii*) is the prey species most likely taken by bowheads.

Ibid.

P. 68, Para. 2. The statement is made that gray whales are found more frequently from Cape Thompson to Point Barrow. More frequently than where? Gray whales are generally absent from the Beaufort Sea. We do not presently believe that OCS activities near Prudhoe Bay represent a threat to their species.

Ibid.

P. 68, Para 3. Harbor seals (*Phoca vitulina*) are not found in the Beaufort Sea; they are spotted seals (*Phoca largha*), a different species.

Ibid.

P. 107, Para. 2. There is no biological basis for stating for any species, that "death of one juvenile can be more serious than death of a few adults". This might be true if juvenile mortality is nil; but mortality in bowheads, especially, is unknown. Given that the age difference is great between the death of a few adults and a juvenile (i.e., if a few very old adults die versus one juvenile, especially if female) then one might argue favorably that the one juvenile female has a greater reproductive potential than the few older animals.

This statement has been deleted.

If you desire additional information, please contact Dr. Michael Tillman, Director, National Marine Mammal Laboratory, telephone (206)442-4711 or FTS 399-4711.

Sincerely yours,

Harry L. Rietze
Director, Alaska Region
National Marine Fisheries Service

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

RECEIVED BY
OCT 1 [illegible]
M J.S.

REPLY TO ATTN OF: M/S 443

OCT 2 1979

Mr. Michael Sotak
Chief, Environmental Assessment Section
Federal Energy Regulatory Commission
Office of Pipeline and Producer Regulation
Washington, D. C. 20426

Dear Mr. Sotak:

We have completed our review of your draft environmental impact statement (DEIS) for the proposed sales gas conditioning facility (SGCF) at Prudhoe Bay, Alaska. As you know, EPA and one of its environmental consultants assisted in the preparation of portions of this EIS as a cooperating agency.

Based upon this review we have found the DEIS to be a generally adequate environmental analysis of the alternatives under consideration. However, we do have some suggestions for improving the information content and producing a better final environmental impact statement.

First, we believe that a more thorough analysis of the cumulative impacts of this facility and the proposed water flood project of the filed operations (Arco and SOHIO/BP) is in order. The water flood project appears to be a direct result of the reduction in reservoir pressures which will result from the natural gas withdrawal which would be facilitated by the proposed SGCF. Furthermore, now that SOHIO/BP and Arco have applied for permits from the Corps of Engineers for their water flood project there is substantially more information available upon which to base an analysis of the cumulative impacts of the projects.

The staff agrees. See sections A.6 and C.12 of the FEIS.

Second, the FEIS should include the results of the biological assessments which you are conducting pursuant to the Endangered Species Act, as amended.

Comment reflected in section C.6 of the FEIS.

Third, the State of Alaska's Coastal Zone Management Program was approved by the U.S. Department of Commerce on July 6, 1979. The FEIS should therefore contain a more thorough analysis of the consistency of the proposed action with the approved State Coastal Zone Management Program.

Comment reflected in sections B.8 and C.8 of the FEIS.

Finally, the discussion of plant processes, process alternatives, and site alternatives would probably be more understandable to the lay audience if the appendices included a glossary which defined the hydrocarbon chemical names and abbreviations.

Comment reflected in "Abbreviations and Acronyms" section of the FEIS.

We have found the effort involved in helping you in preparing this EIS to be an educational experience and appreciate the opportunity to review the resulting document. We would be glad to answer any questions which you may have about our suggestions and are looking forward to working with your staff in the preparation of the FEIS and responses to citizen comments.

Based upon our review we rated this DEIS LO-2 (LO - Lack of Objections; 2 - Insufficient Information). This rating will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions pursuant to Section 309 of the Clean Air Act as amended.

Sincerely,

Roger K. Mochnick, Acting Chief
Environmental Evaluation Branch

RECEIVED BY

OCT 19 1979

M.J.S.

OCTOBER 15, 1979

Federal Energy Regulatory Commission
office of Pipeline 7 Producer Regulation
Washington, D.C. 20426

RE: Prudhoe Bay Project Impact
Draft Environemntal Project
Construction & Operation of a
Sales Gas Conditioning Facitlity
at Purdhoe Bay, Alaska

Dear Sir;

Just now received a copy of EIS on the Gas Conditioning facility for Prudhoe Bay. I had very limited time to proof read and now trying to submit comments at a very limited time frame.

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Allow me to introduce myself. My name is George Nasook Ahmaogak; age 30; born in Fairbanks, Alaska and raised at Barrow which is about 250 miles west of Prudhoe Bay. I serve on the Board of Directors for Arctic Slope Regional Corporation as well in the Exective Board level, and also on the Board of Director of Ukpeagvik Inupiat Corporation also in the Exective Boardleve too which is the Village Corporation under ANCAS for the Village of Barrow. I also serve as Village Chief for the Native Village of Barrow Incorporated under IndianRe-organization Act which is certified by Department of Interior as a federally chartered Tribal government with inclusion of federal trust responsibility over the tribe. Also a member of the Alaska Eskimo Whaling Commission.

My statement being presented on the subject are only my own individual statemants and should not represent whom I serve as stated above.

To begin, I would like to state that I am not against any Energy Development scererio only if it is done to ensure that Natural Resources and environment are managed in the best way as possible.

The development of Arctic resources of the United States is and must remain in our system of free enterprises at the intiative of private individuals Corporations, government, or its agencies, they can encourage the wise development of Arctic resources but cannot, under federal existing laws, initimate it, the givernment has, however a basic responsibility to ensure that development takes place in accordance with the best public interest.

This is a federal policy understood by the Inupiat as given by J.C. Carter, duputy under secretary, Department of the Interior Washington, USA, in May of 1973, given as regulatory framework for development of Arctic oil & gas resources of the United States.

Now, Pafe 111, "However, both the Decision and the Final Environmental Impact statement appear to have considered the transportation system to start at the discharge side of such conditioning and processing facilities". The word "Decision" is the decision of the Presidnetal nature document of September 1977 approving the Alcan route for the projects gas pipeline. F.E.I.S. on the projeted gas pipeline issued by the Federal Energy Regulatory Commission in 1977.

Page IV, "This Draft Environmnetal Impact Statement is unusal in a number of other aspects. The Federal Energy Regulatory Commission staff has prepared this Environmental Impact Statement even though an application for the necessary processing and conditioning facility has not been filed before the Federal Regulatory commission. Federal Energy Regulatory Commission has prepared at the considerable expense of taxpayers, an Environmental Impact Statement that nobody requested. Federal Energy Regulatory Commission is forcing a decision that a gas processing facility is the only facility that will be involved. Thus, trying so hard to force a natural gas pipeline into existance without participation of private individuals or corporations involved.

Page 131, "Alternatives to proposed action which starts, ignores the possibility of alternatives such as methanol conversion facility or even futures helium requirements for energy related applications. Federal document dealing with just the gas conditioning facility must treat all of the alternatives to this proposed action, but it hasn't. Carbob dioxide at 10 percent by volume to be dunped into the atmophere bt the proposed facility. High co^2 will pass through and up the stack to the atmosphere unchanged. at 2.4 billion cublic feet per day of wet gas input, 10% of this is 240 million cubic feet of CO^2 which Federal Energy Regulatory Commission is proposing to dump. The Inupiat, I know would demand Federal Energy Regulatory Commission to look at the alternatives to Sales Gas conditioning facility, not only because the document is not objective but neglectes to state the proposed facility would do immeasurable damage to our Arctic Environment that we are sensitive to.

Page V, "The Commission staff beleives that no further considerable of the pipeline route selected by the President of the United States is necessary". I regret to inform your Commission that further consideration of the pipeline is necessary since major areas of Trans Alaska Pipeline is now sitting on private native property under the act of native allotment of 1906 with fee title incorporated in each.

No permission or concent was ever given to anyone by each owner on terms of a right away which the federal government, the Department of Interior has special trust responsibity on these lands. Not to also mention that 14 families also hold private title with fee simple on Prudhoe Bay, which the Federal government granted temporary selection on top of these to the State Hood Act. What we are saying is the State of Alaska Color of title on Prudhoe Bay is in adverse possitions which the state Constitution specifies in Section Four a disclaimer on any Native property which proves prior use and occupancy, prior statehood.

Page 17,"A small sealift of basic equipment would be scheduled for 1980 and would be supplemented by truck hauling. Two major sealift would be planned for 1981 and 1982."I would like to inform the Commission the west Prudhoe Bay dock road near the shoreline is sitting on private property without the consent by the owner. Adjacent to the road is the explortory well north Prudhoe Bay state number one placed their by Altantic Richfield which the State of Alaska sold oil and gas leases in 1969 on native private property with fee title. My father Walton, ownes that parcel of 80 acres where the west Prudhoe dock is located and also the explortory well is sitution right smack in the middle. We are going to court for trepassing against the State of Alaska, Commission of Natural Resource and Atlantic Richfield, British Petroleum, Exxon, Mobil Oil, and Sophio. We are optismistic that the case is won already prior to going to court since Arco has now qpproach as to buy us out, but we have held our position strong.

I would like to conclude here although I do have numerous items to state for the record that the Draft Environmental Impact Statement is not satisfactory to the best interest of the nation and especially the Inupiat that will be here after this all over.

But the final ststement is the Inupiat have significiant ownership of the oil & gas under the protection of the U.S. Constition because remember the Inupiat were living in Prudhoe Bay prior State of Alaska becoming a part of the union. I might add grandfathers rights. Please advise for further questions.

Yours in Being Inupiat,

George Nasook Ahmaogak

George Nasook Ahmaogak

ALASKA ENERGY CORPORATION
Telephone: (907) 452-5571
427 1st Avenue • P.O. Box 2751 • Fairbanks, Alaska 99707

January 5, 1980

Federal Energy Regulatory Commission
Environmental Assessment Division Rm 33/3
825 North Capital
Washington, D C 20426

RE: Sales Gas Conditioning Facility,
Alaska Natural Gas Transportation System

ATTN: Mr. John Korzeniowski, Project Engineer

Gentlemen,

Attached you will find our preliminary advisory document on the above reference project. The AEC Partnership is a group of dedicated interior Alaska businessmen. The Partnership is committed to the wise utilization of Alaska's resources in both the states and nations best interest. We believe that an interior location for the sales gas conditioning facility, best addresses this concern. Inclusion of this application in the final Environmental Impact Statement, will enable us to proceed expeditiously twoards our phase II program.

Should you require any additional information, feel free to call upon us. I remain very truly yours.

Robert H. Dempsey,
On Behalf of the Partnership

ALASKA ENERGY CORPORATION
Telephone: (907) 452-5571
427 1st Avenue • P.O. Box 2751 • Fairbanks, Alaska 99707

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION
ENVIRONMENTAL ASSESSMENT DIVISION

Alaksa Energy Company/AEC Partnership	*Docket CP 78-123 et al*
Fairbanks, Alaska	*(Final Environmental Impact) Statement*

PRELIMINARY ADVISORY DOCUMENT OF ALASKA ENERGY COMPANY/AEC PARTNERSHIP, AND/OR LEASEES OR SUBLEASEES HEREBY STATES THAT PRELIMINARY INVESTIGATION IS UNDERWAY TOWARDS AN APPLICATION FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE CONSTRUCTION AND OPERATION OF A SALES GAS CONDITIONING FACILITY IN THE FAIRBANKS NORTH STAR BOROUGH

The Alaska Energy Company/AEC Partnership (the Partnership) pursuant to Document FERC/EIS 009D Prudhoe Bay project Draft Environment Impact Statement hereby states that preliminary investigation is underway to ultimately apply for a certificate of public convenience and necessity for the construction and operation of a sales gas conditioning facility in the Fairbanks North Star Borough[1] as set forth in the Alternate Site Recommendation in the Draft Environmental Impact Statement.

In support thereof the Partnership would show as follows:

BACKGROUND

The commission staff has stated that it believes that no further consideration of the pipeline route selected by the President is necessary. However, after closer review, the staff had determined that the FEIS did not fully assess the environmental (socio-economic) impact of the facilities which will be necessary to condition and process Prudhoe Bay gas prior to pipeline transmission. (Briefly, gas conditioning includes dehydration[2] and removal of carbon dioxide (CO_2), while gas processing includes removal and fractionation, including value added product upgrading of natural gas liquids. While many aspects of the conditioning and processing facilities have yet to be finalized,

1. *as described in the Fairbanks Response written comment on the DEIS/Prudhoe Bay project/construction and operation of a gas conditioning facility in the Fairbanks North Star Borough. The Facility (AICAPS) is generally as described in the Fairbanks Response.*
2. *It is recognized here that dehydration facilities presently exist at Prudhoe Bay for the oil recovery process.*

ALASKA ENERGY CORPORATION
Telephone: (907) 452-5571
427 1st Avenue • P.O. Box 2751 • Fairbanks, Alaska 99707

there is no doubt that such facilities will be expensive, will entail substantial construction and will require a significant lead time to complete. The Alaska Natural Gas Transportation System (ANGTS). Section 1 (b) of the Natural Gas Act exempts from the Commission's jurisdiction "the production or gathering of natural gas." As a general rule which applies in this case, conditioning and processing facilities fall within the Natural Gas Act exemption. Accordingly, Commission certification of such facilities is not required, although under the Natural Gas Policy Act of 1978, the Commission must determine whether a conditioning and processing allowance should be included in or added to the well-head gas price, and what this allowance should be.

SUMMARY OF THE PARTNERSHIP'S POSITION

The Partnership hereby states that preliminary investigation is underway to ultimately apply for the issuance of a certificate of necessity and public convenience for the construction and operation of a sales gas conditioning facility in the Fairbanks North Star Borough, The facility (AICAPS) is generally as described in the Fairbanks Response with the capability of conditioning and processing 2.0 - 2.4 BCFD of natural gas produced from the Prudhoe Bay field. The AICAPS will be expandable to meet the requirements set forth in the President's decision (3.2 BCFD) the design criteria including inlet size and pressure is in abbaence pending the outcome of the litigation Alaskans vs FERC, Docket 78-123. The final design will be compatable with the system as finally ordered by the Federal Energy Regulatory Commission and/or any subsequent federal legislation executive orders et al.

The Partnership believes that the greatest public good will be served by the location of the gas conditioning/processing facility in the Fairbanks North Star Borough. The following are issues of national concern addressed in this filing:

The President's mandate to use coal as a fuel whenever possible.

The need of the United States for petrochemicals as feedstocks for industry.

The necessity to deliver Alaskan natural gas to the consumer as expediently as possible.

Most importantly, the ultimate costs of energy to the consumer at the delivery end of that gas.

ALASKA ENERGY CORPORATION
Telephone: (907) 452-5571
427 1st Avenue • P.O. Box 2751 • Fairbanks, Alaska 99707

GENERAL INFORMATION

The Partnership has entered into an agreement with Dallas Engineering, of Tioga,North Dakota/Fairbanks, Alaska, in order to establish computer based life cycle cost estimates of an interior facility. The Base Case will be a modification of the data established in the Parsons Supplementary Study.

Engineering analysis will of necessity await the outcome of this initial phase.

The Partnership considers the conditioning plant to be part of an overall processing/industrial complex, and to that end it plans to utilize funding that may be available for such development under Alaska statute AS 44.16 the Alaska Industrial Development Authority and what ever other public/private revenue sources that may be available.

To this end the Partnership is utilizing the services of Foster and Marshall Investment Bankers, Seattle, Washington/Fairbanks, Alaska who operate under a letter of intent with the Fairbanks North Star Borough, to develop such a complex.

The Partnership in its phase II program will expand its participants to include one or more firms with specific expertise in the fields of NGL processing and recovery. Initial contact has been established with several potential members. Formal negotiations must await the disposition of the final Environmental Impact Statement under this Docket.

Robert H. Dempsey
On behalf of the Partnership

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

RECEIVED BY
AUG 1 3 1979
M. J. S.

OFFICE OF THE ASSISTANT SECRETARY
FOR COMMUNITY PLANNING AND DEVELOPMENT

AUG 7 1979

IN REPLY REFER TO:

Federal Energy Regulatory Commission
Office of Pipeline and Producer Regulation
Washington, D.C. 20426

Dear Sir:

Thank you for providing us with an opportunity to review the Draft Environmental Impact Statement for the Prudhoe Bay Project. We have requested our Seattle Regional Office to review and comment, as appropriate, directly to you by your due date of September 14, 1979.

402

Sincerely,

for
Richard H. Broun
Director
Office of Environmental Quality

RECEIVED
AUG 10 11 22 AM '79
OPPR
OFFICE OF THE
DIRECTOR

403

Earth Resources Company of Alaska

1001 NOBLE, FAIRBANKS, ALASKA 99701

907/456-ERCA

SEP 17 1979

September 11, 1979

Mr. John B. Adger
Alaska Gas Project Office
Federal Energy Regulatory Commission
Washington, D.C. 20426

RE: OPPR-DPC/EEB ALASKA GAS CONDITIONING PLANT

Dear Mr. Adger:

In response to your letter of August 23, 1979, I am enclosing the study by Litwin, along with seven pages of calculations and sketches. Earth Resources Company of Alaska has been informed by Litwin that the remainder of the workpapers are based on information supplied by several firms on a confidential basis. As a result, Litwin is not prepared to turn over these materials for public disemination.

I hope that the information enclosed will assist you in your EIS preparation. The Litwin analysis is, as far as ERCA knows, the only comparison of Prudhoe Bay versus Interior Alaska construction costs that has been brought forward, and it is certainly pertinent to the EIS being considered.

Please feel free to call upon Earth Resources Company of Alaska if you have any further questions.

403

Sincerely,

Lloyd Pernela

Lloyd M. Pernela
Manager of Corporate
Development & Economics

LMP:cm

Enclosure

LITWIN
ENGINEERS & CONSTRUCTORS, INC

June 13, 1979

RECEIVED
JUN 15 1979

Mr. Frank DeLong
Earth Resources Company of Alaska
1001 Noble
Fairbanks, Alaska 99701

Dear Frank:

The attached analysis of construction costs in Prudhoe Bay versus Fairbanks is forwarded in response to your request for comparative costs for a large gas treating plant.

No one party has direct access to detailed estimating informations for both Prudhoe Bay and Fairbanks. In this case we have analyzed our Fairbanks data and can support the calculations. We have used numerous contacts with operating and construction companies to provide basic cost data for Prudhoe Bay. We feel the resulting comparative costs are realistic; I can assure you they were developed with every attempt to be unbiased.

Costs were developed on a $100,000,000 unit installation. This should not be construed to mean that we expect the treating facilities to cost this amount of money--rather it is merely a convenient unit of cost. The accuracy of the total estimate we feel to be relatively good. Fortunately, since the answer is so preponderantly in favor of Fairbanks, we feel confident that the accuracy is adequate to justify the unequivocal statement that Fairbanks erected cost is substantially lower than Prudhoe Bay erected cost for these stated types of construction.

I would like to accept your offer to have one or two of our people visit your plant in the near future. We rarely get the opportunity to follow up on the results to the client of what we did in the construction decision process. I'm very pleased that you offered this opportunity.

Let us know if we can help further in the matter of Fairbanks versus Prudhoe Bay construction costs. Obviously we have done some researching of old numbers, do now have them available, and would be happy to support our findings to the unbelievers.

Regards,

Litwin Engineers & Constructors, Inc.

Ralph L. Bradley

Ralph L. Bradley
President

ENGINEERS & CONSTRUCTORS, INC.

June 13, 1979

RECEIVED
JUN 18 1979

Mr. L. F. DeLong
Earth Resources Company of Alaska
1001 Noble
Fairbanks, Alaska 99701

Dear Mr. DeLong:

We have been reviewing return cost data from Litwin's previous Alaska projects as well as data obtained from other sources. As you are aware, the utilization of an extensive skid mounting concept resulted in appreciable cost savings and schedule improvement for the North Pole Refinery. Cost savings were achieved by utilization of shop personnel and supervision in the "lower 48" which is more economical than field construction in Alaska due to lower wage rates, more favorable climatic conditions and higher shop productivity. Schedule improvement was realized because construction in the "lower 48" proceeded at a peak rate during winter months when Alaska construction is normally shut down.

Litwin's cost evaluation of past Alaskan projects indicates that hydrocarbon processing units constructed normally will cost approximately 35% more when located in the Fairbanks or the Anchorage/Kenai area than similar units constructed on the Gulf Coast. The utilization of a skid mounting concept will result in significant reduction in the cost difference between Gulf Coast and Alaskan (Fairbanks or Anchorage area) units.

The apparently large size of the proposed natural gas treating units planned for Alaska will not allow the degree of skid mounting for construction in the interior which was possible with the North Pole Refinery due to transportation size and weight limitations. However, we feel that considerable skid mounting will be feasible and will result in appreciable cost savings.

Litwin has estimated the weights and wall thickness of vessels required for the treating units (refer to the attached brief calculations and computer runs for metal thickness and weights). Several cannot be shipped to the Fairbanks area completely fabricated. Either multiple vessel units must be utilized or some degree of field fabrication will be required. CB&I has reviewed these vessels and has indicated that field fabrication, including total stress relieving, is well within the "state of the art" and would not be considered unusual.

The generalized cost breakdown of a hydrocarbon processing plant constructed in the Gulf Coast is as follows:

Major Equipment Cost	30%
Commodity Material Cost	30%
Construction Costs (Direct & Indirect)	30%
Engineering Costs	10%

Review of the above cost categories for expected impact of construction in Fairbanks yields the following analysis:

Major Equipment Costs

The cost of major equipment which can ship complete will increase a very minor amount due to special low temperature design conditions. Freight costs will increase considerably (approximately 300% of Gulf Coast freight cost). Costs for field fabricated vessels will be approximately 250% of the cost of shop fabricated vessels for Gulf Coast installation.

Therefore, an estimate of comparative major equipment costs for a $100,000,000 total installed cost Gulf Coast unit is as follows:

	Gulf Coast Cost	Interior Alaska Cost
Total Major Equipment	$30,000,000	$30,000,000
5% Increase Due to Cold Weather Design	---	1,500,000
Increase in Freight	---	2,000,000
Half of Vessels Field Fabricated (assume total vessels to be 20% of total major equipment cost, and that half will require field fab)	---	4,500,000
TOTAL MAJOR EQUIPMENT	$30,000,000	$38,000,000
Increase over Gulf Coast =	27%	

Commodity Material Cost

Commodity material costs will increase approximately 15 percent due to additional low temperature structural and piping materials as well as increases in heat tracing and insulation. Commodity freight costs will increase similar to major equipment freight.

	Gulf Coast Cost	Fairbanks Cost
Total Commodities	$30,000,000	$34,500,000
Increase in Commodity Freight	---	2,000,000
TOTAL COMMODITIES	$30,000,000	$36,500,000
Increase over Gulf Coast =	22%	

Construction Costs (Direct & Indirect)

Construction costs are expected to be approximately double Gulf Coast costs due to high labor rates, high equipment rental costs, additional freight costs, high supervision costs, normal overtime work week, high supervision cost and adverse climatic conditions.

	Gulf Coast Cost	Interior Alaska Cost
Total Construction Cost	$30,000,000	$60,000,000
Increase over Gulf Coast =	100%	

Engineering Costs

Engineering costs are expected to be a maximum of 15% above Gulf Coast design due to arctic engineering requirements.

	Gulf Coast Cost	Interior Alaska Cost
Total Engineering	$10,000,000	$11,500,000
Increase over Gulf Coast =	15%	

TOTAL GULF COAST TIC = $100,000,000
TOTAL INTERIOR ALASKA TIC = $146,000,000

Therefore, the total installed cost of a unit constructed in Fairbanks is estimated to be 46 percent higher than a similar unit constructed on the Gulf Coast with a normal construction approach (no skid mounting).

If an extensive skid mounting concept is utilized, the following is an estimate of cost savings:

Major equipment costs, commodity material costs, freight costs and engineering costs are expected to be essentially unchanged. It has been determined that 30% to 50% of the field labor operations can be transferred to the skid manufacturer's shop. The shop labor productivity is expected to be twice that of the field and labor rates are expected to be essentially half. Therefore, the $24,000,000 portion (40%) of labor removed from the field will be transferred to the shop at an estimated cost of $24,000,000/4 = $6,000,000; a savings of $18,000,000.

Therefore, skid mounting the unit costing $146,000,000 in the interior of Alaska would reduce the cost to $128,000,000 resulting in an increase of only 28% above Gulf Coast.

Comparison of a similar unit constructed at Prudhoe Bay utilizing a modular concept is as follows:

Major Equipment Costs

	Gulf Coast Cost	Prudhoe Bay Cost
Total Major Equipment	$30,000,000	$30,000,000
10% Increase Due to Extreme Cold Weather Design Coincident with Higher Winds	—	3,000,000
Freight Increase ($.70/lb compared to $.15/lb to Fairbanks)	---	9,300,000
Field Fabrication of Vessels	---	---
TOTAL MAJOR EQUIPMENT =	$30,000,000	$42,300,000
Increase over Gulf Coast =	41%	

Commodity Material Cost

Commodity material costs will increase approximately 20 percent due to additional low temperature structural piping material as well as increase in heat tracing and insulation. Costs of concrete will increase significantly. Commodity freight costs will increase similar to major equipment freight.

It should be noted that freight cost is not expected to increase with the skid mounted concept as less overall material will be shipped. Most skid sizes and weights will be designed within economic freight tolerance and light material such as insulation will be shipped as part of the skid and not as light bulk loads. The over-water transportation charges are by load and weight, and not by volume.

	Gulf Coast Cost	Prudhoe Bay Cost
Total Commodities	$30,000,000	$36,000,000
Increase in Commodity Freight	---	9,300,000
TOTAL COMMODITIES =	$30,000,000	$45,300,000
Increase over Gulf Coast =	51%	

Construction Costs (Direct & Indirect)

Prudhoe Bay construction costs are in excess of double Fairbanks costs. However, use of modules will reduce construction labor to a greater degree than the use of skids. Therefore, assume that 50% of the total labor will be transferred to the shop. Total labor if completely field fabricated is 2 x Fairbanks cost = $120,000,000. Fifty percent ($60,000,000) is transferred to the shop resulting in a shop cost of $60,000,000/8 = $7,500,000.

	Gulf Coast Cost	Prudhoe Bay Cost
Total Construction Cost	$30,000,000	$67,500,000
Increase over Gulf Coast =	125%	

Engineering Costs

Engineering costs are expected to be approximately 25% above Gulf Coast design due to extreme arctic conditions of coincident high winds and low temperatures, and modular concept.

	Gulf Coast Cost	Prudhoe Bay Cost
Total Engineering	$10,000,000	$12,500,000
Increase over Gulf Cost =	25%	

TOTAL GULF COAST TIC (conventional) =	$100,000,000
TOTAL PRUDHOE BAY TIC (modular) =	$167,600,000
TOTAL FAIRBANKS TIC (skid-mounted) =	$128,000,000

In spite of the generalization utilized in this study, Litwin is confident that the order of magnitude of these numbers as well as their relative values are correct, and those pertaining to Fairbanks construction reflect actual experience and records.

There are three areas of major risk with regard to construction of major processing units in Prudhoe Bay. They are the high risk of having barges sink in transit, the chance of missing the short "window" of ice breakup in Prudhoe Bay, and the chance that the breakup will not be substantial enough to allow safe transportation. Any one of these problems could cause a one year slippage in project completion. Further instances of the above did occur during construction of existing facilities.

It is concluded that construction in Fairbanks affords considerably less risk and expense than at Prudhoe Bay. This conclusion does not, however, take into consideration any incremental costs which may be encountered in transporting the unprocessed gas to Fairbanks, or the products to market from Fairbanks instead of Prudhoe Bay.

Frank, we certainly hope that the information and data contained in this letter will be of value.

Very truly yours,

Brent Calongne

A.B. Calongne

ABC/ms

Engineers & Constructors, Inc.

CALCULATIONS and SKETCHES

DATE 4.24.79
CONT. NO.
BY G.A. CHK'D
SHEET NO. 1 OF 7

PLANT
REF:

THE FOLLOWING PAGES CONTAIN THICKNESS AND WEIGHTS OF THE LIST OF VESSELS FOUND ON PAGE 2 OF 7. DUE TO A LACK OF CLEAR DEFINITION THE VESSELS ARE BASED ON ASME SECTION VIII, DIV. 1 CODE THICKNESSES WITH 20% ADDED TO SHELL AND HEAD WEIGHT TO ARRIVE AT AN ESTIMATED FABRICATED WEIGHT. TOWERS WILL WEIGH MORE AND HORIZONTAL DRUMS SLIGHTLY LESS. THE INTENT WAS TO ESTABLISH AN ORDER OF MAGNITUDE NUMBER.

THE SAMPLE TAPE BELOW SHOWS THE WAY THE INDIVIDUAL CALCS. TIE INTO THE LIST OF VESSELS ON PAGE 2 OF 7. THE CALCS ARE IN THE SAME ORDER AS THEY ARE IN ON THAT PAGE.

MANY OF THESE THICKNESSES CAN BE REDUCED BY GOING TO DIV. 2 OF SECT. VIII OF THE ASME CODE WHEN MORE DETAILS ARE KNOWN AND CALCULATIONS CAN BE DEFINED. ALL VESSELS WERE FIGURED USING 17500 PSI ALLOWABLE STRESS, 100% JOINT EFFICIENCY AND 1/8" CORROSION ALLOWANCE.

~~ EXAMPLE ~~

```
        10. ____________ DIAMETER OF VESSEL IN FT.
        25. ____________ TANGENT TO TANGENT OF VESSEL IN FT.
SHELL
  5.026102853 __________ SHELL THICKNESS
HEMI-HD
  2.484479383 __________ HEAD THICKNESS
  APPR. WT.
  220461.6274 __________ COMB. OF SHELL & HD. WTS. x 1.2 FACTOR

  220461.6274      x
           3. _____=____ NO. OF VESSELS REQUIRED
  661384.8823 __________ TOTAL WT. OF COMMON SIZE VESSELS.
```

407

Question 12 Answer Cont'd.

	Number of Vessels	Dimensions: Diameter X Tangent-to-Tangent (Feet)	Pressure/Temperature (psig/°F)
(1) NGL Recovery	4	13 x 40	630/-30
	4	6 x 20	620/40
	2	15 x 60	650/125
	4	5 x 24	650/125
	1	25 x 75	195/160
	1	19 x 24	75/50
	1	8 x 10	75/50
	1	17 x 26	75/-15
(2) NGL "Separation" (Fractionation)	1	11 x 46	520/280
	1	19 x 87	520/280
	1	16 x 131	230/270
	1	15 x 122	90/200
	1	18 x 80	350/170
	1	13 x 31	520/280
	1	10 x 20	230/270
	1	10 x 20	90/200
	1	10 x 24	350/170
(3) CO_2 Removal	4	23 x 116	623/60
	4	16 x 111	50/50
	4	14 x 25	623/60
	4	14 x 57	290/40
	4	15 x 67	110/40
	4	14 x 57	50/30
	4	10 x 25	290/40
	4	10 x 25	110/40
	4	10 x 25	50/30
	4	10 x 25	110/40
	4	10 x 25	50/50
	4	10 x 25	60/100
	4	10 x 25	180/100
(4) Utilities (Building heating, utility and instrument air, drain sumps, etc.)	1	12 x 36	280/100
	1	13 x 38	105/650
	1	15 x 44	105/650
	1	7 x 21	90/100
	1	6 x 8	(50) → 15/100
	2	13 x 38	140/120
	1	12 x 60	150/-50
	1	7 x 20	(50) → 25/100
	1	9 x 77	(50) → 25/100
	1	5 x 16	95/650
	1	16 x 20	85/300
	3	10 x 25	1360/120

Hallwood ENGINEERS & CONSTRUCTORS, INC

CALCULATIONS and SKETCHES

DATE 4-24-79
CONT. NO.
BY G.A. CHK'D
SHEET NO. 3 OF 7

PLANT

REF:

(1) NGL RECOVERY

13.
40.
SHELL
2.999591169
HEMI-HD
1.53858892
APPR. WT.
264514.8482

264514.8482 ×
4. =
1058059.393

6.
20.
SHELL
1.432654134
2:1 HD
1.409407616
APPR. WT.
29662.19375

29662.19375 ×
4. =
118648.775

15.
60.
SHELL
3.54880187
HEMI-HD
1.807320046
APPR. WT.
532208.0622 ×
2. =
1064416.124

5.
24.
SHELL
1.26943308
2:1 HD
1.248100086
APPR. WT.
25582.26649

25582.26649 ×
4. =
102329.066

25.
75.
SHELL
1.809080711
HEMI-HD
.9630409599
APPR. WT.
571148.2509

571148.2509 ×
1. =
571148.2509

19.
24.
SHELL
.6153680894
HEMI-HD
0.369926397
APPR. WT.
53542.56021

58542.56021 ×
1. =
53542.56021

8.
10.
SHELL
.3317817244
2:1 HD
.3313384308
APPR. WT.
5222.120781

5222.120781 ×
1. =
5222.120781

17. PRT
26. PRT
SHELL
.5638069321
HEMI-HD
.3442010862
APPR. WT.
46082.6867

46082.6867 ×
1. =
46082.6867

(2) NGL "SEPARATION"

11.
46.
SHELL
2.125523621
HEMI-HD
1.112219166
APPR. WT.
178435.973

178435.973 ×
1. =
178435.973

Hallwood ENGINEERS & CONSTRUCTORS, INC.

CALCULATIONS and SKETCHES

DATE 4-24-79
CONT. NO.
BY G.A. CHK'D
SHEET NO. 4 OF 7

PLANT

REF:

(2) NGL SEPARATION (CONT'D)

19.
87.
SHELL
3.577699558
HEMI-HD
1.827487391
APPR. WT.
974621.531

974621.531 ×
1. =
974621.531

16.
131.
SHELL
1.398398802
HEMI-HD
.7583323797
APPR. WT.
469036.841

469036.841 ×
1. =
469036.841

15.
122.
SHELL
.5899346555
HEMI-HD
0.357190841
APPR. WT.
172774.7122

172774.7122 ×
1. =
172774.7122

18.
80.
SHELL
2.313765182
HEMI-HD
1.209669339
APPR. WT.
548091.7934

548091.7934 ×
1. =
548091.7934

13.
31.
SHELL
2.488567605
HEMI-HD
1.291036222
APPR. WT.
173489.3634

173489.3634 ×
1. =
173489.3634

10.
20.
SHELL
.9214952194
2:1 HD
.9162542198
APPR. WT.
33427.96078

33427.96078 ×
1. =
33427.96078

10.
20.
SHELL
0.435171386
2:1 HD
0.434373392
APPR. WT.
15740.83007

15740.83007 ×
1. =
15740.83007

10.
24.
SHELL
1.342105263
2:1 HD
1.32990982
APPR. WT.
57156.06648

57156.06640 ×
1. =
57156.06648

(3) CO_2 REMOVAL

23.
116.
SHELL
5.14957492
HEMI-HD
2.594641925
APPR. WT.
2258172.194

2258172.194 ×
4. =
9032688.775

409

ENGINEERS & CONSTRUCTORS, INC.

CALCULATIONS and SKETCHES

DATE 4·24·79
CONT. NO.
BY G.A. CHK'D
SHEET NO. 5 OF 7

PLANT
REF:

(3) CO_2 REMOVAL (CONT'D.)

```
       16.
      111.
SHELL
 0.400114482
HEMI-HD
  .2625392969
  APPR. WT.
    114693.607

    114693.607      ×
            4.      =
  458774.4281

       14.
       25.
SHELL
  3.185216218
HEMI-HD
  1.630007828
  APPR. WT.
  199282.7191

  199282.7191       ×
           4.       =
  797130.8766

       14.
       57.
SHELL
  1.533071684
HEMI-HD
  .8242301528
  APPR. WT.
  202307.6922

  202307.6922       ×
           4.       =
   809230.769
```

```
       15.
       67.
SHELL
 .6936446025
HEMI-HD
  .4088212591
  APPR. WT.
  114708.3916

  114708.3916       ×
           4.       =
  458833.5664

       14.
       57.
SHELL
 .3657698912
HEMI-HD
 .2453915404
  APPR. WT.
  48690.23734

  48690.23734       ×
           4.       =
  194760.9494

       10.
       25.
SHELL
 1.131363269
2:1 HD
  1.12301099
  APPR. WT.
  49874.69486

  49874.69486       ×
           4.       =
  199498.7794
```

```
       10.
       25.
SHELL
 .5043592979
2:1 HD
 .5031662759
  APPR. WT.
  22146.1254

  22146.1254        ×
          4.        =
 88584.50161

       10.
       25.
SHELL
 .2970807098
2:1 HD
 .2968348099
  APPR. WT.
 13027.33446

 13027.33446        ×
          4.        =
 52109.33782

       10.
       25.
SHELL
 .5043592979
2:1 HD
 .5031662759
  APPR. WT.
  22146.1254

  22146.1254        ×
          4.        =
 88584.50161
```

ENGINEERS & CONSTRUCTORS, INC.

CALCULATIONS and SKETCHES

DATE 4·24·79
CONT. NO.
BY G.A. CHK'D
SHEET NO. 6 OF 7

PLANT
REF:

(3) CO_2 REMOVAL (CONT'D)

```
       10.
       25.
SHELL
 .2970807098
2:1 HD
 .2968348099
  APPR. WT.
 13027.33446

 13027.33446        ×
          4.        =
 52109.33782
         60.        STO

       10.
       25.
SHELL
 .3315677966
2:1 HD
 .3312135589
  APPR. WT.
 14542.87402

 14542.87402        ×
          4.        =
 58171.49609

       10.
       25.
SHELL
 .7472688592
2:1 HD
 .7440653243
  APPR. WT.
 32862.68937

- 32862.68937       ×
          4.        =
 131450.7575
```

(4) UTILITIES

```
       12.
       36.
SHELL
 1.290185784
HEMI-HD
 .7039262821
  APPR. WT.
 94288.67783

 94288.67783        ×
          1.        =
 94288.67783

       13.
       38.
SHELL
 .5954435969
2:1 HD
 .5940314189
  APPR. WT.
 50744.50264

 50744.50264        ×
          1.        =
 50744.50264

       15.
       44.
SHELL
 .6677037334
HEMI-HD
 .3959125475
  APPR. WT.
  74881.5173

  74881.5173        ×
          1.        =
  74881.5173
```

```
        7.
       21.
SHELL
 .3423134243
2:1 HD
 .3417543308
  APPR. WT.
 8660.143611

 8660.143611        ×
          1.        =
 8660.143611

        6.
        8.
SHELL
 .2283915283
2:1 HD ,
 .2282437839
  APPR. WT.
 2127.648149

 2127.648149        ×
          1.        =
 2127.648149

       13.
       38.
SHELL
 .7530144695
HEMI-HD
 .4382506005
  APPR. WT.
 63185.83924

 63185.83924        ×
          2.        =
 126371.6785
```

ENGINEERS & CONSTRUCTORS, INC.

CALCULATIONS and SKETCHES

DATE 4-24-79
CONT. NO.
BY G.A. CHK'D
SHEET NO. 7 OF 7

PLANT
REF:

(4) UTILITIES (CONT'D)

```
           12.
           60.
SHELL
 .7464101091
2:1 HD
 .7437446383
 APPR. WT.
 88773.62578

 88773.62578      x
           1.     =
 88773.62578

            7.
           20.
SHELL
 .2455638237
2:1 HD
 .2453915404
 APPR. WT.
 5941.519556

 5941.519556      x
           1.     =
 5941.519556

            9.
           77.
SHELL
 .2799084144
2:1 HD
 .2796870534
 APPR. WT.
 31115.66064

 31115.66064      x
           1.     =
 31115.66064
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            5.
           16.
SHELL
 .2890701141
2:1 HD
 0.288624539
 APPR. WT.
 3957.093614

 3957.093614      x
          1.      =
 3957.093614

           16.
           20.
SHELL
 .5932574933
HEMI-HD
 .3588635909
 APPR. WT.
 36352.05415

 36352.05415      x
          1.      =
 36352.05415

           10.
           25.
SHELL
 5.026102853
HEMI-HD
 2.484479383
 APPR. WT.
 220461.6274

 220461.6274      x
          3.      =
 661384.8823
```

TOTAL OF ALL WEIGHTS

```
 1058059.   +
  118648.   +
 1064416.   +
  102329.   +
  571148.   +
   53542.   +
    5222.   +
   46082.   +
  178435.   +
  974621.   +
  469036.   +
  172774.   +
  548091.   +
  173489.   +
   33427.   +
   15740.   +
   57156.   +
 9032688.   +
  458774.   +
  797130.   +
  809230.   +
  458833.   +
  194760.   +
  199498.   +
   88584.   +
   52109.   +
   88584.   +
   52109.   +
   58171.   +
  131450.   +
   94288.   +
   50744.   +
   74881.   +
    8660.   +
    2127.   +
  126371.   +
   88773.   +
    5941.   +
   31115.   +
    3957.   +
   36352.   +
  661384.   =
19248728.
```

410

411

Earth Resources Company of Alaska

1001 NOBLE, FAIRBANKS, ALASKA 99701

907/456-ERCA

November 13, 1979

Mr. Robert Arvedlund
Environmental Evaluation Branch
Federal Energy Regulatory Commission
825 North Capitol St.
Washington, D. C. 20426

Gentlemen: Bob

I bring to your attention the enclosed article on the Shell/Esso 2000+ psig high pressure gas pipeline in the North Sea. This is in response to a statement that a 1680 psi gas pipeline from Prudhoe Bay to Fairbanks is beyond the "state of the art."

We have been in contact with Shell-UK in London and they advise that thicker pipe, crack arresters, and other ingredients in the design of their 2000 psi "Flags" gas line have been successfully tested, designed and procurred and the 36" line will be operational in mid-1981. This line is at 1.1 MMCFD of gas and also will move 100,000 BPD of gas liquids. Although arctic conditions dictate some different design considerations, the ability of "state of the art" technology to address high pressure 1680 psi system is well established.

We are continuing to promote a Fairbanks conditioning plant location and higher pressure pipeline design as providing the lowest cost of acquisition of gas liquids for in-state petrochemical development in the railbelt compared to straddle plant or third pipeline to Fairbanks.

We will let you know as new developments arise.

Sincerely,

Lloyd M. Pernela
Manager of Corporate
Development & Economics

For your information

cm

enclosure

Laying Flags gas pipe line in North Sea took vast research

D. E. Broussard
Shell U.K. Exploration & Production
London

A COMPREHENSIVE research program involving more than 50 separate studies contributed by 18 different organizations was conducted to study factors and to develop a design for protection of the subsea 280-mile, 35-in. diameter, high-pressure Flags gas pipeline in the North Sea.

The Flags gas line is a joint venture of Shell U.K. and Esso U.K. It will transport natural gas and associated liquids from the Brent field in the North Sea to St. Fergus, Scotland. The 280-mile offshore pipeline is the longest ever built in the North Sea.

It is of high-strength steel with a wall thickness of 0.867 in. and will work at an operating pressure in excess of 2,000 psi. The capacity is estimated to be 1,100 MMcfd of natural gas and 100,000 b/d of natural gas liquids.

The pipeline is a critical link for the development and production of the Brent field. The magnitude of the project and its timing, which followed the early experience of pipeline construction in the deep water of the northern North Sea, led to a decision by Shell and Esso to undertake a comprehensive study program for the design for on-bottom safety and stability of the pipeline.

The study involving 18 different organizations, including consultants, universities, testing laboratories, and Shell and Esso research centers, took more than 16 months, cost more than $1 million. It is the most extensive study of this nature that Shell and Esso have ever undertaken.

Pipeline environment. The 450-km (280 mile) route was chosen after detailed surveys of the seabed and discussions with other northern North Sea users (fishermens' associations, offshore operators, etc.). The main characteristics of the environment of the route are as follows:

- 80% of the route lies in water depths of over 100 m (330 ft).
- Deep trenches and pockmarks occur in certain areas, although these were avoided when the exact route was selected. Otherwise there are no major seabed irregularities.
- The seabed in the inshore section consists mainly of hard clay and sands with some exposed rock and rock rubble. In deep water, the soils are mainly soft silts or clay, the soft layer varying in thickness from a few inches to several feet.
- Inshore, tidal currents sweep round the coast at up to 3 knots and storm-driven waves produce high bottom currents. In deep water, storm and tide effects produce negligible bottom currents.
- The route crosses several fishing banks including Rattray Head inshore, South Bank Bosies at kilometer 65, Little Halibut Bank at kilometer 100, and Forty Mile Ground at Kilometer 300.
- The route crosses the Occidental Piper pipeline at kilometer 134 in a water depth of 112 m (367 ft).

Concrete coating. Early experience of pipelay operations in the deep waters and the extreme environment of the northern North Sea indicated a need to improve the strength and quality of the concrete-coating system. The specifications used in moderate water depths and lay conditions could not tolerate the high forces and bending loads imposed on the pipe during pipelay and trenching in marginal weather conditions.

The concrete weight coating is a basic element of the design for sea-bottom safety and stability of the pipe. It must prevent flotation and movement of the pipeline during extreme conditions of storms and tidal currents and, if necessary, withstand repeated impacts by fishing gear.

Working with coating service companies (Bredero-Price UK Ltd. and MK-Shand Coating Division), an improved coating specifications was developed. A three-fold improvement was made in the percent of steel reinforcement, and a two-fold improvement in the composite concrete strength was achieved.

Paper titled "Flags Gas Line—Seabed Safety and Stability," presented at Interpipe '79, Houston, Tex., Jan. 16-18, 1979.

It was elected not to slot the concrete coating. Others have recommended slotting around the girth of the concrete at intervals along the length of about one diameter. This was proposed to reduce the bending stiffness of the composite structure of the steel pipe and concrete coating.

There was concern that a substantial difference in stiffness of the body of the pipe joint, as compared to ends of the joint where the field weld was covered with mastic, would cause large concentrated stresses in the pipe joints from bending during the laying process.

Shell Expro's analysis indicated that the increased stiffness was not large and the increase of bending stresses in the joint was not significant for the pipelaying equipment used on this project.

Preservation of the strength and integrity of the concrete coating was judged a more significant consideration.

Where welded wire cages were used for steel reinforcement, they were overlapped end-to-end to provide continuous reinforcement over the full joint length. One contractor provided a spiral-wound wire cage with longitudinal stringer wires welded at intersections with the spiral. The spiral cage is continuous over the full length of the joint.

Experience with the coating system during pipe-lay operations confirmed anticipated results. Much less concrete damage was experienced than had been observed with previous coating systems.

The bending characteristics of the unslotted coated pipe was satisfactory—not noticeably different from slotted coating. As expected, bending of the pipe in the over bend on the lay-barge ramp induced a series of fine cracks on the tension side of the pipe at intervals of 1 to 3 ft—the closer the spacing, the finer the cracks.

Inspection of the coating on the seabed by video recording showed the fine cracks to be closed and not apparent.

Stability and trenching studies. The concrete weight specified for various locations along the pipeline was based on stability calculations for the combined effects of 100-year storm plus maximum annual tidal currents. Where practical, a surplus amount of concrete weight was specified.

However, near shore in some water depths, the lay barge could not safely handle the heavy pipe weights required for complete stability. In these areas, additional stability means were provided, usually by trenching.

The study of problems of stability and trenching led to the following conclusions. Over 70% of the Flags line can be stabilized by weight coating alone. Trenching and natural backfilling can provide the additional stability for the remaining portion, except for small untrenchable lengths which will be protected by other means.

Equipment available for trenching in deep water will not produce a trench of constant depth and shape and for the most part, the trench will have poor geometry. Natural backfilling will occur rapidly and be effective over the first 50 km (31 miles) of the line, but will occur more slowly and be less effective over the next 100 km (62 miles), and will not occur at all over the rest of the route.

Surplus weights in the sections which do not need trenching are very much greater than anticipated losses, and spans longer than the critical length need to be eliminated by trenching or additional support material.

Fishing activities. Studies were made of fishing activities along the pipeline route to consider the effects fishing might have on the safety of the pipeline and the effects the pipeline and its construction might have on fishing activities.

Laboratory and full scale tests were conducted to simulate large trawl gear repeatedly impacting and pulled over the pipeline. The studies resulted in the following conclusions. The concrete weight-coating on the Flags gas line will provide more than adequate protection from fishing gear, and trawl gear will neither penetrate the weight coat, nor cause a significant loss of concrete. The pullover force (as the trawl board is drawn over the pipeline) may move the pipeline, but only slightly and well within acceptable tolerances.

Trenching would provide no additional protection to the pipeline in the deep-water sections where natural backfill will not occur. Trenching in this area would increase the risk of damage to fishing gear by increasing pullover forces and by creating unnecessary bottom debris.

Trenching in shallow-water areas of high currents will prevent contact with fishing gear because natural backfill will tend to cover the pipe.

Inspection and maintenance. The design for seabed safety and stability includes plans for periodic inspection. Damage or seabed conditions which might lead to progressive deterioration of the pipeline must be detected and rectified before the situation becomes serious.

The inspection program will include an external sonar and video tape inspection after laying and after trenching, external inspections after 6 and 12 months of operation of the Flags gas line, and similar inspections at least annually.

Certain areas may require more frequent inspection, and others, when the line is buried, may require less. Examination of the inspection results over the early period will determine the subsequent frequencies of inspection for each section of the line.

Maintenance will be done according to the results of the inspections to ensure that any potential problems are dealt with.

Research conclusions and results. The main conclusions arising from the research program leading to the design for the Flags gas line are that stability can be achieved by concrete weightcoating alone for more than 70% of the pipeline; additional stability can be achieved by trenching, rock cover, or other means for the remaining portion; and critical spans must be eliminated to avoid overstressing and vibration.

Also, anticipated concrete losses due to mechanical damage are extremely small, and the design provides a large built-in safety margin. Repeated contacts with the heaviest fishing gear have no significant effect on the integrity of the coating or the pipeline.

Pipelines cannot be protected against large anchors by trenching, although, where natural backfill occurs near shore, some protection is provided against small anchors. The effect of fishing across the pipeline would be aggravated by trenching in deep water because loads on fishing gear would be increased.

Trenching produces additional seabed debris due to the anchors used by the barge as well as spoil from the trench. This again is hazardous to fishing operations. An inspection and maintenance program will ensure the continued integrity of the pipeline.

Throughout the course of the research program, the various Scottish and British fishermen organizations, the Department of Agriculture and Fisheries of Scotland (DAFS), and the Chief Pipeline Inspector, UK Department of Energy, were consulted and kept informed of study results and plans.

In the end both the fishermen organizations and DAFS endorsed the plan to avoid unnecessary trenching. The design for safety of the pipeline was also approved by the Department of Energy.

The author . . .

D. E. Broussard

D. E. (Doug) Broussard was recently named manager, Northern Gas Transport System, Shell U.K. Exploration & Production Ltd. to oversee the completion of the system which will transport North Sea gas through the Flags gas line to St. Fergus, Scotland. Previously he was manager of the Flags offshore project. Broussard joined Shell Oil Co. (USA) in 1948, after having received BS and MS degrees in mechanical engineering from Texas A&M University. He first became involved in offshore pipeline technology in 1965 when he was assigned to Shell Pipe Line R & D Laboratory to organize and supervise a task group to develop the capabilities to construct offshore pipelines in water depths to 1,000 ft. Later, in 1974, he organized and was the initial project manager of Shells' deep water pipeline feasibility study which was cooperatively sponsored by 37 international companies to evaluate technology for pipelines in water depths to 3,000 ft. Broussard holds several U.S. patents in this field, including the 'Articulated Stinger,' the 'Bending Shoe Riser,' and the 'Buckle Arrestor' for deep-water pipelines. He is a member of the Society of Petroleum Engineers (AIME), the American Society of Mechanical Engineers, the Pipeline Industries Guild (U.K.), and is a registered professional engineer.

Acknowledgements

The results summarized, as mentioned, stem from more than 50 separate studies contributed by 18 different organizations. Research and staff specialists of Shell Center in London, The Hague, Rijswijk, and West Hollow Research Center (Houston) as well as the Exxon Production Research Co. Houston, provided much of the basic analysis. Laboratories and individuals at Delft Hydraulic Laboratories, University of Berlin, University of Bath, VHL-River and Harbour Laboratories (Norway) contributed key reports. Contractors and consultants to the offshore industries were also major contributors. The study program was spearheaded by E. L. Killin of Shell International Petroleum Maatschappij, The Hague, who was seconded to the Flags gas line project for the study effort. Don K. Kiltau and Bryan G. S. Taylor of Esso Exploration and Production (U.K.) assisted in preparing summaries and presentations to governmental authorities and fishermen organizations. These presentations were abstracted for this article.

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FAIRBANKS NORTH STAR BOROUGH

Box 1267, Fairbanks, Alaska 99707

August 23, 1979

Bob Arvedlund
Federal Energy Regulatory Commission
825 North Capital Street
Room 3311
Washington, D.C. 20426

Dear Mr. Arvedlund,

Ron Hauenstein from the Borough's Public Information Office has told me that you are interested in receiving copies of the publications which the Center prepares on socio-economic and energy issues affecting the Borough.

I should explain, that the Borough's Community Information Center functions primarily as an economic office for borough government and monitors socio-economic conditions in the area. It originated as the Pipeline Impact Information Center and was established in 1974 to monitor the socio-economic impacts of the construction of the trans-Alaska oil pipeline on the Fairbanks area. In recent years, the Canadian federal government has established a center in Whitehorse, Yukon Territory, modeled directly after this office and a similar effort is underway in Anchorage.

I have enclosed for your use the following publications:

Fairbanks/Anchorage Business Cost Comparison

1978 Fairbanks Energy Inventory

North Pole Refinery Energy Impact

Community Information Quarterly, July 1979

1979 Fairbanks Cost of Living Update

If you have any questions regarding this material or I can be of any other assistance, please feel free to contact me.

Sincerely,

Ben Harding
Director
COMMUNITY INFORMATION CENTER

BH/ln

Glenn E. Shaw
% Geophysical Institute
University of Alaska
Fairbanks, Alaska 99701
September 23, 1979

Mr Micheal Sotak
Chief, Environmental Assessment Section
Federal Energy Regulatory Commission
Alaskan Gas Line Project
825 N. Capital
Washington, D. C. 20426

Dear Mr Sotak:

I am writing with regard to the possible plans of placing a petrochemical industry at Fairbanks, Alaska. As you are by now aware, the business and labor communities are exerting pressure on the govenment to place such an industry here. I am writing to make you aware of the fact that a decision to place a petrochemical industry here would be unwise for the simple fact that Fairbanks has the highest pollution potential of any city in the world. The latter is of course a radical statement to make, but the statement can be supported from an objective analysis of data accumulated by the Institute where I am employed and from other additional sources, such as by the Stanford Research Institute and by the Cold Regions Research and Engineering Laboratory. The appropreate technical documents can be made available to you and I am taking the liberty of sending, by seperate mail, a sample of the technical reports to your office.

You should be aware that Fairbanks is pollution-prone for the following reasons:

1. The air at Fairbanks is characterised by extreme stability. It is a stagnant more than 90 percent of the time. We have strong, persistent temperature inversions with temperature inversions of 20 °C in the lowest 200 meters. They are, as far as we know, the strongest recorded inversions of any inhabited area in the world.

2. The area of Fairbanks is almost completely surrounded by low hills and mountains. The wind speed is almost zero in winter. The dispersion of air pollutants is severely limited, both in the vertical and horizontal.

3. Fairbanks has severe periods of ice fog which lingers for up to two weeks at a time and acts to scavenge gases and particulates in the air. It is believed that fine, sub-micron, air pollutants (lead for example) attach to the ice crystals and, when breathed, can be deposited deep into the lungs.

3. The air in Fairbanks is nearly saturated or saturated with respect to ice approximately 60-80 percent of the time and hence the air chemistry that takes place is greatly complicated and made much more dangerous than it would otherwise be. All serious air pollution disasters have occurred as a result of reactions in air masses overstaturated with water, for example the Meuse Valley, Belgium episode which left 60 dead, thousands affected, the 1948 Donora, Pennsylvania which left 20 dead and 14,000 sick and the 1952 London killer fog which killed 4,000 people.

Already the air pollution problem at Fairbanks is at crisis proportions. The following gases and particles commonly exceed federal or recommended highest allowances: Nitrogen Oxide, Nitrogen Dioxide, Lead particulates, Carbon Monoxide, Hydrocarbons Sulfur gases. I have data which shows that lead concentration at Fairbanks was more than 10 times higher than the highest levels reported in a compilation by Kenneth Rahn (University of Rhode Island, Graduate School of Oceanography). An interesting report on the high levels of air contaminants at Fairbanks is Jenkins et al, CRREL Special Report 225 entitled "Accumulation of Atmospheric Pollutants near Fairbanks, Alaska, During Winter"; April, 1975.

A great many words have been written about the air pollution potential of Fairbanks, Alaska. Not one investigation that I know of has ever concluded anything but bad news. As sympathetic as I am to seeing new industry for Fairbanks, I also believe firmly , as I'm sure you do too, that the health of citizens comes before the wants of special interest groups. I reluctantly conclude that a petrochemical industry may go a good many places in this world, but Fairbanks should be the very last place where one ought to be built. It would, in my estimation, be very wrong to grant a license to seed petrochemical industrialization at Fairbanks.

Thank you very much for considering these statements. I really do wish I could say more positive things about my town, but nature has not been kind regarding the dispersion of air pollutants at Fairbanks.

Sincerely,

Glenn E. Shaw, PhD

December 6, 1979

Mr. Charles B. Curtis
Chairman, Federal Energy and
Regulatory Commission
Washington D.C, 20426

Dear Mr. Curtis:

I am requesting neccessary forms and a list of permits needed to construct and operate a gas conditioning and processing plant in the Fairbanks area. Recent data indicates construction and operating costs would make the project feasible.

It appears as though no action in this regard has been taken by producers, purchasers or transporters. This inactivity has created a void which must be filled.

My proposal would entail the construction of a facility which could process and condition approximately 2.8 Billion cubic feet of gas. This gas would be from Prudhoe and be dehydrated with some of the heavier hydrocarbons removed.

Preliminary indications are that:

1. Coal would be used for basic heat.
2. Charges for conditioning/processing would approximate 61.4¢/M.C.F. of inlet gas.
3. The process would most likely be to use CO_2 in a methanol system.

Thank you very much for your prompt attention to this matter. Your expediantcy is very much appreciated.

Very truly yours,

Gerry K. Winner

Gerry K. Winner
4728 Stanford Drive
Fairbanks, Alaska 99701

RECEIVED BY

OCT 1 [illegible]

M. J. S.

RECEIVED
[illegible] 1 23 PM '79
PROGRAM PLANNING AND ADMINISTRATIVE STAFF

September 27, 1979

Federal Energy Regulatory Commission
Office of Pipeline & Producer Regulation
Washington, D.C. 20426

Dear Sir:

This is in reference to your draft environmental impact statement entitled "Prudhoe Bay Project." The enclosed comments from the National Ocean Survey, National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure: Memo from Mr. Gordon Lill, National Ocean Survey

TO: PP - Richard L. Lehman

FROM: OA/Cx1 - Gordon Lill Gordon Lill

SUBJECT: DEIS #7907.57 - Prudhoe Bay Project; Prudhoe Bay, Alaska

The subject statement has been reviewed within the areas of NOS responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The following comment is offered for your consideration.

This statement has a minimum of precise environmental information with respect to physical conditions. This is understandable, however, since very little information exists from any source. The contractors are, therefore, encouraged to carry out an observational program (especially in this case) to determine the physical oceanographic features in Prudhoe Bay and its tributaries in much greater detail than presently exists.

Rec'd PP/EC
AUG 31 1979

416

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-3111

RECEIVED BY
OCT 1
M. J. S.

RECEIVED
OCT 1 23 PM '79
PROGRAM PLANNING AND ADMINISTRATIVE STAFF

September 27, 1979

Federal Energy Regulatory Commission
Office of Pipeline & Producer Regulation
Washington, D.C. 20426

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Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure: Memo from Mr. Gordon Lill, National Ocean Survey

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

OA/C52x6:JLR

AUG 29 1979

TO: PP - Richard L. Lehman

FROM: OA/Cx1 - Gordon Lill

SUBJECT: DEIS #7907.57 - Prudhoe Bay Project; Prudhoe Bay, Alaska

The subject statement has been reviewed within the areas of NOS responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The following comment is offered for your consideration.

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Rec'd PP/EC
AUG 31 1979