United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

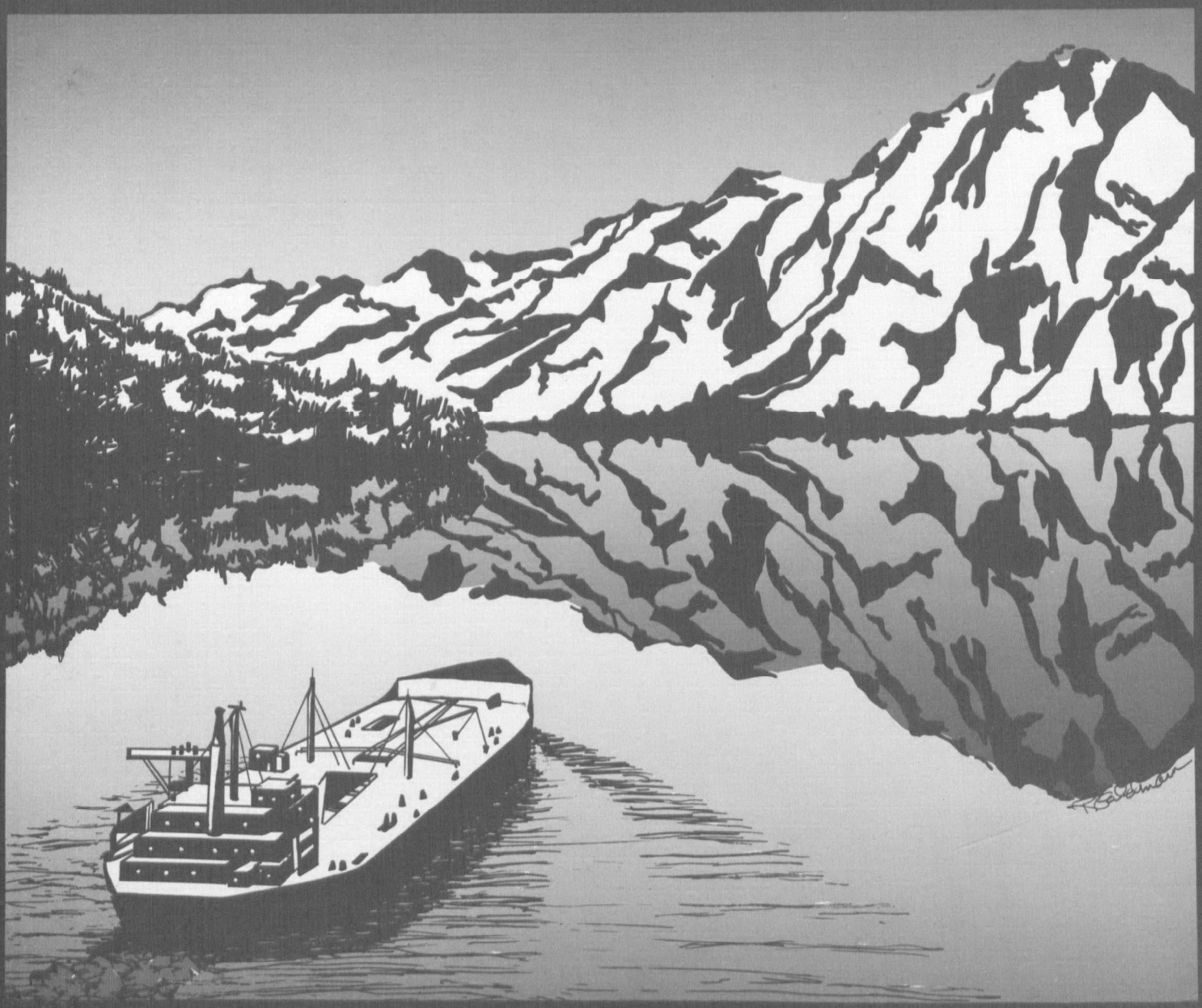
EPA-10-AK-Valdez-NPDES-79
December 1979
EPA 910/9-79-064

Draft

Environmental Impact Statement

Alaska Petrochemical Company

Refining and Petrochemical Facility
Valdez, Alaska



DRAFT ENVIRONMENTAL IMPACT STATEMENT

Alaska Petrochemical Company

Refinery and Petrochemical Facility,

Valdez, Alaska

Prepared by
U.S. Environmental Protection Agency
Region 10
Seattle, WA 98101

With Technical Assistance from
CCC/HOK-DOWL
4040 B Street
Anchorage, AK 99503

Responsible Official:

Donald P. Dubois
Regional Administrator

December 7, 1979
Date

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE

SEATTLE, WASHINGTON 98101

1979

REPLY TO ATTN OF: M/S 443

To: All Interested Government Agencies, Public Officials, Public Groups and Citizens

Pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 and implementing Federal Regulations, I am forwarding for your review and comment this Draft Environmental Impact Statement (EIS) for the Alaska Petrochemical Company's (ALPETCO) proposed Refinery and Petrochemical Facility in Valdez, Alaska. ALPETCO has applied for a National Pollutant Discharge Elimination System (NPDES) Permit to discharge pollutant to navigable waters pursuant to the provisions of the Clean Water Act (Public Law 95-217). The proposed facility has been determined to be a New Source under Section 306 of the Clean Water Act and hence is subject to the provisions of the National Environmental Policy Act (83 Stat. 852) under Section 511(c)(1) of the Clean Water Act. Pursuant to 40 CFR Part 124.31(d), the draft New Source NPDES permit has been released for concurrent public review with this EIS. Please see the attached Notice for details.

The United States Environmental Protection Agency (EPA) will announce the availability of this document in the Federal Register on Friday, December 7, 1979, initiating a 59-day review and comment period. It is requested that comments on the draft EIS be submitted by 1 February 1980. Comments on the draft EIS should be submitted to Ms. Deborah Kirk, Environmental Evaluation Branch, Mail Stop 443, at the above address. Substantive comments on the draft EIS will be considered in the preparation of the final EIS.

Please note that this draft EIS consists of a Text, Attachments and multiple technical appendices. All technical appendices were not distributed to all agencies and persons. If you need additional copies of the draft EIS or any of its technical appendices, please contact Deborah Kirk at the listed address or telephone (206) 442-4011 or (FTS) 399-4011. All volumes are available for review at the locations noted on the attached Notice.

Public hearings on the draft EIS and the draft New Source NPDES permit will be held in Anchorage, Valdez and Juneau on January 29,30 and 31, 1980, respectively. Please see the attached Notice for details.

It should be noted that if changes to the proposed project and draft EIS are minor, the final EIS will consist primarily of: 1) a summary, 2) pages with modifications, addition and/or deletions as necessitated by the coordination and review process; and 3) a new coordination section containing comment letters received on the draft EIS with EPA's responses to those comments. Therefore, the draft EIS should be retained since it, along with the final EIS, will provide a full analysis of the environmental issues. The final EIS will be sent only to the agencies and interested parties who request a copy or make substantive comments on the draft.

If you need additional information, please contact Ms. Deborah Kirk at (206) 442-4011 or (FTS) 399-4011.

Sincerely yours,

Donald P. Dubois
Regional Administrator

Attachment

United States Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101
(206) 442-1270

NOTICE OF PROPOSED ISSUANCE OF NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT(S) TO DISCHARGE TO WATERS OF THE UNITED STATES,

NOTICE OF DRAFT ENVIRONMENTAL IMPACT STATEMENT, AND

NOTICE OF PUBLIC HEARING, AND

NOTICE OF STATE CERTIFICATION

Public Notice No.: AK-002763-4
Public Notice Issuance Date: December 7, 1979
Public Notice Expiration Date: February 1 , 1980

1. Applicant: Alaska Petrochemical Company
(ALPETCO)
Valdez, Alaska

a. The applicant has applied for a National Pollutant Discharge Elimination System (NPDES) permit to discharge pollutants to navigable waters pursuant to the provisions of the Clean Water Act (CWA). The applicant proposes to operate an oil refinery and petrochemical facility in Valdez, Alaska. The treated wastewater discharges resulting from the proposed facility will be discharged to Port Valdez, which is classified as Type II/Marine Waters according to the State's federally approved water quality standards.

b. The National Environmental Policy Act (NEPA) requires that a detailed statement be prepared for every major federal action with a potential for significantly affecting the quality of the human environment. This statement, called an Environmental Impact Statement (EIS), evaluates the potential environmental effects of such federal actions in addition to identifying alternatives to the proposal. EPA's NPDES regulations state that the issuance of an NPDES permit to a new source may be a major federal action and therefore subject to the NEPA requirements.

An NPDES permit is required for the proposed ALPETCO facility. ALPETCO has been determined to be a new source under the NPDES regulation definitions. An environmental review conducted for this proposal shows that significant environmental impacts may occur. Therefore, the issuance of an NPDES to the proposed ALPETCO facility is a major federal action requiring the preparation of an EIS.

c. The EIS has been prepared and is being released for concurrent public review with the proposed NPDES permit. The EIS considers the environmental impacts of the proposed facility as well as feasible alternatives (such as the location and design of the refinery). Social and economic impacts on the City of Valdez in particular and State of Alaska in general are discussed at some length.

EPA has been the lead agency in preparing the EIS; the U.S. Corps of Engineers (COE) has been a cooperating agency.

d. On the basis of the information in the draft EIS, EPA has made a preliminary determination to issue the NPDES permit to the applicant.

e. The applicant has also applied to EPA for a Prevention of Significant Deterioration (PSD) permit, under the Clean Air Act of 1977. EPA is presently reviewing the application and will be making a preliminary determination of the approvability of a PSD permit. This preliminary determination will be made available for public comment in the near future. The analysis of air quality impacts in the EIS is based on the analyses conducted by the applicant in preparing the PSD application. Should significant changes in EPA's assessment of the air quality impacts of the proposal result from EPA's review of the PSD application, the EIS would be supplemented to reflect that new information.

2. State Certification

This notice also serves as public notice of the intent of the State of Alaska, Department of Environmental Conservation to consider certifying that the subject discharges will comply with the applicable provisions of Sections 208(e), 301, 302, 303, 306 and 307 of the Clean Water Act. The NPDES permit will not be issued until the certification requirements of Section 401 have been met.

3. Public Hearings

EPA will hold public hearings on the proposed NPDES permit and the draft EIS at the following locations and times:

Anchorage January 29, 1980 Sheraton Anchorage Yukon Room 401 East 6th Avenue 7:30 pm	Valdez January 30, 1980 City Council Chambers City Hall 7:30 pm	Juneau January 31, 1980 Juneau High School 1250 Glacier Highway 7:30 pm

The purpose of these hearings is to allow all interested parties an opportunity to express their views and furnish specific data on matters pertinent to the proposed NPDES permit and draft EIS. Written and oral comments are welcomed and will be placed into the record.

4. Public Comments

The proposed issuance of the NPDES permit and the availability of the draft EIS will be announced in the Federal Register on December 7, 1979.

This announcement will initiate a 59 day review period, ending February 1, 1980. EPA solicits comments from all interested persons and will consider these comments before any final actions are taken. All comments should include the name and address of the commentator, and concise statements of the relevant background documentation or facts which the comment is based upon.

Written comments on the EIS should be submitted to EPA to the attention of Deborah Kirk, Mail Stop 443, 1200 Sixth Avenue, Seattle, Washington 98101 by February 1, 1980 or presented to EPA at the public hearing. Written comments on the NPDES permit should be submitted to EPA to the attention of Michael Johnston, Mail Stop 521, 1200 Sixth Avenue, Seattle, Washington 98101 by February 1, 1980 or presented to EPA at the public hearing.

Oral comments will be accepted at the public hearing.

Persons wishing to comment on the State Certification should submit written comments to the State of Alaska, Department of Environmental Conservation, Central Office, Pouch O, Juneau, Alaska 99811, by February 1, 1980, or presented at the public hearing.

5. Administrative Record

The proposed NPDES permit, draft EIS and other related documents are on file and may be inspected at any time between 8:30 am and 4:00 pm Monday through Friday at EPA in Room 11D, 1200 Sixth Avenue, Seattle, Washington. A copying machine is available in the Seattle office for public use at a charge of 20 cents per copy sheet.

Additional copies of the NPDES permit and fact sheet may be obtained from Kim Wilson, Mail Stop 521, EPA, 1200 Sixth Avenue, Seattle, Washington 98101 or by calling (206) 442-1270.

Additional copies of the draft EIS may be obtained from Deborah Kirk, Mail Stop 443, EPA, 1200 Sixth Avenue, Seattle, Washington 98101 or by calling (206) 442-4011.

6. Availability of Documents

The proposed NPDES permit, fact sheet and draft EIS will be available for inspection at the following locations:

Alaska Operations Office
EPA
Federal Building, Room E535
701 'C' Street
Anchorage, Alaska

City of Valdez
Public Library
Egan Drive
Valdez, Alaska

City of Juneau
Public Library
114 W. Fourth Street
Juneau, Alaska

Please bring this information to the attention of other persons who might be interested in this matter.

SUMMARY
ENVIRONMENTAL IMPACT STATEMENT

New Source NPDES Permit for the
Alaska Petrochemical Company
Refinery and Petrochemical Facility, Valdez, Alaska

U. S. Environmental Protection Agency
Region 10
Seattle, Washington

(X) Draft Environmental Impact Statement

( ) Final Environmental Impact Statement

Type of Action:

(X) Administrative

( ) Legislative

Summary Description of Administrative Action:

The United States Environmental Protection Agency (EPA) is considering the issuance of the New Source National Pollution Discharge Elimination System (NPDES) permit for wastewater discharge from the proposed Alaska Petrochemical Company (Alpetco) Refinery and Petrochemical Complex in Valdez, Alaska. The issuance of such a permit requires that the provisions of the National Environmental Policy Act of 1969 (NEPA) apply to that action. Pursuant to NEPA and implementing regulations of the Council on Environmental Quality (CEQ) and EPA, an Environmental Impact Statement (EIS) has been prepared to evaluate the potential impacts of the proposed action on the environment.

EPA's action will consist of either the issuance, denial or issuance with conditions of an NPDES permit. Such a decision will follow a complete evaluation of any significant beneficial and adverse environmental impacts which would occur.

Summary Description of the Proposed Project

The Alaska Petrochemical Company (Alpetco) proposes to build a grassroots refinery and petrochemical facility in Valdez, Alaska, to process 150 thousand barrels per day of Alaska North Slope crude oil into the maximum practicable quantity of refined products to supply the West Coast petroleum fuels market. Royalty crude oil would be purchased from the State of Alaska under an existing contract ratified by the Alaska legislature in June 1978.

It is estimated that the proposed project would require three years and $1.8 billion to construct. The plant would be fully operational in early 1984.

The proposed location is a 1,400-acre tract of land owned by the City of Valdez which lies north of the Richardson Highway and south of Valdez Glacier. Other facilities would include a products shipping dock near Solomon Gulch on the south shore of Port Valdez, an industrial wastewater treatment plant and an on-site power plant. A construction barge dock would be built at an old city dock site adjacent to a leased staging area, and a temporary construction camp would be located on the plant site.

Feedstock for the facility would be provided via a 20 inch pipeline connection from an existing valve in the trans-Alaska pipeline to on-site storage. All product storage also would be on-site. Refined products would be carried in small-diameter pipelines to the products dock.

Projected Impacts

Air pollutant concentrations would increase in the plant vicinity. EPA will soon make a determination on the most representative method for predicting air quality impacts. Sulfur dioxide standards would be the most difficult to meet. Also, an average of 7.4 million gallons per day of treated industrial wastewater would be discharged into Port Valdez. It is expected that the treated effluent would meet the EPA refinery effluent standards and State of Alaska receiving water standards.

Shipping of refined products would add approximately 128 vessels per year to the Port Valdez marine traffic. General marine cargo would be transported from the Valdez city dock. The increased vessel traffic would be well within the capability of the existing Coast Guard Vessel Traffic System to provide navigational assistance.

The available supply of permanent housing in Valdez would not be sufficient to accommodate growth during the early years of refinery construction and operation. Positive economic impacts would affect employment, the proposed new city dock and public revenues. Municipal services seem adequate to meet the resulting population growth. Valdez community support for the proposed facility is strong.

Although in a seismically active area, the proposed site has no seismic constraints to construction of a safe facility assuming proper design and construction practices. The soils generally are well graded and have a low potential for frost heave and would not be a construction problem. There is a sufficient supply of groundwater to supply the refinery's needs without affecting the surrounding area.

The National Marine Fisheries Service and U. S. Fish and Wildlife have determined that there are no endangered species that would be threatened by the proposed facility. Several salmon-spawning streams adjacent to the site would have to be protected by design and operating procedures.

Other impacts from noise, odor, solid waste disposal and visual effects do not appear significant.

The facility poses no known threat to any property listed in, or eligible for inclusion in, the National Register of Historic places.

Alternatives Considered

The constraints of the Agreement for the Purchase and Sale of Alaska Royalty Crude Oil between Alpetco and the State of Alaska require that the proposed refinery be constructed within Alaska. The merits of 12 locations throughout

Alaska were considered during final site selection. Valdez was selected as the site for the proposed facility, primarily due to the community support received, the proximity to the crude supply, the deep-water port, no evidence of insurmountable environmental problems, and an existing infrastructure to accommodate anticipated growth.

From four alternative access routes on the south and west sides of the site the existing Valdez Glacier Stream Haul Road is proposed as the primary access to the facility. Solomon Gulch on the south shore of Port Valdez was selected over Ammunition Island on the north shore and Allison Point adjacent to the Alyeska Marine Terminal as the site for a tanker dock for shipping refinery products.

In order to best meet potential West Coast market demands and to minimize the production of unmarketable residual heavy fuel oils, a slate of products is planned consisting of about 52% unleaded gasoline, 20% jet fuel and 28% other fuel and chemical products. More than one hundred variations of several process schemes were evaluated to arrive at an ultimate process design. Coal, fuel oil and by-product gas were considered as energy sources.

A biological treatment system using rotating biological contactors was preferred to activated sludge, activated carbon, stabilization ponds, trickling filters and deep well injection as an industrial wastewater treatment design. Best available control technology (BACT) must be used to meet air quality standards.

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ATTACHMENT B

Memorandum of Understanding
NPDES Permit Application and Draft Permit
PSD Permit Application Submittal Letter
COE Sections 10 and 404 Permit Applications
COE Public Hearing Notice

ATTACHMENT C

PSD Permit Application

APPENDIX VOLUME I

Geotechnical
Hydrology
Ecosystems
Oceanography

APPENDIX VOLUME II

Socioeconomics
Refinery Processes
Archaeology
Acoustics

The Anchorage Historical and Fine Arts Museum provided historical photographs of the Valdez area which appear on the divider pages. Their cooperation and assistance are appreciated. Following are descriptions or captions for the photographs.

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Cliff Mine, Valdez Bay (now called Port Valdez), Alaska. Circa 1905.

Purpose and Need

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Refinery Processes

Valdez's first newspaper in its last home before the beginning of new Valdez. August 24, 1907.

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Acoustics

Goddess of Liberty Float, Valdez. July 4, 1907.

1 Introduction

1. INTRODUCTION

1.1 PROJECT HISTORY

On August 1, 1977, in response to a request for proposal, Alaska Petrochemical Company (Alpetco) presented to the State of Alaska a preliminary proposal to purchase 85 percent of the one-eighth share of State of Alaska royalty crude oil and to construct a grassroots refinery petrochemical complex (hereafter referred to as the refinery or facility) in Alaska. This response was followed by the presentation of a final proposal. Alpetco, a corporation formed specifically for this project in July 1977, is owned by Alaska Interstate Company, Seatrain Lines, Inc., and six Alaska Regional Native Corporations.* In February 1978 Alpetco was awarded a 27-year contract to purchase up to 150 thousand barrels per day (thousand bpd) of the state's royalty crude oil and to build and operate a refinery and petrochemical facility in Alaska. The contract was ratified by the Alaska legislature in June 1978. The proposed facility would be located at Valdez and would supply various products principally for West Coast markets.

The Agreement for the Sale and Purchase of Alaska State Royalty Crude Oil between Alpetco and the State of Alaska (the State Contract) includes several benchmarks, or specific performance measures, which were designed by the state to insure both compliance with the contract and that Alaska obtain maximum benefits from in-state processing of the royalty oil. Since ratification of the contract by the state legislature, Alpetco has: developed its project staff; selected design and construction management consultants; selected a site in accordance with the State Contract; begun negotiations with major suppliers; proceeded with marketing and financing negotiations; and initiated preliminary design criteria and extensive environmental studies.

* In late October 1979, Alpetco informed the State of Alaska that E. F. Hutton of New York, an international financial service company, and the Charter Company of Jacksonville, Florida, a company heavily engaged in refinery and petrochemical activities, have agreed to form a joint-venture corporation called the Alpetco Company to build the proposed facility. Participation in the joint-venture would be Charter (70 percent), E. F. Hutton (6.6 percent) and Alpetco (23.4 percent).

1.2 EPA'S DECISION TO PREPARE AN ENVIRONMENTAL IMPACT STATEMENT

Alpetco submitted an application (AK-002763-4) on September 12, 1978 to the Environmental Protection Agency (EPA), Region 10, for a National Pollutant Discharge Elimination System (NPDES) permit for discharge of wastewater from the proposed refinery. Based on a review of information submitted with the application, EPA determined that the facility would be a new source of discharge (under 40 CFR 6.906d promulgated 11 January 1977) and, therefore, the issuance of a permit would be a major federal action requiring an Environmental Impact Statement (EIS) (under 40 CFR 6.910 promulgated 11 January 1977).

EPA's alternatives in this case are limited to issuing the NPDES permit, denying it, or issuing it with conditions. The draft of an NPDES permit for this facility (see Attachment B) already contains several conditions directly related to the wastewater discharge, including a long-term monitoring program. Mitigating measures already incorporated into the design of the facility or which will become design constraints at the appropriate planning stage, are discussed individually in Section 6, Environmental Impacts, and are summarized in Section 7, Mitigating Measures. However, EPA will consider the complete range of environmental impacts in acting on this application and will not make a final decision until the National Environmental Policy Act (NEPA) review process has been completed.

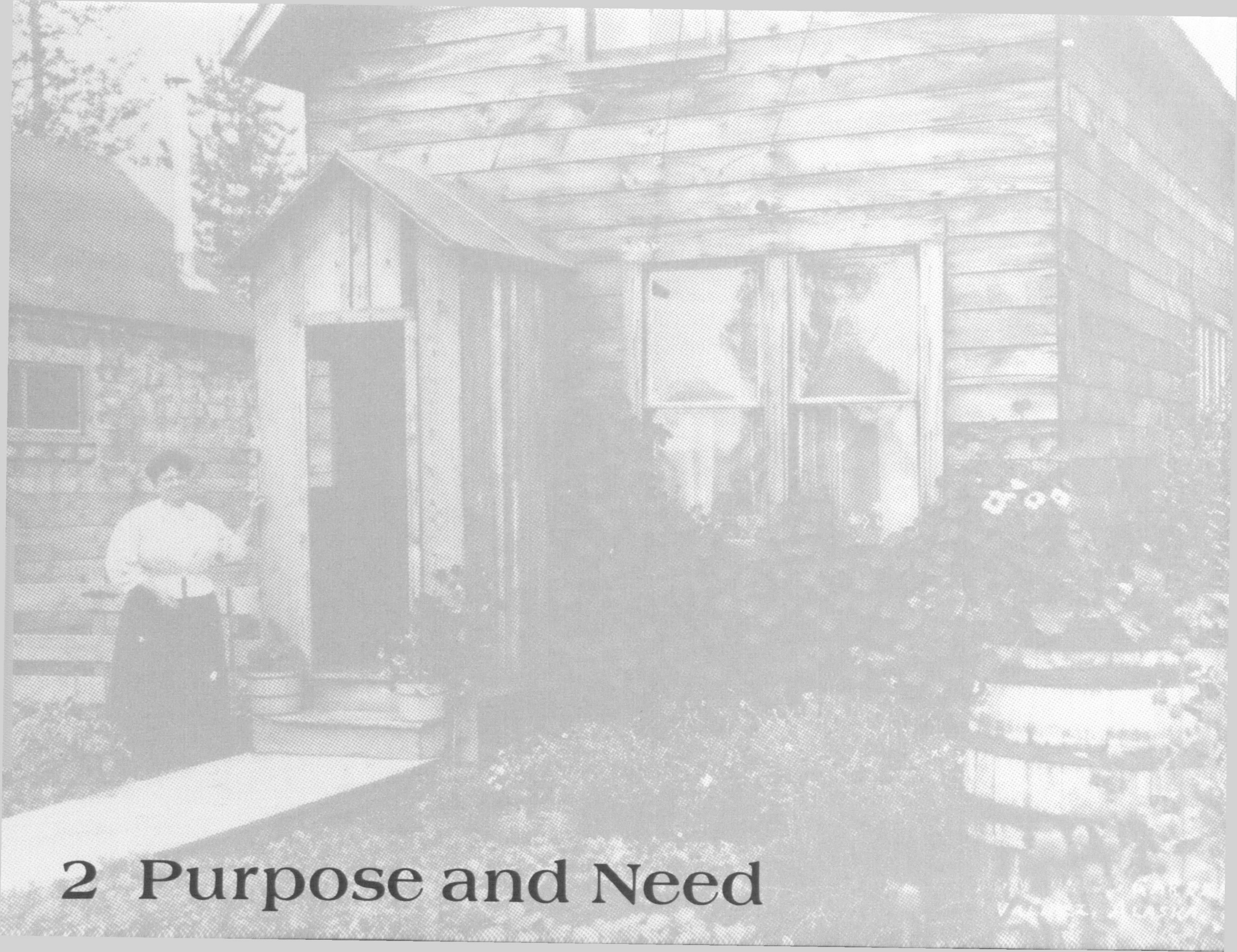
Through a "Memorandum of Understanding," (see Attachment B) Alpetco and EPA agreed to engage a third-party consultant for the purpose of preparing the EIS under the provisions of the National Environmental Policy Act. CCC/HOK-DOWL, of Anchorage, Alaska, was selected as the EIS consultant.

Preparation of the EIS began before final promulgation of the Council on Environmental Quality (CEQ) regulations on implementation of the procedural provisions of the NEPA (40 CFR Parts 1500-1508). However, during preparation of the EIS every effort was made to comply with the proposed regulations, particularly with respect to coordination among

agencies or groups interested in or affected by the proposed project. The coordination efforts are described in Section 9.

1.3 U. S. ARMY CORPS OF ENGINEERS REGULATORY PROGRAM

During review of the proposed project it was determined that components of the refinery complex would come under the jurisdiction of the U. S. Army Corps of Engineers (COE) regulatory program. Acting at the request of the Environmental Protection Agency, the Corps became a cooperating agency in EIS preparation. Therefore, for the purpose of satisfying COE requirements under the National Environmental Policy Act, the proposed action is issuance of permits under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Federal Water Pollution Control Act of 1972 as amended by the Clean Water Act of 1977. Additionally, the EIS serves to identify the impacts of this proposed action.



2 Purpose and Need

2. PURPOSE AND NEED

2.1 NEED FOR THE PROJECT

The Alpetco project stands on its own economic merits independent of the compelling national need to develop long-term solutions to national energy problems and to the present West Coast crude oil surplus. The Alpetco project would alleviate some of these problems in a number of concrete and important respects: (1) reduce the West Coast crude oil surplus by 150 thousand bpd; (2) provide nearly 145 thousand bpd of unleaded gasoline, jet fuel, and other refined products for which the demand is strong and growing; (3) reduce the present import of refined petroleum products to the West Coast; and (4) add no residual fuel oil to the West Coast residual market (see Section 4.1 for a discussion of the West Coast crude oil and residual oil markets).

The proposed refinery would fill a void that has been created on the West Coast, as well as create a foundation for future economic development in the city of Valdez and the state of Alaska. There are no known major new refinery facilities and only one major expansion planned for the West Coast. Alpetco's proposed facility would play an important role in the supply of refined petroleum products in this area. The proposed facility, using the latest technology, would process 150 thousand bpd of crude oil into approximately 75 thousand barrels of unleaded high-octane gasoline, 30 thousand barrels of jet fuel, 5 thousand barrels of diesel fuel, and 35 thousand barrels of benzene, toluene and other petrochemicals.

2.2 STATE OF ALASKA OBJECTIVES

Alaska's royalty crude oil, one-eighth of all crude oil produced from wells on state leases, represents one of the state's major natural resources. Processing the oil in Alaska would provide essential new U. S. refining capacity on the West Coast, as well as stimulate economic development in Alaska.

Significantly, Alpetco enjoys the strong support of the State of Alaska's administration. This is perhaps best illustrated by the words

of Governor Jay S. Hammond who, responding to reporters after a June 1978 contract ratification vote in the legislature to approve Alpetco's royalty oil contract, stated: "I've said we should have three considerations in looking at projects of this type--is it a good business deal, is it environmentally sound, and do the people of the state want it; Alpetco is a good deal on all three counts." It is the goal of the State of Alaska administration to promote orderly development of Alaska's natural resources and encourage a broader, more stable economic base for its citizens. The administration feels the proposed project is compatible with those goals.

2.3 ALASKA PETROCHEMICAL COMPANY OBJECTIVES

Alpetco intends to construct a state-of-the-art refinery to process 150 thousand bpd of crude oil into refined fuels and petrochemical feedstocks. The facility would be ready to start-up late in 1983 and to be fully operational early in 1984.

Alpetco's product slate has been defined by the anticipated refined products demand in Petroleum Administration for Defense District V (PAD-V) which includes Alaska, Arizona, California, Hawaii, Nevada, Oregon and Washington. Unleaded gasoline and jet fuel are expected to be the major components of growth in refined products demand on the West Coast and Hawaii, and the products which existing refiners will be least able to supply. There are several political and economic factors which support this expectation; these factors combine to create a need for additional PAD-V refining capacity which is insulated from the uncertainties of crude supply and environmental problems (see Section 4.1).

Alpetco's principal target market is the West Coast and includes major West Coast refiners and marketers, large independent refiners and distributors, airlines, and chemical companies.

3 Proposed Project

3. PROPOSED PROJECT

3.1 GENERAL DESCRIPTION

EPA categorizes refineries into five classes (A through E) according to their processing capabilities. The proposed facility would be a Class C refinery, meaning it would have cracking and petrochemical production capabilities. When crude oil enters a refinery it initially is heated and separated into different components according to boiling temperature range. Cracking takes this component separation process a step further through a complex rearrangement of hydrocarbon molecules.

It is proposed that the facility be a "bottomless" refinery thereby processing 100 percent of the raw material crude into a maximum practicable slate of products leaving only about 3 percent of the products as residual heavy fuel oils. No crude bottoms would be returned to the crude source pipeline. In response to the environmental, contractual and marketing constraints on this project, the refinery would be the most technologically advanced facility of its kind in existence today.

Including start-up cost, the total capital investment in 1979 dollars would be $1.8 billion. Constructed during a three-year period, the facility would have a minimum operating life of 21 years (the remaining duration of the 27-year royalty oil contract period).

3.2 PROJECT SITING

The proposed project site is within jurisdictional limits of the City of Valdez, a town in Southcentral Alaska located on Port Valdez, which is connected by the Valdez Narrows and Valdez Arm to Prince William Sound, the Gulf of Alaska and the North Pacific. Valdez is a year-round ice-free port. Details of the site selection are presented in Section 4.2.

Valdez has become known as the terminus of the trans-Alaska oil pipeline and the location of the Alyeska Pipeline Service Company's marine terminal. The town includes an area sometimes called old Valdez, which sits on the shore at the east end of Port Valdez. This was the orig-

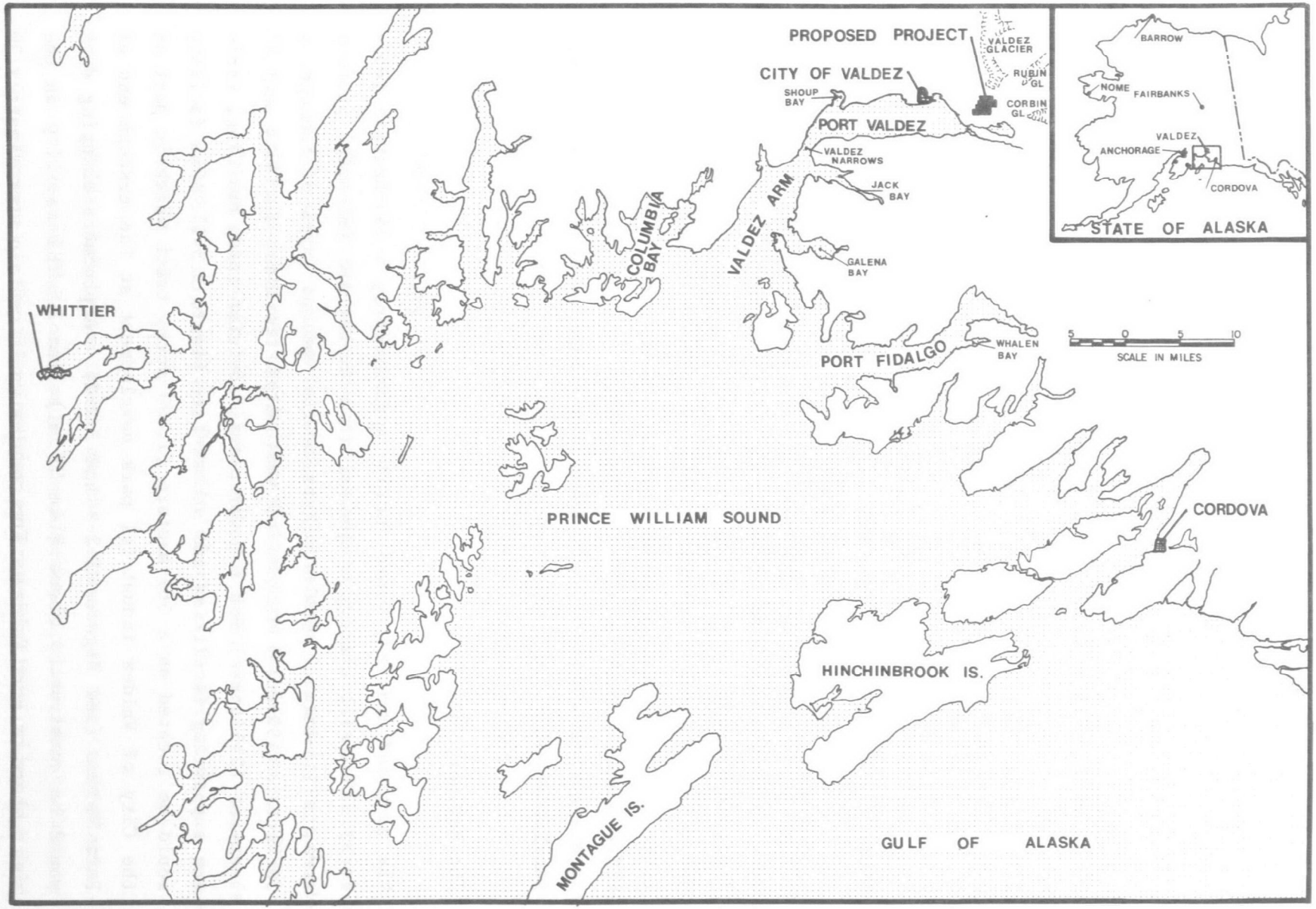
inal townsite, which virtually was destroyed as a result of the Great Alaskan Earthquake of 1964. After the disaster, the town was quickly rebuilt about 6.5 km (4 mi) west on the north shore of the port. This rebuilt townsite area is sometimes called new Valdez. Both areas are within the current city limits. Figures 3.2-1 and 3.2-2 are regional and vicinity maps of the area.

3.3 LAND REQUIREMENTS AND EXTERNAL APPEARANCE

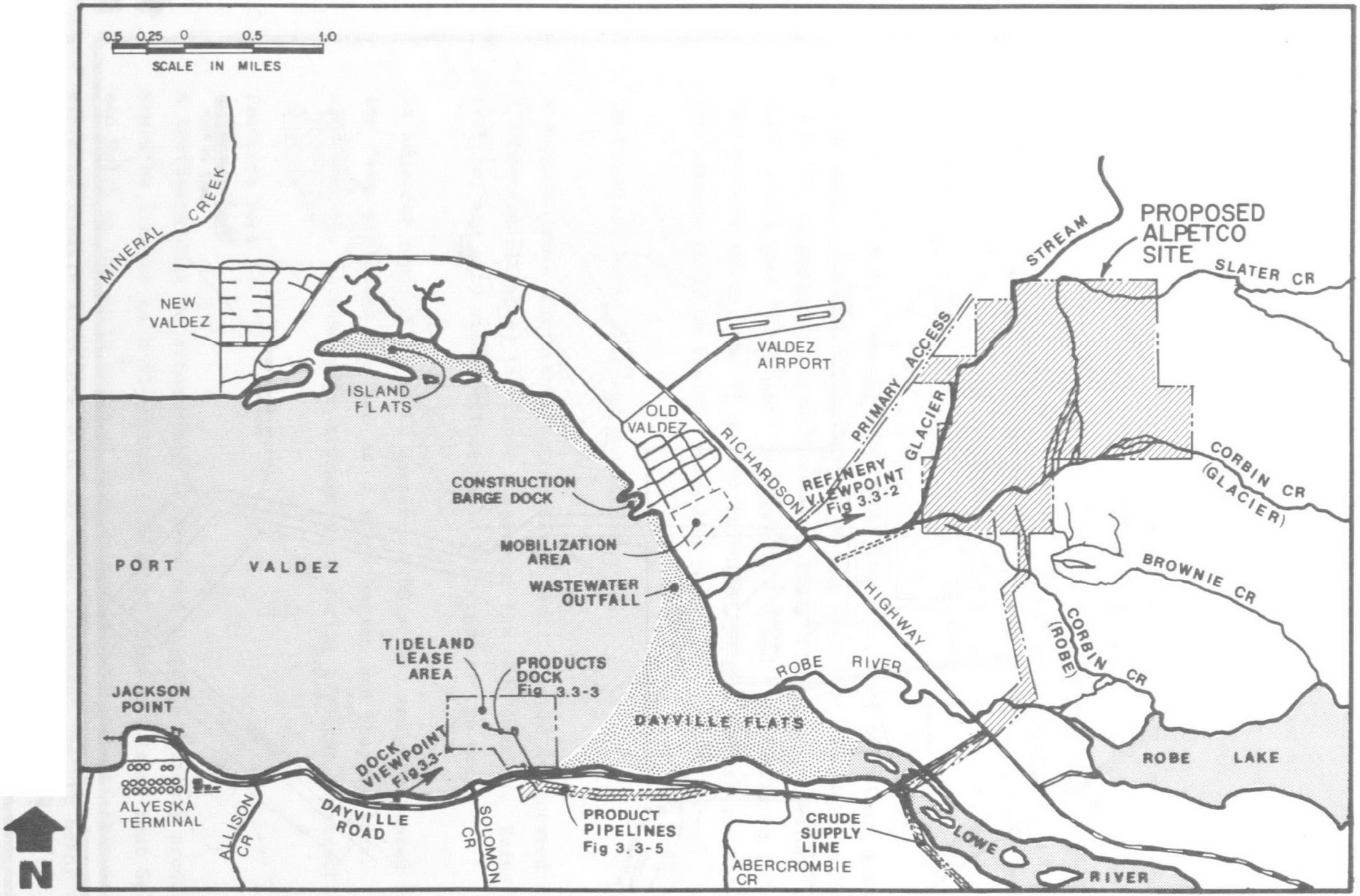
The proposed refinery would be comprised of facilities at three locations: the process facilities, tankage, off-site operations and temporary construction camp located on the proposed refinery site east of Valdez Glacier Stream; the construction barge dock and mobilization yard at the old Valdez townsite; and the products dock near Solomon Gulch on the south side of Port Valdez, and inter-connecting pipelines. The refinery would be served by one primary access road and by incoming crude oil and outgoing refined product pipelines. The pipeline corridor would include a service road. This section discusses the land area requirements and visual exposure and appearance of these proposed facilities.

3.3.1 The Refinery Site

The proposed refinery would include approximately a 263-hectare (650-acre) industrial complex comprised of a 26-hectare (65-acre) process area, a 113-hectare (280-acre) tract for various types of tankage, a 36-hectare (90-acre) industrial wastewater treatment facility and 87 hectares (215 acres) for a power plant, administration building, various supporting facilities and access (see Figure 3.3-1). The facility would be located on a 567-hectare (1,400 acre) tract which is part of the City of Valdez industrial park development at the eastern end of Port Valdez (see Figures 3.2-1 and 3.2-2). A products shipping dock would be constructed about 8 km (5 mi) west of the facility on the south shore of Port Valdez. The complex would contain approximately 30

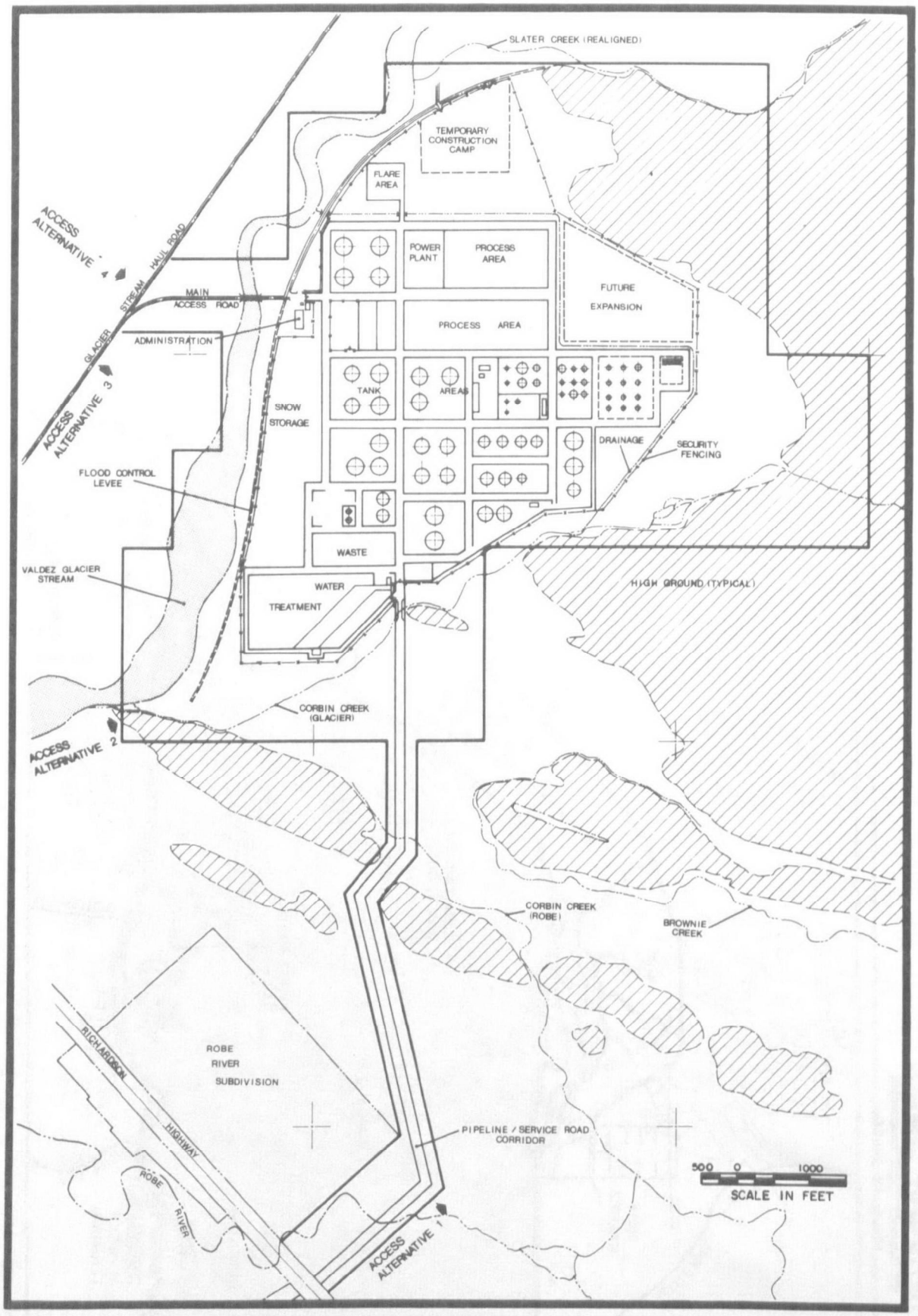


REGIONAL MAP **Figure 3.2-1**



VICINITY MAP

Figure 3.2-2



SITE PLAN & ACCESS **Figure 3.3-1**

refining and distillation units ranging in height from 46-76 m (150-250 ft) in the northern part of the site. The tankage would consist of approximately 77 steel storage tanks ranging in size from 70 m (232 ft) in diameter and 17 m (56 ft) high downward to smaller spherical and horizontal cylindrical pressure vessels. Situated in the western and southern parts of the site would be such support facilities as the administration building, fire station, warehouses, and wastewater treatment facility. The power plant, emergency flare, and a construction camp housing 2,500 employees in approximately 23 prefabricated, two-story dormitory-style buildings, are shown located to the north (see Figure 3.3-1).

Because trees and low hills surround the site, only one clear, ground-level public view of the refinery would be possible: looking northeast from the vicinity of the Richardson Highway bridge across Valdez Glacier Stream (see "Viewpoint" on Figure 3.2-2 and view on Figure 3.3-2). The process units, the 91 m (300 ft)-high emergency flare and much of the tankage would be visible above the trees.

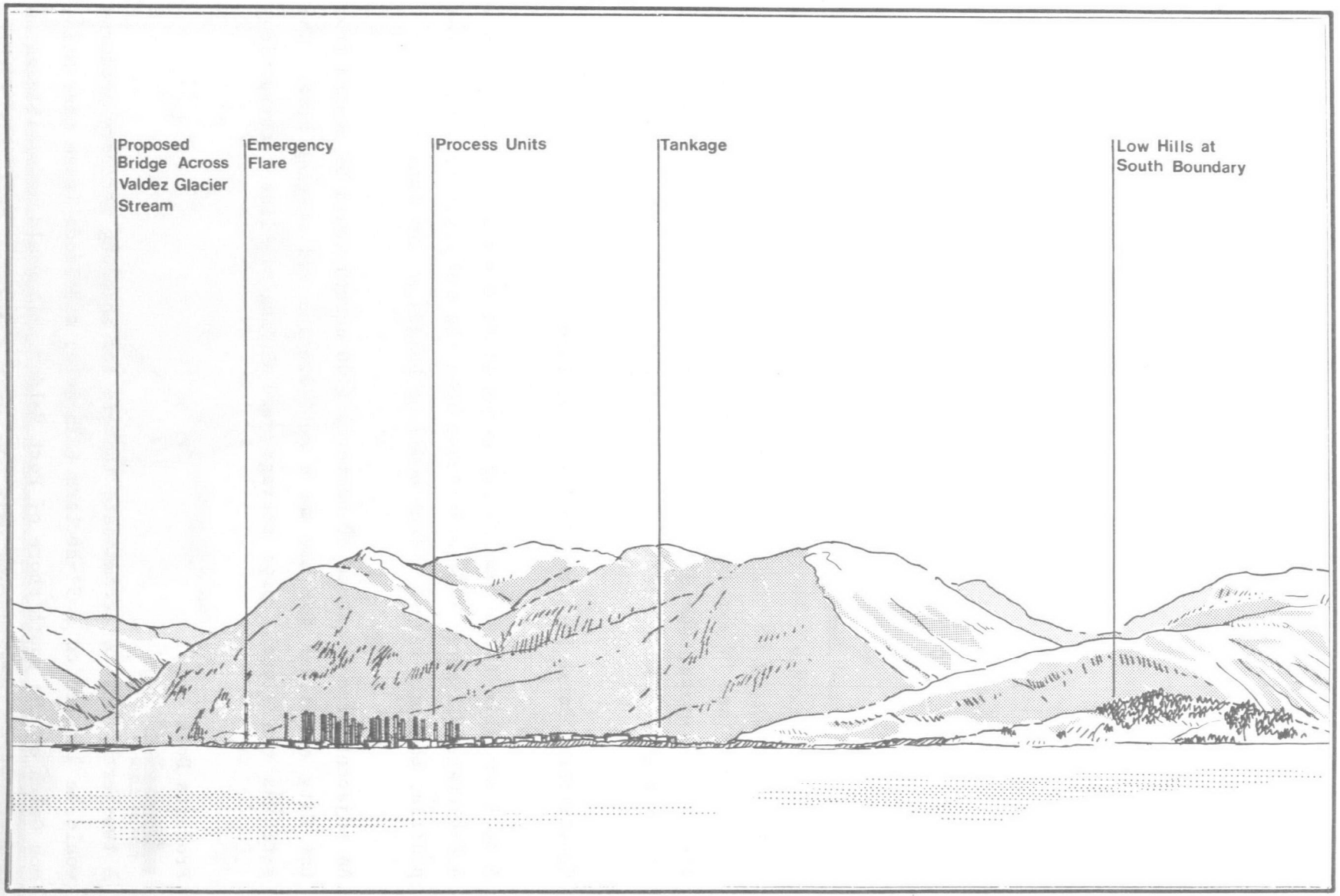
3.3.2 Construction Barge Dock and Mobilization Yard

A dock suitable for accommodating barge traffic would be located on a 4.8-hectare (12-acre) tidelands lease near the old townsite. Being low profile, the only visual effect would be barges at the dock.

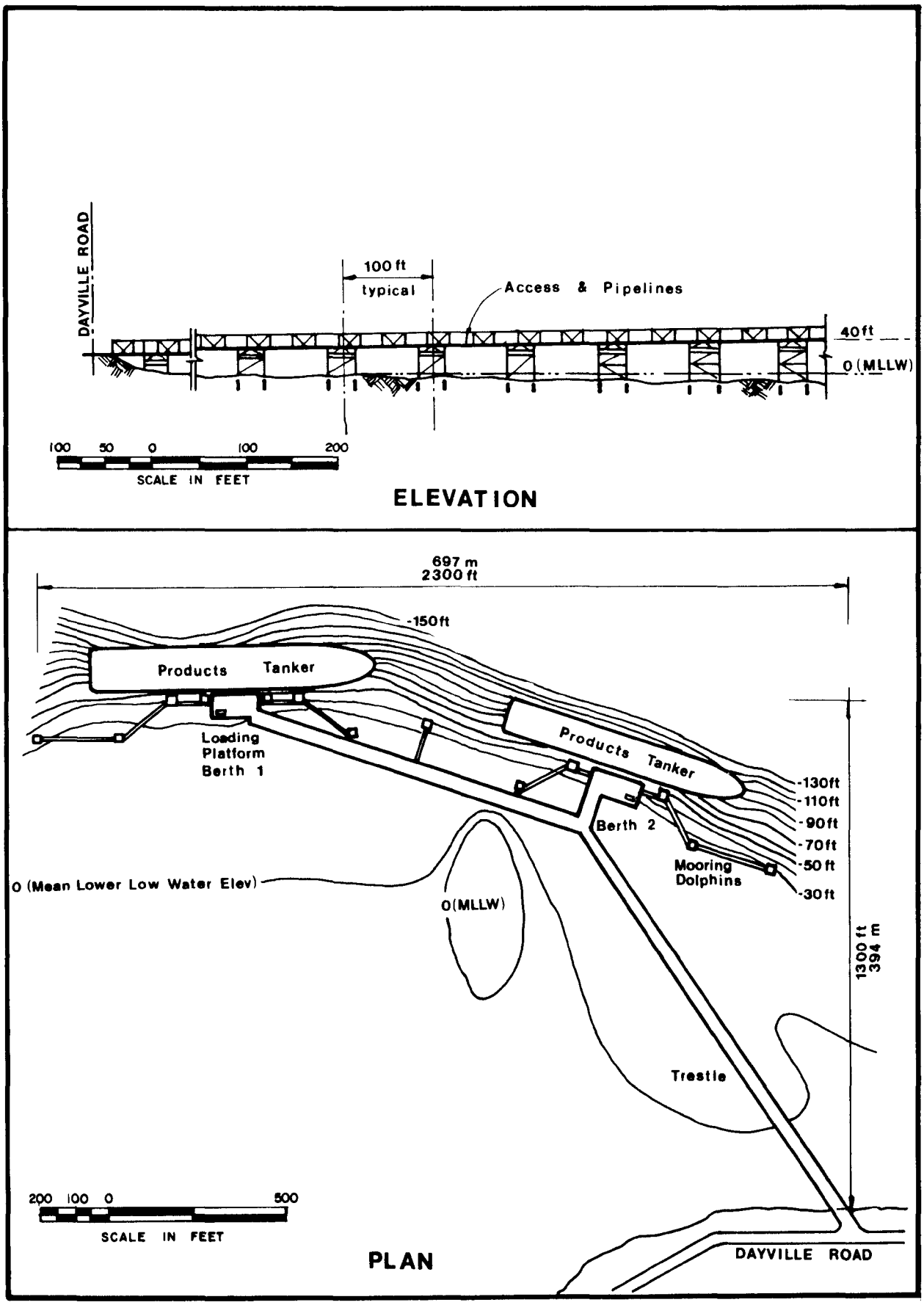
An adjacent area of about 40 hectares (100 acres) would be leased from the City of Valdez for use as a mobilization and staging area. The site was the Alyeska pipe storage yard during pipeline construction.

3.3.3 Products Dock

A two-berth dock to accommodate tankers for shipping refinery products would be located on a 91-hectare (225-acre) tidelands lease near Solomon Gulch on the south shore of Port Valdez. It would be visible as an elevated trestle structure with the most prominant feature being the loading arms and control towers at the berths (see Figure 3.3-3). The



VIEW OF THE PROPOSED REFINERY FROM THE RICHARDSON HIGHWAY **Figure 3.3-2**



PRODUCTS DOCK **Figure 3.3-3**

products dock would be visible from many vantage points in Valdez, including sections of the Richardson Highway and most of Dayville Road (see "Viewpoint" on Figure 3.2-2 and view on Figure 3.3-4).

3.3.4 Pipelines

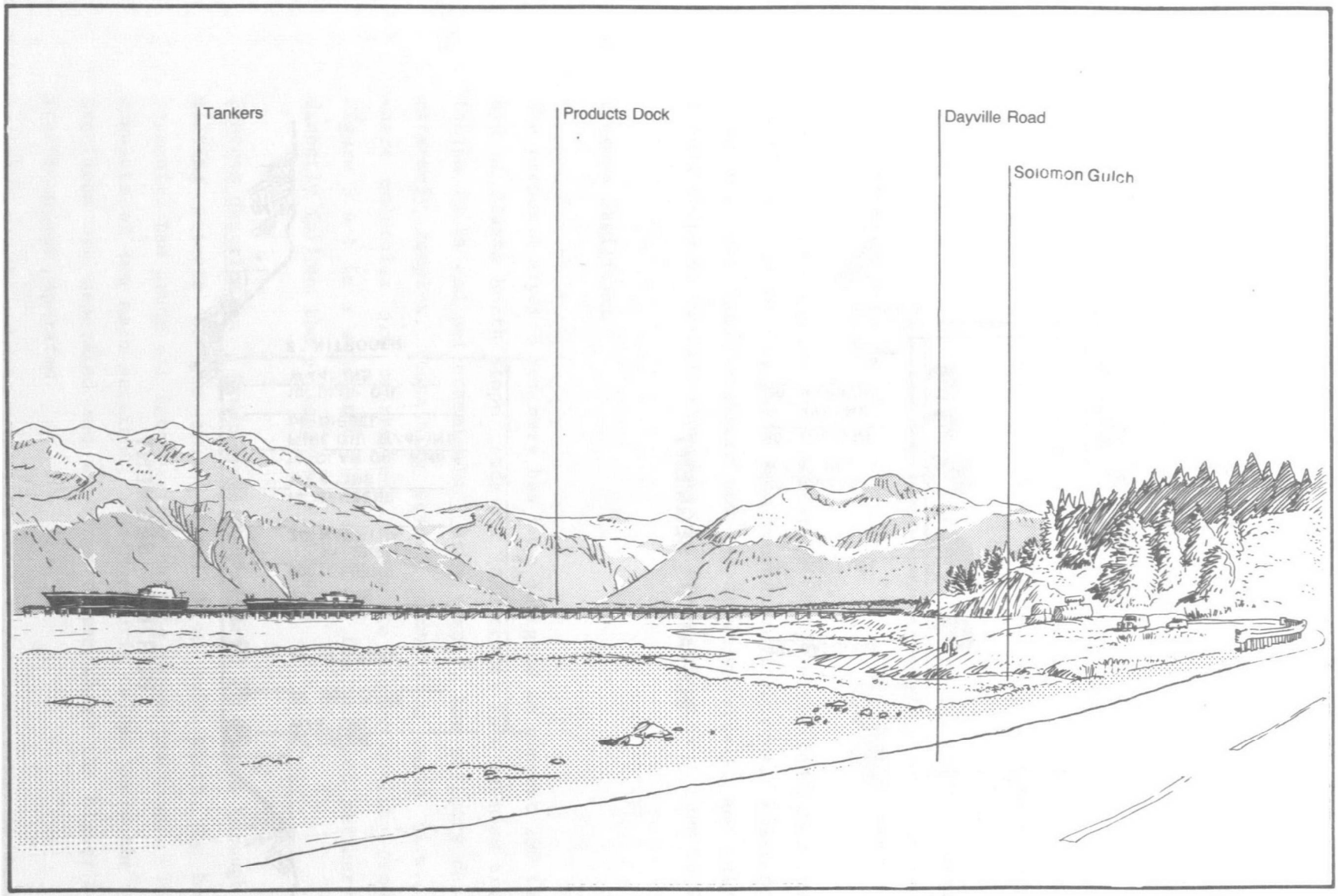
There would be 10 products pipelines and one crude supply line which would be constructed in a buried mode for about three-quarters of the overall length from the refinery site to the products dock. The final 2.1 km (1 1/3 mi) of the products lines, from the point of departure from the Dayville Road right-of-way to the dock, would be constructed above-ground on a two-level structure (see Figure 3.3-5). The elevated segment would not be visible from Dayville Road. The pipeline rights-of-way, to be acquired by lease from the State of Alaska, would be 91 m (300 ft) wide except for a 2.1 km (1 1/3 mi) stretch immediately west of the Lowe River Bridge which would use the southern 21 m (70 ft) of the Dayville Road right-of-way.

3.4 REFINERY PROCESSES

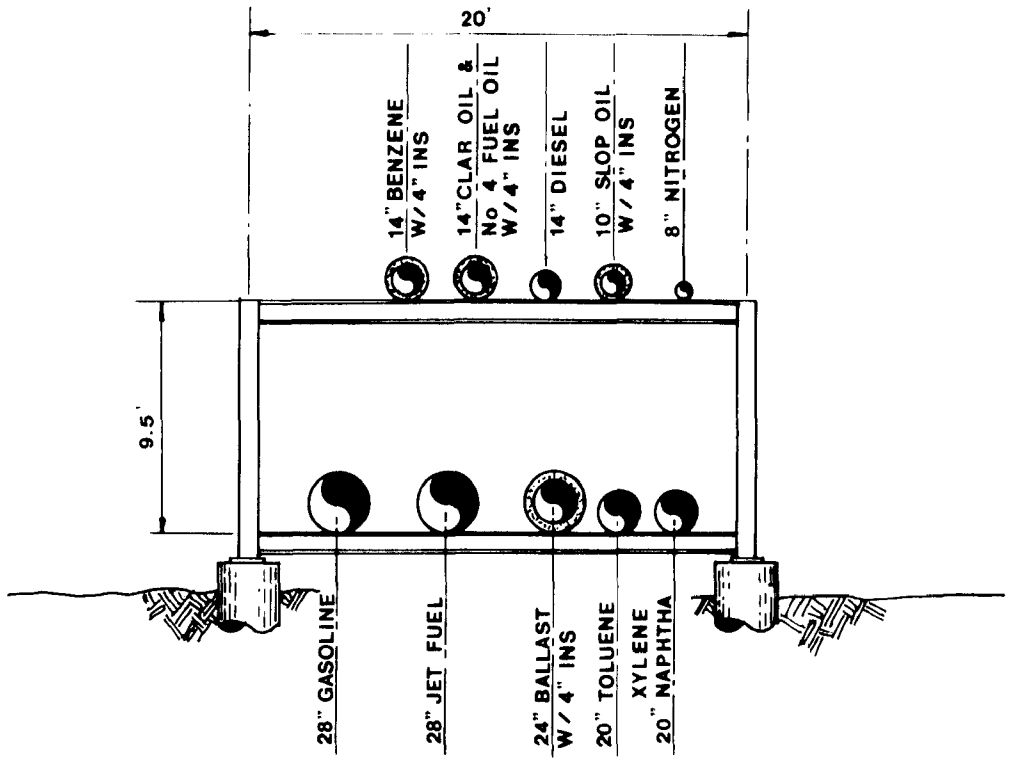
3.4.1 Feedstock and Process Raw Materials

Sources: The royalty oil contract would allow Alpetco to purchase 150 thousand bpd of the State of Alaska's North Slope royalty crude oil (26.7° API, 1.02 weight percent sulfur) which is to be supplied via the Trans-Alaska Pipeline System. Having secured this steady source of principal refinery feed, the facility can be self-sufficient in producing intermediate feed streams for all the units and other process raw materials with proper design. No significant outside sources in the southern Alaska area exist for such intermediate feedstocks.

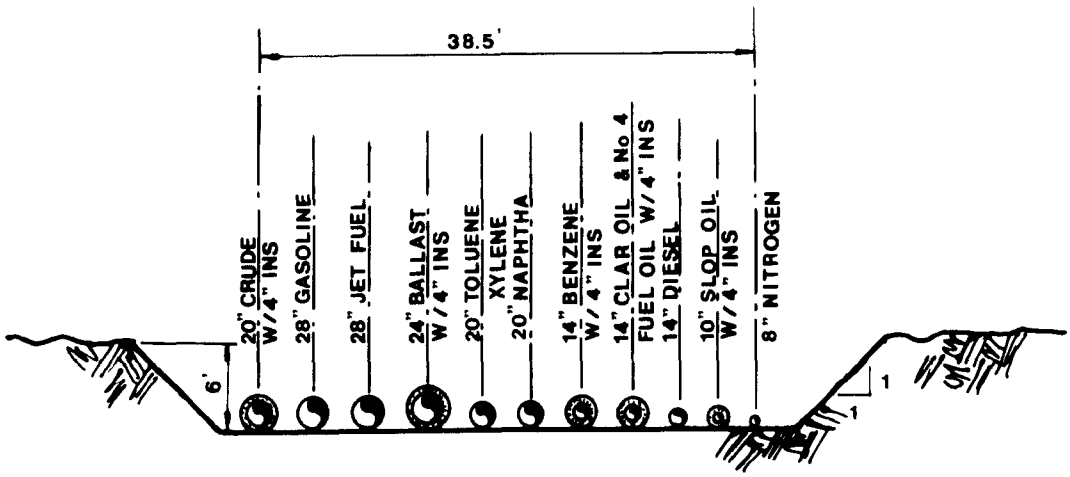
Other commodities required for operation of the facility include catalysts, gasoline additives, lubricating materials, soaps, and such items which can be obtained readily from many sources. Higher delivery costs are to be expected compared to locations in the contiguous U. S.



VIEW OF THE PROPOSED PRODUCTS DOCK (LOOKING EAST) **Figure 3.3-4**



ELEVATED SEGMENT



BURIED SEGMENT

TYPICAL PIPELINE CONFIGURATIONS **Figure 3.3-5**

Availability: Daily crude oil production from Alaska's Prudhoe Bay field was approximately 1.2 million barrels per day (MMBD) early in September 1979 and was to reach 1.5 MMBD by 1980. Proven reserves of the Prudhoe Bay field is 9.6 billion barrels as of year-end 1977. While lease activity has been dormant in recent years, the State of Alaska has announced plans for at least 15 lease sales in the next three years, including additional leases on the North Slope which could lead to increased availability of oil to the trans-Alaska pipeline.

Alpetco's 27-year contract assures the right to purchase a total of up to 150 thousand bpd from any state leases, should production from current Prudhoe Bay leases fall short.

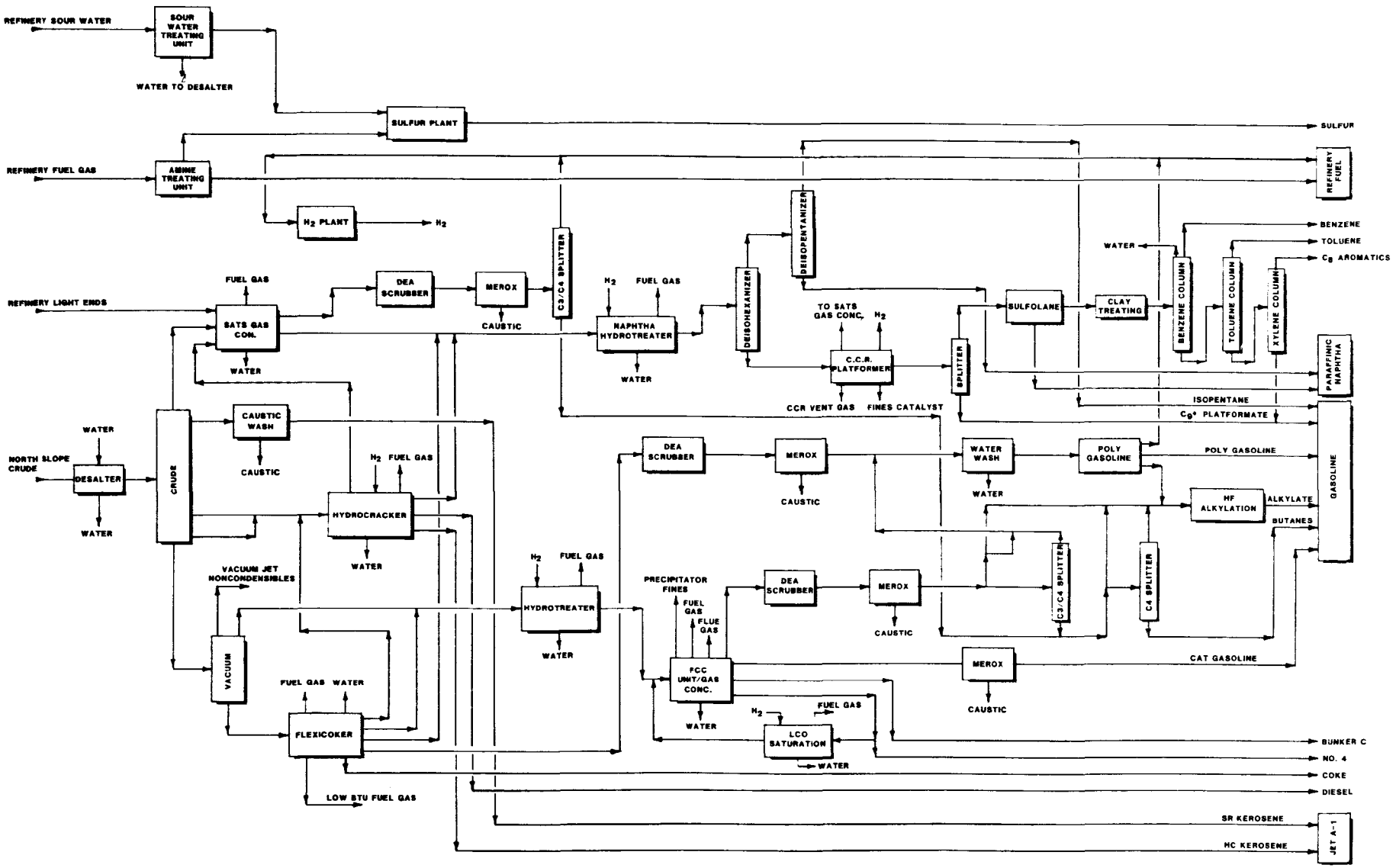
Miscellaneous supplies such as catalysts, gasoline additives and spare parts are readily obtainable from conventional sources. Existing Canadian and West Coast refiners now use these materials, and only additional shipping charges should be incurred to transport them to Valdez.

3.4.2 Process Facilities

The proposed Alpetco refinery has been designed to convert 150 thousand bpd of Alaska North Slope crude oil (ANS crude) into premium transportation fuels and petrochemicals. As a result, the refinery design is extremely complex, containing several conversion units (i.e., units where molecules are rearranged to produce higher quality products). Figure 3.4-1 is a schematic flow sheet of the proposed refinery which directly follows the process description.

Process description: Crude oil from tankage is pumped through a desalting process to the crude distillation unit which, by heating, separates the crude oil into various boiling range fractions. The unit consists of two main sections, an atmospheric column where the lighter fractions are separated and a vacuum column where the higher boiling fractions are separated.

Naphtha and lighter components are routed to a saturates gas concentra-



Source : Pace 1979

PROCESS FLOW DIAGRAM **Figure 3.4-1**

tion unit where the streams are separated into a fuel gas stream, C_3/C_4 stream (a mixture of propane, propylene, butane and butylene), and naphtha stream. Fuel gas is routed to an amine scrubbing unit (DEA scrubber) where hydrogen sulfide (H_2S) is removed before the fuel gas is burned as plant fuel. The C_3/C_4 stream is also denuded of hydrogen sulfide in an amine unit and then mercaptans are extracted in a Merox unit. The C_3 is then separated from the C_4 in a C_3/C_4 splitter and routed to the hydrogen plant as feedstock. The C_4 is routed to the hydrogen fluoride (HF) alkylation process or a C_4 splitter.

Naphtha from the gas concentration unit flows to the naphtha hydrotreater for removal of sulfur compounds and nitrogen. Nonreformable isohexane and lighter components are removed as overhead product in the deisohexanizer. Isopentane is then fractionated from this overhead for gasoline blending by use of a deisopentanizer. Deisopentanizer bottoms (low-octane components) are routed to paraffinic naphtha.

Deisohexanizer bottoms are routed to the continuous reformer where the octane of the stream is upgraded chiefly by conversion of naphthenes and paraffins to high-octane aromatic compounds. As the reaction proceeds, hydrogen is produced and used in hydroprocessing units. During the reforming process a portion of the feed is converted to butane and lighter components. These are removed in a debutanizer and routed to the gas plant.

The debutanizer bottoms (reformate) are routed to the reformate splitter. Here the xylene and lighter components are taken overhead and the components heavier than xylene are produced as a bottoms product and routed to gasoline blending. The splitter overhead stream is routed to the Sulfolane unit where the aromatic components (benzene, toluene and xylene) are separated from the non-aromatic components by use of a selective solvent. These non-aromatic components are routed to paraffinic naphtha. The aromatics are routed to a clay treater for removal of trace olefins and then separated into benzene, toluene, xylene, and gasoline streams by a series of three conventional fractionators.

Kerosene from the crude unit is caustic washed for mercaptan removal and then routed to jet fuel blending.

Diesel and heavy atmospheric gas oil from the crude unit are routed to the hydrocracker where it is cracked into light ends, naphtha and jet fuel in the presence of hydrogen. Light ends are routed to the gas concentration unit; purge hydrogen is routed to fuel gas; jet fuel is routed to blending; naphtha is routed to the naphtha hydrotreater.

Vacuum gas oil from the vacuum unit is routed to the fluid catalytic cracker feed hydrotreater. This unit removes sulfur and nitrogen compounds and upgrades the feed for improved gasoline production. There is a slight amount of light ends produced in the hydrotreating reaction which is routed to fuel gas. The hydrotreated gas oil then flows to the fluid catalytic cracking unit (FCCU). Here the gas oil is cracked to gasoline and lighter components in the presence of a circulating stream of catalyst. The net products from this unit are fuel gas, C_3/C_4, gasoline, light cycle oil and decanted oil. These products are separated at the unit by means of a main fractionator and gas concentration unit. Product dispositions are:

Material	Disposition
Fuel Gas	Plant Fuel (following amine treating)
C_3/C_4	C_3/C_4 Splitter
FCCU Gasoline	Gasoline Blending
Light Cycle Oil	No. 4 Fuel Oil
Decanted Oil	Bunker C

For maximizing gasoline yield there is a recycle of the cycle oil. Before being recycled to the reactor, the recycle is hydrotreated for gasoline yield improvement.

The C_3/C_4 stream is routed to an amine unit for removal of hydrogen sulfide and then to a Merox unit for mercaptan removal. The stream is then split into propane/propylene and butane/butylene streams.

The propane/propylene stream is routed to the polymer gasoline unit where propylene (and any contained butylene) is polymerized to gasoline in the presence of a solid phosphoric acid catalyst. This polymer gasoline subsequently is routed to gasoline blending. Unreacted propane is routed to storage for refinery fuel and unreacted butane is routed to gasoline.

The butane/butylene stream is routed to a splitter where isobutane and most of the butylenes are separated from normal butane. This stream then flows to the HF alkylation unit where isobutane reacts with butylenes in the presence of the hydrofluoric acid catalyst (and any contained propylenes) to produce high-octane alkylate for gasoline blending.

Bottoms material from the vacuum tower in the crude unit is routed to the Flexicoker. Here the material is converted into the following light clean fuels plus low-BTU gas by combined fluid coking and coke gasification processes:

Material	Disposition
Fuel Gas	Plant Fuel
C_3/C_4	Polymer Gasoline Unit
Naphtha	Naphtha Hydrotreater
Coker Distillate	Hydrocracker
Coker Gas Oil	FCCU Feed Hydrotreater
Low-BTU Gas	Plant Fuel

The unit has a fractionator and a gas concentration unit to separate the reactor effluent into these various products.

Coke from the fluid coking reactor is transported to the gasification section where steam and air are used to produce a low-BTU gas which comprises 35 percent of the plant fuel requirement.

Hydrogen sulfide-rich amine from several amine contactors is routed to a central regenerator where the hydrogen sulfide is stripped overhead

as acid gas. This acid gas then flows to a sulfur recovery unit where the H_2S is reacted with air to produce elemental sulfur. Tail gas from the sulfur plant is processed in a Beavon/Stretford unit which reduces the concentration of sulfur compounds in the effluent to less than 100 parts per million (ppm).

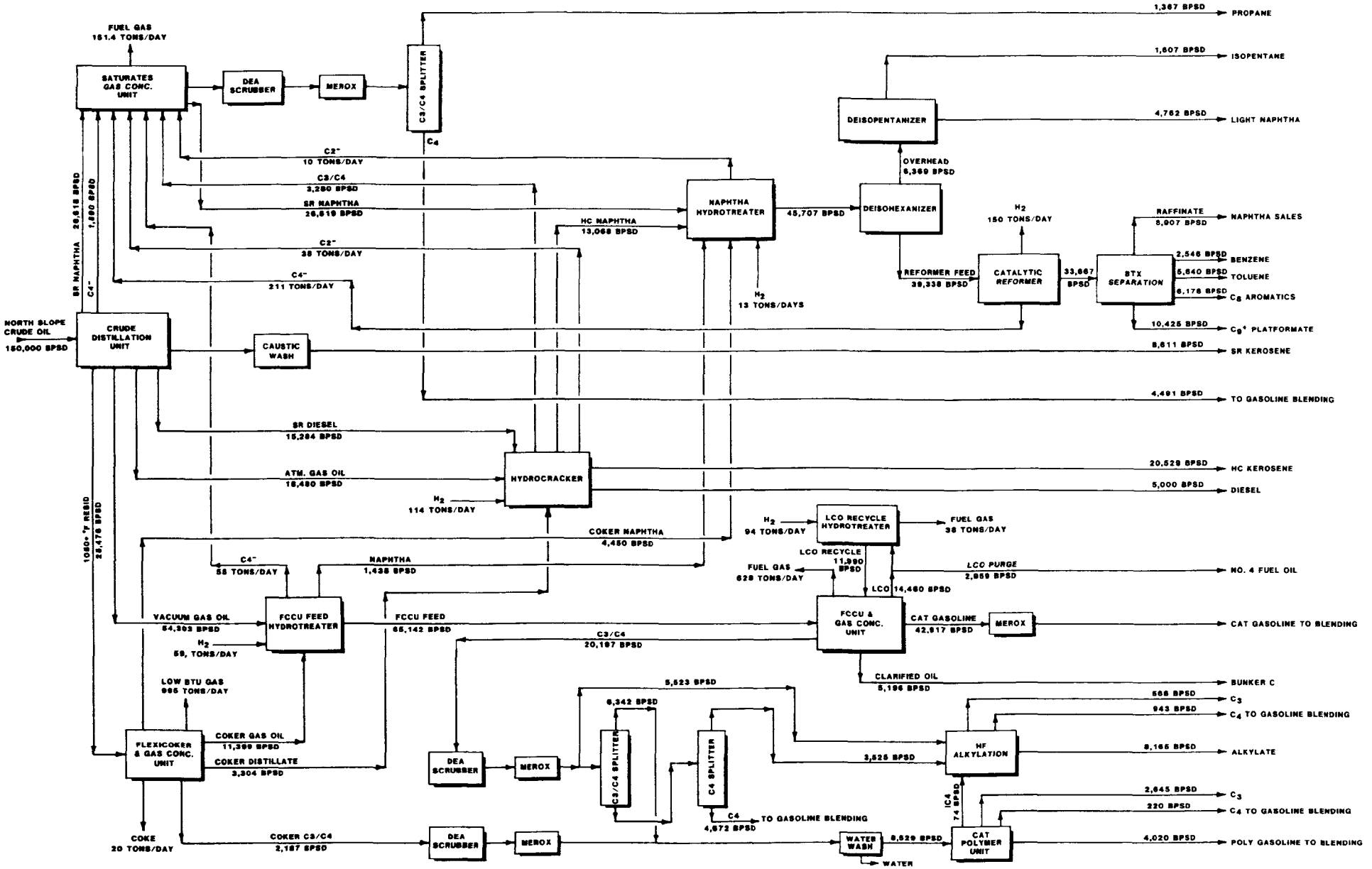
Process water streams bearing hydrogen sulfide and ammonia (NH_3)are sent to a sour water stripper where the NH_3 and H_2S are removed. This acid gas then is routed to the sulfur recovery unit.

To provide security and reliability for complete and continuous sulfur recovery, two sulfur plants, each having sufficient capacity to process all hydrogen sulfide gas, are provided in the facility design.

Material balances: A material balance is a weight accounting in which all the pounds per hour charged to the facility are shown to equal the total pounds per hour of all products and materials produced by the facility. The bases for the material balance are the linear programming (LP) results prepared by Alpetco's design consultant. These were checked independently, and the material balance was found to be reasonable and to reflect actual operations to a reasonable degree of accuracy.

The bases for checking the reasonability of the material balance are: yields of products from the crude unit were checked based on independent assays of ANS crude; the LP results were checked for internal consistency; process unit yields and utilities were checked with data for similar units and also with several computer process models; and the overall LP material balance was compared to the process design for each of the individual units.

The overall feed and product material balance is shown in Figure 3.4-2. Essentially, 150 thousand bpd of ANS crude is converted into sufficient fuels to operate the refinery, and into approximately 145 thousand bpd of fuels and petrochemical products. These figures are based on the daily receipt of Alpetco's entitlement to 150 thousand barrels; how-



Source: Pace 1979

MATERIAL BALANCE **Figure 3.4-2**

ever, because the facility would not refine crude oil 365 days per year, the process schematics reflect the number of barrels per stream day (160 bpsd), or per day of refining, which would be handled. Flow diagrams of acid gas, solid emissions and waste streams, and tables of waste streams and emissions and of caustic streams for disposal, are contained in the Appendix Vol. II.

Intermittent process operations: During certain intermittent refinery operations some processes produce emissions which are not produced during normal operations. These intermittent modes are: start-up; shutdown; in situ catalyst regeneration; furnace decoking; and equipment cleaning.

Start-up: In general, emissions during unit start-up are not significant. An exception is the sulfur recovery plant since some sulfur dioxide (SO_2) emissions are inevitable before bringing the unit to design conditions.

Shutdown: The shutdown of all units usually results in some amount of flaring during the depressuring and purging operations. As a result there can be minor amounts of sulfur dioxide and nitrous oxides (NO_x) emitted to the atmosphere.

In situ catalyst regeneration: Catalysts lose their activity due to the accumulation of coke and sulfur as a part of the normal operation of the unit. Some catalysts can be regenerated in place several times, while others must be replaced once the initial activity is lost. At the proposed facility, the only catalysts that could be regenerated in place would be hydrotreating and hydrocracking catalysts. On the average, these catalysts require regeneration at approximately six-month intervals. The following deposits on the catalyst are typical:

Deposit	Weight Percent on Catalyst
Sulfur	4 - 7
Carbon	5 - 25
Hydrogen	0.4 - 1.8

The catalyst is regenerated by burning the deposits from the catalyst, yielding sulfur oxides, carbon dioxide, and water. This burn is accomplished by circulating a stream of nitrogen with a small quantity of air injected to provide oxygen for the combustion. The products of combustion are vented to the atmosphere. Total sulfur emissions during a simple regeneration at the proposed facility would be about six tons (or about 2.7 percent of the total annual SO_2 emissions from the refinery). The overall regeneration procedure is completed in about four days.

Furnace decoking: As the crude oil flows through the process furnace and is heated, some small amount of coking occurs on the interior of the furnace tubes. These coke deposits gradually accumulate and retard heat transfer, resulting in excessive tube wall temperatures. It is necessary to remove this coke from the furnace tubes of both the atmospheric and vacuum heaters approximately every one to two years. This removal is effected by a procedure known as steam/air decoking.

Steam/air decoking refers to the cleaning of furnace tubes by the action of steam and air on the coke deposit. Coke is removed by three distinct processes: (1) Shrinking and cracking the coke loose by heating the tubes from the outside while steam flows through the tube; (2) The chemical reaction of hot coke and steam (coal gas reaction) producing carbon monoxide (CO), carbon dioxide (CO_2), and hydrogen (H_2); and (3) The chemical reaction of coke with oxygen in the air, producing CO and CO_2.

The steam/air/gas mixture would be vented to the atmosphere through a stack.

Equipment cleaning: Additional process wastewater can be produced as pieces of equipment are cleaned after unit shutdown. Instances of this are: caustic soda wash of hydrocracker and hydrotreater reactor sections; caustic soda wash of amine units for degreasing; and FCCU gasoline sweetener water wash.

This wastewater would be combined with the normal refinery wastewater streams and treated in the wastewater treatment facility.

3.4.3 Control of Waste Streams

Wastewater: The proposed refinery would produce several types of wastewater. The treatment requirements for each type or category of wastewater vary considerably. The basic treatment concept for refinery wastewater is to segregate various types of streams, provide the appropriate treatment for each, and then combine the treated streams into a single outfall. Wastewater from the Alpetco refinery would fall into one of these seven categories: clean storm runoff; contaminated storm runoff; non-organic waste streams; ballast water; high-oil waste streams; low-oil waste streams; and sanitary wastes.

The proposed outfall location would be immediately northwest of the mouth of Valdez Glacier Stream off the shore of old Valdez. The outfall, a 53 cm (21 in)-diameter pipe, would extend approximately 366 m (1,200 ft) offshore to a depth of 55 m (180 ft) (see Section 6.3.2 for diffuser description).

Clean, uncontaminated storm water would be routed directly to the outfall and would be monitored during storm conditions to ensure effluent quality.

Contaminated storm runoff would be collected in an impoundment basin to allow treatment at a controlled flow rate. The surge pond would be sized to collect runoff from a 10-year, 10-day storm. Water would be released from the system at a constant rate equivalent to one-tenth of the design volume per day. A skimmer would remove any floating oil. The skimmer would discharge to the API separator. This would allow for a greater pumping rate, and the oil concentration in the pond would be kept at a very low level.

Non-organic waste streams are created by regeneration of demineralizers, the hydrogen plant, and boiler water blowdown.

The wastewater from regenerating demineralizers would contain the same types of organic material found in the water supply. The pH of the stream would vary from highly acidic to highly basic depending on the phase of the regeneration cycle. The regenerant wastewater streams would be routed to an equalization tank where adequate retention time (24 hours) would allow for partial self-neutralization of the stream. Following equalization, the stream would enter a neutralization tank where pH would be controlled to a range of 6.5 to 8.5 before discharge.

Wastewater from the hydrogen plant would be essentially free of organic contamination. Therefore, this stream would be directed to the regenerant equalization tank rather than biological treatment. The buffering capacity of the stream also assists in neutralizing the acid streams.

The boiler blowdown would contain relatively high concentrations of dissolved solids, some suspended solids, biochemical oxygen demand (BOD), and phosphorus. Since the phosphorus is an essential nutrient for biological treatment, boiler blowdown would be mixed with deoiled process water and treated at the main treatment system.

The proposed ballast water system would provide treatment within the normally anticipated range of characteristics. Since ships discharge ballast at very high flow rates, the water would be pumped to a steam-traced receiving tank to allow for equalization and rapid oil-water separation.

Water in the receiving tank would be pumped at a constant rate to a corrugated plate interceptor (CPI). The plate separator operates on the principle of reducing the distance oil must travel before reaching the collecting surface. The oil particles coalesce on the underside of the plates and creep up to the surface of the water. The distance an oil drop travels before being trapped is only a few inches, versus a few feet in an alternate unit, the API separator. Alum and polymer then would be added to the CPI effluent to further coagulate oil and solids. These residual materials would be removed in a dissolved air flotation (DAF) unit.

The primary treatment methods are designed to remove free and emulsified oil plus suspended solids. The chemical oxygen demand (COD) and the BOD of the wastewater would be reduced by rotating biological contactors. Effluent suspended solids generated by biological treatment would be removed by a clarifier. Filtration of the effluent would ensure maximum effluent quality.

International agreements and Coast Guard regulations are leading to a future requirement that all ballast be clean and transported in segregated ballast tanks in the ships, making biotreatment unnecessary. Therefore, the two biotreatment systems (ballast and process wastewater) were segregated in the design of this facility so that ballast could be phased out without upsetting process wastewater treatment. Identical systems would be used for each principal wastewater stream so that treatment units could be switched to different service if required.

The proposed treatment system represents the best available demonstrated technology for ballast water. Table 3.4-1 provides a comparison of New Source Performance Standards (NSPS) and the anticipated quality of treated ballast water. After treatment, the water would be mixed with the inorganic wastewater in the equalization basin.

The basic treatment concept for oily waste streams consists of oil removal, biological oxidation, and suspended solids removal.

The sulfide caustic streams from the Merox units would be pretreated using air oxidation to convert sulfide to thiosulfates and sulfates.

The effluent from the oxidation tower would be combined for treatment with water from the desalter, the olefin poly plant, and oily water sewer. Since each of these streams would have the potential to contain very high oil concentrations, the API separator would be used to remove oil and to protect downstream operations.

Alum and polymers would be added to the combined API separator and

Table 3.4-1

COMPARISON OF NSPS AND BALLAST WATER
EFFLUENT QUALITY
(Excluding Process Wastewater)

Average Monthly Lbs./Day

Component	NSPS	Projected Effluent
Biochemical Oxygen Demand	630	375
Total Suspended Solids	509	375
Chemical Oxygen Demand	5,992	3,449
Oil & Grease	201	200

Flow (gpm) = 2,080

storm surge pond effluent. The floculated wastewater then would be treated further for oil removal in a DAF unit. The DAFs proposed for process water and ballast water are similar in design.

Wastewater from the sour water stripper, the sulfur plant tail gas cleanup, and pretreated HF alkylation wastes would have relatively low oil concentrations. These waste streams would be combined with deoiled process wastes and storm water for biological oxidation. The combined streams would be neutralized prior to bio-treatment to ensure maximum treatment efficiency. Nutrient in the form of phosphoric acid would be added as required.

Biological oxidation of soluble organic molecules in the deoiled wastewater would be achieved using a rotating biological contactor (RBC). A typical RBC unit consists of a series of thin, large diameter corrugated plastic discs mounted on a central steel shaft to form a unified treatment module. Microorganisms adhere to the disc surfaces, which are partially (approximately 40 percent) submerged in the wastewater, to be treated. As the discs rotate, the microorganisms alternately are exposed to the wastewater and to the air.

As the biomass metabolizes organics in the wastewater, the biological growth on the discs increases. Eventually rotational stress shears a portion of the biomass from the surface of the disc. Typical of fixed growth biological systems, the excess sludge sloughs from the discs in an agglomerated mass. In this condition the sludge is quite amenable to gravity clarification. A polishing filter would be used to ensure maximum effluent quality.

The system proposed would provide considerably better treatment than is required by the guidelines. Table 3.4-2 provides a comparison of the anticipated process water effluent quality and the NSPS. Figure 3.4-3 is a schematic flow diagram of the proposed wastewater treatment system.

All sanitary wastes would be collected and discharged by sanitary sewer

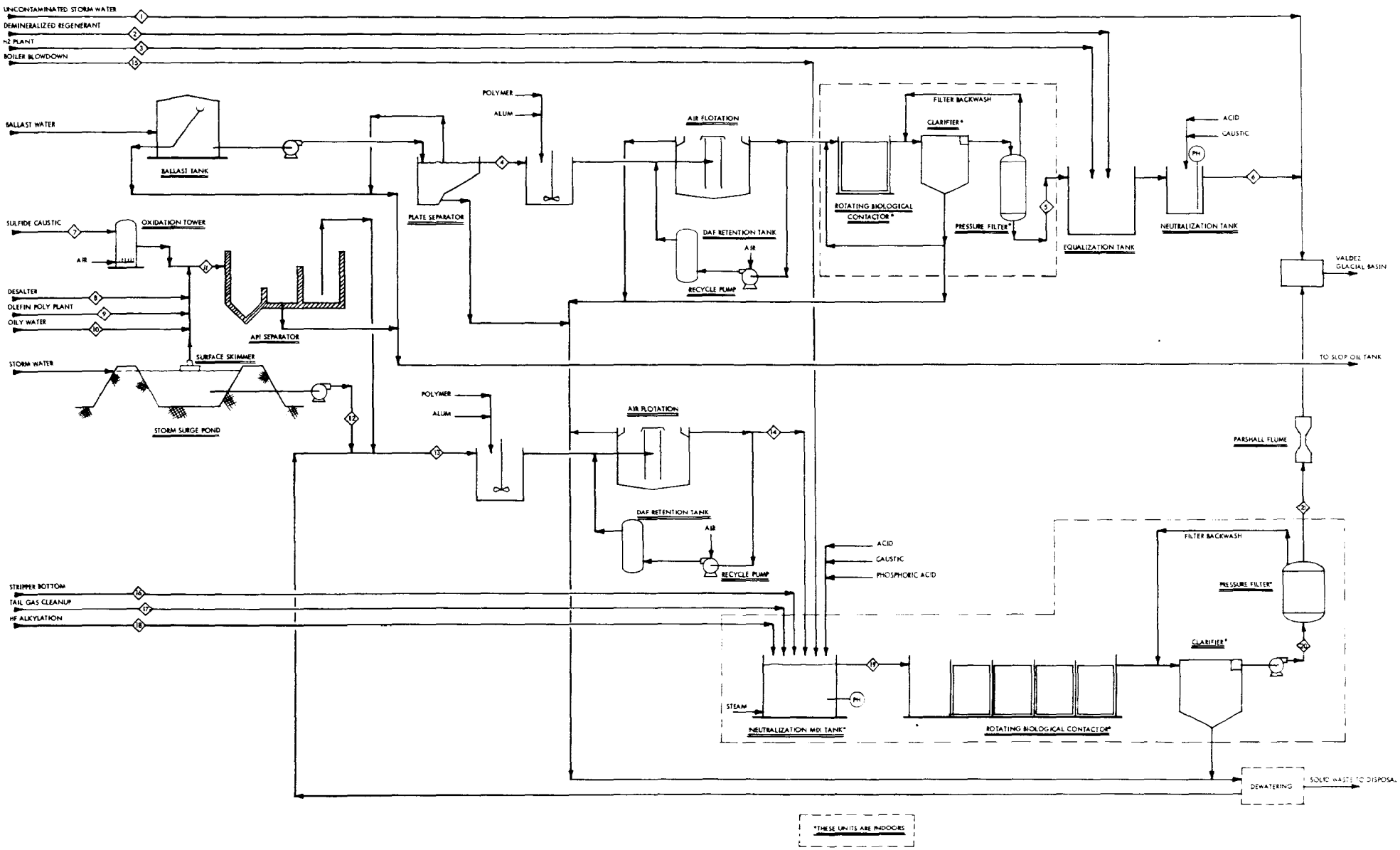
Table 3.4-2

COMPARISON OF NSPS AND WASTEWATER EFFLUENT QUALITY

(Excluding Ballast Water)

Average Monthly Lbs./Day

	Process Water		Process Water and Contaminated Storm Water	
	NSPS	Projected Effluent	NSPS	Projected Effluent
Biochemical Oxygen Demand	1,041	216	1,491	416
Total Suspended Solids	838	216	1,202	416
Chemical Oxygen Demand	6,096	1,655	10,317	3,187
Oil & Grease	330	115	452	222
Phenolics	6.9	2.44		
NH_3-N	965	129		
Sulfide	5.6	2.02		
Total Chromium	17.3	-		
Hexavalent Chromium	1.1	-		
pH	6-9	6.5-8.5		
Flow (gpm)	1,201	2,301		



Source: Pace 1979

WASTEWATER TREATMENT FLOW DIAGRAM

Figure 3.4-3

to the Valdez municipal treatment plant.

Atmospheric emissions: The sources of atmospheric emissions fall into three major categories: refinery (including processes, incinerator and tankage); power plant; and docks. The major generators of pollutant emissions are the process heaters and combustion systems. Other sources include ships under power at the loading berths, and fugitive emissions. Fugitive emissions are those vapors which are not confined to a specific vent or stack such as those emitted to the atmosphere from leaking tank seals, valve seals and similar related peripheral equipment. Emissions in tons per year anticipated from the proposed facility are summarized in Table 3.4-3.

Table 3.4-3

ESTIMATED AIR EMISSIONS
(Tons/Year)

Pollutant	Refinery	Plant	Docks	Total
Sulfur Dioxide	1,920	54	105	2,079
Total Suspended Particulates	461	144	14	619
Nitrogen Oxides	2,529	1,439	56	4,024
Hydrocarbons	38	22	6	66
Carbon Monoxide	215	122	3	340

Because an emission inventory alone provides no indication of severity or seriousness of effect upon ambient conditions for any of the pollutants inventoried, the relative magnitude of emission among the various pollutant classifications has little meaning. However, the inventory does provide an indication of relative source contribution of a given pollutant to the atmosphere. To illustrate the order of magnitude of a pollutant, a non-technical analogy is that the 619 tons/ year of suspended particulates is somewhat equivalent to the dust that would be produced by one vehicle traveling on a dry gravel road at 40 kph (25 mph), eight hours per day for one year. Since Valdez is an attainment

area for all pollutants governed by the Clean Air Act Amendments of 1977, air emissions control standards are governed by the definition of Best Available Control Technology (BACT). Section 4.3.3 describes the BACT for the proposed facility.

3.4.4 Solid Waste

The solid wastes the refinery would generate are divided into two categories: hazardous wastes and other solid wastes. A hazardous waste, as defined by the Resources Conservation and Recovery Act of 1976, is "a solid waste, or combination of solid wastes, which because of its properties may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." Other solid wastes include all other construction and refinery operation solid wastes, exclusive of sanitary waste.

Hazardous wastes as described in the proposed Federal Hazardous Waste regulations would be generated during operation of the proposed facility. These consist primarily of refinery process spent catalysts, clays, and sludges from the API (wastewater treatment) separator and the HF alkylation process unit. The catalysts, after having served their useful purpose, retain various degrees of toxicity. The clay, a synthetic material from the benzene, toluene, xylene clay treater, contains residual aromatics and a heavy polymer. The clay is toxic because of the difficulty of stripping all aromatics and polymers from the spent clay.

The sludges are normally a semi-solid by-product of a process that retain their toxicity due to unreacted chemicals. The hydrofluoric acid alkylation sludge is a cream-brown slurry of relatively insoluble calcium fluoride (CaF_2) produced by neutralizing with lime the spent hydrofluoric acid used in alkylation. Lime must be kept in excess and the contents mixed to assure complete reaction. Spent catalysts, occurring usually in a dry powdery state, would be generated at the rate of approximately 4,400 tons/year from the fluid catalytic cracker

(largest user) and around 400 tons/year from all other sources. This would be equivalent to about 12 thousand 50-gallon drums per year, or 35 drums per calendar day.

Construction activities would generate land clearing and excavation material, shipping material, construction materials, construction camp refuse and scrap metal. Very small quantities of replaced machinery oil and cleaning solvents also would be generated during construction. Refinery operations would produce other solid wastes such as solids from wastewater treatment, scrap metal, worn out machinery and refuse from offices and the cafeteria.

Approximate quantities of solid waste materials are summarized in Table 3.4-4.

Table 3.4-4

SOLID WASTE

Construction

Item	Source	Quantity
Land Clearing Debris	Site Preparation	250,000 cu yds
Scrap/Excess Construction and Shipping Materials	Construction Activities	1,500 tons
Domestic Refuse	Construction Camp	1,600 tons

Operation

Item	Source	Quantity
Spent Catalysts	Process Units	4,800 tons/yr
Sludges/Clays	Process Units/ Water Treatment	2,100 tons/yr
Scrap	Maintenance and Housekeeping	No Estimate
Refuse	Office and Cafeteria	500 tons/yr

3.5 OFF-SITE OPERATIONS

3.5.1 General Description

The proposed refinery would consist of the process area, which is the core of the plant, and various supporting facilities known in the refining industry as off-site operations. The primary off-site operations in the proposed refinery would be the product transportation and storage facilities (products dock, pipelines and tankage), the power plant and the wastewater treatment facility. Wastewater treatment is discussed separately under Section 3.4.3.

3.5.2 Product Storage

The tankage area described in Section 3.3.1 would have a total liquid storage capacity of 10 million barrels.

Liquid storage facilities can be divided conveniently into four primary service categories: feedstock, intermediate, gasoline blend, and product shipping. The feedstock tanks would provide a 10-day, 24-thousand-barrel stored reserve of crude oil to avoid shut-down of the refinery in the event of an interruption of the crude supply from the Alyeska pipeline.

Intermediate tankage holds materials that are feeds to process units or that are refinery products awaiting testing and transfer to larger product storage tanks. Most intermediate storage at the proposed refinery would be at atmospheric pressure; however, some tankage designed for liquefied gases would be pressurized from 15 to 200 pounds per square inch gauge (psig). Some intermediate tankage for heavy stocks would be insulated and kept hot.

Gasoline blend component storage tanks would hold the various process unit products that later would be mixed (blended) to make the various grades of finished gasoline. Both atmospheric and pressure storage would be involved.

Shipping tankage, as the name implies, would accumulate large volumes of the various products for loading aboard ships as they arrive at the dock. These tanks would experience infrequent but rapid withdrawals followed by less rapid refilling. The ballast water tanks and a slop oil tank also are included in this category because of their close association with ship-loading operations. Ballast tanks would accommodate surges in the line during deballasting and provide short-term storage if necessary before the ballast water is pumped to the wastewater treatment plant.

Tanks which would contain products which have a true vapor pressure at storage temperatures of less than 1.5 pounds per square inch absolute (psia) would be of the fixed roof design. Tanks which would contain heavy high boiling oils (residues and gas oils) would be ventilated. Such oils can be stored in this manner even at elevated temperatures without excessive hydrocarbon loss to the air. Tanks which would contain the higher vapor pressure materials would have a fixed roof with an internal floating roof to reduce hydrocarbon loss to the atmosphere. The products so stored would have a true vapor pressure at storage conditions of less than 11 psia. Pressurized storage does not pose an emission problem because any changes in vapor volume are compensated for by evaporation of or condensation to the liquid phase.

3.5.3 Pipeline System

Products would be transported from the refinery to the shipping dock via pipelines ranging in size from 8-inch diameter to 28-inch diameter. Ten adjacent pipelines would be used to transport all liquid products to the dock and to deliver ballast water from the ships to the refinery's wastewater treatment facility. Pipeline length from the refinery site to the dock would be approximately 8.5 km (5-1/3 mi). Approximately 2.1 km (1-1/3 mi) would be supported on above-ground structures and the remainder would be buried (see Figure 3.3-5).

Crude oil feedstock would flow under pressure directly from the Alyeska pipeline via a 20-inch diameter pipeline connection to an existing

valve. The 20-inch crude oil pipeline would join the products pipeline bundle at Dayville Road and would parallel the products pipelines to the refinery. Pipeline length from the crude source to the refinery site would be approximately 5.6 km (3-1/2 mi).

3.5.4 Products Dock

The two-berth products dock would extend about 394 m (1,300 ft) offshore near Solomon Gulch. The dock would accommodate tankers up to 45,000 dead weight tons (dwt) at one berth, and up to 80,000 dwt at the other berth. The average tanker that would call at the dock would be in the range of 36,000 dwt.

The dock would be an elevated steel structure on a driven pile foundation, and would be about 12.1 m (40 ft) wide. The products pipeline bundle would terminate at loading arms at the end of the dock. Ship loading rates would range from 120-475 barrels per minute.

3.5.5 Transportation

Land: The proposed project would generate both truck and passenger vehicle traffic. Truck traffic would be low because nearly all products from the refinery would be transported by pipeline to the products dock for shipment, and requirements for local supplies would be relatively small.

If by-product sulfur is stored at a location near the Valdez City Dock, an estimated 15-20 semi-trailer or flat-bed, five-axle truck loads of sulfur by-products and catalytic wastes would be carried each day between the plant and the dock area. Most non-process wastes would be incinerated on-site, and approximately 8-10 remaining truck loads per week including the ash would be hauled to a city landfill site (see Section 3.4.3).

The project would generate an estimated 1,250-1,300 vehicle trips per day, primarily employee traffic. Of these, approximately 20-30 trips

would be attributed to the products dock. The products dock would not generate general cargo traffic.

Air: Demand for air transportation would be related more to general community population increases (discussed in Section 6.10.7) than to the specific operational requirements of Alpetco. Air freight requirements would be minor.

Marine: A construction barge dock would be built at the far east end of Port Valdez at the former old Valdez city dock site. The site would allow direct access to an adjacent City of Valdez tract of land that Alpetco would lease for a mobilization yard, to offload heavy materials, equipment and prefabricated modules during refinery construction. Sheet piling would be driven along one side of an existing projection of land and fill would be placed behind it. Construction of the dock would require approximately 765 cubic meters (1,000 cubic yards) of dredging and 3,058 cubic meters (4,000 cubic yards) of fill. The dock would accommodate approximately 31 x 122 m (100 x 400 ft) barges. Upon completion of the project and expiration of the tidelands lease, ownership of the barge dock would revert to the City of Valdez. During two years of construction, large pressure vessels, equipment, and construction materials totaling approximately 750 thousand tons would be transported to Valdez by cargo vessels and barges and offloaded across this dock. General cargo would arriv at the Valdez City Dock.

During operation of the proposed refinery, petroleum products would be transported in tank vessels and barges from the products dock, primarily to the ports of Seattle, San Francisco, Los Angeles, and Honolulu. Certain products may also be barged to Anchorage and Kenai, Alaska. The possibility exists that naphtha, benzene, toluene, xylene and sulfur would be shipped to Japan and/or the Far East. Table 3.5-1 summarizes the estimated quantities of products which would be shipped. All vessel traffic into and out of Port Valdez would be tug-assisted and under the navigational control of the U. S. Coast Guard Vessel Traffic System (VTS) control center in Valdez.

Table 3.5-1

ESTIMATED QUANTITIES OF PRODUCTS FOR SHIPMENT

Product	Barrels per Calendar Day	Thousands Long Tons Per Annum
Motor Gasoline	75,090	3,208.6
Aviation Jet Fuel	29,139	1,286.7
Diesel Fuel	5,000	242.7
Residual Fuel (No. 4 grade)	2,959	153.5
Heavy Gas Oil (clarifier oil)	4,861	252.1
Naphtha (for ethylene production)	13,700	616.7
Benzene	2,546	127.7
Toluene	5,640	281.2
Xylenes	6,177	306.3
Total	145,112	6,553.6*
Sulfur	214 T/D	78.1
Fluid Coke	25 T/D	9.1

*Includes sulfur

Vessels would range in size from 10,000 dwt to 80,000 dwt. Based on an average vessel size of 36,000 dwt, 186 trips annually or about one vessel every two days would be required to transport refined products from Valdez.

Containerized or bulk dry sulfur in 1,000- to 10,000-ton lots would be shipped across the Valdez City Dock in ordinary cargo vessels. The total annual quantity of sulfur to be shipped (78,100 tons) would be equivalent to about 10 cargo vessels each year. The cargo vessels which would carry the sulfur probably would not be destined for the four U.S. West Coast ports which would be the destinations for products vessels.

During approximately nine months preceding the refinery start-up anticipated in 1983, approximately 2,000 tons of catalysts and chemicals would be transported to Valdez in cargo vessels. These materials would include: catalytic cracking catalysts; hydrocracking catalysts; desulfurization catalysts; reforming catalysts; activated clays; ethanolamines; caustic soda; and hydrofluoric acid. Following the commissioning of the refinery, replacement of catalysts and chemicals would be at a rate of 1,000 tons annually.

3.5.6 Power Generation

The refinery would have its own power plant located in the northwest corner of the site adjacent to the process area (see Figure 3.3-1). The power plant would produce about 70 MW of electricity with multiple, equally sized, gas turbine-driven generators plus one standby unit and space for a future unit of similar size. Refinery operation would require approximately 45 MW for the process units and 25 MW for offsite operations. Generation and distribution would be at 13.8 kV and 60 Hz. Primary fuel source for the power plant would be plant fuel gas (propane/butane) from the process units supplemented as required by low-BTU Flexicoker gas and refinery-produced fuel oil. The power plant would be situated near the process units.

3.6 LABOR FORCE

3.6.1 Construction Work Force

It is estimated that construction of the refinery would begin late in 1980 and continue into 1983, a total of more than 36 months. Peak construction labor force of 2,820 workers would occur in approximately October 1982. Monthly average work force would be approximately 1,128.

Peak manpower requirements by craft are estimated to be 800 pipefitters, 500 electricians, 400 ironworkers, 300 laborers, 200 each carpenters, equipment operators, and insulators, and 100 or fewer each boilermakers, cement finishers, millwrights, riggers, truck drivers, and painters.

3.6.2 Operations Work Force

Total permanent operations work force requirement is estimated to be 579. This includes 231 persons in plant process operations; 291 in maintenance; and 57 in administration.

3.7 PRODUCTS AND MARKETING

Alpetco's product slate from the process facilities described in Section 3.4 and shown in Table 3.7-1.

The total U. S. market for refined products is indicative of the situation on the West Coast. The Department of Energy (DOE) estimates that by 1980 it will be necessary for the U. S. to import 300 thousand barrels of gasoline per day. Approximately 220 thousand barrels per day were imported by the U. S. in 1977. Total U. S. gasoline demand is expected to increase at a 2.5-3.0 percent annual rate through 1982 or 1983 and increase at a lower rate or decline slightly thereafter. This suggests that there will be little need for additional gasoline capacity after 1983. However, there is a demonstrated need for additional

Table 3.7-1

PRODUCT SLATE

Fuel Products	Barrels Per Calendar Day
Premium Unleaded Gasoline	49,474
Regular Unleaded Gasoline	25,616
Jet Fuel	29,139
Diesel Fuel	5,000
No. 4 Fuel Oil	2,959
Chemical or Other Products	
Benzene	2,546
Toluene	5,640
Xylenes	6,177
Naptha (1)	13,700
Clarified Oil (Bunker C)	4,861
Sulfur	214 tons/calendar day
Fluid Coke	25 tons/calendar day

(1) Cracking feedstock for ethylene production

unleaded gasoline capacity as the proportion of total unleaded marketed will increase. This need is created by a shift in demand toward unleaded gasoline induced by EPA's lead phase-down requirements.

The demand for unleaded gasoline was 10 percent of the total gasoline demand in 1975, and is expected to be almost 80 percent of the total by 1985 as shown in Table 3.7-2.

Table 3.7-2

PROJECTED MARKET SHARES OF LEADED VS. UNLEADED GASOLINE
(Percentage)

	Unleaded	Leaded Regular	Leaded Premium
1977	25.3	59.4	15.4
1978	33.3	54.4	12.3
1979	41.2	49.1	9.7
1980	49.4	43.2	7.5
1981	56.9	37.4	5.6
1982	63.6	32.2	5.6
1983	69.2	27.7	3.1
1984	73.8	23.8	2.3
1985	77.5	20.8	1.7

Source: U. S. Department of Energy

Even though total U. S. gasoline demand is expected to level off after 1983, the demand for unleaded gasoline will continue to increase in the foreseeable future. This refinery would produce only unleaded gasoline.

It is generally believed that the West Coast gasoline market will follow the same general pattern as the U. S. market with certain significant differences: West Coast damand for gasoline and jet fuel is expected to grow faster than overall U. S. demand; it is less likely that additional refining capacity can be built on the West Coast than elsewhere due to stringent environmental regulations in PAD-V; and effective capacity of West Coast refineries is reduced by increased use

of heavy California and Alaska North Slope crude oils in response to economic and political pressures.

Table 3.7-3 summarizes the historical and projected demand for refined products in PAD-V, and Table 3.7-4 summaries PAD-V refining capacity.

The PAD-V refining industry is confronted with an environment characterized by rapidly increasing demand for unleaded, high octane gasoline; an increased proportion of heavy, high-sulfur crude oil being processed, causing a greater dependence of refinery economics on the vagaries of the West Coast residual fuels market; and environmental and economic restrictions on new refining capacity.

Section 4.3 of the Alaska Royalty Crude Oil Contract states:

> "In order to provide fuels for distribution within the State of Alaska, Buyer shall design and construct the Petrochemical Facility to include a capacity to process 30,000 barrels of crude oil per day into energy fuels. If Buyer does not utilize the royalty oil sold and delivered hereunder, or traded or exchanged oil, in the Petrochemical Facility, then it shall utilize its best efforts to assure that at least 30,000 barrels per day of said royalty oil will be processed instate for production into energy fuels for intrastate distribution and sale, unless such processing would be surplus to the then prevailing intrastate domestic and industrial needs."

In view of this commitment, the Alaska refined products market is considered separately.

Total 1976 demand for refined products in Alaska was about 63 thousand bpd, increasing to 68 thousand bpd in 1977, the first post-pipeline year. In Alaska's thin, undeveloped economy, a single major project, such as the trans-Alaska pipeline, can have a significant impact on in-state fuels consumption. Demand forecasting is therefore highly speculative.

Table 3.7-3

PAD V DEMAND

Thousand Barrels per Calendar Day

	1975	1976	1977	1978*	1980	1985	Growth Rate Percent (1978-1985)
Gasoline (total)	973	1022	1080	1113	1143	1083	0
Leaded	849	822	804	751	581	287	(12.8)
Unleaded	124	200	276	362	562	796	11.9
Jet Fuel	290	291	297	300	360	427	5.2
Distillate	264	280	298	337	415	434	3.7
Residual	398	452	566	550	633	689	3.3
Other	570	597	316	316	427	479	6.1
TOTAL	2125	2359	2600	2616	2987	3112	2.5

*Estimates based on 7 months actual
Source: Sherman H. Clark Associates
DOE Petroleum Statements
Industry Sources

Table 3.7-4

PAD V REFINING CAPACITY

as of January 1, 1978

Thousand Barrels per Calendar Day

	Capacity	Percent of Total	Number of Refiners
California	2,374	80.0	40
Washington	382	13.0	8
Hawaii	107	4.0	8
Alaska	96	3.0	5
Oregon	14	.5	1
Arizona	6	.2	1
Nevada	2	0	1
TOTAL	2,981	100.0	57

The Alaska refined products demand for 1977 was:

Table 3.7-5

REFINED PRODUCTS DEMAND IN ALASKA 1977

Product	Barrels per Day (bpd)
Gasoline	15,000
Jet Fuel	22,400
Diesel Fuel	17,000
Fuel Oil	13,600
TOTAL	68,000

Source: Alpetco/State of Alaska

This demand is generated 85 percent by the private and commercial sector and 15 percent by the government and military sectors.

Unless industrial development and associated migration into Alaska accelerate, total refined products demand is expected to stabilize at a 4 percent growth rate, all in the commercial sector. Demand for jet fuel and aviation gasoline is expected to increase more than 6 percent annually, and considering recent trends in the airline industry, this may be conservative. The growth for the remaining refined product markets is stimulated solely by a modest 3 percent population growth rate. Projected demand by type and use is presented in Table 3.7-6.

The existing Alaska refineries with a total capacity of 95,600 bpd* can supply the present local demand for fuel oil, all but high grade diesel, less than half the jet fuel and about half the gasoline.

* On October 30, 1979, Tesoro-Alaskan Petroleum Company announced plans to expand its Kenai refinery cracking capacity to increase jet fuel production by 4 thousand bpd and automobile gasoline production by 5 thousand bpd.

Table 3.7-6

DEMAND FORECAST FOR PETROLEUM PRODUCTS IN ALASKA
(bpd)

		1976 ACTUAL	1980 FORECAST	1985 FORECAST	1990 FORECAST	COMMENTS
COMMERCIAL DEMAND	Highway					Gasoline demand has declined since completion of the pipeline. Growth in per capita demand and conservation measures should be approximately offsetting. Therefore, it is assumed that increases in gasoline consumption will correspond to the population growth rate of 3%. Diesel fuel demand also declined significantly (22%) in 1977. Any major in-state construction projects will reverse this trend. Diesel fuel demand is assumed to grow at 5% annually.
	Gasoline	11,930	13,427	15,565	18,045	
	Diesel	9,111	11,074	14,134	18,039	
	Aviation					The historical pattern of aviation demand in Alaska has been erratic, subject to the decisions of a few international carriers. Demand should increase at least with population growth (3%), and given recent trends in the airline industry, a per capita growth in demand of 3% seems reasonable.
	Gasoline	899	1,139	1,530	2,056	
	Jet Fuel	15,105	19,134	25,715	34,559	
	Marine					ISER states that: "Marine diesel use has grown 4% annually since 1971...increased consumption...is closely related to the level of activity in the fisheries industry. With the institution of the 200 mile limit an avowed policy of assistance to renewable resources industries by the state government, demand for marine diesel fuel should continue to expand. 5% annual growth is assumed..."
	Gasoline/Diesel	2,009	2,441	3,117	3,977	
	Electricity					A modest 4% growth in demand for fuel oils to generate electricity is assumed.
	Diesel/Fuel Oil	5,336	6,242	7,594	9,240	

Table 3.7-6

DEMAND FORECAST FOR PETROLEUM PRODUCTS IN ALASKA
(bpd)
Continued

	1976 ACTUAL	1980 FORECAST	1985 FORECAST	1990 FORECAST	COMMENTS
Space Heating Fuel Oil	8,838	9,947	11,531	13,368	Fuel oil constitutes 56% of Alaska home heating fuel. The proportion is expected to stabilize. A 3% increase in demand is assumed for this sector.
TOTAL COMMERCIAL	53,228	63,404	79,186	99,284	The commercial sector demand for petroleum products is expected to grow at 4.55%.
TOTAL MILITARY	9,701	9,701	9,701	9,701	Given a relatively stable population of military personnel, fuel consumption is expected to remain constant.
GRAND TOTAL	62,932	73,105	88,887	108,985	Total in-state consumption of petroleum products is estimated to increase at 4% annually.

*Sources: Discussions with Division of Economic Enterprise and Institute of Social and Economic Research Economists (August, 1978)

Alpetco believes opportunities exist to market the following quantities of products in Alaska:

Product	Quantity bpd		
Unleaded Gasoline	7,000	to	8,000
Jet Fuel	10,000	to	12,000
High Grade Diesel	3,000	to	5,000
Low-Sulfur Fuel Oil	3,000	to	5,000

The following is a summary of Alpetco's current plans for product marketing:

Unleaded Gasoline - 75,000 bpd: Alpetco expects to sell all of the unleaded gasoline (except approximately 7,000 bpd reserved for the Alaska market) to major West Coast refiners, large independent refiners, and large gasoline distributors.

Jet Fuel - 29,140 bpd: No problem is anticipated securing contracts for the jet fuel. Alpetco's potential customers include a major oil company, a large independent, and several airlines which operate on the West Coast mainland, and in Alaska and/or Hawaii.

Diesel Fuel - 5,000 bpd and No. 4 Fuel Oil - 3,000 bpd: Since the Alaska market is expected to absorb these products, such sales would be made preferentially in Alaska.

Aromatics: Benzene - 2,550 bpd, Toluene - 5,640 bpd and Xylene - 6,180 bpd: Alpetco expects to sell these aromatics on a long-term contract to one or more Japanese trading companies.

Naphtha - 13,700 bpd: The logical market for naphtha is in Japan for use as ethylene plant feedstock; export of naphtha would require a permit from the Department of Commerce.

Sulfur - 214 tons/day: Sulfur most likely would be sold to a Japanese trading company for use in Southeast Asia; a small market exists in the

Pacific Northwest in the pulp and paper industry.

Fluid coke - 25 tons/day: This product would be sold to a Japanese trading company; the possibility of metals recovery from this product is also being considered by potential purchasers.

3.8 SPILL PREVENTION AND CONTROL

Prevention of spills of oil and related petroleum products is one of the prime objectives both in the design and the operation of the proposed facility and includes but would not be limited to: siting and design criteria for all facilities; operating procedures and their periodic review; inspection and monitoring of facilities; personnel training; revision of operating procedures (where required); and redesign of facilities (if necessary).

Among specific design parameters are: containment dikes around all tankage (feedstock and product); ability to treat contaminated storm water in the wastewater treatment facility; containment of storm water from the process area(s); leak-detection for the pipeline system; and appropriate use of valves to minimize potential spill volumes.

Prior to facility operation, Alpetco would develop an oil spill contingency plan that would address (at least) the following: facility testing (to include pipelines); operational procedures specific to operation of the products dock; detection and reporting of oil spillage; operational procedures to minimize spill volumes; operational procedures to contain and cleanup spills; rehabilitation and/or restoration of affected areas; notification procedures; operational procedures necessary to insure public safety; procedures for cooperation with local, state and federal authorities; procedures for cooperation with Alyeska Pipeline Service Company; training, emergency drills, and field exercises; chemical treatment; and liability and responsibility.

The oil spill contingency plan would be developed in at least three specific parts: general provisions, storage tanks and pipelines, and

products dock. All would be compatible with plans developed by the Alaska Department of Environmental Conservation (1978), Alyeska Pipeline Service Company (1978), and the Marine Safety Office of the U. S. Coast Guard (Valdez, 1979).

3.9 PLANT SECURITY

Alpetco would establish security groups, organized and staffed by specially selected people trained to respond to all levels of incidents ranging from minor to major events, natural or man-made.

The responsibilities of the security department would include fire prevention and detection; prevention of unauthorized entrance; protection of plant equipment, property, and employees' personal property; control of all in-coming and out-going traffic; response to emergencies; assisting plant visitors; assisting management as necessary; and assisting the City of Valdez when feasible.

Alpetco would develop a security manual which would assist personnel in the execution of their duties. The manual would include as a minimum the following sections:

1. Security department responsibilities: A description of security group organizational structure, authority and duties.

2. General directives: A list of standard orders for conduct and appearance.

3. Patrol procedures/equipment: A description of mobile patrols, vehicle equipment, equipment for security personnel, and duties of each patrol.

4. Emergency procedures: A detailed definition of situations which would require a Response Action (ReAct) by the security group. The ReAct procedures would be defined, within limits, for potential situations such as fire, injury/medical emergency, mechanical incident, and

power failure; natural disasters such as severe weather, and earthquakes; and bomb threats.

5. Civil disorders: A definition of civil disorders and appropriate ReAct procedures.

6. Emergency communication: A description of communications equipment, visual/audio alarms, and staff requirements; and call lists to plant personnel, mutual aid groups and proper local, state and federal agencies.

3.10 FIRE PROTECTION DESIGN

Because a limited number of refinery operations personnel would be present and available for fire-fighting purposes, and due to the physical size of the proposed facilities and the hazards involved, Alpetco's proposed primary fire protection design emphasizes automatic fire detection and protection systems, backed up by manual systems.

3.10.1 Scope

Alpetco would develop fire protection design criteria which consider the standards and recommended practices of the National Fire Protection Association (NFPA), Occupational Safety and Health Administration (OSHA) and the current requirements of the Alaska Safety Code and ordinances of the City of Valdez.

Alpetco's stated design philosophy is to provide systems and equipment to limit the loss of life and the extent of damage to property from the potential hazards involved with refinery facilities and their operations. The following specific measures are proposed by Alpetco.

Water would be used extensively for fire-fighting protection. A buried pipeline system would be installed to distribute water throughout the facilities to supply hydrants, monitors, water spray and sprinkler sys-

tems, and foam systems. The underground system would be designed in accordance with NFPA Standard No. 24.

Water spray primarily would provide exposure protection and fire control. The sprinkler and spray systems could be operated manually or would be actuated automatically by fire detection systems. Automatic sprinkler protection would be provided where necessary. Water spray and sprinkler systems would be designed in accordance with NFPA Standards No. 13 and 15.

Foam systems would be installed where flammable liquids are handled, transported or stored. Foam systems would conform with NFPA Standards No. 11 and 11A.

Dry chemical extinguishing systems would be provided in areas where rapid knock-down of fires involving flammable liquids could be required. Dry chemical systems would be designed in accordance with NFPA Standard No. 17.

In areas near extensive electronic or electrical equipment, halon extinguishing systems would be installed, designed in accordance with NFPA Standard No. 12A.

Fire trucks and other mobile equipment would be provided for backup of the fixed fire-fighting systems, and to transport manpower and special equipment to the scene of an emergency. Appropriate sizes and types of portable fire extinguishers would be situated throughout the facilities in accordance with NFPA Standard No. 10. Pipe racks and structures would be provided with fire-proofing as necessary.

An integrated alarm and detection system would activate appropriate fire-fighting systems and would signal alarms locally and at the central control building.

3.10.2 Fire Water Supply

Alpetco would determine the maximum probable fire-water demand based on providing water-based protection for the largest single fire risk area, and would install a system of appropriate capacity.

The proposed fire-water system would be charged under normal conditions with water supplied by an electrically driven, horizontal, centrifugal jockey pump. The primary firewater source would be the final effluent pond of the wastewater treatment system.

The fire-water system would be pressurized during use by one electric pump and several diesel-driven horizontal, centrifugal fire-water pumps. The fire-water pump controllers would automatically start the fire-water pump drivers in sequence as the demand for water increased. The number and size of the fire-water pumps would be based on providing the maximum probable fire-water demand, with one additional pump on standby reserve. This pump would be activated automatically if one of the primary pumps were out of service.

The underground fire-water distribution system would consist of a network of appropriately sized pipe, looped throughout the facility to provide water from more than one direction. Indicating post-type control valves would allow any section of a loop to be isolated for repair without impairing the remainder of the system. Pipe and fittings would conform to the guidelines of NFPA Standard No. 24.

Fire hydrants would be located to make each important building or structure accessible from at least two hydrants. The maximum space between hydrants around major facilities would be 121 m (400 ft). Water in the underground distribution system would be circulated through the fire-water pumps and heated at several points to prevent freezing of the system. A series of automatic valves would insure complete circulation, and during fire conditions would allow full flow to all areas.

3.10.3 Detection and Alarm Systems

Alpetco would install automatic alarm systems with detectors of combustible gas and flame; manual alarm stations; and television monitoring of selected areas. All detection systems would actuate a local alarm and transmit signals to the main alarm panel at the central control room. Alarm signals would be interconnected to a site-wide alarm system for immediate action by on-duty personnel. Signals to mutual assistance organizations and emergency units would be by telephone from the central control room.

Manual fire alarm stations throughout the facility would be connected to the central fire alarm panel for proper annunciation. They also would actuate certain extinguishing and fire control systems.

Detectors of combustible gas would provide continuous monitoring and would sound an alarm at two selected levels of gas concentration which are both below the lower flammable limit.

The fire detection system would include high-temperature, rate-of-rise and ultraviolet detectors. The system would be supervised and would have both actuation and reporting responsibilities. Upon receiving alarm signals at the central panel, actuation signals would be transmitted automatically to fire extinguishing and control systems. A delay before actuation of some systems would allow manual override. Other parts of the system would require confirmation by a second detector before automatic actuation.

The main alarm panel would be in the central control room for continuous monitoring. The panel would be a zone-type display and would annunciate, by audible and visual indication, the status of each detection system and the fire-water pumps, and the operation of each individual fixed fire control system. Trouble in the detection equipment would be indicated by visible and audible alarms. Emergency power would be provided for the alarm and detection systems. In addition, audible alarms to signal fire or a concentration of combustible vapors

would be distinctly different from any other audible signal.

3.10.4 Mutual Aid

Alpetco would pursue mutual aid programs with the City of Valdez Fire Department, City of Valdez Police Department, Alyeska Pipeline Service Company, Alaska State Troopers, U. S. Coast Guard, and Federal Aviation Administration.

3.11 HEALTH AND SAFETY

3.11.1 General

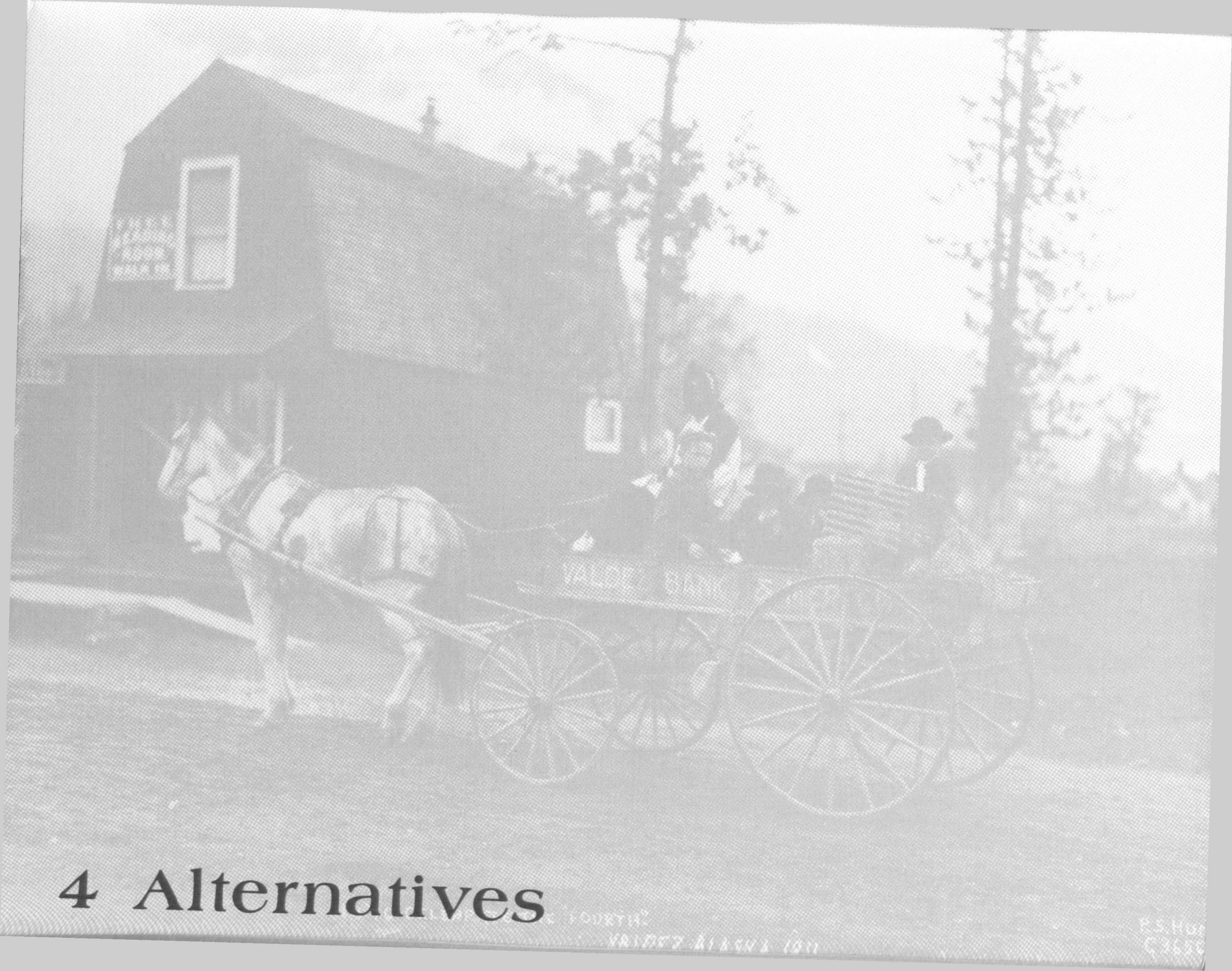
The following considerations have been and continue to be included in the design criteria: safety and health of employees during facility operation is a paramount design goal; reduction of the possibility of an undesirable occurrence is a design constraint; safe design will take precedence when a design choice exists; and compliance with all safety and health laws, statutes, ordinances and established industrial standards and practices will be required.

A comprehensive accident prevention and loss control program would be developed prior to refinery start-up. An annual formal review of the safety and health and loss prevention status of the Alpetco facilities would be conducted, and the safety engineer would, as indicated by the review, institute corrective actions to eliminate problem conditions found during the review or as a result of spot inspections.

3.11.2 Safety, Health and Loss Prevention Standards

Shift supervisors would be the key figures in the effective application and direction of safety at the proposed facility. Safety would be enhanced by eliminating known hazards, and by personnel training. All personnel would be responsible for preventing and eliminating unsafe conditions and practices and for reporting such conditions or practices to the appropriate authority.

The refining process and the equipment used within a refinery are increasingly complex, and while no single reference can address all questions, Alpetco proposes to develop a manual of safety standards and procedures. The procedures would be developed to conform with local, state and federal standards and regulations.



4 Alternatives

4. ALTERNATIVES

4.1 ALTERNATIVES TO REFINERY CONSTRUCTION IN ALASKA

Environmental Impact Statements prepared under Section 102 of the National Environmental Policy Act of 1969 must include a discussion of "alternatives to the proposed action," which is meant to include "the alternative ways of accomplishing the objectives of the proposed action and the results of not accomplishing the proposed action."

The following discussion considers the alternatives of: not authorizing the proposed project; imposing regulatory measures which would obviate the need for the project; and building a plant outside Alaska.

The general conclusions are that the facility would increase the supply of gasoline on the West Coast and generally help to reorganize the West Coast petroleum market, benefits which would be lost if permits were denied. Regulatory action by the federal government to increase the supply of gasoline or decrease demand for gasoline, and thereby obviate the need for the project, is not realistic because it is uncertain whether and when such regulatory action could be implemented; and location of the proposed refinery on the West Coast outside Alaska might involve net economic advantages over an Alaska site; however, the subject is moot because the royalty oil contract between the State of Alaska and Alpetco requires Aleptco to build the processing plant in the state.

4.1.1 No Project

Denial of necessary permits would prevent construction of the proposed refinery. Local impacts of plant construction and operation, including positive economic benefits to the state and local economies, are fully discussed in later portions of this statement. These impacts would not be realized if the necessary permits were denied. In addition to these considerations, denial of the project would have other, non-local consequences as well, because the proposed project would affect the general economic efficiency of the entire West Coast petroleum fuel market.

This section discusses the effects of the proposed project on the West Coast energy market in order to identify all consequences of the no-project alternative. The West Coast petroleum supply and demand situation is extremely complex, and a full explanation of every facet of it is well beyond the scope of this statement.

In general, the pertinent features of the West Coast petroleum market have been: shortages in the supply of gasoline, particularly unleaded gasoline; excess supplies of ANS crude oil*; a surplus of high sulfur residual fuel oil; and continued imports of Indonesian crude oil.

The West Coast petroleum market is characterized by a mismatch of refining capabilities and domestic crude oil properties. ANS crude is sour, which means it has a high sulfur content (approximately 1 percent by weight) and it is relatively heavy (gravity of 27° API), which means it has comparatively fewer easily extracted light fractions, which produce gasoline. California crude, the only other domestic crude produced in PAD-V, is even heavier and more sour. In contrast, Indonesian crudes are sweet (less than 0.1 percent sulfur by weight) and light (gravity of 35° API or higher).

Under conventional refining, a barrel of ANS crude yields less gasoline and more residual fuel oil than does most light crude; however, there is a relatively high demand for gasoline on the West Coast and relatively low demand for residual fuel oil. Furthermore, without expensive desulfurization, ANS crude produces a residual fuel oil that is too high in sulfur content (1.5 to 1.7 percent) to meet California air pollution regulations (fuel oil may not exceed 0.25 percent sulfur in southern California and 1.0 percent sulfur in northern California). Residual fuel oil produced from sweet, light crude such as Indonesian

* A recent report of the Senate Energy Committee found that, technically, there was little or no ANS crude surplus to West Coast refinery demands. Rather, it said, North Slope producers would not sell ANS crude to independent or competing refiners; instead they ship it through the Panama Canal to Gulf Coast refineries which they own.

is within these limits. Thus, refiners prefer sweet, light crude to better match their slate of products with current market demands.

Furthermore, West Coast refineries generally are not equipped to handle large volumes of high sulfur crude, because it requires more expensive and elaborate refining equipment. To refine sour crude, critical process units such as distillation towers and catalytic reactor vessels must be fabricated with special alloy steel to resist the corrosive effect of sulfur at high temperature and pressure. Also, in order to produce low sulfur fuel oil from sour crudes, a refinery must have a sulfur recovery system; and to obtain the maximum gasoline production from heavy crudes, a refinery must have downstream processing units such as catalytic crackers and cokers which break the heavy fractions into lighter products. Therefore, to handle larger proportions of heavy, sour crude in the existing mix of crude feedstocks, most West Coast refineries would have to undergo modification, referred to as "retrofitting" or making a "sour crude revamp."

Because Indonesian sweet crude yields a slate of products that is better suited to the local market than does ANS crude, imports have continued even though abundant ANS crude is available. Prudhoe Bay oil has displaced most sour crude imports on the West Coast since it entered the market in 1977. Nevertheless, approximately 500 thousand bpd of foreign oil, primarily Indonesian, continues to be imported to the West Coast (USDOI, 1979; USDOE, 1979).

ANS crude that is not refined on the West Coast is shipped via the Panama Canal to refineries on the Gulf Coast and in the Virgin Islands. North Slope production early in September 1979 was about 1.2 million barrels per day (MMBD), and producers expected to increase that rate to 1.5 MMBD by the end of 1979. About .84 MMBD of this oil is refined on the West Coast; therefore, approximately .36 MMBD or more are shipped through the canal.

The Jones Act requires that U.S.-built ships be used in trade between United States ports, so ANS crude must travel in comparatively costly

American tankers, and it must be off-loaded for trans-shipment through the Panama Canal because the very large crude carriers (VLCCs) that transport the oil from Valdez are too big to pass through the canal. As a result, the shipment of ANS crude from Valdez to Gulf ports makes it "by far the most expensive tanker transportation in the world" (Martingale, Inc., 1978). Transportation charges for ANS crude beyond West Coast ports are approximately $1.80 per barrel (Martingale, Inc., 1978). This cost is subtracted from the value of the oil at the well head, reducing producer profits and royalty income to the State of Alaska.

An objective of federal, State of California, and State of Alaska policies is to reorganize the West Coast petroleum market by increasing gasoline production, increasing refining capacity for sour crude and thereby increasing West Coast processing of ANS and California crudes, and reducing imports of foreign sweet oil.

West Coast refiners are proceeding slowly with expansions and modifications necessary to accomplish these objectives. There are several reasons for this slow response:

1. The spread between the cost of sweet imported crude and ANS crude is not great enough to justify major investments in sulfur recovery and cracking capacity, particularly where existing equipment is not fully depreciated; and even if the current price spread were attractive to some refiners, it is expected to shrink if a proposed west-to-east ANS crude oil pipeline were constructed (USDOE, March 1979; A. D. Little, Inc., 1978).

2. Other major investments already are required immediately by refiners to increase the octane rating of the gasoline without using lead, primarily through additions to catalytic reforming and isomerization capacity (Oil and Gas Journal, April 9, 1979, June 4, 1979).

3. Refiners are hesitant to invest in new refineries or major expansions of existing plants because the demand for gasoline is expected to

decline, or the rate of increase of demand to slow dramatically, in the 1980s (Wall Street Journal, October, 10, 1978; National Petroleum News, May 1979); and there is apprehension concerning the availability of cheaper foreign imports when U. S. price controls on domestic crude oil are phased out (Oil and Gas Journal, March 12, 1979).

4. The permitting process for construction of new refineries and for modifications to existing refineries, which involves local, regional, state and federal agencies, involves substantial expense, potential for protracted administrative proceedings and litigation, and a high risk of eventual denial.

The proposed Alpetco refinery has been designed to maximize the yield of light products from ANS crude, so it would help reorganize the West Coast petroleum market by increasing the supply of gasoline by approximately 75 thousand bpd (this would eliminate the need for gasoline imports into the region); by increasing by 150 thousand bpd, the volume of ANS crude which is refined on the West Coast; and by alleviating 150 thousand bpd freight charges through the Panama Canal (at $1.80 per barrel, this amounts to a total annual savings of $98.5 million to North Slope producers and the State of Alaska).

The Alpetco project would slow the rate of increase of sweet crudes to the West Coast.

While denial of permits would prevent construction of the Alpetco refinery, it also would result in loss of the foregoing benefits to the local economy and to the West Coast energy market.

4.1.2 Regulatory Measures that would Eliminate Need for the Project

Regulatory measures could be taken by the federal government which would reduce overall gasoline demand and/or increase fuel production from existing refineries, thereby partially obviating the need for the proposed project. Administrative agencies acting under existing statutory authority could implement some measures that would have marginal

impact on supply and demand. For example, EPA could delay its scheduled phase-down of lead additives in gasoline. However, major actions would require new congressional authorization. For example, congress could offer attractive financial incentives for installation of sulfur recovery equipment on existing refineries; accelerate new car mileage performance standards; or impose gasoline rationing.

While regulatory measures of this type are potentially effective means of manipulating both supply and demand of petroleum fuel, thereby alleviating need for the project, the possibility of any such measures being implemented is remote and speculative. Existing federal regulations affecting fuel consumption and production in the United States have long, complicated procedural histories. These regulations are key elements of federal energy policy, and changes in them could affect many public and private interest groups. Thus, the outcome and timing of an effort to change regulatory policy by congressional action would be so uncertain that this avenue is not a realistic and practical alternative to accomplishing the desirable policy objectives of the project.

4.1.3 Locate a Refinery on the West Coast Outside Alaska

A refinery located on the West Coast outside Alaska would make the same contribution to reorganizing the petroleum market as would an Alaska refinery. In addition, refinery construction and operation costs would be lower. However, location outside Alaska for this refinery is not a realistic alternative because the State of Alaska has made it an explicit condition of the sale of royalty oil that a refinery be constructed in the state of Alaska. Indeed, the main objective of the state of Alaska in taking its royalty "in kind" (oil) rather than "in value" (dollars) is to create economic development in the state through local refining and petrochemical manufacturing.

4.2 SITE ALTERNATIVES

Alpetco's site selection and evaluation process occurred in three

phases. The pre-contract analyses (preliminary phase) were made preparatory to the August 1977 preliminary proposal to purchase Alaska State royalty crude oil, and the subsequent final proposal the following October. Then, more detailed post-contract evaluations began in February 1978 and included both a screening phase and an evaluation-review phase.

Under terms of the State Contract, Alpetco is required to locate the petrochemical facility within Alaska, and further to notify the state of the final choice and show the reasoning behind the selection. The final location was subject to approval of the State Commissioner of Natural Resources, with a primary consideration being the desires of the people who live in the vicinity of the proposed site. In addition, site selection and certain other activities were assigned performance deadlines in the State Contract, and the post-contract analyses took place within that timetable.

4.2.1 Site Evaluation Criteria

In its Preliminary Proposal for the Purchase of Alaska State Royalty Crude Oil and the Construction of a Petrochemical Refinery Complex in Alaska (the Proposal), Alpetco noted the following considerations in the selection of any site: location near the crude supply, to minimize tankage and crude pipeline requirements; location near a deep-water harbor, to allow shorter and simplified product pipelines and reduce materials handling difficulties; availability of services, such as access roads to the site, temporary facilities for a construction staging area, permanent facilities such as housing, utilities, roads, waste disposal, and dock facilities to receive construction material; and manpower, in terms of availability of both local construction workers and permanent personnel, and availability of training or education programs.

Other considerations included evaluations of the current air quality and climatic conditions, and flora, fauna and terrain conditions, in order to establish the best system technology to minimize any adverse

effects; constraints on the methods of disposal for liquid, solid and gaseous streams; and noise control.

Site evaluation criteria also involved anticipating and resolving any construction problems which might arise related to soil conditions or mechanics, temperature, precipitation and other weather conditions, and access roads and transportation for heavy equipment.

4.2.2 Candidate Sites

Alpetco initially considered the following locations in three general areas to be potential sites. In the Prince William Sound area: Sheep Creek Camp (30.6 km [19 mi] east of downtown Valdez), Valdez Harbor (City of Valdez Property 5.6 km [3 1/2 mi] east of the Alyeska terminal), Point Gravina, and the vicinity of Parshas (north side of Point Gravina); In the Cook Inlet area: the vicinity of Nikishka, the west side of Cook Inlet, the Wildwood Military Reservation, and Cape Starichkof; and in Southeast Alaska: the vicinities of Ketchikan (Metlakatla) and Haines.

Selection process: From the beginning, sites in Interior and northern Alaska were eliminated from consideration due to the economics of moving crude to those areas, and the economics of moving the finished product to market. Therefore, on the basis of maps, aerial reconnaissance and on-the-ground inspections and analyses, the aforementioned 10 sites in Prince William Sound, Cook Inlet and Southeast Alaska were selected for study and comparison.

Alpetco's August 1977 preliminary Proposal stated an initial preference to locate the refinery in or near Valdez, in order to be near the crude supply and existing shipping facilities, and to avoid the cost of added tankage which would be necessary in order to receive the oil at Valdez, then ship it to a remote site.

However, subsequent, more detailed evaluations and comparisons of the 10 candidate sites indicated the Wildwood Military Reservation near

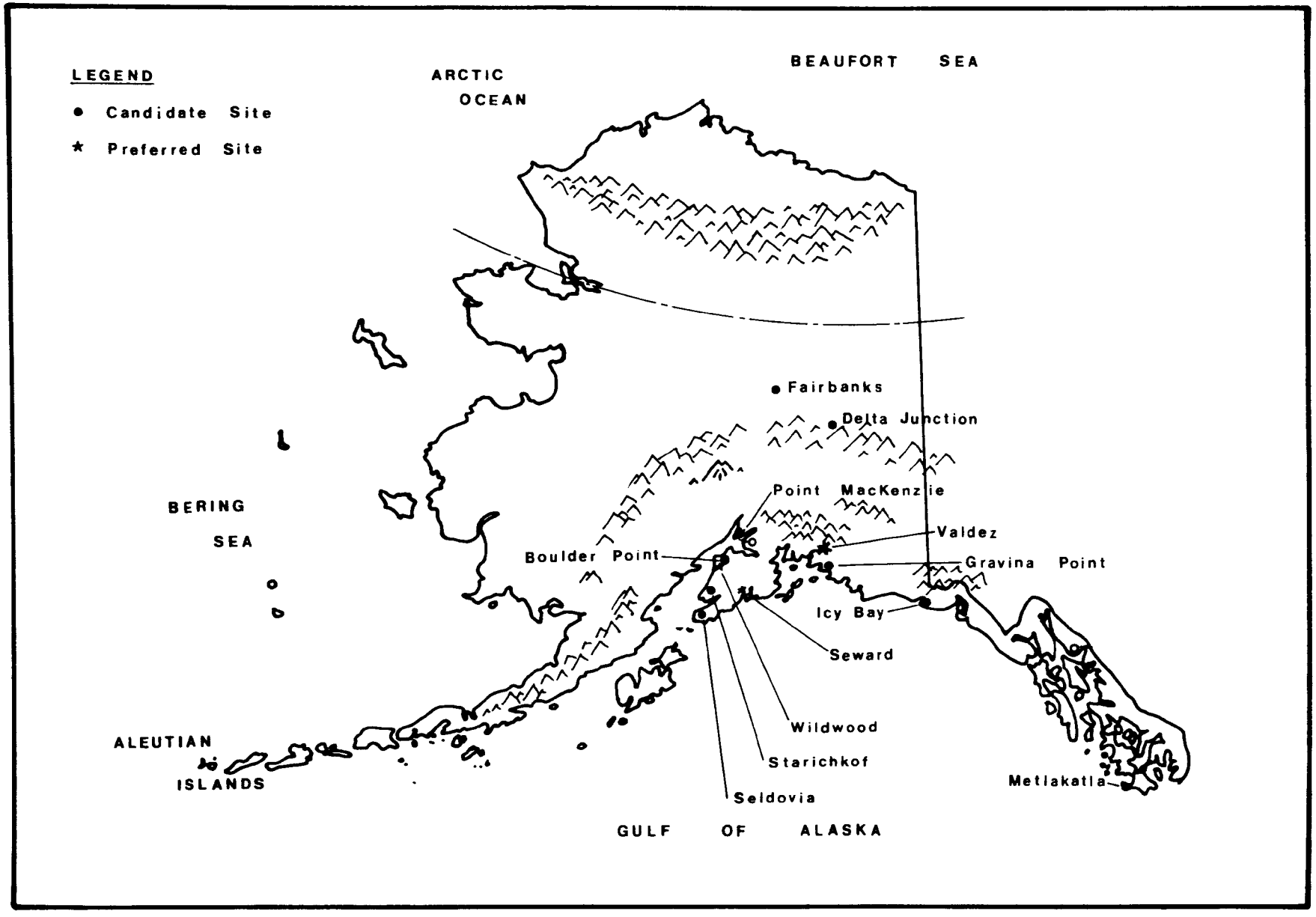
Kenai was the best choice. Alpetco's initial site selection report, and its final Proposal, summarized the advantages of the Wildwood site as follows: ample land is readily available; up to 40 percent of the land is desirable for plant construction with minimal clearing and stripping required; housing is available; an initial labor force probably is available; weather is relatively advantageous; potential for environmental problems is relatively low (no anadromous fish streams, or known air quality problems); and plant arrangement would not be inhibited by the shape of the property. Distance from the source of crude oil, and uncertainty regarding availability of adequate fresh water were the only disadvantages detected relative to the Wildwood site.

After February 1978, when the Contract was awarded to Alpetco, the second phase of site selection began.

To ensure that no potential site within the state was overlooked, newspaper advertisements were placed statewide to solicit suggestions. The advertisement requested suggestions of sites meeting the following criteria: minimum 607 hectares (1,500 acres) of contiguous land, roughly rectangular in shape, with minimal seismic risk, reasonable soil-bearing conditions, level terrain, free of permafrost, and well drained; adjacent to or near the state highway system; adjacent to or access to an ice-free port capable of handling 12 m (40-ft)-draft vessels; community infrastructure capable of accommodating a population increase of about 2,500; no major environmental problems; and community interest and support.

Alpetco received 12 responses to the advertisement: Valdez, Seward, Kenai-Wildwood, Kenai-Starichkof, Delta Junction, Gravina Point and Icy Bay area, Seldovia, Point MacKenzie and area, Fairbanks, Haines, Boulder Point, and Metlakatla (see Figure 4.2-1). Several of these responses suggested previously considered candidate sites.

Evaluation process: The 12 sites were evaluated equally with regard to the general criteria mentioned in the advertisement, and specifically



ALTERNATIVE SITES

Figure 4.2-1

with regard to the characteristics set out in Section 4.2.1 above. On the basis of these comparisons, four of the sites were selected for more intensive study.

The following sites were eliminated from further consideration for the primary reasons indicated: Kenai-Starichkof (lack of infrastructure, proximity to major recreational and commercial fishing areas); Delta Junction and Fairbanks (lack of port access); Gravina Point and Icy Bay area (lack of access and infrastructure); Seldovia (lack of access, unsuitable site topography, and proximity to major recreational and commercial fishing area); Haines and Metlakatla (excessive transportation distance from crude, land use conflicts with the Tongas National Forest, proximity to scenic Alaska State Ferry route, potential wilderness lands classification, and limited infrastructure); and Boulder Point (limited acreage, rough terrain, and lack of deep-water dock site).

4.2.3 Preferred Sites

Valdez, Seward, the Wildwood site near Kenai, and the Point MacKenzie area were deemed potentially suitable sites for the project, and were evaluated further. This evaluation by Alpetco was constrained by the State of Alaska's selection criteria which were primarily to insure that the facility is sited "(1) in a location where local residents support its construction and (2) in a location where there are no insolvable environmental problems that can be foreseen before specific study. The intent in the contract was to leave the commercial and economic aspects of site selection to the discretion of the buyer," as stated in a letter from Alaska Commissioner of Natural Resources Robert LeResche to Alpetco Environmental Programs Manager, Ronald Dagon dated August 24, 1978 (see Section 9.4).

Evaluation process: The final four candidate vicinities were visited by Alpetco's site selection team for a close examination of the characteristics set out in Section 4.2.1. These sites also were evaluated on the basis of broad-base estimates of costs of docks, pipelines, site

preparation, transportation, and any special problems anticipated.

At Valdez, a tract of land northwest of Robe Lake appeared favorable environmentally and enjoyed great community support. The Seward site was attractive due to the availability of deep water and the transportation infrastructure. The topography of the Wildwood and Nikishka areas near Kenai was favorable, and a local infrastructure also made the Kenai area attractive. In the Point MacKenzie area, topography of the available land was attractive for development, and in addition it was determined that soil conditions there are good and adequate groundwater is available.

Elimination criteria: The four sites were evaluated in detail and compared with one another in regard to the following aspects: Site conditions: availability of land, topography, soil conditions, and seismic risk; Marine Transportation: dock sites, hazards, and crude shipment; Land and Air Transportation: roads, air services, and railroad; Environmental: physical, biological, and socioeconomic; Support Facilities: infrastructure, port facilities, future development, and public acceptance; Economics: land acquisition, construction costs and operating costs (see Table 4.2-1). Also, it was estimated that shipping the crude by barge to any acceptable site other than Valdez would cost some $20 million per year; and while specific pipeline costs were difficult to estimate, experience indicates that the cost of a small diameter crude line would be difficult to offset (see Table 4.2-2).

Seward was eliminated primarily because of anticipated excessive site preparation costs resulting from a hilly terrain with significant elevation changes. In addition, the area might be subject to flooding, and has a potential for tsunamis, landslides, williwaws, heavy snow loads and possible air inversion conditions. Also, crude supply would have to be barged to the site. Point MacKenzie was eliminated from consideration because of a lack of infrastructure, and shallow water conditions which would make port development difficult, as well as its immediate proximity to the Anchorage-Mt. McKinley viewscope.

Table 4.2-1

NON-ECONOMIC SITE SELECTION

	PT. MC KENZIE	SEWARD	VALDEZ	WILDWOOD
A. COMMUNITY INFRASTRUCTURE				
1. Acceptance	2.5	2.5	2.5	2.5
2. General desirability of community	4	3	1.5	1.5
3. Ability of community to absorb labor force				
a. construction	4	3	1	2
b. permanent	4	3	1	2
4. Access				
a. road	4	1.5	3	1.5
b. air	4	3	1.5	1.5
c. rail	3	1	2	4
d. marine	4	2	1	3
5. Schools	4	3	1	2
6. Technical Training	4	2.5	2.5	1
7. Health & Safety	4	2.5	1.0	2.5
8. Public Finance	3	4	1	2
9. Aesthetics	2.5	4	2.5	1
10. Cost-of-Living Index	2	3.5	3.5	1
Totals	49	38.5	25.0	27.5
Relative Rank	4	3	1	2
B. SITE SPECIFIC				
1. Suitable Acreage	2.5	4	2.5	1
2. Climate	2	3.5	3.5	1
3. Geology				
a. foundation	4	3	1	2
b. erosion	2	3.5	3.5	1
c. special problems	4	3	2	1
4. Seismic Risk	2	4	3	1
5. Groundwater/Surface Water	3	2	1	4
6. Floodplain, Watershed, Wetlands	1	4	3	2
7. Air Quality	3	4	1.5	1.5
8. Environmental Concern(s)	3	4	2	1
9. Natural Resources Utilization (competition with)	3	4	2	1
10. Natural Hazards	2	4	3	1
11. Uniqueness of Fauna & Flora				
a. terrestrial	3	1.5	1.5	4
b. aquatic	3	4	2	1
c. marine	2	4	2	2
12. Rights-of-Way (environmental problems)	3.5	3.5	1	2
13. Marine Access (environmental problems)	4	2	1	3
14. Historic and/or Archeological Sites	4	2	2	2
15. Controversy (degree of)	4	3	2	1
Totals	54	67	39.5	32.5
Relative Rank	3	4	2	1
C. PERMITS (Degree of Difficulty)	3	4	1.5	1.5
Relative Rank	3	4	1.5	1.5

* Ranked in order of relative merit with 1 being highest and 4 being lowest (from Alpetco's perspective)

Table 4.2-2

SITE SELECTION PARAMETERS*

Summary Sheet

	WT	POINT MACKENZIE	SEWARD	VALDEZ	WILDWOOD
I. ECONOMIC					
A. Land Acquisition	10%	2 (0.20)	3 (0.30)	1 (0.10)	4 (0.40)
B. Construction Costs	20%	4 (0.80)	3 (0.60)	2 (0.40)	1 (0.20)
C. Operating Costs	50%	4 (2.00)	2 (1.00)	1 (0.50)	3 (1.50)
II. NON-ECONOMIC					
A. Community Infrastructure	3%	4 (0.12)	3 (0.09)	1 (0.03)	2 (0.06)
B. Site Specific	7%	4 (0.28)	3 (0.21)	2 (0.14)	1 (0.07)
C. Permits	8%	4 (0.32)	3 (0.24)	2 (0.16)	1 (0.08)
D. Intervenors	2%	4 (0.08)	3 (0.06)	2 (0.04)	1 (0.02)
RANKING	100%	4 (3.80)	3 (2.50)	1 (1.37)	2 (2.33)

* Ranked in order of relative merit with 1 being highest and 4 being lowest (from Alpetco's perspective)

The Kenai-Wildwood site and the Valdez site appeared equally favorable in most respects, even following site-specific soils investigations. The Wildwood site proved to have level terrain, good soil conditions and excellent accessibility and infrastructure. However, crude oil would have to be barged to the site; availability of an industrial water source was uncertain; and a location for a products dock was difficult to identify. At Valdez, development would require a flood control levee along the west side, moderate site preparation, and construction of an access road from the nearby Richardson Highway. However, other aspects appeared favorable. Economic considerations tipped the balance in favor of Valdez.

4.2.4 Final Site

The preferred site of Valdez meets the physical requirements for development and also is economically attractive. An important advantage of the Valdez site is its proximity to the crude supply at Alyeska's marine terminal. The location would allow crude oil to be moved to the plant by pipeline rather than by barge. The need to barge the crude to other potential sites would have meant increased marine traffic with increased potential for spills in waterways. Another economic advantage to the Valdez site is the ability and expressed willingness of the City of Valdez to finance some of the plant facilities by revenue bond financing. Community support for the plant was demonstrated at a public hearing conducted in January 1979 by the Alaska Commissioner of Natural Resources, and by letters of support to Alaska Petrochemical Company from Valdez city officials which indicate the community "currently has all the necessary utilities, schools and other community facilities necessary to accommodate the demands of a construction boom followed by additional permanent residents without the need for additional facilities or financial support" (see Section 9.4).

The Valdez location selected was a 567-hectare (1,400-acre) site lying east of Valdez Glacier Stream and north of the Richardson Highway in a nearly flat glacial outwash basin. This site best meets the siting criteria and is available through long-term lease from the City of

Valdez. Other Valdez locations had prohibitive air emission, wastewater discharge, access, space and economic constraints.

A final site analysis complete with financial considerations estimating costs of infrastructure, off-site, and marine facilities ($70-90 million; $195-205 million; and $80-90 million respectively) was submitted to the State of Alaska in November 1978, and the state's formal approval of the selected site of Valdez was contained in a letter dated March 5, 1979 from Commissioner of Natural Resources Robert LeResche to Alpetco President Gordon Cain. His letter of approval quotes the Department of Environmental Conservation as indicating, "...there were not insurmountable environmental problems evident from knowledge present at this time which would prevent location of the plant at Valdez," and quotes the Alaska Department of Fish and Game as approving the selection because "no additional tanker transport of crude oil would be required and navigation for tankers carrying products was relatively safe because of the sophisticated ship traffic control system in the area" (see Section 9.4).

4.3 PLANT DESIGN ALTERNATIVES

This section discusses the plant design alternatives which were considered during development of plans for the proposed refinery, including alternate process designs for the refinery itself; alternate sources of energy to fuel the refinery; alternate methods to achieve air quality standards compliance; alternate methods of disposal for solid waste and wastewater; alternate types of cooling systems for the refinery; alternate sites for the refinery products dock; and alternate transportation routes relative to the proposed site.

4.3.1 Alternate Process Design Considerations

In selecting the process design proposed for the plant, Alpetco conducted an extensive study involving the use of computer refinery modeling. This is a linear program with which all feasible technology can

be analyzed with respect to economics, technology, and environmental factors.

Selection of a process design was based on these criteria: The refinery must be a clean facility, in keeping with strict environmental standards; it must be self-contained with utilities such as electrical power; the technology which is employed must be well proven; it must minimize production of residual fuel oil; the facility must be fueled entirely with by-product gas; and the design must be compatible with the manufacture of petrochemicals.

This section discusses the major alternatives which Alpetco had available in designing the basic refinery flow scheme (see Figure 3.4-1) to optimum handling of naphtha, gas oils, FCCU cycle oil, and vacuum residuum (resid).

Naphtha processing: Alternate schemes for processing naphtha are determined by the need for high octane quality gasoline and aromatic production. The industry standard process is the catalytic reformer.

Gas oil processing: Gas oil can be processed for maximum production of gasoline, jet fuel or diesel. Alternate schemes of hydrotreating, hydrocracking, and catalytic cracking of atmospheric and vacuum gas oils result in varying yields of these products. The desire to minimize the production of heavy products establishes an optimum blend of these operations.

FCCU cycle stock: To keep the quantity of residual fuel produced by the plant at a minimum, the light cycle stock may be processed further. This is normally accomplished by either a hydrocracking operation or by hydrogenation to saturate polycyclic aromatics and then recycling back to FCCU feedstock. Recycle to the FCCU is usually favored because of capital, process stability, and operating costs.

Residual processing: The heaviest crude cut, the vacuum resid, contains the highest fraction of sulfur and metals. This stream must be

subjected to the most severe refining operations to minimize the quantity of heavy products. Several processes theoretically are feasible, but would not be practical for Alpetco's requirements. Residual catalytic cracking is not fully proven for such feedstock and would pose unacceptable process and environmental risks. Use or sale of resid for plant fuel wouldn't be practical economically or favorable environmentally. Deasphalting and partial oxidation would create severe disposal problems and would require a large investment. The only viable alternatives are delayed coking and flexicoking, both of which have certain advantages. The delayed coker has higher quality products while the Flexicoker produces a low-BTU, low sulfur fuel gas to supplement the plant fuel.

4.3.2 Alternate Energy Sources

This section defines the energy requirements of the proposed facility, and evaluates the feasibility of providing that energy using oil, coal, refinery by-product gas and low-BTU gas. The availability, cost and benefits of the various energy sources then are compared and refinery by-product gas is identified as the preferred major fuel source of the refinery's energy supply.

Energy requirements: The Alpetco refinery is designed to be totally self-sufficient with regard to electricity and fuel. Process electricity, steam and fuel would be supplied by burning the light noncondensable gases from various process units, low-BTU gas produced in the Flexicoker, and clarified oil from the catalytic cracking unit.

Table 4.3-1 presents the type and quantity of the fuel sources planned for use in the proposed refinery. Approximately 97 percent of the refinery fuel needs would be met by combustion of various refinery fuel gases, including Flexicoker low-BTU gas.

Table 4.3-1

ALPETCO REFINERY FUEL SOURCES

Description	Quantity MMBTU/D
Fuel Gas	48,372
Low-BTU Gas	20,496
Propane	10,115
Liquid Fuel	2,176
Total	81,159

The fuel requirements for individual refinery units are shown in Table 4.3-2 and are classified by service categories. These service categories are: Process heaters for high-temperature process reactions or reactions at high pressures and associated elevated temperatures; process heaters operating under conditions in which the process fluid is subject to thermal decomposition; process heaters used for general heating service in which little or no thermal decomposition occurs; and steam generation and electrical generation units.

Process heaters used for high temperature and high pressure operations generally require close control of maximum tube metal temperatures and heat flux. Process fluid subject to thermal decomposition requires that the process heater be designed for close temperature control, short response times and be capable of instantaneous shutdown under such conditions as flow stoppages or power failures. Process heaters for general heating service and steam generation and electrical generation units have less severe design requirements regarding process control, circulation control, temperature control and heat flux control than the aforementioned categories.

Fuel requirements during construction for equipment operation and electrical power generation are estimated to average 26 thousand gallons per day of diesel fuel and 2,500 gallons per day of gasoline.

Evaluation of alternate energy sources: Following is a comparison of

Table 4.3-2

INDIVIDUAL REFINERY UNIT FUEL REQUIREMENTS

Process Units	Fuel Requirements (MMBTU/D)	Service Category
Crude Unit	11,687	General Heater
Vacuum Unit	6,858	General Heater
Distillate Hydrocracker	5,094	High Pressure/ Temperature
Flexicoker	240	General Heater
Gas Oil Hydrotreater	2,691	High Pressure/ Temperature
HF Alkylation	1,367	General Heater
Catalytic Condensation	958	General Heater
Naphtha Hydrotreater	7,756	High Pressure/ Temperature
Platformer	11,284	High Pressure/ Temperature
BTX Sulfolane and Prefrc.	3,490	General Heater
Hydrogen Plant	6,313	High Pressure/ Temperature
Amine and Sulfur Plant	576	High Pressure/ Temperature
Power and Steam	22,831	Steam/Electricity

the availability, cost and benefits associated with use of oil, coal, refinery by-product gas and low-BTU gas to power the proposed facility.

Fuel oil: The Alpetco refinery's planned fuel system would use a very small amount of liquid fuel to supply refinery energy needs. Approximately 2.2 billion BTU per day or 335 bpd of No. 4 fuel oil would supplement the refinery fuel system. This represents 3 percent of the total refinery energy demand.

Combustion of liquid fuels in process heaters is an established practice. The design of heaters which burn oil is similar to gas-fired units, with the major difference being in the design of the burners.

Selection of the hydrotreated (desulfurized) cycle oil (No. 4 fuel oil) stream to help supply refinery energy needs was based on a trade-off between value of the stream and environmental (sulfur content less than 0.3 weight percent) considerations. The use of the stream would reduce the amount of marketable refinery products; however, this is considered the most logical supplemental fuel supply due to the small quantities involved and other considerations such as availability of supply, environmental desirability, and relative interchangeability with refinery fuel gas.

Estimated emissions in pounds per million BTUs resulting from burning the cycle oil stream are: particulates, 0.014; sulfur dioxide, 0.150; carbon monoxide, 0.036; nitrogen oxide, 0.16; and nonmethane hydrocarbon, 0.007.

Coal: Direct coal combustion for the proposed refinery was considered only in supplying energy for electrical power and for steam generation because the technology for combustion in process heaters has not been demonstrated. The preliminary design of a coal-fired steam and power system is based on a net process requirement of 270 thousand lb/hr of 150 and 50 psig steam and 51,671 kW of electrical demand.

Coal-fired boilers designed to produce 800 thousand lb/hr of steam,

including the 270 thousand lb/hr process requirement, coupled with a topping and a condensing turbine would be capable of providing the necessary power and steam requirements. Approximately 1,300 tons per day (TPD) of coal would be needed to fire the boilers.

The most attractive source for supplying coal to the proposed refinery would be the Usibelli mine near Healy, Alaska. Coal reserves at the mine are adequate to supply the refinery for a 30-year period. Coal could be shipped from the mine to Whittier via an existing railroad and then transported by barge to Valdez. This would require upgrading of the railroad to handle unit train traffic, and the construction of coal transfer and barge loading and unloading facilities. Delivered cost in 1979 dollars is estimated at $29.26 per ton or $1.78/MMBTU.

Technology for control of emissions resulting from the handling, burning and disposing of waste streams from coal-fired boilers is available for industrial applications. Table 4.3-3 presents an estimate of emissions which would result from burning coal at the proposed refinery and compares these emissions with those which would result from burning refinery fuel gas.

Table 4.3-3

ALPETCO EMISSION ESTIMATE COMPARISON
FUEL GAS/COAL STEAM AND POWER FACILITY
(Tons/Year)

	SO_2	NO_x	CO	HC	Particulate
Fuel Gas	165	929	98	17	58
Coal	123	1,967	231	69	117

Direct coal combustion is not considered feasible for the refinery for the following reasons: Emissions of nitrogen oxides, carbon monoxide, hydrocarbons and particulates from burning coal would be more than double the emissions from fuel gas; in order to supply the refinery with coal, the capacity of the Usibelli mine would have to be doubled

or a new mine would have to be opened in another area; the existing railroad would have to be upgraded to handle unit trains; coal receiving and handling facilities for barge transport would have to be installed; and the cost per BTU of burning coal would be considerably more than for by-product oil and gases (approximately 20 percent more plus additional related costs such as handling and storage).

Other factors preclude burning coal at the proposed plant. First, coal use at the refinery would require a large plant area to accommodate the required 45-day coal inventory storage pile, a reclaim system, and coal crushers, feeders, conveyors, silos, and bunkers. In addition to these systems, space also would be required for the particulate and sulfur removal systems. Storage of coal would generate fugitive TSP emissions, and combustion of coal would generate considerable quantities of solid and liquid waste (see Table 4.3-4).

Table 4.3-4

SOLID AND LIQUID WASTE
FROM COAL COMBUSTION
(Lb/Day)

Description	Quantity
Bottom Ash	38
Fly Ash	214,914
Scrubber Solids	552,340
Scrubber Liquids	451,915

By-product gas: Refinery by-product gas (including Flexicoker low-BTU gas) is the major fuel source planned for the proposed refinery and accounts for 97 percent of the total refinery energy supply. Table 4.3-1 lists the refinery fuel gas sources and their quantities. These gases are produced in the cracking, hydrotreating and Flexicoking operations. The preferred disposition of these gases is refinery fuel. There is no current market for LPG near the proposed refinery. The recovery, purification and separation of by-product gases into market-

able products would be difficult due to the fluctuations which would occur in composition and quantity of these gases.

Low-BTU gas: There are two ways in which low- and medium-BTU gas could be produced for use as fuel in the Alpetco refinery. The first method is gasification of coke produced in the Flexicoker unit and the second is by gasification of coal. The technology for combustion of low- or medium-BTU gas is commercially available no matter which method is used.

The gasification of coke to produce low-BTU gas is included in Alpetco's proposed base design and includes the necessary gas cleanup system to produce a clean, low-sulfur (less than 0.2 weight percent sulfur) fuel gas. This method of low-BTU gas production is attractive in that it takes a low quality refinery by-product (coke) and converts it into a clean refinery fuel.

Gasification of coal to produce low- or medium-BTU gas is technically feasible and could replace propane and cycle oil in the fuel system. However, this alternative fuel source is faced with the same problems as direct combustion of coal (see coal discussion above) related to source availability, transportation, cost, and environmental emissions.

With coke valued at $20/ton, low-BTU gas can be produced at a cost of about $1.50 per million BTU. The capital required is $28 million. Coal gasification requires a comparable capital outlay of $34 million. With a delivered coal cost of $29.26/ton, low-BTU gas production cost would be about $3.50 per million BTU. The economic advantage of the coke gasification is created by its association with a coking operation and the input of energy required to support that operation. Heat input to the coking operation is by direct contact of hot low-BTU gas with recycle coke. The resulting hot recycle coke is fed back to the coking reactor. The sensible heat is recovered from the low-BTU gas.

Preferred energy source: Refinery by-product gas (including Flexicoker low-BTU gas) is the major fuel source planned for the proposed Alpetco

refinery. Combustion technology for burning refinery by-product gases is highly developed so that design of process heaters to handle these gases would not present a problem. In addition, the available process technology can control potential pollutants, such that emissions meet applicable air quality standards.

4.3.3 Air Quality Standards Compliance

Four sets of national air quality standards could or do apply to the proposed Alpetco refinery: National Emission Standards of Hazardous Air Pollutants (NESHAPS), New Source Performance Standards (NSPS), National Ambient Air Quality Standards (NAAQS), and Best Available Control Technology (BACT). The Alpetco refinery would not produce materials currently regulated by NESHAPS. However, in the near future benzene probably will be regulated by NESHAPS, and possibly toluene and xylene will as well.

New Source Performance Standards: The three sections of NSPS which apply to the proposed refinery are 40 CFR 60 Subparts D, J, and K. Subpart D controls emissions from steam generators greater than 250 million BTUs per hour of heat input. Subpart J includes the control required for petroleum refineries and Subpart K addresses the NSPS for petroleum storage vessels.

Boilers are controlled under Subpart D of NSPS, which requires emission levels of less than 0.8 pounds of sulfur dioxide per million BTUs for oil fired boilers; and 0.2 pounds of nitrogen oxides per million BTUs and 0.3 pounds of nitrogen oxides per million BTUs for gas- and oil-fired boilers respectively. Alpetco would meet these requirements by burning low sulfur fuels. In addition, the boilers would be fitted with low nitrogen oxides burners reducing the emissions to well below the NSPS.

Within a refinery are three major areas of control under NSPS Subpart J. Particulates emissions from the FCCU are not to exceed 1.0 pound per thousand pounds of coke burned in the regenerator. Carbon monoxide

emissions from the FCCU regenerator gases are not to exceed 0.050 percent carbon monoxide on a dry weight basis. The sulfur dioxide released from burning refinery fuel gas is controlled by limiting the hydrogen sulfide content of the refinery fuel gas to 0.1 grains per dry standard cubic foot. The Alpetco refinery would meet the NSPS for refineries by using an electrostatic precipitator to control particulate matter from the FCCU; by using high temperature regeneration to control carbon monoxide; and by amine stripping the fuel gas.

Subpart K requires hydrocarbon storage vessels containing materials with high vapor pressures to be equipped with vapor recovery systems. Those storage vessels containing materials which have intermediate vapor pressures are to be equipped with floating roofs. Alpetco would store high vapor pressure hydrocarbons in pressure vessels and intermediate vapor pressure hydrocarbons in cone roof tanks with internal floating roofs.

In addition to these two subparts, EPA has proposed NSPS for gas turbines. Alpetco would comply with the NSPS when it is finalized.

National Ambient Air Quality Standards: The NAAQS are standards which establish baselines above which pollution levels are hazardous to public health (primary standards) or public welfare (secondary standards). EPA has established NAAQS for sulfur oxides, particulate matter, carbon monoxide, photochemical oxidants/hydrocarbons, nitrogen oxides, and lead. These NAAQS are shown in Table 4.3-5.

Valdez is considered an attainment area for all pollutants. An attainment area is an area which does not violate the NAAQS. Monitoring has confirmed this at Valdez. In addition, no industrial growth has occurred since 1975 which would consume allowable sulfur dioxide or particulate increments.

Best Available Control Technology: Since Valdez is an attainment area for all pollutants governed by the Clean Air Act Amendments of 1977, control standards are governed by the definition of Best Available Con-

Table 4.3-5

NATIONAL AMBIENT AIR QUALITY STANDARDS

($\mu g/m^3$)

Pollutant	PRIMARY STANDARD		SECONDARY STANDARD	
	Annual Mean	Maximum Concentration (Allowed Once Yearly)	Annual Mean	Maximum Concentration (Allowed Once Yearly)
Sulfur Oxides (SO_x) (measured as SO_2)*	80	365 (over 24 hours)		1300 (over 3 hours)
Particulates	75	260 (over 24 hours)	60	150 (over 24 hours)
Carbon Monoxide (CO)	-	10 milligrams/m^3 (over 8 hours) 40 milligrams/m^3 (over 1 hour)	Same as Primary Standard	
Photochemical Oxidants	-	234 (over 1 hour)	Same as Primary Standard	
Hydrocarbons (HC)	-	160 (over 3 hours 6-9 a.m.)	Same as Primary Standard	
Nitrogen Dioxide (NO_2)	100	-	Same as Primary Standard	
Lead	1.5*	-	Same as Primary Standard	

* Quarterly mean

trol Technology (BACT). BACT is defined in the Clean Air Act as:

> "...The maximum degree of reduction of each pollutant...taking into account energy, environmental, and economic impacts and other costs..."

In actual practice this definition has become essentially the best proven control in use unless considerable energy is wasted, emissions of other pollutants increase, or cost increases substantially.

Each abatement device and each application are reviewed on a case-by-case basis. Although there are some standard devices which are commonly accepted as BACT for a refinery, other pollution control equipment may be substituted if it shows a considerable cost saving or is as effective in reducing pollution.

BACT definitions must be determined for a series of units and operations within the Alpetco refinery. These include combustion equipment, sulfur recovery, fluid catalytic cracking, incineration, flare, storage tanks, fugitive emissions, and the products BACT is the only alternative available to Alpetco for controlling air emissions dock. The Alpetco refinery would control emissions from all of these units by using the following proposed best technology available. The EPA BACT determination will appear in the Final EIS.

Combustion equipment: The particulate, carbon monoxide, and hydrocarbon emissions would be controlled by monitoring the excess air which will allow proper burner adjustments. The sulfur dioxide would be controlled by burning refinery fuel gas or low sulfur fuel oil. The nitrogen oxides would be controlled by limiting excess air and using low nitrogen oxides burners.

Sulfur recovery: Sulfur dioxide emissions would be controlled by employing tail gas recovery.

FCCU: The particulate emissions from the FCCU would be controlled

by using an electrostatic precipitator. The carbon monoxide emissions would be controlled by employing high temperature regeneration.

Incineration: Incinerator offgases would be fired in an after-burner chamber to affect complete combustion. These offgases then would be scrubbed to remove particulates to less than 3 pounds per ton of dry feed before being vented to the atmosphere.

Flare: Emissions from the flare would be reduced by using steam injection to accomplish proper mixing and reduce thermal nitrogen oxide production.

Storage tanks: High vapor pressure hydrocarbons would be stored in pressure vessels vented to the flare. Intermediate vapor pressure hydrocarbons would be stored in cone roof tanks with internal floating roofs. Low vapor pressure hydrocarbons would be stored in cone roof tanks.

Fugitive emissions: The only fugitive emissions within the Alpetco refinery would be hydrocarbons. Fugitive hydrocarbon emissions would be controlled by incorporating proper engineering design and by a maintenance and monitoring program designed to locate and repair sources of emissions. Since all roads would be paved, no fugitive TSP emissions would be generated.

4.3.4 Alternate Methods of Solid Waste Disposal

Available disposal techniques: There would be both hazardous and non-hazardous solid waste by-products from operation of the proposed facility. In the past there have been no comprehensive federal regulations governing the disposal of hazardous solid wastes. Alaska currently does not have a federally approved hazardous waste management program; however, the state does have a solid waste disposal permit program. Federal hazardous waste guidelines and regulations which are pending promulgation would allow EPA to delegate the program to states with approved plans, or to retain regulatory responsibility in states not

prepared to assume the responsibility. The solid waste disposal plan for the refinery is intended to be responsive to the provisions of the draft regulations.

The four basic alternatives for disposing of solid wastes are on-site incineration, landfill, recycling and secondary use. A variation might involve long-term on-site storage prior to disposal. The City of Valdez has offered to allow Alpetco to use the municipal landfill for disposal of certain non-hazardous wastes (see Section 9.4). Hazardous wastes would require removal to a suitable hazardous waste disposal site outside Alaska, presumably on the West Coast.

Preferred disposal alternatives: The preferred alternative for disposal of a spent catalyst is to return it to a processor for reclaiming inherent precious metals. This is economically viable and also recycles a resource. Approximately 10 percent of the catalysts can be handled in this manner. Universal Oil Products, Inc., has offered to reclaim or serve as a broker for specified catalysts in this category. A majority of the spent catalysts come from the FCCU in an inert state. There is a potential recycle market for these; however, the market is unstable and periodic landfill may be required at the Valdez municipal landfill. Two catalysts from the hydrogen plant are expected to be toxic and without reclamation value, thereby requiring removal to a specially designated off-site hazardous material disposal area, either in Alaska or on the West or Gulf coast. There currently are no areas designated for hazardous waste disposal in Alaska. Capacity and future regulatory constraints preclude a treater or receiver of solid waste from making a commitment this early in the project to take these wastes. The fluid coke and sulfur both have market value and are included in the proposed product slate. The 214 tons of sulfur generated daily would be either accumulated on-site under cover storage or stored in a similar manner in a facility provided by the City of Valdez near the city shipping dock. When sufficient quantities for shipment have been acquired, the sulfur would be barged or shipped from Valdez (see Section 3.5.5).

The preferred alternative for handling waste sludges and clays is incineration, with subsequent disposal of the ash in the Valdez municipal landfill. Incineration reduces the sludge to a sterile state and removes offensive odors. The volume of clays and sludges from the refinery processes closely represents the volume of final ash due to the small amount of combustible substance in the materials. Many of the combustible substances already would have been removed in the high temperature process units, some of which operate at higher temperatures than does an incinerator. Wastewater solids, however, are reduced considerably in volume as the biological substance is burned.

Other alternatives for disposing of sludge include wet landfill, on-site retention, and removal to off-site waste treatment or receiving sites, all of which are either uneconomical or environmentally unsound for the proposed project. Calcium fluoride sludge from the proposed refinery would be retained on-site in a neutralization pit designed for 20-year retention. The final disposition of this material upon reaching capacity of the neutralization pit is uncertain due to regulatory and receiving facility constraints 20 years hence, but likely would involve removal and transportation to a reclaimer or receiver of such materials. Alternatives include treating (neutralizing, washing and filtering) and selling to a hydrogen fluoride manufacturing company, or regular removal to an off-site hazardous waste disposal area neither of which would be feasible economically for this facility, primarily because of distance and quantities.

Domestic refuse, construction shipping materials and normal plant maintenance housekeeping scrap would be disposed of in the Valdez municipal landfill. The viable alternatives to this include incineration of some of the combustibles (which could be done during operations but is not possible during construction), and salvage of certain scrap metals and worn out machinery. Alpetco proposes to use these options wherever practical.

Debris from land clearing would be removed to a landfill (location yet to be determined) in the Valdez area and the surplus excavation would

be used as fill material for the dikes. The larger trees would be made available to local citizens for firewood.

4.3.5 Alternate Wastewater Treatment Systems

Several alternatives were considered in developing a wastewater treatment facility for the proposed refinery. The criteria used to evaluate the alternatives were: All applicable federal, state, and local water quality standards must be met or exceeded; the system must be economically feasible; and the system must be operationally and mechanically reliable with a proven track record in other similar facilities.

By adhering to the criteria listed above, Alpetco has selected a wastewater treatment facility which would provide a high-quality, low-volume effluent stream. Refinery wastewater would receive efficient treatment which is based on proven technology. Segregated sewer systems would be employed to maximize water reuse and recovery, consistent with the goals of the Clean Water Act Amendments. The various sewer systems can be classified as contaminated, uncontaminated, sanitary, and storm water impoundment.

The secondary wastewater treatment system which was selected for the proposed Alpetco refinery is based on biological treatment. Biological treatment has been proven cost-effective in removing soluble organics from refinery wastewaters, it is highly dependable, and it produces an effluent of excellent quality. In general, the goal of the biological process is to remove organic material either by oxidation to carbon dioxide, water, and other derivitives, or by conversion of organic material into a settleable form that can be removed by sedimentation. The wastewater treatment system proposed for the Alpetco refinery is shown in Figure 3.4-3.

The following discussion concerning wastewater treatment alternatives applies to ballast water treatment as well as contaminated process water treatment, except that a gravity separator is not included with the ballast water treatment since removal of large quantities of oil is

not a necessity for ballast water which the proposed Alpetco refinery would be receiving.

Activated sludge: This discussion concerns conventional activated sludge processes as well as enriched air (oxygen) systems which currently are offered by several manufacturers. Activated sludge processes are used extensively to coagulate and remove non-settleable colloidal solids, as well as to stabilize organic matter. A high quality effluent is obtainable from a properly designed and operated activated sludge system. The process is an aerobic biological procedure wherein a high concentration of microorganisms is maintained within a reaction tank by recycling thickened biomass (sludge). Oxygen is supplied to the wastewater in the reaction tank either by mechanical aerators or a diffused-air system. Since the microorganisms remove the organic materials by biochemical synthesis of new cell mass and oxidation reactions, the converted organic matter must be removed by sedimentation. The sludge removed from the sedimentation tank is recycled to maintain the required concentration of microorganisms.

Nutrients--primarily nitrogen and phosphorus--are required to maintain a healthy growth of microorganisms within the system. Generally, refinery wastewater contains enough ammonia to supply adequate nitrogen, but it may be deficient in phosphorus. Some of the sources of these elements are: water condensate from the FCCU normally contains ammonia and other nitrogen compounds; phosphates can be leached with water from spent phosphoric acid catalyst from the catalytic polymerizaton units; and boiler or cooling tower blowdown contains phosphates.

An inadequate supply of nutrients results in poor stabilization of the wastes and will stimulate fungi growth. This results in poor sludge settling characteristics and the need for longer periods of aeration.

The following removal efficiencies are typical of activated sludge processes: BOD 80-99 percent; COD 50-95 percent; total suspended solids (TSS) 60-85 percent; oil 80-99 percent; phenol 95-99+ percent; ammonia 33-99 percent; and sulfides 97-100 percent.

Some of the major advantages of the activated sludge system are: minimal land requirements; the excellent response of the activated sludge systems to changing organic loads obtained by varying solids recycle; and the ready availability of data on treatability of similar refinery effluents by the activated sludge process.

Disadvantages of the activated sludge process include: temperature sensitivity, since the optimum temperatures for the activated sludge process are 20 - 30°C (68-86°F). In the cool Valdez climate, this would present a problem; and energy consumption for this process is relatively high since oxygen must be supplied either by mechanical aerators or a diffused air system.

Activated carbon: There has been a tremendous development in recent years in the use of activated carbon for the removal of dissolved organic material from wastewater. However, since experience with this system as secondary treatment on a commercial scale has not been proven successful, it is normally used for final polishing of the effluent from a biological treatment process. It is feasible only if a very high quality effluent is needed.

Activated carbon removes organic contaminants from water by the process of adsorption (the attraction and accumulation of one substance on the surface of another). In general, high surface area and pore structure of carbon are the prime considerations in adsorption of organics from water; whereas, the chemical nature of a carbon surface is of relatively minor significance. Granular activated carbons typically have surface areas of 500 to 1,400 square meters per gram. Activated carbon has a preference for organic compounds and, because of the selectivity, is particularly effective in removing organic compounds from aqueous solutions.

A carbon adsorption unit consists of the adsorbers in which the wastewater stream contacts the activated carbon bed; a transport system for moving the carbon from the adsorbers to the regenerator and back; and a regeneration system usually consisting of a rotary kiln furnace. The

adsorbers may be arranged in parallel, or in a moving carbon bed in which carbon periodically is removed from the bottom and fresh carbon is added at the top. Of the various methods of carbon regeneration that have been used, thermal regeneration is the most applicable because multiple-hearth furnaces, rotary kilns, or fluidized bed furnaces may be utilized.

Experience with activated carbon as secondary wastewater treatment has not proven successful. In one well documented instance, a 2.2 million gallons per day (mgd) filtration-carbon adsorption wastewater treatment plant was placed in operation at the Marcus Hook refinery of BP Oil, Inc., in March 1973, after extensive pilot plant testing. After more than two years in operation, this system was not producing equal to design expectations. The major problems experienced with this activated carbon system were: a substantial reduction in the adsorptive capacity of the regenerated carbon was observed after several months; design flow rate could not be maintained because of plugging of the effluent septums (screens) by carbon fines; the production of sulfides across the carbon columns was observed and was shown to be the result of bacterial action as well as influent characteristics; and various significant mechanical problems involving the carbon transport system, automatic valves, and the regeneration furnace were experienced.

Although granular activated carbon is unproven as sole secondary treatment for refinery wastewaters, it has shown some promise as a polishing step following biological treatment. Of particular interest is the possibility of using powdered activated carbon for wastewater polishing, since this system would result in substantially reduced costs and would eliminate the need for carbon transfer and regeneration equipment.

Rotating Biological Contactors (RBC): The RBC process is the fixed-film biological treatment system which has been selected for secondary treatment of the proposed Alpetco refinery wastewater. The RBC system consists of a number of large-diameter, high-density polyethylene discs, which are mounted on a horizontal shaft and placed in a basin

with a sloped floor. The discs rotate with approximately 40 percent of their surface area submerged in the wastewater.

Organisms naturally present in the wastewater adhere to the rotating surfaces and cover the entire surface of the discs with a biomass growth. During rotation, the discs carry a thin film of wastewater into the air, where the water trickles down the surface of the discs and absorbs oxygen. Organisms in the biomass then assimilate both dissolved oxygen and organic materials from this film of wastewater. As the discs continue to rotate through the wastewater in the basin, further assimilation of dissolved oxygen (DO) and organic materials is performed by the biomass. Operating in this manner, the discs perform these functions: provide support media for the development and propagation of a fixed biological growth; provide intimate contact of the growth with the wastewater; provide an oxygen enriched wastewater film for high metabolism rates; and provide an excess amount of aeration in the treated wastewater.

Shearing forces exerted on the biomass as it passes through the wastewater cause excess biomass to slough from the discs into the water. This maintains a fixed and relatively constant microbial population on the discs' surfaces. The mixing action caused by the rotating discs keeps the sloughed solids in suspension until the treated wastewater carries them out of the RBC unit for separation and disposal.

The major advantages of the RBC system are: minimal land requirements; minimal energy requirements; simplicity of operation, since it is a "once-through" system with no recycle necessary and requires minimal operator attention; quick recovery from major upsets is achieved, even in the case of a complete bug population kill. Often only the organisms on the discs of the first few shafts in series are affected by an upset, leaving the biomass intact and functional on the last discs in series; and, should powdered activated carbon be proven as a reliable means for polishing wastewater or for control of toxics or aromatic hydrocarbons, the RBC system is readily adaptable to the addition of powdered activated carbon at the bio-disc effluent trough.

Disadvantages of the RBC system are: the initial capital cost is relatively high and earlier installations of such systems experienced many mechanical failures. The shafts, discs, and support members have been redesigned, and now appear to be mechanically sound.

Stabilization (oxidation) ponds: A stabilization pond is simply a large shallow pond in which bacteria stabilize the wastewater fed to the pond. The ponds normally are 4 feet deep, since shallower ponds tend to have excessive weed growth and deeper ponds do not get adequate oxygen transfer to maintain aerobic conditions which are essential to refinery wastewater treatment.

Stabilization ponds were not considered for the proposed Alpetco refinery because large land requirements are essential; the soils on the proposed refinery site are extremely porous, and thus would quickly diffuse into the groundwater any wastewater which might leak through a crack in the pond liner; and stabilization in an oxidation pond is influenced by climatic conditions. During cold weather under ice cover, biological activity is extremely slow. The process, for all practical purposes, is reduced to sedimentation, and BOD reductions are generally about 50 percent.

Trickling filter: A trickling filter is an aerobic biological device that is used extensively in the refining industry. Although it may be used as secondary treatment by itself, whenever a high quality effluent is required, a trickling filter is not used. This system consists of a filter bed with a wastewater distributor and a sedimentation tank. The filter is usually a bed of broken rock, coarse aggregate, or plastic sheets. Only at extremely low loadings can a high quality effluent be obtained and it is at such loadings that the cost of the trickling filter is higher than other comparable processes. Consequently, this filter is feasible only as a "roughing" device rather than as a complete treatment system.

Deep well injection: It is generally agreed that deep well injection should be practiced only for those wastes which are not amenable to

conventional surface treatment. Since the proposed Alpetco refinery wastewater could be treated quite efficiently by conventional processes, deep well injection has not been considered as a treatment alternative.

Alternate processes: In addition to the main biological treatment options discussed above, alternative designs for other integral units of the wastewater treatment system were evaluated.

Sulfide ammonia stripping: Significant amounts of hydrogen sulfide and ammonia are found in refinery wastewaters due to the breakdown of organic sulfur and nitrogen compounds during the various refining processes. These compounds can be removed by air or steam stripping.

Oil removal: The traditional method of oil separation in refinery wastewater has been the API gravity separator, which is sized to allow most of the free oil to float to the surface and the heavier solids to fall to the bottom. These separators are normally an integral part of the operation due to the amount of recoverable oil in refinery wastewaters. Wastewaters that contain a high volume of free oil normally are treated in the gravity separator before being mixed with other non-oily streams. This allows a separator to be sized for a smaller throughput volume.

Another type of gravity separator finding increased use in the refining industry is the tilted plate separator. The corrugated plate interceptor (CPI) is one of the most common tilted plate separators. This unit is made up of one or more modules consisting of corrugated plates tilted at a 45° angle. As the water flows between the plates, oil droplets collect on the underside and move to the top of the module. Improved efficiencies at less cost and space than those needed by the API separators have been reported. The CPI was selected for use in the ballast water treatment process of the proposed refinery wastewater treatment system.

The API separator has been selected as the primary gravity separator

for the proposed refinery. This decision was based mainly on the API separator's ability to handle an accidental massive oil release into the wastewater system. The API separator can retain larger quantities of oil than a CPI separator without permitting oil breakthrough to the secondary treatment system.

Intermediate oil and suspended solids removal: Dissolved air flotation (DAF) normally is considered an intermediate treatment process for further removal of oil and suspended solids from API separator effluents, prior to biological treatment. In the dissolved air flotation process the waste stream is saturated with air under a pressure of several atmospheres. The stream then is held in a retention tank for a period of minutes so that the air will dissolve. As the stream exits from the retention tank it flows through a pressure-reducing valve -- dropping the pressure to atmospheric -- and then into a flotation tank. When the pressure is released, the air comes out of solution forming minute bubbles within the liquid. These bubbles, which are about 30 to 120 microns in diameter, adhere to the suspended particles, forming an aggregate which rapidly rises to the surface and is skimmed from the flotation tank. Although the use of DAF as an intermediate treatment step is not necessary for secondary treatment, its use generally does produce a higher quality effluent from the downstream secondary biological treatment system.

Final filtration: A sand filter was selected for final filtration of the proposed Alpetco refinery wastewater effluent to obtain a very high-quality effluent. Organic matter in suspended or colloidal form is filtered to reduce solids in the effluent to extremely low levels. Multimedia filters or microscreens also can be used in this service but were not selected for the proposed Alpetco refinery. The multimedia filter, which may be composed of anthracite and sand, activated carbon and sand, or resin beds and sand, would not produce a higher quality effluent than the sand filter in this application and would result in higher capital costs. Microscreens would not produce effluent of as high a quality as either sand filters or multimedia filters since available screen mesh size is too large.

4.3.6 Cooling Systems

Most of the refining and petrochemical processes require heating of the crude oil feedstock and intermediate streams with either steam exchangers or fired heaters to initiate chemical reactions or effect separations by distillation. To conserve energy the processes are designed to recover, to the greatest extent possible, the heat from the product streams before routing them to tank storage. This heat is recovered by exchange with feed streams or by raising steam. Unfortunately it is not economically feasible (or technically possible) to recover all of this heat for useful purposes and thus it is necessary to reject the residuum by means of cooling water exchangers or air coolers.

With a few exceptions (discussed below) Alpetco has selected air cooling to avoid the problems that would be inherent with either evaporative cooling (wet cooling towers) or once-through seawater cooling with resulting thermal plume. Evaporative cooling could cause fogging with reduced visibility and freezing problems during cold weather, and wastewater pollution problems (chromates) at all times. Once-through seawater cooling could cause thermal discharge problems in the receiving body of water, such as upsetting the environment for marine life. The areas where air cooling would not be used are:

Alkylation reactors: These reactors have been developed over a number of years based on water cooling. An alternative to water cooling would require a pioneer development effort.

Alkylation coolers: Where cooling of an acid-bearing stream is required, water cooling must be used to guard against the possibility of spraying acid about the unit in the event of a tube failure. Air cooling would introduce that danger.

Pump and compressor cooling: It is necessary to use a liquid coolant for cooling of the internals of these rotating machines.

Flexicoker gasifier condenser: Water cooling is used in this service

to minimize the required surface area. The stream being cooled is extremely corrosive and therefore an expensive alloy must be used for fabrication of the exchanger. As a result there is a strong economic incentive to use water cooling to minimize the required exchanger surface area.

In all of the above cases, Alpetco proposes to use a circulating glycol-water stream for cooling. The glycol-water solution would be pumped to the process for cooling and the heat picked up by the glycol-water would be transferred to air in air coolers. The glycol-water would then be recirculated to the various processes. It is necessary to use a glycol-water system for cooling instead of a simple water system because of the low ambient temperatures at the refinery site.

4.3.7 Alternate Products Dock Sites

Consideration of the alternatives: Several factors influenced the selection of potential Port Valdez sites for the products dock. The area on the north side of the port, west of Valdez townsite, was eliminated because of the lack of road access, difficult topography and the necessity to cross the townsite with product pipelines. All areas west of the Alyeska marine terminal on the south side of the port were eliminated because that facility cuts off all road and pipeline access. Areas in the far east end of the port, in the vicinity of the old townsite, were eliminated because this area has been designated a high seismic risk zone and the bathymetry would require dredging or an unnecessarily long dock structure. From the remaining eastern Port Valdez areas three locations were originally considered as potential dock sites: (1) Ammunition Island, (2) Allison Creek and (3) Solomon Gulch.

The Ammunition Island site is located on the north shore of Port Valdez, east of the Valdez small boat harbor and adjacent to Island Flats. The positive aspects of this site include proximity to existing industrial land use zones in the old townsite area and reasonably short distance from the proposed refinery site. The area, however, has a number of negative aspects. This site has been proposed by the City of Valdez

as the location for a new port facility and joint use would not be compatible. Furthermore, the Island Flats is an environmentally sensitive area. The mudflat/marsh area is productive and utilized seasonally by concentrations of waterfowl and salmon. Additionally, a pipeline from the refinery site would have to cross several small salmon streams.

The Allison Creek site is located on the south shore of Port Valdez, adjacent to Allison Creek and immediately east of the Alyeska marine terminal. The primary positive aspect of this site is its favorable bathymetric features allowing a short access trestle and, consequently, lower dock construction costs than at the other sites. The Allison Creek site, however, would involve longer products pipelines--about 2.1 km (1 1/3 miles) longer than either of the other alternatives. The mountainous and possibly unstable terrain adjacent to the site could create engineering problems for the dock or its associated pipelines. Geophysical studies conducted by Alyeska Pipeline Service Company and earlier USGS studies show this area to have potentially unstable bottom conditions. Potential environmental impact resulting from a refinery dock at the Allison Creek location would be moderate and less severe than at the Ammunition Island site. The productivity of marine organisms (primarily worms and clams) is moderate to high, but the habitat is not unique and not used by unusual numbers of predators.

The Solomon Gulch site is located on the south shore of Port Valdez, adjacent to Solomon Gulch Creek and about 2.1 km (1 1/3 miles) east of Allison Creek. This site was selected as the preferred location for the refinery products dock because it represents a reasonable compromise in regard to the positive and negative features associated with the other alternatives. Bathymetric and engineering studies indicated that a dock on the south shore at Solomon Gulch would be feasible and almost as economical to construct as at Allison Creek. Since the Solomon Gulch site is closer to the proposed refinery than is the Allison Creek site, a substantial savings in both cost and environmental impact would result from shorter pipelines. The soils are not unstable, nor is the pipeline access as mountainous as for Allison Creek. Potential adverse environmental impacts resulting from a dock at Solomon Gulch

would be similar to impacts resulting from a dock at Allison Creek and less than impacts which would result from the Ammunition Island site. A dock at Solomon Gulch would be sufficiently isolated to assure safety and prevent conflicts with other industrial facilities.

Description of the Solomon Gulch site: Dock dimensions and basic facilities are shown in Figure 3.3-3. They would consist of a 335 m (1,100 ft) pipeline and roadway trestle leading from Dayville Road to a dock and berthing structure roughly paralleling the 15 m (50 ft) bathymetric contour. The structure would be supported by driven piles and elevated above mean lower low water 12 m (40 ft) at the berths and 8 m (26 ft) at the road junction. No dredge or fill operations are anticipated.

Solomon Gulch Creek flows off of the mountainside and enters Port Valdez immediately west of the proposed dock site. A gravel delta extends into the intertidal area opposite the stream mouth. To the east the intertidal zone increases in breadth due to sand and silt deposition on the Lowe River delta. Dayville Flats, a broad mudflat/ marsh area, is located about 1.2 km (3/4 mile) east of the site.

A seismic reflection survey and preliminary soils investigation (August 1979) conclude that the site conditions are suitable for the construction of the proposed dock. The area is characterized by a wedge of unconsolidated sediments atop an irregular surface of greywacke bedrock. Both the bathymetric and sub-bottom surveys indicate that slumping has been an active process in this region, but no clear evidence of recent displacements, either slumps or faults, could be identified in the data. The soils at the site are essentially frictional silt and sand. Due to frictional resistance it may not be possible to drive the piles to the desired depth; therefore, some predrilling may be necessary.

The biological resources of the intertidal zone consist of an assemblage dominated by burrowing worms, and small clams, (see Appendix Vol. I). Productivity is moderate in the upper intertidal and becomes

relatively high in the lower regions. This assemblage is uniformly present along the south shore of Port Valdez between Allison Creek and the Lowe River. The shallow subtidal region also supports a characteristic and widespread assemblage dominated by different species of worms and clams.

The gravel delta of Solomon Gulch Creek represents a departure from the typical intertidal habitat. A relatively dense growth of rockweed covers portions of the area. Also present are barnacles and blue mussels (Feder et al 1979).

Pink and chum salmon spawn within the intertidal zone at the mouth of Solomon Gulch Creek. As many as 1,500 pink salmon have been observed (Johnson and Rockwell, 1978). The spawning area is about 609 m (2,000 ft) from the edge of the proposed facility. Pink salmon fry can be expected to occur in the area for a short time in the spring following their emergence from the gravels. The southeast shore is not thought to be a concentration area for salmon fry (see Appendix Vol. I).

The intertidal and shallow subtidal area is utilized by various species of birds including ducks, gulls, and shorebirds. Harbor seals and sea otters occasionally feed in the area. Harbor seals have been observed to haul out on an old piling structure seaward from Solomon Gulch. Sea ducks also tend to concentrate in the vicinity of the structure.

A National Marine Fisheries Service (NMFS) biological monitoring site is located within the intertidal zone about 0.8 km (1/2 mile) east of the proposed facility. Populations of marine organisms, particularly the clam Macoma balthica, are being observed to detect oil pollution in relation to the Alyeska marine terminal activities.

In addition to this effort, the National Oceanographic and Atmospheric Administration Office of Marine Pollution Assessment has a project development plan for studying, in part, the fate and effects of petroleum hydrocarbons in Port Valdez. This plan is an initiative for fiscal year 1982 and has not yet been funded by NOAA.

4.3.8 Alternate Transportation Routes Relative to the Site

Vehicular routes: There are four alternative vehicular routes to the proposed site: Route #1 is coincident with the proposed products pipeline route directly north from the intersection of the Richardson Highway and Dayville Road; Route #2 is the existing levee off the Richardson Highway, adjacent to the east side of Valdez Glacier Stream; Route #3 is Glacier Stream Haul Road from the Richardson Highway; and the Route #4 is the Valdez Airport Road, with construction of a connecting road to the site (see Figure 3.3-1).

The proposed primary access to the site is Route #3 using the city-owned Glacier Stream Haul Road. A 606-m (2,000-ft) connecting road would be needed from the haul road to the site, including a bridge across the main channels of Valdez Glacier Stream. For primary access, Route #3 provides the most direct route to the administrative sector of the site and minimizes traffic in or adjacent to plant process and tankage areas. Route #3 also uses an existing road that will be central to a future Valdez Industrial Park and consequently avoids all residential areas. Because the Glacier Stream Haul Road would be improved and maintained for construction access, continued use of this route as a permanent access would be expeditious, cost effective and would avoid committing undeveloped areas to new road construction. A secondary service road is proposed along Route #1. This road would serve a dual purpose of also providing access to the proposed crude and products pipelines route.

Alternate Route #2, entering the southwest corner of the site, would require improving approximately 914 m (3,000 ft) of existing dike. The 1,829 m (6,000-ft) distance from the southwest corner of the site to the refinery administrative headquarters would be less compatible with the site layout and also would incur an economic penalty in approximately 1,220 m (4,000 ft) of additional new road construction. There also would be river and wetland crossings along this route. Route #2 therefore was considered less desirable for a main access than the haul road and not reasonable for emergency access since Route #1 coincident with the preferred pipeline corridor would be required anyway.

The Valdez Airport Road, Route #4, was not desirable for a main access route because of potential conflicts with airport-related traffic, and the need to construct a mile of new connecting road to the site.

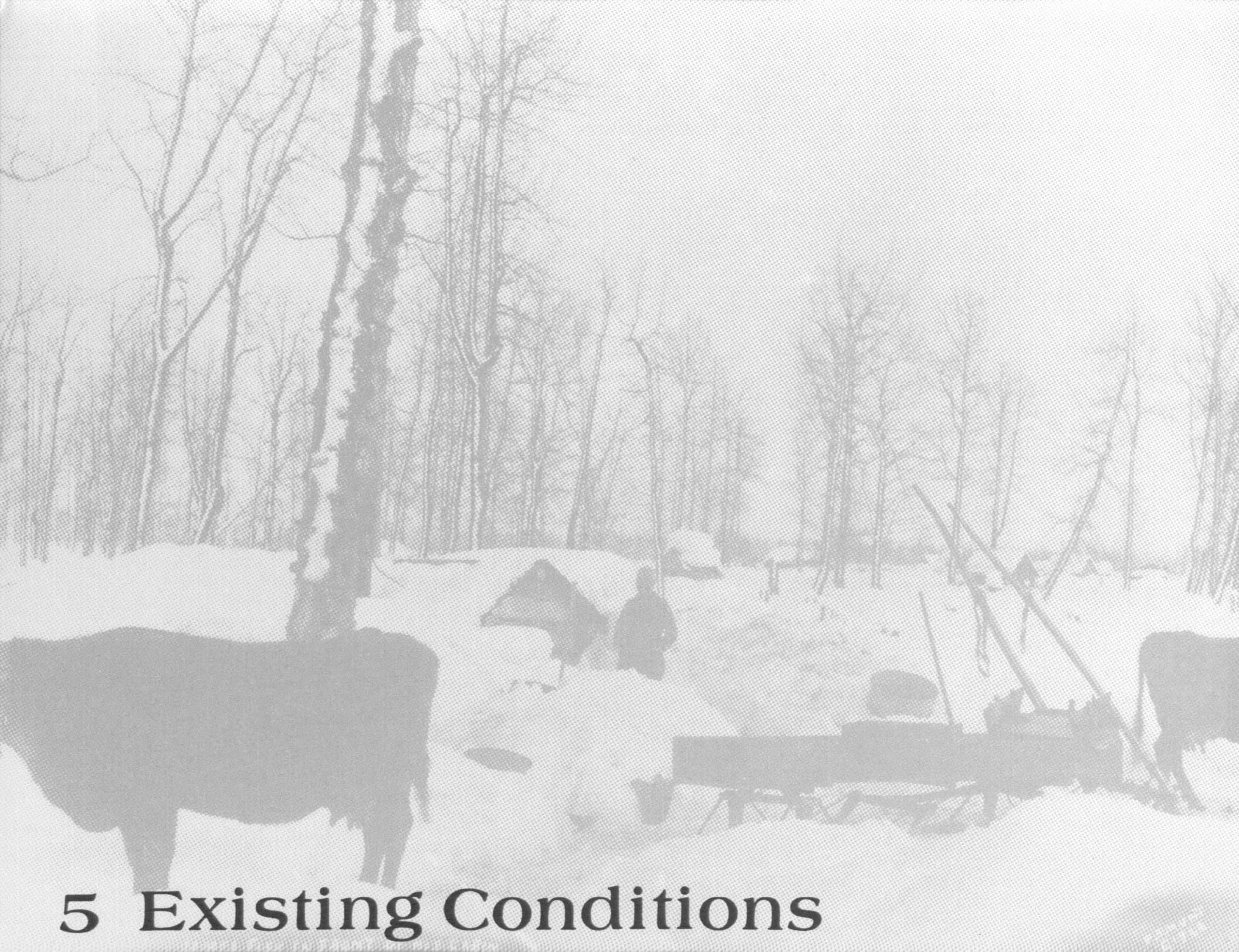
Pipeline routes: From the intersection of the Richardson Highway and Dayville Road there are two alternative routes to enter the site with the crude and products pipelines. The preferred route is directly north from the intersection of the Richardson Highway and Dayville Road. The alternate route is to travel parallel to the Richardson Highway from Dayville Road to the existing levee along Valdez Glacier Stream, then along alternate vehicular Route #2 to the proposed site.

The preferred route would be shorter than the alternate route by approximately one mile. It would be located in a 290 m (950 ft)-wide corridor immediately adjacent to Robe River residential subdivision and in a 122 m (400 ft)-wide corridor from there to the site. Adjacent to the subdivision the pipelines and a service road would be placed on the far east side of the wide corridor to provide a buffer zone between it and the subdivision. This route would involve crossing two anadromous fish streams, Robe River and Corbin Creek (Robe), and adjacent wetland areas. The remainder of the route would be located on suitable soils and would avoid marsh and other wetland areas.

The alternate pipeline route would be located on the south side of the Richardson Highway right-of-way. This would minimize conflicts with adjacent privately owned property but would not avoid private residential property located in the route west of the Robe River. This route would require three crossings of Robe River due to the meandering of the channel immediately west of Dayville Road, and a crossing of Corbin Creek (Glacier). Robe River is an andromous fish stream. By entering the site at the southwest corner, this route would be less compatible with the preferred site layout and most likely would require crossing the wetland area near the southern perimeter of the site.

The preferred pipeline route was selected as having the least direct environmental impact. The economic impact of the additional mile

length associated with the alternate route is more than $2 million plus costs and other factors associated with maintaining and operating the additional length of line. The preferred route likely would have clear right-of-way through the lease of state land whereas it may be difficult to obtain necessary right-of-way across private property for the alternate route.



5 Existing Conditions

5. EXISTING CONDITIONS

5.1 GEOTECHNICAL

5.1.1 General Geologic Description

The proposed refinery site lies in a foothill valley of the Chugach Mountains. The valley is of glacial origin and is filled with outwash deposits of the Valdez and Corbin glaciers. The site is bounded on the north, east and south by bedrock outcrops, and on the west by Valdez Glacier Stream. The topography is relatively flat, falling 30 - 38 m (100 - 125 ft) to the south at a slope averaging 1.5 percent, and rising slightly to the east to conform to the outwash of Corbin Creek (Glacier). The surrounding bedrock outcrops rise steeply to the north and to the south and more gently to the east.

A wetlands area which is connected to the Robe Lake system extends northward into the southeast portion of the property bounds but falls outside the proposed plant siting. The proposed site is generally well drained as a result of gently sloping topography, permeable soils and surface drainage features.

The rock surrounding the site is slightly metamorphosed graywacke and phyllite. The beds of this mildly metamorphic rock dip at a steep angle to the north and have a high density of joints and fractures. The joints can be grouped into sets of similar orientation. The folds, faults, fractures and joints are results of intense tectonic activity which has occurred in this region during the past 70 million years. The most recent period of major orogeny (mountain-building by folding and thrusting) occurred more than 30 million years ago.

Prince William Sound lies close to the boundary of the North American and Pacific tectonic plates. This boundary is a megathrust fault, termed a subduction zone, and is the direct cause of the area's intense tectonic and earthquake activity.

Although Prince William Sound is noted for its abundance of economic mineralization, no evidence of ore minerals was found on-site or in

the immediate area. However, some placer mining has been conducted on Valdez Glacier Stream in the past.

The site lies approximately 1.6 km (1 mi) south of Valdez Glacier. Valdez Glacier has been receding at an average rate greater than 10.5 m (35 ft) per year since 1898 with the exception of the year 1906. In that year it advanced 76 - 107 m (250 - 350 ft). The continued recession of the glacier since 1906 and the present recessional trend observed for coastal glaciers throughout Alaska suggest that advancement of the glacier, which might affect the site, is unlikely during the life of the proposed facility.

5.1.2 Soils

The valley floor within the project area is composed of glacial stream deposits and includes till from Valdez and Corbin glaciers. These heterogeneous deposits originated in the talus slopes (rockfalls) of the steep valley walls, the moraines at the terminus of glaciers, and from direct release of the glacial load material (material scoured and transported by glaciers). Local sorting is significant and common throughout the site, and is evident in the five distinct structural soil layers encountered within the project bounds.

The first layer is topsoil and an organic mantel varying in thickness from a few centimeters to 0.6 m (2 ft). This layer is deepest in the eastern and southern portions of the site.

The second layer is a noncohesive mixture of boulders, cobbles, gravel, sand and silt which lies above a depth of 15 m (50 ft). This layer is typically sandy gravel with layers of cobbles and occasional layers of sand which range from several inches to several feet. Boulders seldom exceed 30 cm (12 in) in diameter, and are estimated to constitute less than 5 percent of the material in this layer. Silts are encountered throughout the soil mass, often in isolated lenses up to 30 cm (12 in) thick. Some of the silt lenses contain buried root systems.

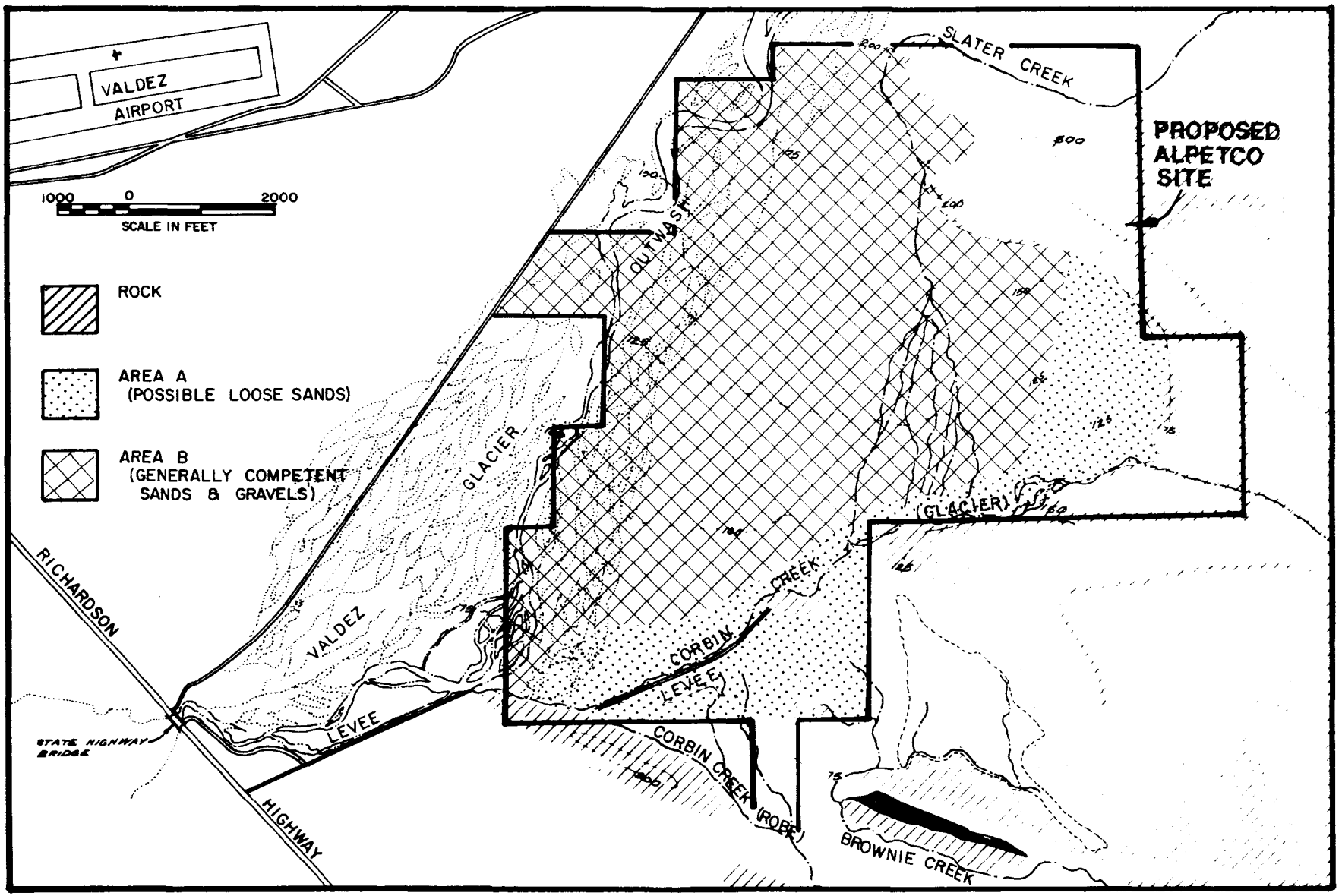
In the eastern and southern portions of the site, the soils of the second layer tend to grade toward sands; in the north and west the trend is toward gravels. Loose saturated sand with liquefaction potential is suspected in the eastern and southern portions of the site, shown as Area A on Figure 5.1-1. The area shown as Area B has soils which are considered satisfactory in both the static and seismic modes for foundation purposes. During field studies in the summer of 1979, the water table was encountered during drilling from the surface to more than 18 m (60 ft) below grade. The water table was deepest in the northwest portion of the site.

The third layer is approximately 39 m (130 ft) thick and lies below a depth of 15 m (50 ft). The soils of the third layer are similar to, though finer than, those of the second layer. However, potential for liquefaction in the third layer is not a threat. Below a depth of 15 m (50 ft), the potential for liquefaction is no longer a structural concern.

The fourth layer is a silt believed to be a lake deposit. The deposit appears to become thinner from northwest to southeast and to conform roughly to a maximum elevation of 15 m (50 ft) below sea level. The silt layer's great depth below existing grade, 55 m (180 ft) or more, its coarseness, and its stiff to hard consistency indicate no significant potential for time-dependent consolidation. The silt ranges from slightly plastic to nonplastic and has the strength properties of a dense noncohesive soil.

The fourth layer appears to separate the groundwater system into an unconfined upper and confined lower aquifer. This is discussed further in Section 5.2.2.

The fifth layer is similar to the second and third layers in texture and physical characteristics except that it appears to be somewhat denser. This layer may be the result of a glacial deposition, which subsequently was overridden and densified by glacial advances. This layer may include remnant morainal deposits as well as outwash. The



SURFICIAL SOILS **Figure 5.1 1**

strength of the fifth layer is equal to or greater than that of the overlying layers.

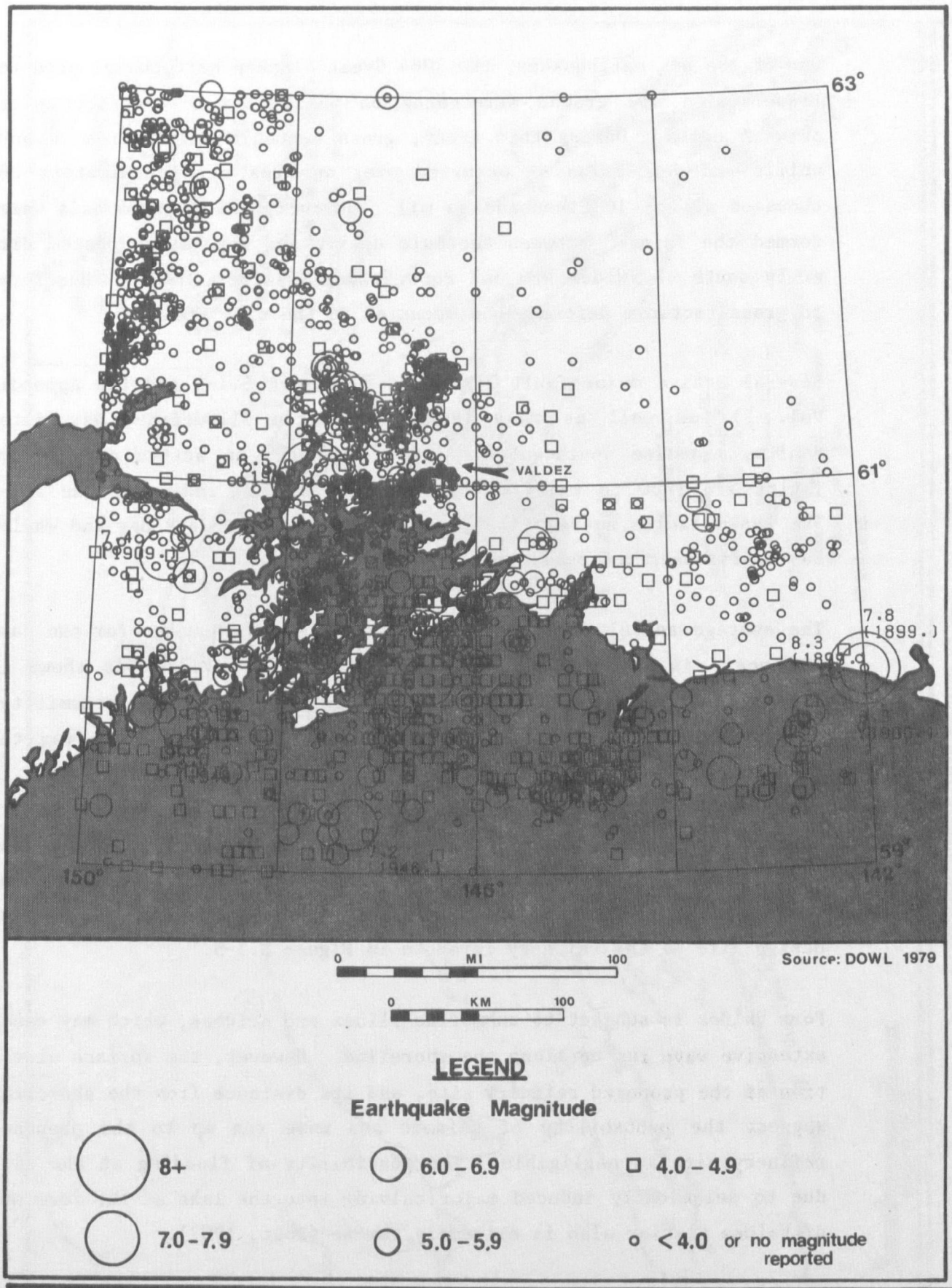
Bedrock as determined by geophysical methods (seismic refraction) varies from 91 - 213 m (300 - 700 ft) below grade, and conforms to the shape inferred from the visible portions of the Valdez and Corbin glacier valleys.

Within the area proposed for development, hazards such as rock falls, avalanches, slope failure, time-dependent deep-seated settlement, and permafrost appear to be absent.

5.1.3 Seismology

The proposed refinery site is located in one of the most seismically active areas of the world. The Pacific Ocean Plate dips below the North American Continental Plate directly below the southern coast of Alaska. The Aleutian Island chain and the coastal mountain ranges are the surface expressions of the collision of these two tectonic plates. Their interaction, and the continual realignment of faults within the region, results in approximately 6 percent of the world's earthquakes occurring along the fault systems of southcentral Alaska.

More than 2,300 earthquakes are known to have occurred since 1890 within a 192 thousand sq km (74 thousand sq mi) area centered around Valdez (see Figure 5.1-2). The radius of this area ("search area") is defined as the farthest distance from the proposed site that an 8.5+ magnitude earthquake could occur and cause ground shaking significant to structures at the site. Six of the 2,300 earthquakes have produced significant effects in Port Valdez and on the Valdez Glacier/Lowe River outwash delta. Some of these effects included strong ground shaking, submarine slides, and seiching (seismically induced waves in closed bodies of water) (Tarr and Martin, 1912; Grant and Higgins 1913; Coulter and Migliaccio, 1966; Plafker, et al, 1971; Wilson and Torum, 1972).



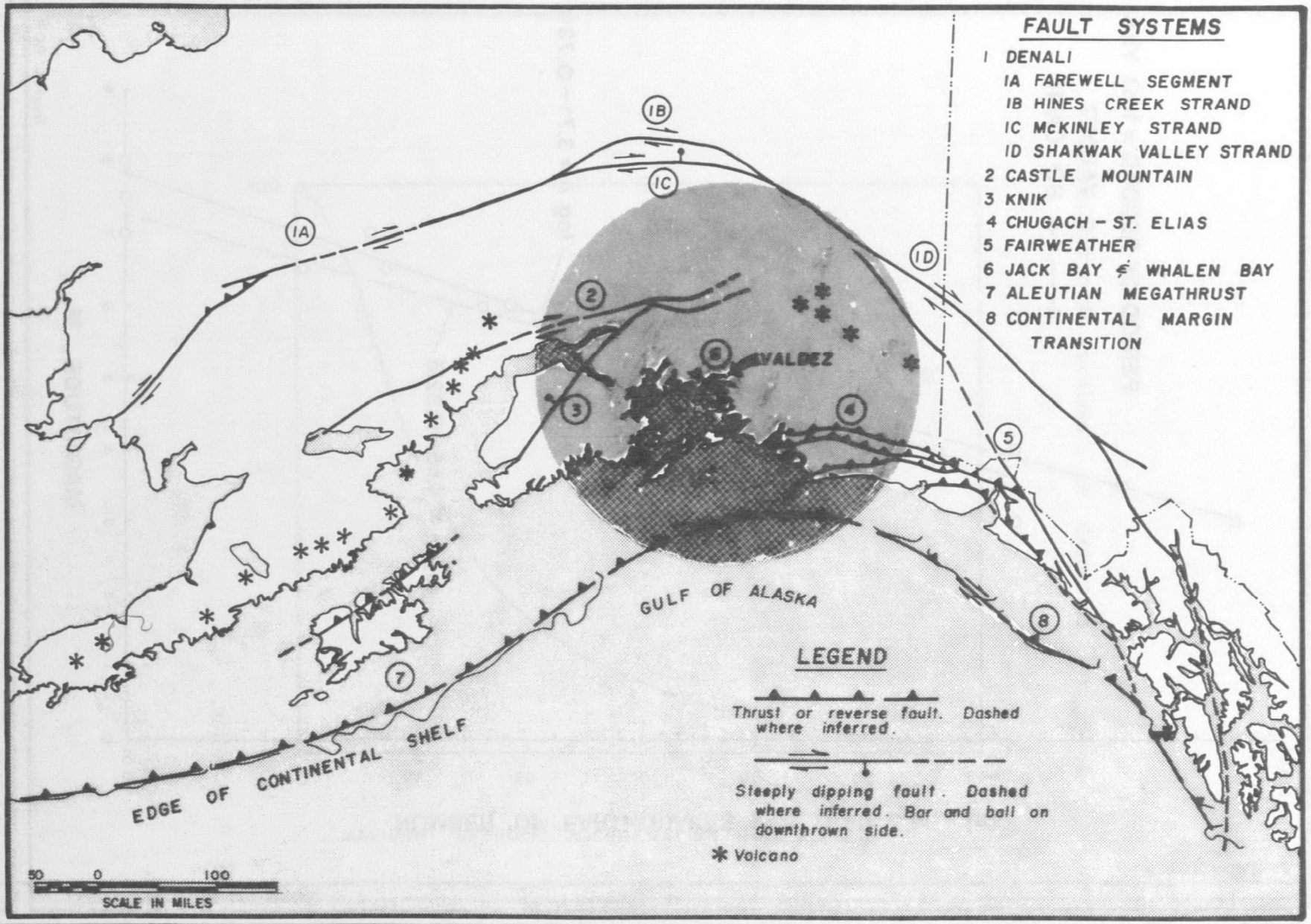
EARTHQUAKE EPICENTERS 1899-1977 **Figure 5.1-2**

One of the six earthquakes, the 1964 Great Alaskan Earthquake, produced liquefaction and ground stretching on the Valdez Glacier/Lowe River outwash delta. During this event, gross tectonic deformation -- both uplift and depression -- occurred over an area of approximately 280 thousand sq km (108 thousand sq mi). However, the neutral axis which formed the "hinge" between tectonic uplift and depression passed directly south of Valdez Arm and Port Valdez (Plafker, 1972); therefore, no gross tectonic deformations occurred in the site area.

Several active major fault systems (see Figure 5.1-3 and the Appendix Vol. I), as well as many lesser and often ill-defined associated faults, traverse southcentral Alaska; however, no active or inactive faults are know to exist within a 16 km (10 mi) radius of the site. The known faults nearest the proposed site are the Jack Bay and Whalen Bay faults near the entrance to Port Valdez.

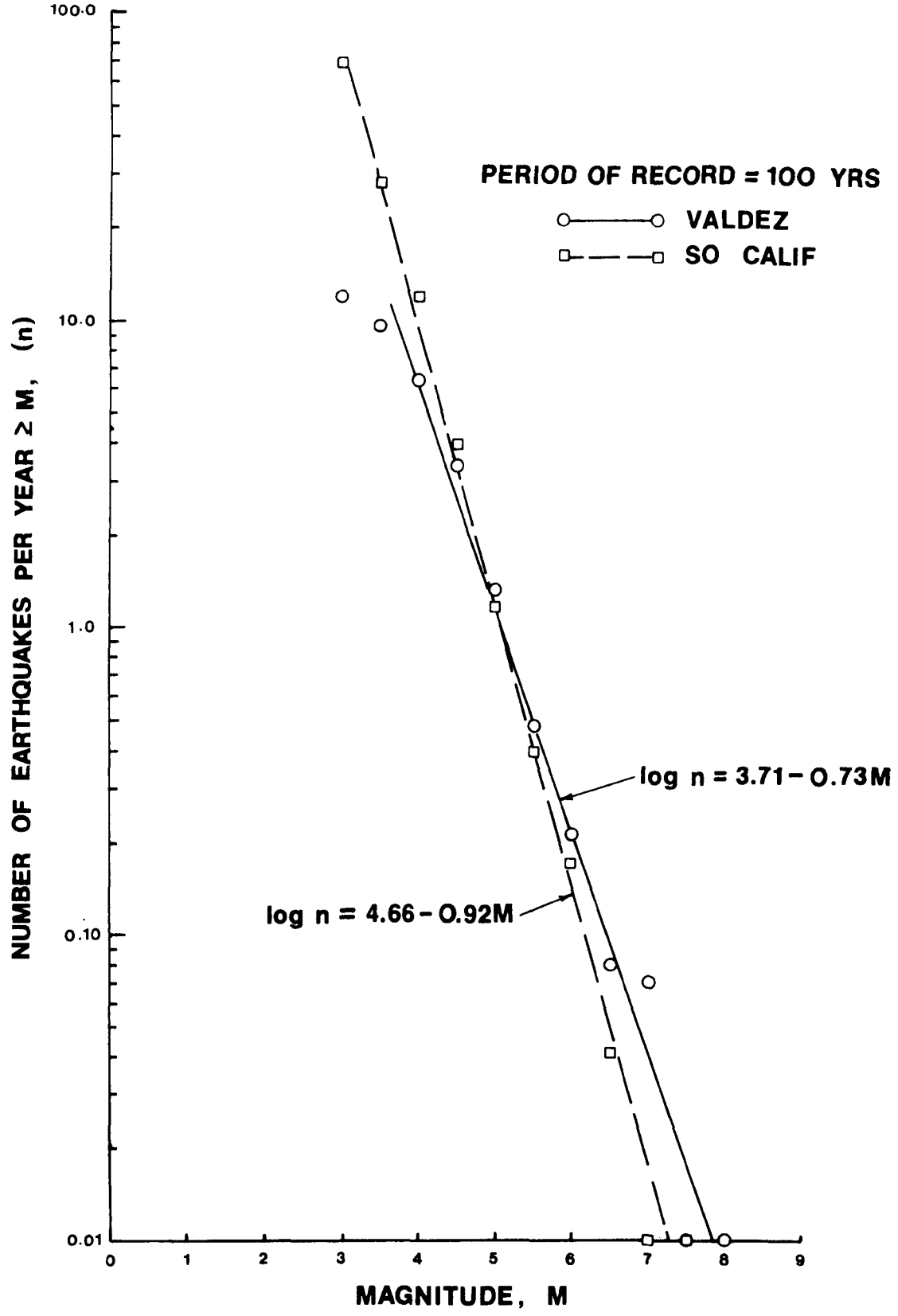
The average annual frequency of occurrence of earthquakes for the past 100 years in the "search area" centered around Valdez is shown in Figure 5.1-4. A similar plot of the earthquake history, or seismicity, of southern California is also shown on this graph. Comparing the seismic history of the Valdez region to that of an equivalent area in southern California shows Valdez to be slightly more seismically active than Los Angeles with respect to events large enough to be significant to structures (magnitude greater than 5). A probabilistic assessment of expected levels of ground motion at the site during the 30-year design life of the refinery is shown in Figure 5.1-5.

Port Valdez is subject to submarine slides and seiches, which may cause extensive wave run up along the shoreline. However, the surface elevation of the proposed refinery site, and its distance from the shoreline suggest the probability of seismic sea wave run up to the proposed refinery site is negligible. The possibility of flooding at the site due to seismically induced major calving into the lake at the terminus of Valdez Glacier also is extremely remote (Post, 1967).



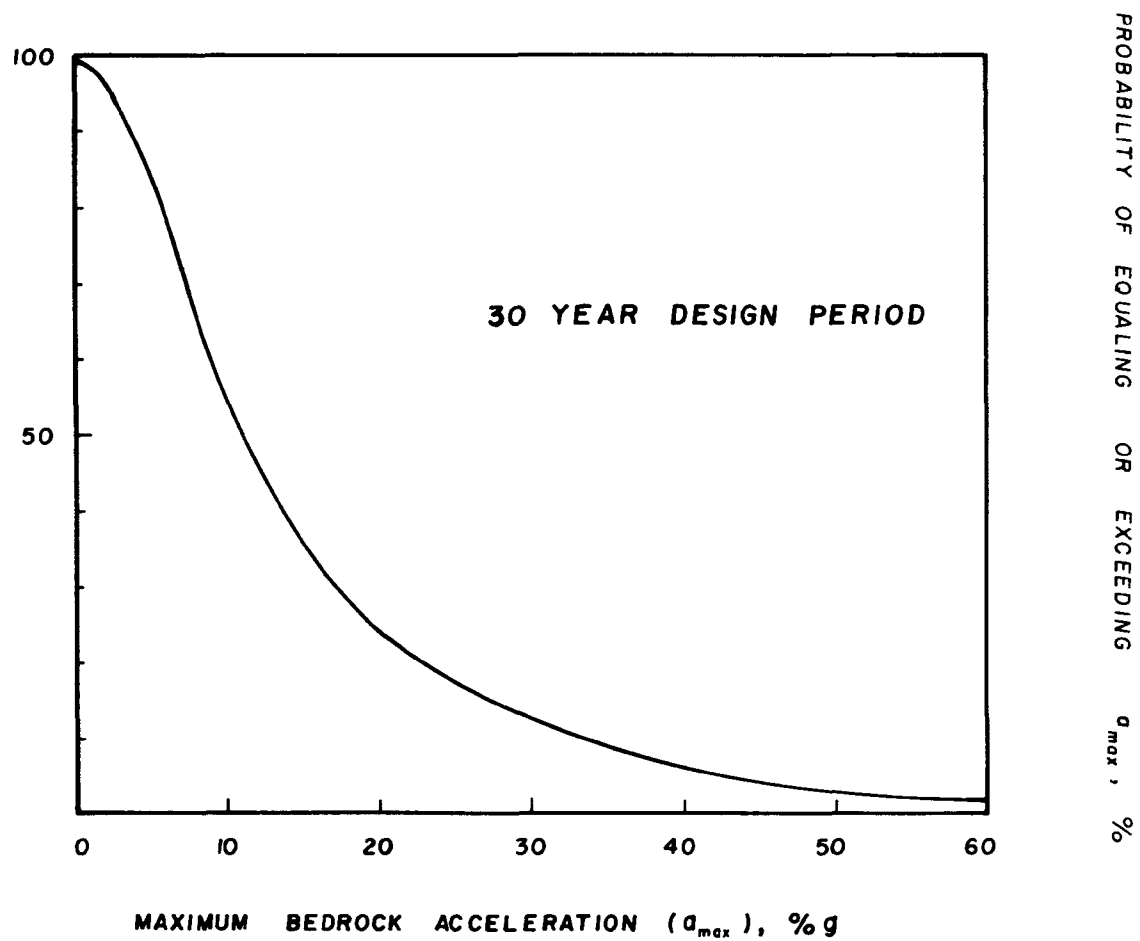
MAJOR FAULTS IN SOUTHCENTRAL ALASKA

Figure 5.1-3



Source: DOWL 1979

CUMULATIVE MAGNITUDE / FREQUENCY RELATIONSHIP **Figure 5.1-4**



Source: DOWL 1979

SEISMIC RISK

Figure 5.1-5

5.2 HYDROLOGY

5.2.1 Surface Water

Hydrologic description: Figure 3.2-2 illustrates the important streams within the project area. Valdez Glacier Stream, draining an area of approximately 406 sq km (157 sq mi), is the principal drainage system immediately adjacent to the site. The principal tributary of Valdez Glacier Stream is Corbin Creek (Glacier), and the principal tributary of Corbin Creek (Glacier) is Slater Creek. They originate from Corbin Glacier and an unnamed glacier to the northwest of Rubin Glacier respectively, and together comprise 49 sq km (19 sq mi) of drainage basin. Corbin Creek once flowed directly into Robe Lake, but in the late 1950s it was diverted into Valdez Glacier Stream by construction of a dike. The dike was built by Valdez citizens, because a channel of Valdez Glacier Stream had broken into Corbin Creek in the 1930s causing glacial sediment to be deposited in Robe Lake. The dike is constructed of streambed gravels, and allows leakage in the summer of 0.11-0.23 cubic meters per second (cms) (4-8 cubic feet per second [cfs]) to the old Corbin Creek channels south of the dike to form another creek. The upper stream now is called Corbin Creek (Glacier), and the lower one is called Corbin Creek (Robe).

Water leaking through and beneath the Corbin Creek dike is filtered naturally and has little siltation effect on Robe Lake. However, erosion of the dike is very severe at some locations. The width of the dike crest at the worst locations after temporary repairs made in 1979 is no more than 0.9-1.2 m (3-4 ft). Along the dike, aggradation of the streambed and erosion of the bank appear to be the present trend. It is doubtful that the dike can survive without maintenance for many more years. If the dike erodes away, the natural flow of Corbin Creek (Glacier) again will be in the direction of Robe Lake.

The southern half of the study area occupies the upper drainage basins of the Corbin Creek (Robe) and Brownie Creek hydrologic units. Water temperature comparisons suggest that the two systems may be independent

of each other. Brownie Creek begins immediately southeast of the proposed site and is fed primarily by shallow groundwater there. Corbin Creek (Robe) also is fed by shallow groundwater, as well as by seepage through and beneath the dike. Temperatures in Corbin Creek (Robe) in late winter, are 2°-4°C (36°-39°F) and Brownie Creek stays at approximately 4°C (39°F).

Larger streams, such as Valdez Glacier Stream, Slater Creek, and Corbin Creek (Glacier), are fed by rainfall and by meltwater from snowfields and glaciers.

Estimates of average annual runoff for the study area can be made from drainage area relationships and precipitation data. However, a paucity of weather stations which record precipitation data on the mountains restricts the precision of this analysis. The mean annual runoff ranges from approximately 0.09-0.1 cms per square km (cmsk) (8-9 cfs per sq mi [cfsm]). During late summer, as a result of rapid glacial melt and heavy precipitation, mean annual peak runoffs average 0.9-1.1 cmsk (80-100 cfsm), nearly a tenfold increase over the mean annual runoff. Mean annual low monthly runoffs, which occur in late winter, are in the range of 0.006-0.011 cmsk (0.5-1 cfsm) (Grumman Ecosystems Corp., 1975). Between 80 and 90 percent of the annual runoff occurs in the four months from June through September.

Severe channel erosion and lateral migration occurs on Valdez Glacier Stream, which tends to meander toward the east. Lateral erosion rates computed from aerial photographs taken 14 years apart range from 2.6-6.7 m/year (8.5-22.3 ft/year). The streambed material in the vicinity of the proposed project consists primarily of very coarse gravel and cobbles. Near its headwaters, Valdez Glacier Stream has deeply cut banks, indicating that scouring of the bed material is the general trend there. Terraces at various levels along the stream show that the recent history of the river has been one of degradation rather than aggradation, and the stream is degrading moderately at present. A summary of hydrologic conditions of the streams within the study area is presented in Table 5.2-1.

Table 5.2-1

SUMMARY OF HYDROLOGIC CONDITIONS OF THE STREAMS
AT SELECTED CROSSINGS IN THE PROJECT AREA

STREAM	GENERAL	BED MATERIAL	WINTER	SUMMER
Valdez Glacier Stream	Swift braided meandering glacial	Gravels, cobbles and boulders and some sand.	Dry upstream 0.01-0.06 cms (0.4-2 cfs) by Richardson Highway bridge. Ice thickness 0.3-0.6 meters (1-2 feet)	45 to 56 cms (1,600-2,000 cfs) normal flows. Large diurnal fluctuations. Avg. Vel. = 1.5-2.4 mps (5-8 fps).
Corbin Creek (Glacier)	Swift, straight, glacial	Gravels, cobbles, some sand.	Open surface flow upstream by the foothills, 0.11-0.14 cms (4-5 cfs). Dry downstream. Ice thickness less than 0.2 meters (0.7 feet).	11 to 14 cms (400-500 cfs) normal flows. Large diurnal fluctuations. Avg. Vel. = 1.2-1.8 mps 4-6 fps).
Slater Creek	Swift, highly braided at the confluence; otherwise straight. Glacial	Gravels, cobbles, some bounders. Large deposition of silt and sand at the confluence.	Dry. Ice thickness less than 0.1 meters (0.3 feet).	3 to 7 cms (105-250 cfs) normal flows. Ave. Vel. = 1.2-1.5 mps (4-5 fps).
Corbin Creek (Robe)	Slow, braided, non-glacial	Gravels, cobbles	Dry upstream. 0.006-0.014 cms (0.2-0.5 cfs) in the middle reaches.	0.1-0.2 cms (4-7 cfs) normal flows. 0.2-0.3 mps (0.5-1.0 fps).
Brownie Creek	Slow, braided, non-glacial	Fine gravel and coarse sand.	Flows year-round. 4°C (39°F) winter temperatures 0.006-0.014 cms (0.2-0.5 cfs) flow.	0.2-0.4 cms (7-14 cfs) normal flows. Avg. Vel. = 0.2-0.5 mps (0.5-1.5 fps).

Hydrologic hazards pertinent to the project site include the potential for sudden release of water stored in or dammed by the glaciers (jokulhlaups), and the tendency of the Valdez Glacier Stream channel to migrate laterally across the valley to the east. A previous study lists three glacier-dammed lakes on Valdez Glacier, posing "moderate (flood) hazard on the Valdez River floodplain" (Post and Mayo, 1971). Dumping history of these glacial lake outbursts is not recorded.

As part of an ongoing flood risk study, field reconnaissance trips to the glacier-dammed lakes in the summer of 1979 by Woodward-Clyde Consultants under contract to the City of Valdez have identified five glacial lakes within the drainage basin of Valdez Glacier Stream. One of the lakes was observed to be blocked off by a lateral moraine rather than an ice dam, and hence is not considered a potential threat. Visual observations and relatively high discharge values measured on Valdez Glacier Stream have shown that two of these lakes drained subglacially during the summer of 1979, releasing an estimated 71 million cubic meters (2.5 billion cubic feet) of water into Valdez Glacier Stream. The flow rate was between 142-170 cms (5,000-6,000 cfs). The fourth lake potentially could drain into either the Valdez Glacier Stream or Lowe River drainage basin. The fifth lake lies near the terminus of the Valdez Glacier and is fed by meltwaters from Camicia Glacier.

Water quality: The surface waters, particularly those of glacial origin, vary in quality during the year. The variance is seated in the suspended-sediment concentrations which are greatest in the summer and least in the early spring. Turbidity values are increased greatly due to increased fine sediment discharge.

The surface waters are of the calcium bicarbonate type and are considered medium to hard. The dissolved solids content shows seasonal variations and also variations from stream to stream. During the periods of high runoff, the concentrations of dissolved substances are low.

During the winter, since the surface flows are of groundwater origin, the concentrations of all chemical constituents are within EPA and State of Alaska drinking water standards. In the summer, suspended sediments (glacial flour, clays, silts) impart high turbidity, beyond the drinking water standards, to the waters of Valdez Glacier Stream, Slater Creek, and Corbin Creek (Glacier). Dissolved oxygen content ranges from 8 1/1 at the headwaters of Brownie Creek in winter, to 14 1/1 in Corbin Creek (Glacier) in summer. Values of pH are well within the State of Alaska water quality standards for most uses, ranging from 6.5 to 8.5.

Surface water winter temperatures range from 0°C+ (32°F+) in Corbin Creek (Glacier) to 4°C (39°F) in Brownie Creek. Corbin Creek (Robe) winter temperature also remains in the range of 2-4°C (36-39°F). Since Corbin Creek (Robe) and Brownie Creek are not directly glacier-fed (both are fed by groundwater), they are free of suspended sediments and maintain chemical and physical water-quality characteristics within the acceptable limits throughout the year.

Utilization of waterways and water bodies: Currently, no direct surface water consumption exists within the proposed project area. The only physical limitations for utilization of surface water during the periods of high flow are the high suspended sediment concentrations and the increased turbidity values. During winter, most of the streams are at zero or low flow and surface water for beneficial use becomes unreliable. Groundwater would be used for refinery construction and operation activities. There are no other navigational or commercial uses of the streams in the project area with the exception of occasional gravel extraction during low flow periods on the west side of Valdez Glacier Stream.

5.2.2 Groundwater

Regional groundwater conditions: The developable areas of the Valdez region are located in the larger valleys which have been carved by recent glacial action. The floors of these valleys are formed predomi-

nantly of very permeable sands and gravels, deposited by the glacial outwash streams. These permeable deposits compose the aquifers investigated for the proposed project. Recharge to the aquifers comes from the streams which flow through the valleys, as well as from the high amount of direct rainfall occurring during the summer months. During winter, many of the streams dry up as glacial melt and rainfall cease. Thus, recharge to the aquifers occurs primarily during summer months. The water table elevation probably declines during winter months due to the reduction of recharge, even where no man-made withdrawals are made.

Due to the low density of Valdez population and the absence of significant water-using industry in the region, very little use is being made of the existing groundwater resources. The nearest residential wells are 3.6 km (2¼ mi) south of the proposed refinery production wells. The only sizable uses include that of the Valdez municipal water supply wells, which withdraw a quantity estimated to be less than 3,785,000 liters per day (lpd) (1 million gallons per day [mgd]), and two intermittently used industrial wells located in gravel pits approximately 1.6-2.4 km (1-1.5 mi) northwest of the site. Due to the high rates of runoff and recharge experienced during summer months, it appears that very substantial quantities of water could be withdrawn before a significant lowering of the water table would result.

Site groundwater conditions: The site is underlain by two major aquifer systems: the upper, unconfined aquifer, and the lower, confined (or artesian) aquifer. The upper aquifer is highly permeable. Test pumping at rates approaching 7,600 liters per minute (lpm) (2,000 gpm) for 72 hours was not sufficient to cause measurable drawdown of the water table in observation wells 150 m (500 ft) from the pumped well. An observation well 15 m (50 ft) from the pumped well showed 1.2 m (4 ft) of drawdown during the test. The static water level (level of standing water in wells drilled into this aquifer) was found to vary from more than 18 m (60 ft) deep near the northern edge of the site, to the ground surface near the southern edge.

The upper aquifer appears to be the winter water source of Corbin Creek (Robe) and Brownie Creek, the streams which originate near the southern edge of the site. Investigations during the spring of 1979 noted that the Valdez Glacier Stream bed was dry, as were beds of other streams that traverse the proposed site; but open water was appearing in the Valdez Glacier Stream bed slightly upstream of the Richardson Highway bridge. The only known winter stream recharge to this aquifer in the vicinity of the site is a flow of approximately 0.14 cms (5 cfs) which enters at the eastern edge of the site via the Corbin Creek (Glacier) channel and promptly permeates the porous material of that streambed. In addition, some snowmelt and winter rains are believed to enter the soil directly with little or no runoff. Due to the highly seasonal nature of the groundwater recharge and the slope of the groundwater table, the water table elevation probably fluctuates rather widely over the year. Groundwater level data recorded during 1979 seems to verify this fluctuation; however, no field data is available for the winter season to verify the pattern.

The lower, confined aquifer seems to be separated from the water table aquifer. There is abundant water in the upper aquifer, and existing wells drilled in this region of the valley probably have penetrated only the upper aquifer. The static level of the lower aquifer lies much flatter than that of the unconfined formation, and in fact has about 2.7 m (9 ft) of artesian head near the southern boundary of the site. A 24-hour pump test at 1,250 lpm (330 gpm) was performed in a 15-cm (6-in) well drilled into the formation near the north edge of the site. The well drawdown recovery data indicated that, although of good permeability, the formation apparently has little if any recharge within the vicinity of the project site.

Logs of the wells and test holes and other field data appear in Appendix Vol. I.

Groundwater quality: The quality of the site groundwater meets or exceeds EPA and State of Alaska drinking water standards.

5.3 OCEANOGRAPHY

5.3.1 Introduction

Port Valdez is a glacial fjord approximately 5.5 km (3.4 mi) wide and 18 km (11 mi) long. With steep sides on the north and south, it has a nearly horizontal bottom at a depth of about 240 m (787 ft) over three-quarters of its length. The bottom rises rather uniformly in the easternmost quarter to the eastern shore at the former townsite of Valdez. The maximum depth of Port Valdez is 247 m (810 ft) in the southwestern corner while the overall mean depth is approximately 180 m (590 ft). At Valdez Narrows is a sill with a maximum depth of 160 m (525 ft) which limits direct exchange water below that depth of Port Valdez with the deep waters of Prince William Sound. The tides in Port Valdez are mixed, semi-diurnal with a mean height of 3 m (10 ft). The tidal prism is about 1.6 percent of the total volume of the port. Weather fronts, wind and runoff, in addition to tidal exchange affect the oceanographic conditions of Port Valdez.

5.3.2 Data Sources

Port Valdez has been the subject of two intensive surveys in the past nine years (IMS, 1973 and 1979). These studies first were initiated in response to the construction of the Alyeska marine terminal. In 1971-1972, an intensive one-year survey was undertaken to establish baseline conditions in the port and to describe the significant physical, chemical, biological and geological oceanographic features of the Port Valdez region. The second study, lasting 32 months from 1976-1978, continued the oceanographic baseline studies and developed monitoring procedures designed to detect changes in the environment resulting from the discharge of Alyeska's ballast water treatment system. The studies included extensive hydrographic sampling as well as various short- and long-term current meter stations. Both studies were undertaken by the Institute of Marine Science (IMS) of the University of Alaska.

A limited field program was undertaken as part of this investigation to supplement the existing data with physical oceanographic data essential to evaluating the proposed discharge. On May 12, 1979, current meters were deployed at two sites in eastern Port Valdez and one in Valdez Narrows. Each of the Port Valdez moorings consisted of continuous recording current meters at three depths, while meters at Valdez Narrows were installed at four depths. Also, a seven-station survey of salinity-temperature-depth (STD) profiles in the eastern quarter of Port Valdez was taken at low tide. A subsequent field effort on July 28-30, 1979, recovered the current meters. Additional STD profiles also were obtained at high and low tides at the stations occupied previously.

5.3.3 Physical Hydrology

Flushing: Studies in Port Valdez indicate that STD profiles are similar throughout the port except at the peak runoff time when eastern Port Valdez tends to be less dense at the surface than the western portion of the port. In March, densities (calculated from salinity and temperature) are nearly uniform, with little or no evidence of stratification. In April, solar warming increases the temperature of the upper waters and begins to melt the glacial streams. The freshwater flows continue to increase and reach their peak in July or August, resulting in stratification in the upper 20-30 m (66-99 ft) of the water column. During the summer this upper layer tends to flow outward due to the driving force of the advective freshwater inflow. Prevailing winds are toward the Gulf of Alaska (which tends to have low pressure) from the cold interior (which tends to have high pressure). Thus these winds are the primary outward driving force of the surface layers during the winter months. The surface waters then are replaced by an intrusion of denser bottom waters from Valdez Arm. As the temperatures drop in October and November, the stratification weakens, and eventually disappears by March allowing greater mixing of the port waters.

The two-layered flow driven principally by fresh water is only one of the mechanisms which causes replacement of the port waters. Current

measurements at Valdez Narrows are available for varying lengths of time during all seasons of the year. While current measurements confirm the classic estuarine flows of the high runoff summer stratified season, they also show two-layered reversing flows at other times of the year. The upper layer (20-50 m or 66-164 ft thick) flows opposite the lower layer and the layers can reverse directions over a period of several days. These direction changes correlate well with rapid changes in barometric pressure. The pressure changes, which are believed to be due to intense storm activity, result in large exchanges of water with Prince William Sound. For example, on May 19, 1979 the exchange of water in the port was about 8,000 cms (282 thousand cfs) resulting in a residence time in Port Valdez of 25 days. Although frequent at other times of the year, such storm activity is not frequent during the height of the freshwater runoff season.

In summary, Port Valdez has excellent flushing capacity for its size due to freshwater advective flows in the summer, and large weather-related exchanges of water during the rest of the year. Significant flow events occur at Valdez Narrows, possibly caused by storm-induced barometric pressure variations, and are instrumental in the good flushing characteristics of the port.

Circulation: Circulation patterns in the eastern end of Port Valdez are summarized based on continuous recording current measurements in the eastern port area (taken from May through July 1979) and the relation of these measurements to concurrent measurements taken at Valdez Narrows. Flows are east-west due to tidal currents except at the far eastern end, where flows turn north-south, parallel to the shoreline at the eastern port boundary. Two layers exist which flow opposite each other; the layer interface is approximately 20-50 m (66-164 ft) deep. Data from both this summer's study and earlier studies in the vicinity of Jackson Point indicate currents at depths greater than 15 m (50 ft) are generally low, 0.015 meters per second (m/s) (.05 ft/sec), which is at or below the limit of detection of the current meters.

Significant flow events at Valdez Narrows were found to affect current direction changes at the eastern end of the port near the proposed discharge. These events cause either northerly (counterclockwise) or southerly (clockwise) circulation patterns parallel to the eastern port boundary, with layers flowing opposite to each other. For example, a large flow event occurred at Valdez Narrows on May 18-20, 1979. In the eastern port area, the upper layer direction changed from southerly to northerly, with the reverse occurring in the lower layer.

Similarly, low flows at Valdez Narrows are associated with low velocities in the eastern end of the port. For example, a "quiet" period occurred from about June 17 to about July 15, 1979. During this period, currents were at or below the threshold value (lowest recordable value) of the current meters. Such periods occur primarily during summer months, when storm-driven circulation is at a minimum and freshwater runoff is near its annual maximum.

5.3.4 Chemical Hydrology

Water quality: Water quality in Port Valdez also was investigated during the IMS studies. Dissolved oxygen, pH and various trace metals were among the parameters investigated in the extensive earlier hydrographic studies. The lowest DO measured was 6.7 1/l in bottom waters in the winter. The flushing characteristics of the port appear to keep all waters well oxygenated. No standards violations for either DO or pH have been recorded. Trace metal concentrations also are within the expected ranges. Overall, the available data suggest that the port waters are a clean environment which easily permits "the intended use of Port Valdez for growth and propagation of fish, shellfish, aquatic life and wildlife, including seabirds, waterfowl and furbearers" (State of Alaska, 1979).

Current discharges: The water quality of Port Valdez is currently affected by two NPDES permitted discharges. The City of Valdez is permitted to discharge an average daily effluent of 1.25 mgd from its sewage treatment lagoon. The treatment plant discharges into a ditch

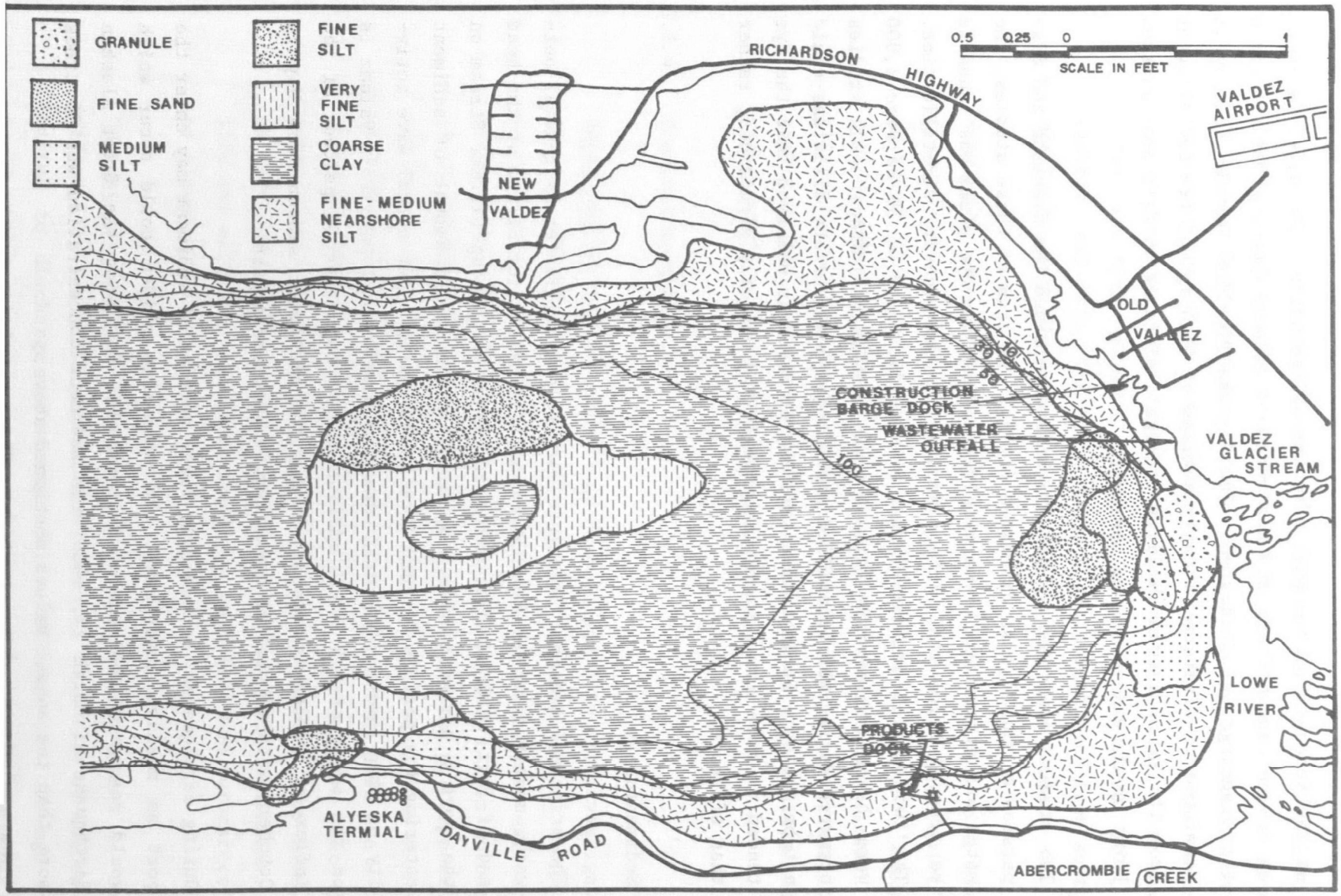
at the head end of the port near the old townsite. The ditch is known as Sewage Lagoon Creek and has become a salmon spawning habitat since the discharge was initiated. The Alyeska Pipeline Service Company is permitted to discharge a daily average of 41.4 mgd of treated effluent from its ballast water facility through a diffuser outfall near Jackson Point on the south side of the port.

Two studies conducted by the IMS have determined the dilution and dispersion of the Alyeska discharge (1979). In each of these studies, the water was stratified to varying degrees and the dye plume was found to be trapped below the surface because of this density stratification. The two studies indicated that initial dilutions of 30 to over 1,000 were being achieved by the Alyeska diffuser. Since both studies occurred during the stratified conditions, near-surface dilutions could not be tested. During these studies, it also was observed that the dye tended to move along shore in easterly and westerly directions, rather than offshore.

5.3.5 Sedimentology

The principal sediment load into Port Valdez originates as glacial outwash, mainly from the Lowe River and Valdez Glacier Stream at the head end of Port Valdez and from Mineral Creek and Shoup Glacier Stream on the port's northern side. A minor, undetermined amount of sediment entering the port is derived from bank erosion under normal wave activity or ship wakes. The mean annual sediment load into Port Valdez is on the order of 2.5 - 3.4 million tons. More than 95 percent of the influx of sediments occurs during the meltwater season from May to October, with 60 percent occurring in July and August.

During earthquakes, exceedingly large volumes of sediment may enter the port as massive landslides, and submarine slides could occur which would resuspend sediments. For example, following the Great Alaskan Earthquake of March 27, 1964, the sediment concentration was 30 times more than the annual values mentioned above.



INFERRED SEDIMENT DISTRIBUTION FOR EASTERN PORT VALDEZ

Figure 5.3-1

Bottom deposits: In general, sediments in the eastern portion of Port Valdez are poorly sorted clays and silts with local accumulation of sand and granule-sized sediment at the distal portions of the glacial outwash fans. Figure 5.3-1 shows the approximate distribution of surficial bottom deposits with coarse clay forming the dominant grain size. Mean grain size increases toward the mouths of the Valdez Glacier Stream and the Lowe River. The near-shore and intertidal zones around the port consist mainly of sand and mud, forming extensive tidal flats east of downtown Valdez due to the relatively high tidal range. Beaches, principally located near the high water level, consist of coarse granule to gravel-sized sediments.

The majority of bottom sediments tend to be fine to extra fine due to the mixture of clay-sized sediment in most samples. Clay is present in sediments throughout the port and along the near-shore zone. Fine-grained sediments generally are absent from beaches fringing Port Valdez near the high water level.

5.4 METEOROLOGY/AIR QUALITY

5.4.1 Meteorology

General climatology: The complex terrain surrounding Valdez and the proposed project location influences many aspects of the local climate. Port Valdez is virtually surrounded by the Chugach Mountains which, except for the south and southwest portions, are glaciated and rise to elevations exceeding 1,219 m (4,000 ft). The high mountain ridges to the north protect Valdez from extreme cold in winter and prevent the warmer interior air from reaching Valdez in summer. The mountains to the south provide a barrier to the warm, moist air from the Gulf of Alaska in winter, but any protection they provide in summer by modification of the marine air and the resulting increase in temperature is offset by cool drainage winds off the nearby glaciers. Temperatures average -8°C (18°F) during the coldest month (January) and 12°C (53°F) during the warmest month (July). Comparative mean temperatures for the

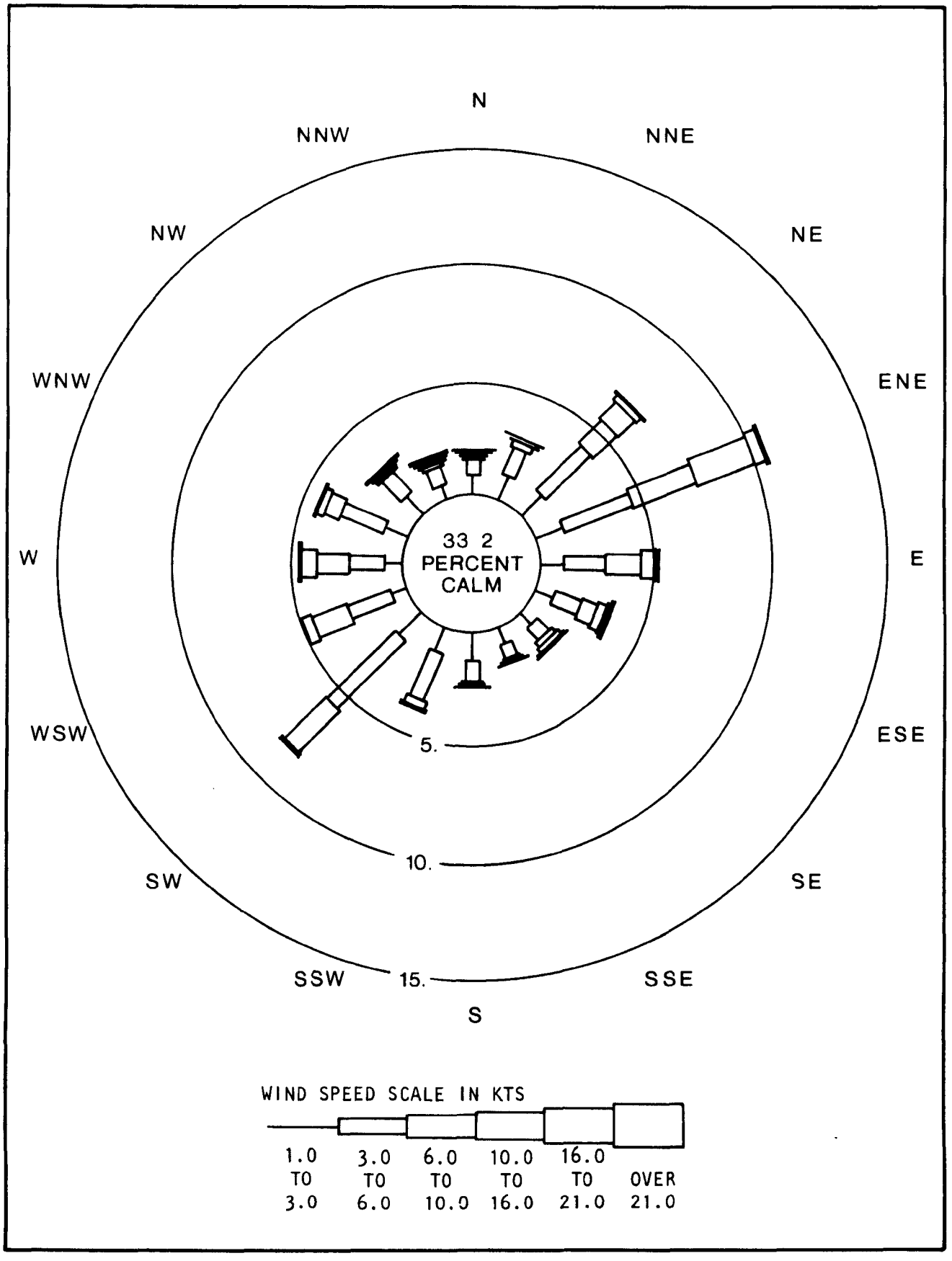
coldest and warmest months in Fairbanks are -23°C to 16°C (-10°F to 60°F), respectively. Temperatures reach -18°C (0°F) or below about 15 days annually in Valdez (USDC, 1978).

Rainfall is abundant in Valdez, averaging 150.7 cm (59.31 in) per year. September, the wettest month, averages 19.66 cm (7.74 in), while June, the driest month, averages 6.86 cm (2.70 in). Snowfall in Valdez is heavy, averaging almost 747.3 cm (294.2 in) annually, with an average of more than 100 cm (39.4 in) each month from December through March. There is considerable cloudiness the entire year.

The prevailing wind direction is from the northeast from October through April and from the southwest from May through September, demonstrating the strong influence of the local terrain. Annual percentage frequencies of surface winds for the 3-1/2-year period from July 1, 1975 through December 31, 1978 are shown in Figure 5.4-1. These data indicate that, on an annual basis, the prevailing wind direction is east-northeast. The annual average wind speed based on these data is 4.3 knots (2.2 m/s [4.9 mph]); and it is calm approximately 33 percent of the time.

Air pollution climatology: Meteorological conditions which lead to high air pollution potential are light winds accompanied by surface inversions and above-surface stable layers (limited mixing). Surface inversions are typically short-term, early morning phenomena; usually heating eliminates inversions and creates a uniform mixing layer by mid-afternoon. Mixing depth is defined as the surface layer in which relatively vigorous vertical mixing takes place.

Mixing depth data are available in the Valdez area as a result of two local studies. Starting in January 1979, acoustic measurements have been made at Alpetco preconstruction monitoring site No. 2 (see Figure 5.4-2) to obtain mixing depths. An earlier mixing depth study was conducted by the Alyeska Pipeline Service Company (Alyeska, 1974). Average seasonal mixing depths resulting from these studies are summarized in Table 5.4-1. The winter data from Alpetco Site 2 were



HOURLY AVERAGE SURFACE WINDS PRECENTAGE FREQUENCY OF OCCURANCE VALDEZ WSO WIND ROSE (7/75-12/78) **Figure 5.4-1**

Table 5.4-1

VALDEZ SEASONAL MIXING DEPTHS

(Meters)

Season	Valdez Airport	Lowe River	Shoup Spit	Valdez Narrows	Alyeska Terminal	Alpetco Site 2
Summer	221	-	194	186	166	-
Fall	-	221	-	111	-	-
Winter	-	184	-	105	-	734
Spring	-	-	-	-	-	310

Table 5.4-2

VALDEZ ANNUAL STABILITY CLASS FREQUENCY DISTRIBUTION

Stability Class	Definition	Frequency
A	Extremely Unstable	0.10
B	Unstable	4.62
C	Slightly Unstable	10.78
D	Neutral	63.11
E	Slightly Stable	5.35
F	Moderately Stable	9.42
G	Extremely Stable	6.62

biased by a "short" winter season, and an unusual windy period in February (Dames and Moore, 1979) which produced many mixing depths of 1,000 m (3,300 ft)--the limit of the instrumentation.

Variations of the seasonal mixing depths for four different time periods each day are given in Table 6.4 of Attachment C. Generally, the variations per time of day are fairly small, ranging from only 50 m (165 ft) at Valdez Narrows in the fall to approximately 500 m (1650 ft) at the Alyeska terminal site in summer.

The mean annual frequency distribution of stability classes for the 3-1/2-year period of record at Valdez (July 1, 1975 through December 31, 1978) is summarized in Table 5.4-2. The stability classes are based on Pasquill's classifications (Turner, 1964).

In the Valdez area, the high frequency of low wind speeds and corresponding poor ventilation is offset by a low frequency of limited dispersion conditions as evidenced by the fact that Stability Classes E, F and G, combined, were present only about 20 percent of the time.

5.4.2 Existing Ambient Air Quality

Ambient air quality levels in the vicintiy of the proposed facility are available as a result of Alyeska Pipeline Service Company's monitoring network and the preconstruction monitoring program established by Alpetco for the proposed project. Applicable state and National Ambient Air Quality Standards (NAAQS) are listed in Attachment C.

A summary of the first six months of data at Alpetco Sites 1 and 2, covering the period from November 20, 1978 to May 23, 1979 is presented in Table 5.4-3. Locations of Site 1 and Site 2 are shown in Figure 5.4-2. These data indicate that the air quality in the site vicinity is excellent; uniformly low values of all pollutants were measured. All pollutant concentrations were less than 20 percent of the applicable standards except for ozone and the maximum ozone concentration was only 50 percent of the NAAQS.

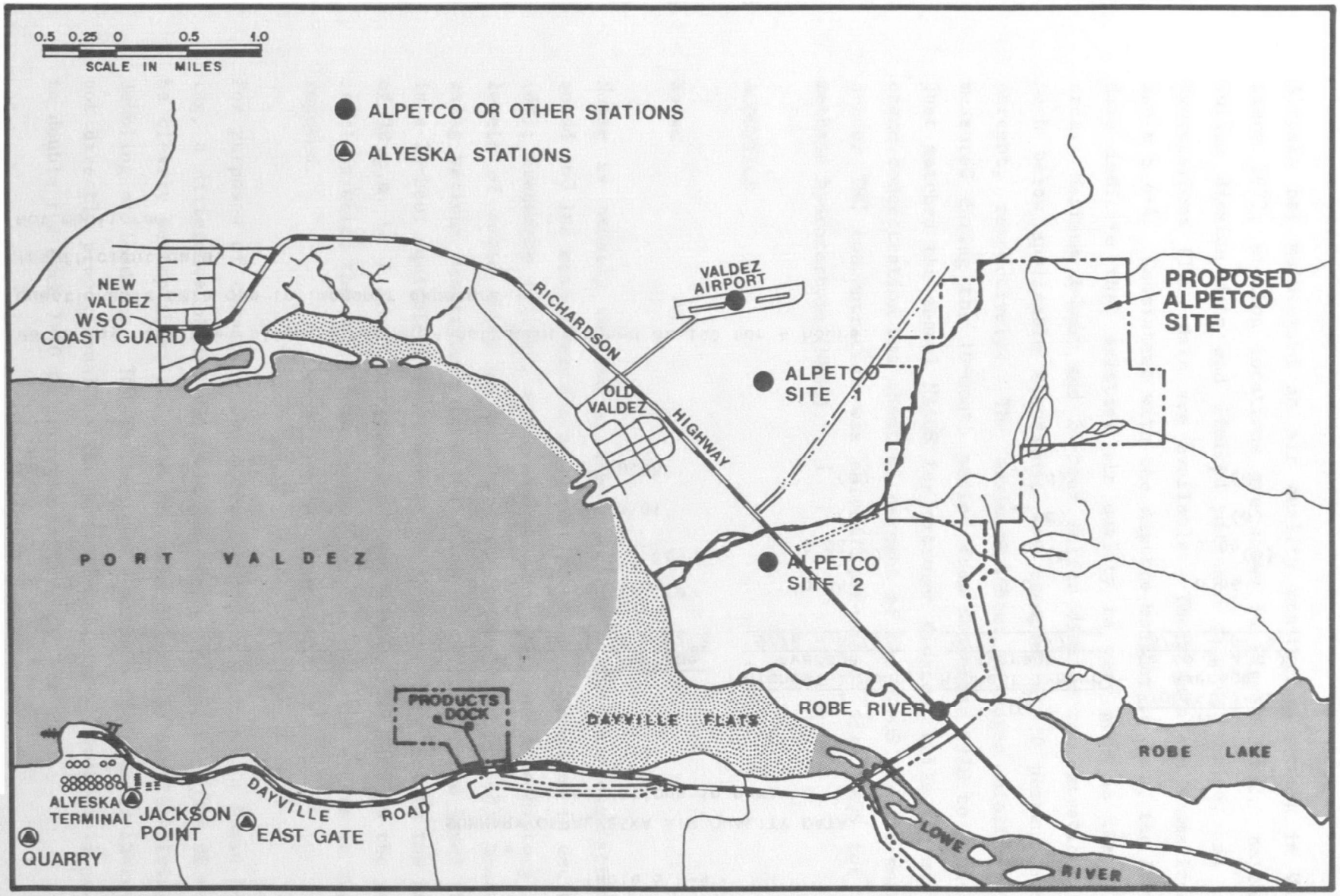
Table 5.4-3

FIRST 6 MONTHS SUMMARY OF AIR QUALITY DATA
ALPETCO SITES 1 AND 2
(November 20, 1978 To May 23, 1979)[a]

Pollutant	Averaging Period	Concentrations[b] Site 1	Site 2
SO_2	Highest 24-Hour Average	0.01	0.02
	2nd Highest 24-Hour Average	0.01	0.02
	Highest 3-Hour Average	0.01	0.03
	2nd Highest 24-Hour Average	0.01	0.03
TSP	Geometric Mean	6	5
	Highest 24-Hour Average	48	21
	2nd Highest 24-Hour Average	46	16
CO	Highest 8-Hour Average	2	1
	2nd Highest 8-Hour Average	1	1
	Highest 1-Hour Average	5	1
	2nd Highest 1-Hour Average	3	1
O_3	Highest Daily 1-Hour Average	0.05	0.06
	2nd Highest Daily 1-Hour Average	0.04	0.05
NO_2	Arithmetic Mean	0.003	0.004

(a) Attachment C

(b) Concentrations in ppm except $\mu g/m^3$ for TSP. The format of these tables is based on EPA recommendations for data reporting as given in 40 CFR Part 58 Appendix F (44 FR 27558 May 10, 1979).



LOCATION OF METEOROLOGICAL DATA SOURCE USED IN MCRSVAL MODELING ANALYSES

Figure 5.4-2

Table 5.4-4

SUMMARY OF ALYESKA AIR QUALITY DATA
(Concentrations in ppm)

	SO_2				NO_2	O_3	THC
	Highest 3-Hour Average		Highest 24-Hour Average		Highest 1-Hour Average	Highest 1-Hour Average	Highest 3-Hour Average (6 to 9 a.m.)
	9/77 - 8/78	9/78 - 6/79	9/77 - 8/78	9/78 - 6/79	9/78 - 6/79	9/78 - 6/79	9/78 - 6/79
Coast Guard Building	0.04	0.10[a]	0.02	0.02[a]	0.05	0.07	0.06
Robe River	0.03[b]	--[c]	0.01[b]	--[c]	0.01[b]	0.06[b]	0.04[b]
Quarry	0.07	0.05	0.01	0.01	--[d]	--[d]	--[d]
East Gate	0.06	0.08	0.04	0.03	--[d]	--[d]	--[d]

(a) Value may have been slightly higher--instrument pegged at 100 for 4 hours.

(b) Questionable data due to improper exposure.

(c) Insufficient data.

(d) Not monitored.

Alyeska has maintained an air quality monitoring network in Valdez since 1977; station locations are shown in Figure 5.4-2. Extensive sulfur dioxide data and limited nitrogen dioxide, ozone, and total hydrocarbons (THC) data are available. These data are summarized in Table 5.4-4. Consistent with the Alpetco monitoring data, the Alyeska data indicate that existing air quality is very good in the Valdez area. Maximum 3-hour and 24-hour sulfur dioxide concentrations were much below applicable standards, for example, at 20 percent and 29 percent, respectively. The maximum 1-hour nitrogen dioxide value measured during the 10-month period from Septemter 1978 to June 1979 just matched the annual NAAQS for nitrogen dioxide, while the maximum ozone concentration was about 60 percent of the NAAQS and the maximum 3-hour THC concentration was only 40 percent of the NAAQS for non-methane hydrocarbons (NMHC).

5.5 ACOUSTICS

5.5.1 Noise

Noise is usually defined as unwanted sound. The characteristics of sound and its measurements are: level (loudness), measured in decibels (dB); frequency (pitch), measured in Hertz (Hz); and time history (the levels of sound which occur over a particular time period), measured using various descriptors in units of dB. Day-night sound level (Ldn) is a 24-hour equivalent level with a 10 dB penalty applied to the hours of 10 p.m. to 7 a.m. Background ambient sound level (Lb) is the noise level on which the noise from intermittently occurring events is superimposed.

For purposes of comparing sound levels applicable here to human hearing, a difference of 1-2 dB would be barely perceptible; 3-5 dB would be clearly perceptible; and 7-10 dB would be an approximate halving or doubling of loudness. The judgment of a sound's loudness is therefore not directly proportional to the sound level, since loudness is judged to double for each 7-10 dB increase in level.

The result of combining two sounds is not additive. When two sounds are combined, the overall sound level is not normally more than 3 dB greater than the louder component.

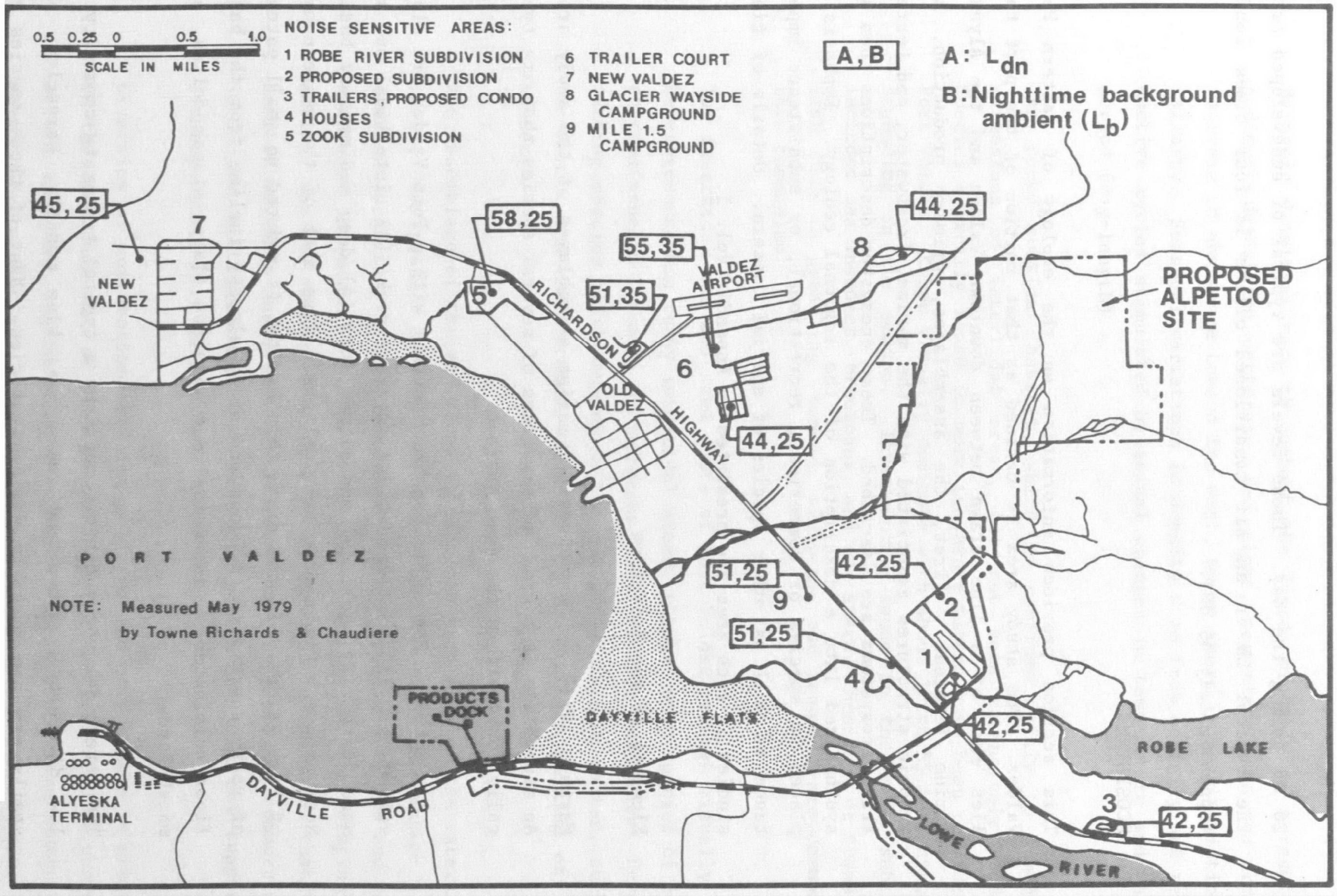
EPA Region 10 offers the following general noise guidelines: day-night sound levels greater than 70 dB generally have unacceptable public health and welfare impacts; significant adverse impacts are associated with day-night levels of 65-70 dB; adverse impacts are associated with day-night levels of 55-65 dB; and levels less than 55 dB generally are acceptable. Further, increases over the present ambient levels of up to 5 dB are considered to have slight impact; increases of 5-10 dB would have significant impact; and increases of more than 10 dB would have very serious impacts.

5.5.2 Noise-Sensitive Land Uses

Residential and recreational areas are the principal noise-sensitive land uses. Robe River Subdivision is the nearest permanent residential development to the proposed facility and Valdez Glacier Wayside campground is the nearest overnight facility (see Figure 5.5-1). There has been an expansion considered for Robe River Subdivision for the area between the present subdivision and the proposed refinery site.

5.5.3 Existing Sound Levels

Sound levels in the eastern Port Valdez area are quite low, with occasional vehicular traffic or light aircraft fly-overs being the only significant sources of noise. Existing sound levels in areas adjacent to the proposed site were monitored in April 1979. Day-night sound level generally is in the low to mid 40 dB range except near the highway and airport where the Ldn is about 10 db higher. Residential areas near large cities generally are about four times noisier (approximately 60 dB). The measured background noise level (Lb) was due primarily to cascading water; without the waterfalls, the fall and winter Lb on which refinery noise would be superimposed are about 24 dB at night and



EXISTING NOISE LEVELS

Figure 5.5-1

26 dB during the day. These levels are typical of undeveloped area; the typical Lb in an air conditioned office is four times louder (approximately 45 dB).

5.6 ECOSYSTEMS

This section provides information on the ecology of eastern Port Valdez. The study area is defined as that portion of the port that lies east of a line drawn between downtown Valdez and the Alyeska Marine Terminal. First, the assemblages, primary production, and trophic structures associated with the marine, freshwater, and terrestrial ecosystems are described. These ecosystem descriptions then are synthesized into a description of the regional ecology. Emphasis is placed on species of commerical, recreational, or subsistence importance as well as other species of special concern. Details of field studies in each area are presented in Appendix Vol. I.

5.6.1 Elements of the Ecosystem

Marine: This section discusses marine assemblages of the study area. An assemblage is a group of organisms of several species that are typically found within the same habitat.

Benthos: The major benthic habitats within Port Valdez are classified as: (1) intertidal and subtidal rock, (2) intertidal mud and sand flats, (3) subtidal mud slopes, and (4) deep sedimentary basin. Rocky shore and a narrow subtidal shelf line much of the western half of Port Valdez. In the east, this habitat is reduced to small patches of rocky substrate. A broad and steep sloping incline from the basin floor culminates in intertidal mud and sand flats, stream deltas, and marsh lands.

The intertidal rocky habitat supports a typical temperate community of low diversity. Brown and red algae, blue mussels, barnacles, and snails are the visually dominant species. Many of these species exhibit seasonal and spatial patterns of variation in population density.

Barnacle densities vary throughout the fjord, probably as a result of sediment deposition patterns. Red algae, sea stars, and sea urchins increase in abundance toward the west, where there is less variation in salinity. Seasonal variations in density stem from activity and reproductive cycles stimulated by annual changes in temperature and photoperiod (day-length).

The rocky subtidal habitat, which is confined mainly to submerged extensions of intertidal areas, has not been extensively studied. Species typically found in more temperate waters have been recorded in Port Valdez. Kelps visually dominate with about 15 to 55 percent cover depending on the season. Invertebrate fauna in the rocky subtidal includes sea anemones, bryozoans, and sun stars. Resident or transient fish such as greenling, tomcod, sculpins, and ronquils are common to this community.

The intertidal mud and sand flats of Port Valdez, though visually less heterogenous than rocky intertidal areas, support many species of polychaetes(annelid worms), crustaceans, and bivalve molluscs. Deposit feeding species which depend on the "rain" of organic matter, such as the worms and crustaceans, dominate in the eastern portion of Port Valdez.

The assemblage of the mud slope is distinct from that of the intertidal shelf, but grades into the deep sedimentary basin assemblage. The dominant organisms in all three habitats are bivalve molluscs and polychaetes. The mud slope also is used by tanner crabs for foraging and mating, and the abundance of very young individuals indicates that this habitat may be a nursery area. Tanner crabs are exploited commercially in Prince William Sound, but the local population will not support a fishery within Port Valdez.

Diversity of soft-bottom dwelling molluscs and polychaetes is greatest in the deep subtidal of Port Valdez. Species are distributed unevenly across the deep subtidal basin expanse, and studies have shown that statistically distinct groups segregate along its east-west axis. The

eastern group is dominated by deposit feeders, while the western group is dominated by suspension feeders (Feder and Matheke, 1979). The two areas support about equal biomass of consumers. This pattern reflects the gradient of sediment deposition in Port Valdez, with rates highest in the east near the mouths of glacial streams.

Notable epibenthos and nekton (highly mobile animals living on or above the bottom) include two species of panadalid shrimp, tanner crab, and Dungeness crab. Density, as sampled by trawl catches is lower than in other areas of Prince William Sound (Columbia Bay and Port Etches).

Plankton: Zooplankton (animals that drift with the current) assemblages of Port Valdez appear to be less diverse than those of fjords on the Gulf of Alaska, though they are similar in composition and structure. Zooplankton biomass follows the typical seasonal pattern, peaking in spring in response to the phytoplankton bloom.

Phytoplankton (microscopic plants that drift with the current) assemblages are highly seasonal, both in species compositon and levels of standing stocks. Typically, diatoms dominate the spring blooms, while dinoflagellates dominate the smaller fall bloom. Midsummer and fall production levels are relatively low due to the low salinity and high turbidity resulting from the influx of silt-laden glacial meltwaters (Alexander, 1979).

Marine fish: Fishes inhabitating the deepwater region of Port Valdez are poorly known. The limited data suggest that demersal fishes such as yellowfin sole, flathead sole, scupins, tomcod, and pollock are moderately abundant (Smith and Stoker, 1969). Other fish occasionally caught by fishermen include lingcod, greenling, and halibut (Alyeska, 1977). Starry flounder may constitute the most common fish found in the intertidal. Pelagic species that migrate into Port Valdez include red, silver, pink, chinook, and chum salmon and Pacific herring.

Marine birds: Approximately 90 bird species are found in the Port Valdez area. Nearly two-thirds of these species are associated with

the marine environment for at least a part of their life cycle. Most of these species inhabit the near-shore or intertidal zone and feed on benthic invertebrates of the shelf and slope communities. A lesser number prey on the inshore and pelagic fish species.

The time of peak activity is during the winter months when large numbers of sea ducks and dabbling ducks return from inland breeding grounds to spend the winter in near-shore areas of Port Valdez. Loons, grebes, mergansers, gulls, and alcids also winter in this region. Barrow's Goldeneye is the most abundant species during this time period. Diving duck densities averaged 10.3 birds/km of shoreline in the winter of 1977-1978 (Sangster, 1978).

The major feeding areas for these wintering birds at the east end of Port Valdez are located at Solomon Creek and Allison Point on the south shore, and Island Flats, east of downtown Valdez on the north shore.

Migrating geese, dabbling ducks, and some shorebirds utilize the intertidal and marsh areas during spring and fall migrations. However, their numbers are relatively low (in the hundreds).

Summer is the period of least activity for marine birds in Port Valdez. Gulls are the predominant species and are found mainly along salmon-spawning streams, where they feed on salmon carcasses, and around the city landfill.

The closest large seabird colonies include a black-legged kittiwake and Arctic tern colony at Shoup Bay near the west end of Port Valdez. Small numbers of Arctic terns nest on the small islands off Island Flats and along the outside beach of Valdez Harbor. Waterfowl nesting occurs primarily in Shoup Bay, with some activity on Mineral Creek delta.

Primary production: Rates of net primary production in Port Valdez have been reported to be impressively high. However the general applicability of earlier studies and the importance of open-water phyto-

plankton production in Port Valdez to marine systems in Valdez Arm or Prince William Sound is uncertain. Mudflat assemblages appear to depend primarily on plant material from marsh grasses and phytoplankton. Such assemblages also depend to a lesser degree on local benthic algae and seagrass. This is a consequence of the bathymetry, salinity, turbidity, and substrate of Port Valdez, which impose specific developmental limitations on marine plant resources and restrict them primarily to the western end of the port.

Trophic structure: Energy pathways for the major marine communities of Port Valdez are short and comparatively simple. Low levels of primary productivity limit the energy flow through the ecosystem. This is reflected in the low species diversity and standing stocks of primary consumers and predators. Phytoplankton, benthic diatoms, algae, seagrasses, and marsh and terrestrial plants all contribute to the supply of organic energy at the base of the food web.

Energy pathways in Port Valdez are divided into two systems, linked only at their terminal points. Both rely primarily on the consumption of plant material. The pelagic system depends mainly on the primary consumption of living plant material to transfer organic energy from plant to animal tissues, as is the case in classic terrestrial food webs. In sharp contrast, in the benthic system most of the plant material is converted to organic debris, or detritus, by physical action and/or microbial degradation. Detritus then is ingested by both suspension feeders and deposit feeders primarily for the colonizing bacteria, which constitute a nitrogen-rich diet. The detritus is subsequently egested, usually having been ground into smaller particles. In a few days, following bacterial recolonization, the particles may be reingested to begin the cycle anew.

Predators on primary consumers in the shallow benthic system include starry flounders, sea ducks, shorebirds, and sea stars. Shorebirds and salmon fry prey on harpacticoid copepods. Starry flounder and sea ducks feed extensively on the intertidal clams and crustaceans. Starry flounder subsequently are eaten by seals and sea lions, and salmon fry

are the prey of fish and diving marine birds. Few members of this group are strict residents of the fjord. Thus, it appears that much of the energy transformed by consumers in the shallow habitats ultimately is transported to other systems, sometimes quite far removed from Port Valdez.

Primary consumers of the slope and deep subtidal habitats are preyed upon by tanner crabs, shrimp, and demersal fish such as tomcod. Predators at the next levels include fish, seals, and salmon. Seals, sea otters, and sea lions are the ultimate predators of the system.

In the open-water assemblage, direct consumption of phytoplankton by copepods is an important interaction. In addition to transforming large amounts of energy, this interaction facilitates the movement of detritus from the euphotic zone (where light levels permit photosynthesis) to the deep subtidal zone. In the open waters overlying the deep subtidal zone, two energy pathways exist. The first links chaetognaths (a planktonic predator) with pelagic forage fish, a series of vertebrate predators such as salmon, marine birds, seals, sea lions, killer whales, and ultimately, with man. In the benthic detrital pathway, tanner crabs and pandalid shrimp are important predators on primary consumers. The benthic pathway rejoins the open-water pathway through the same series of vertebrate predators.

Species commercially exploited by man primarily are associated with the open-water and offshore assemblages. These assemblages include pelagic forage fish, marine mammals and birds. In the offshore benthos, tanner crabs and pandalid shrimp are important predators on primary consumers. Most ecologically important interactions occur there. However, the inshore areas support the out-migrating fry of pink and chum salmon, which spend their first several weeks in marine shallow waters feeding on benthic and planktonic crustaceans. At this point in their life, they are particularly susceptible to perturbations in food supply. The inflexible migratory patterns of salmon fry and their limited fat reserves establish the conditions wherein gross alterations in the quality or quantity of inshore habitat could damage seriously the sport fishery of Port Valdez.

Freshwater systems: The assemblages, primary production, and trophic structures of the freshwater systems in the Valdez area vary widely according to the river or stream system considered. Therefore, the rivers and streams potentially affected by development of the proposed facilities have been divided into five major groups to facilitate the discussion of their ecological characteristics. These groups are: (1) the Valdez Glacier Stream System; (2) Corbin Creek (Robe) and Brownie Creek; (3) the Robe River; (4) the Lowe River System; and (5) additional tributaries of eastern Port Valdez.

The Valdez Glacier Stream System: The Valdez Glacier Stream System is that freshwater system closest to the proposed refinery. The system includes the Valdez Glacier Stream and its two major tributaries: Slater Creek and Corbin Creek (Glacier). All of the above streams receive a major portion of their flow from glacial meltwater. Common physical characteristics, typical for streams of glacial origin, include high midsummer flow, little or no winter flow, and turbid water due to the presence of glacial silt. The biological productivity of these streams is extremely low, and within some stream sections may be nonexistent. Documentation of fish usage is limited to one unidentified fish in Slater Creek (see the Appendix Vol. I) and a small number of eulachon in Valdez Glacier Stream (Johnson and Rockwell, 1978). Detailed information on ecosystem structure is lacking. Production of plants and stream dwelling invertebrates can be assumed to be small. An isolated portion of the upper end of Corbin Creek (Glacier) contains clear flowing water in the winter and may sustain a minimum year-round aquatic community. The lower portion of Corbin Creek (Glacier) freezes to the bottom in winter.

Corbin Creek (Robe) and Brownie Creek: Corbin Creek (Robe) and Brownie Creek are two small stream systems that drain the area adjacent to the southern boundary of the proposed refinery site and flow south into Robe Lake. These streams derive their flows primarily from groundwater input and are characterized by year-round discharge, clear water, and partially ice-free conditions in the winter. Biological communities are moderately well-developed. Corbin Creek (Robe) sup-

ports the greatest number of silver salmon spawners (up to 4,839 fish) of any Port Valdez drainage (ADFG, 1978) and also contains a resident Dolly Varden population. Silver salmon spawning occurs from late August to early November. Brownie Creek supports up to 9,188 spawning red salmon per year (ADFG, 1977), serves as a rearing area for red and silver salmon, and contains a large Dolly Varden population in the summer. Red salmon spawning occurs from mid-June to late September. Information on other members of the biotic community within the above streams is scant. Invertebrates appear to be moderately abundant. Some production of plant matter occurs in these streams; however, it is likely that much of the organic matter needed to support the aquatic ecosystems is derived from the surrounding terrestrial areas (leaf litter). The yearly input of organic matter and nutrients from salmon carcasses undoubtedly is another important factor in sustaining productivity.

The Robe River: The Robe River, which would be crossed by the proposed crude oil and products pipelines and service road, connects Robe Lake with Port Valdez. Salmon are the most important biological resource. The river serves as a migratory corridor for silver and red salmon enroute to Robe Lake tributaries such as Corbin Creek (Robe) and Brownie Creek, provides spawning habitat for substantial numbers of pink and chum salmon, and provides rearing habitat for silver and red salmon. Dolly Varden and three-spine stickleback are also present. Other components of the biota are poorly known. The Robe River probably should be considered highly productive relative to other streams in the vicinity.

The Lowe River System: The large Lowe River system enters Port Valdez at its southeastern corner. Pink, chum, and silver salmon spawn within tributaries of this glacial river. Red salmon and Dolly Varden also use this system. The other components of the biota are poorly known; however, biological communities are probably well-developed. The Lowe River, like the Robe River, should be considered highly productive.

Additional tributaries of eastern Port Valdez: Eleven short streams flow directly into eastern Port Valdez. All of these streams provide spawning habitat for pink and/or chum salmon. One short stream of particular interest is Solomon Gulch Creek, adjacent to the proposed products dock. Moderate numbers of pink salmon spawn within the intertidal zone at the mouth of Solomon Gulch Creek. Peak numbers occur in odd years and spawning takes place from late June to late August.

Terrestrial assemblages

Vegetation: The vegetation occurring in and adjacent to the proposed refinery site can be classified by floristic components into four major communities (1) deciduous forest, (2) alder shrub, (3) spruce forest, and (4) freshwater marsh; and one minor community, riparian woodland.

Deciduous forest dominated by black cottonwood is the largest and most widespread community in the proposed site. This plant complex occurs throughout the central portion of the site along the floodplain of the Valdez Glacier. This type of deciduous forest is typical of vegetation occurring in old glacier floodplains throughout the region and appears to be a sub-climax state of the spruce forest. All successional stages of deciduous forest development are present in the area, ranging from open stands of immature black cottonwood, alder, and willow (with an understory of lichens, moss, fireweed, and grass) to mature, closed-canopy cottonwood forest (with a dense understory of devil's club, alder, mountain ash, and ferns). The understory, although generally limited to the elements cited above, varies in density and species distribution within the on-site deciduous forest. The ground-cover element of the mature cover-canopy forest typically is wintergreen.

The alder shrub community is found above the 30 m (100 ft) contour of all mountain slopes around the refinery site. The dominant species is alder with lesser occurrence of mountain ash and red-berried elder. The understory is dominated by devil's club and salmonberry. Bent grass and false helebore occur in open areas throughout this community.

Spruce forests are the least abundant vegetation type in the vicinity of the proposed site and are generally located in the service road/ pipeline corridor to the southeast of the refinery site. In the older spruce forests, the species deversity is relatively low with the understory dominated by devil's club, alder, and marsh ferns. Blueberry, stink current, and salmonberry are present, although relatively sparse. Ground cover basically consists of wintergreen and enchanter's nightshade. Spruce forests mix with deciduous forests in much of the area south of Corbin Creek (Robe).

Riparian woodland is a minor community type that occurs along the streams of the proposed refinery site. Vegetation occurring in riparian woodlands consists of dominant shrubs such as willow, alder, and black cottonwood, with an occasional Sitka spruce, and an understory of lichens, bedstraw, and horsetail. Species diversity throughout this area is very low. The largest riparian woodland on the refinery site is located on the east bank of Valdez Glacier Stream. Other large communities in this area are located on the west bank of the Valdez Glacier Stream and on the north bank of the Lowe River where it enters Port Valdez. Smaller communities are located on Corbin Creek (Glacier) in the eastern portion of the proposed refinery site and along Brownie Creek. The smaller riparian communities are characterized by differing floral compositon and closely resemble adjacent deciduous forests.

Several freshwater marshes are located on each side of the transportation/pipeline corridor south of the refinery site. The most significant of these is located in the old bed of Robe Lake. Two smaller marshes are located north and northwest of the Robe Lake marsh. All these marshes are characterized by standing water and are dominated by moss and emergent aquatic vegetation such as horsetail, buckbean, and sedge. Decreasing water levels in Robe Lake have resulted in dramatic increases in aquatic vegetation in the large associated marsh. The occurrence of such freshwater marshes is unusual in the Port Valdez and Prince William Sound areas.

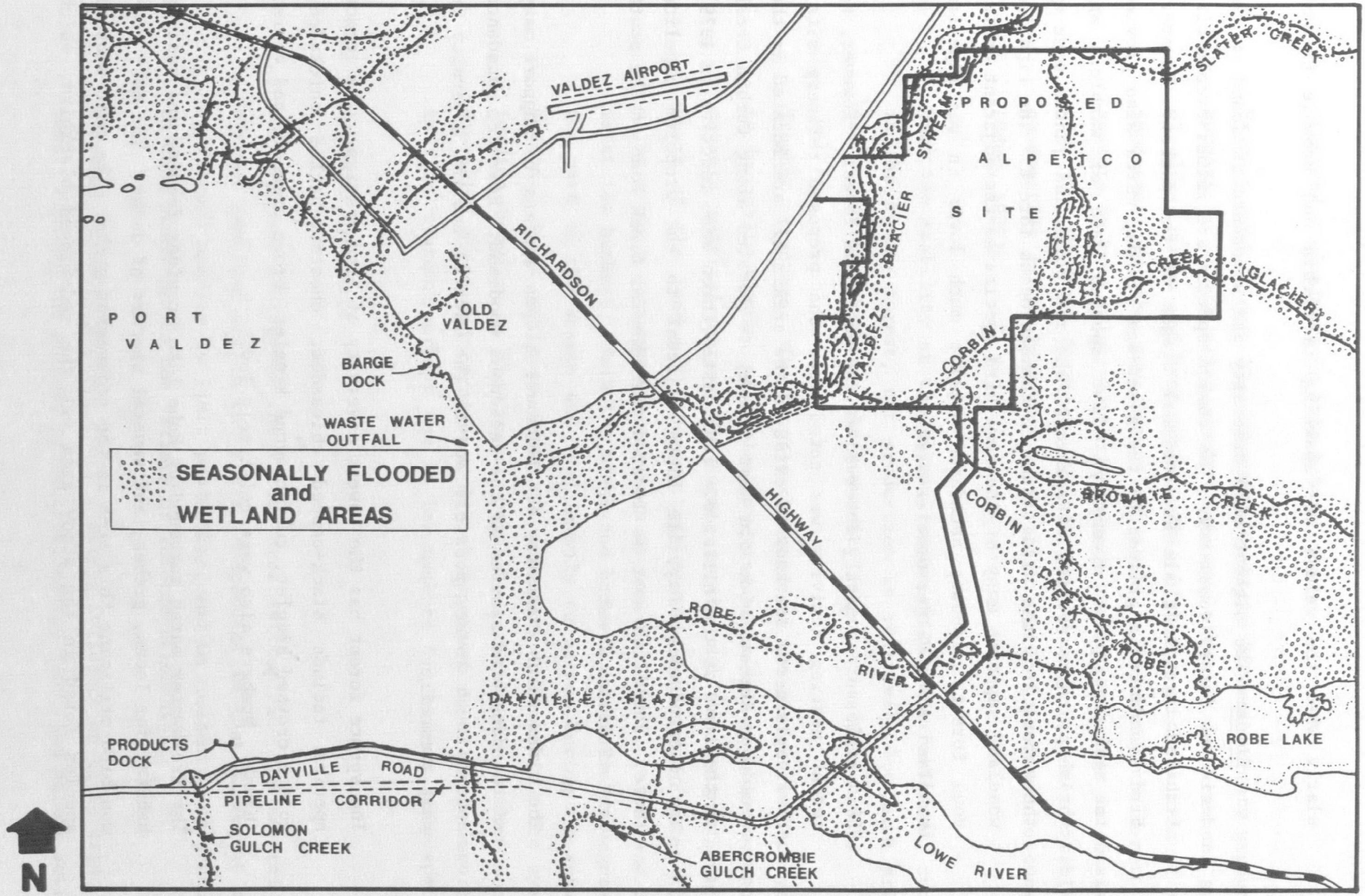
Wetlands: The Corps of Engineers (COE) describes wetlands as "those

areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Federal Register Vol. 42, No. 138, Tues. 19 July 1977). The proposed project site being located contiguous to various streams, marshes and headwaters does contain wetland areas that meet the above description.

Delineation of wetlands was based on COE criteria. Seasonally flooded land, all permanently flooded land, lands of saturated soil, intertidal lands, and lands currently supporting hydrophytic species were included. In areas of high surface water infiltration rates and high groundwater percolation rates, the distribution of certain plant species was used only as a general guide. Wetland limits in these cases were defined by the flood debris line, the silt line, or an estimate of the one- to two-year flood recurrence elevation. In areas of braided stream channels, the outer limits of the channel pattern were used. Valdez Glacier Stream, Slater Creek, Corbin Creek (Glacier), Corbin Creek (Robe), Robe River, Lowe River, Abercrombie Creek, and unnamed tributaries attendant to these systems have wetlands which are delineated as mentioned above. Figure 5.6-1 shows the wetland areas relevant to the proposed project.

Mammals: Mammal diversity throughout these communities is relatively low. The most common small mammal species is the red-backed vole, which occurs in all habitats but is most abundant in the deciduous forest. Only two other species, the masked shrew and the tundra vole, are found in significant concentration between the alder shrub community and the deciduous forest.

Although 24 other species of mammals are believed to frequent this area, the only species of major significance are the black and brown bears. Black bears are common throughout this area in a variety of habitats from late spring to fall. Black bears feed both on vegetation (salmonberries, blueberries, fern and horsetail) and spawning salmon (McIlroy, 1970). Brown bears are also common summer residents, partic-



SEASONALLY FLOODED AND WETLAND AREAS **Figure 5.6-1**

ularly when the salmon are spawning in Corbin and Brownie Creeks.

Birds: The highest bird diversity and abundance is found in the deciduous forest community. The common species are rather evenly distributed throughout all successional stages of the forest. However, bird abundance is greater in the mixed-age stands, which also provide the greatest plant diversity. Five species each of warblers and thrushes, three species of sparrows, and red polls and juncos made up the majority of the birds found in the deciduous forest. The riparian woodland supports many of the same bird species as the adjacent deciduous forest, although abundance appears much lower in the riparian woodland along Valdez Glacier Stream.

Bald eagles are commonly observed in the deciduous forest. However, no recent nesting activity was noted near the proposed refinery site. Five eagle nests are know to exist in the area. All are located in the deciduous forest. One old nest remnant is located along Corbin Creek at the base of the hillside. Four nests (three were inactive in 1979) are located near Dayville Flats adjacent to the proposed pipeline route. The fifth nest is located near Mineral Creek Road on the south fork of Siwash Creek.

The alder shrub community of the lower slopes appears to support many of the same bird species as the deciduous woodland. However, abundance appears much lower, possibly due to the lack of habitat diversity in this community.

The spruce forest has the lowest diversity of bird species. The common species include black-capped chickadee, chestnut-backed chickadee, golden-crowned kinglet, ruby-crowned kinglet, brown creeper, and varied thrush. Numbers also were relatively low.

The freshwater marsh surrounding Robe Lake provides feeding and nesting habitat for loons, grebes, and several species of ducks. The most common bird utilizing this area is the red-necked grebe. The most unusual species found in the study area was the red-winged blackbird, which

occurred exclusively in this habitat type.

Primary production: The community with the highest primary production appears to be the alder shrub community, with its dense annual growth of alder, ferns and bent grass. This high net production is of major importance in the development of soils. The deciduous forest also appears to have relatively high primary production. This is consistent with the observed tendency for net productivity in newly established communities to be high due to the high ratio of producer to consumer (Odum, 1959).

Once the stability of the climax community has been attained, such as in the spruce forest, net production is relatively low with primary production approximating the community respiration (Odum, 1959).

Trophic structure: The trophic structure of the terrestrial ecosystems is basically simple, with plant species assimilating large amounts of organic material during the summer months and thereby providing the basis of the food web. During this period, consumption rates of the major primary consumer species such as insects, birds, voles, and bears is at its highest. Both the black and brown bears browse on vegetation for part of the season and feed heavily on salmon during the spawning season. Birds are also important secondary consumers in the system, feeding heavily on the insect population during the summer months. Raptorial birds and carnivores do not appear to be of major importance in this system, perhaps due to low numbers of resident prey species.

5.6.2 Regional Synthesis

The regional ecology of the Valdez area is complex. The several ecosystems involved are in one sense independent in that different sorts of factors operate to limit production, and in another sense dependent on each other due to the variety of interrelationships.

Seasonal climatic factors exert a strong influence on terrestrial systems. Most of the primary production, energy flow, and animal activity

occurs during the summer months. In contrast, the marine and perpetually flowing freshwater ecosystems are influenced less by extremes in temperature and snowfall. The Port Valdez marine environment has a peak primary production in spring followed by a drastic reduction in summer because of increased suspended sediments. Energy flow through the higher food chain levels occurs all year within the marine system. The productivity of the Valdez area as a whole is probably moderate relative to other Alaska coastal areas.

The freshwater ecosystems appear to be the most dependent on other systems. Organic matter supplied to streams by the surrounding forest and by the annual salmon migrations provide an energy base upon which higher levels in the food web can build. The salmon provide an ecological link between the open ocean, estuarine, freshwater, and finally terrestrial ecosystems, where they are consumed by bears and other animals. Some flow of energy and nutrients also occurs in the reverse direction as streams carry organic matter and chemicals from the forest to the sea. Salt marshes and other intertidal habitats supply important quantities of plant matter to detritus-based benthic communities within the mudflats and deepwater areas. Birds and marine mammals feeding within the estuary transport energy to other ecosystems, sometimes far removed from Valdez.

5.6.3 Field programs

This section provides a brief description of field studies undertaken to establish baseline data about the proposed project area. Details of the programs and finds are in the Appendix Vol. 1.

Marine: Various alternative sites were surveyed intertidally and subtidally using quantitative sampling techniques and complemented with qualitative visual assessments.

Freshwater: Limited field investigations were conducted to determine the characteristics of freshwater aquatic habitats near the proposed refinery site. Some additional information of these habitats was col-

lected during the salmon fry dispersion studies.

Terrestrial: Field programs were conducted in the project area to determine the characteristics of terrestrial communities and ecosystems. Small mammal characteristics were determined by transect sampling and a limited qualitative mapping survey. Characteristics of the bird and large mammal populations were determined by random qualitative evaluation. Vegetation and characteristics were determined by transect sampling.

5.6.4 Commerical, Recreational, and Subsistence Use of Systems

Marine: Commercial salmon fishing in Port Valdez has been closed since the mid-1950s to protect spawning stock. However, pink and chum salmon are fished in Valdez Arm and in eastern Prince William Sound using purse seines. Utilizing average escapements and assuming that contribution to the fishery is proportional to escapement, it has been calculated that approximately 20 percent of the pink salmon caught in that fishery during odd years is contributed by the major Island Flats streams (City Limits, Siwash, Loop Road No. 1, and Loop Road No. 2) and the Lowe River and Robe Lake systems (Dames and Moore, 1979). The largest pink salmon escapement of any stream in the eastern management district for 1973 and 1975 was in Siwash Creek (Pirtle, 1977). Also, about 1 percent of the chum salmon harvested commercially are contributed by the Island Flats streams (Dames and Moore, 1979).

The once-substantial commercial salmon fishery may be enchanced in the future by the Valdez Fisheries Development Association. The association in the fall of 1979 constructed a pink and chum salmon incubation facility with a capacity for 1-1/2 million eggs adjacent to City Limits Creek, and, pending additional funding, plans to construct a similar facility near Solomon Gulch. In late September 1979 the association was filing permit applications for the Solomon Gulch facility.

A very intensive salmon sport fishery exists in Port Valdez during July and August. The major species fished include the silver salmon (which

spawn in the Robe Lake and Lowe River systems) and pink and chum salmon. Additional species fished recreationally include saltwater fish, such as halibut and red snapper, as well as Dolly Varden char entering stream in the fall

A minor subsistence fishery for halibut and Dungeness crab exists. Most of the fishing for the latter occurs near the eastern end of Port Valdez.

Freshwater: Difficult access combined with the long-standing closure of Port Valdez tributary streams to salmon fishing has prevented recreational or subsistence utilization of fish resources within streams on or near the proposed refinery site. Some sportfishing for Dolly Varden occurs in the Robe River and Robe Lake. In addition, some future potential may exist for a Dolly Varden sportfishery in Brownie Creek.

The Robe Lake system, including Corbin Creek (Robe), Brownie Creek, and the Robe River, provides important spawning and rearing habitat for salmon species that contribute to the sport and commercial marine salmon fishery described above. Other tributary streams of eastern Port Valdez also provide salmon habitat. The proposed products dock would be constructed about 610 m (2,000 ft) east of the mouth of one such stream: Solomon Gulch Creek.

Terrestrial: Hunting is permitted in areas 1.6 km (1 mi) or greater from the Richardson Highway. Potential hunting pressure on black bear is considered high is the Valdez area while potential hunting pressure on moose, generally occurring in the Lowe River Valley, is considered low. Mountain goat are hunted heavily in the surrounding mountains. Migratory waterfowl hunting occurs on the north side of Robe Lake (Brantley, 1979). Sport trapping of land otter, lynx, wolverine, and mink exists in the Valdez area.

The habitat in the spruce forest along the corridor is suitable for blueberry and salmonberry picking.

5.6.5 Species of Special Concern

Marine: All marine mammals are protected under the Marine Mammal Protection Act of 1972, which prohibits the taking (except by natives) of any species. Marine mammals found in Port Valdez include harbor seal, sea otter, Steller (Northern) sea lion (Pitcher, 1975; Dames and Moore, 1979), harbor and Dall porpoise, and killer whale (Perkins, 1979). Minke and hump-backed whales may use Port Valdez infrequently.

Sea birds are protected under various treaties and acts, including the Migratory Bird Treaty Act of 1918 (as amended), the Japanese-United States Migratory Bird Treaty, and the Canadian-United States Migratory Bird Treaty. These treaties specifically prohibit destruction of the birds, the taking of their eggs, and any harassment that leads to mortality.

The American bald eagle is protected under the Bald Eagle Act of 1940, as amended in 1972. The act prohibits harassment or destruction of the birds, their eggs, and nests. It has been an accepted practice in Alaska to impose a protective zone of 91 m (300 ft) around nest trees on federal property. Human activities that could potentially disturb bald eagles are discouraged within this zone. Such activities include logging, development of industrial site, use of chemicals toxic to eagles, and even human entry into the zone during critical nesting or breeding periods. There are five known American bald eagle nests (three were inactive in 1979) in the vicinity. The locations of these nests are described above in the bird subsection of Section 5.6.1.

Freshwater: The four Pacific salmon species inhabiting freshwater habitats within the proposed development area are all of special concern because of their economic and ecological importance. Silver salmon, the most important sport fish species, are the most vulnerable because of limited spawning and rearing habitat primarily in Corbin Creek (Robe). Red salmon from the remnant Robe Lake population are not commercially important at present; however, the potential exists for enhancement and possible future exploitation. Pink and chum salmon are

the most abundant species.

Terrestrial: Endangered species that may migrate through the Valdez area in the spring and fall include two peregrine falcon subspecies: *Falco peregrinus anatum* and *F. peregrinus tundrius*. *Falco peregrinus pealei* nests in Prince William Sound but is not considered an endangered species (Benfield, 1979). There are no records of endangered species in the project area (see Section 9.4).

Black bear and brown bear are found in the Valdez area. The latter is particularly common along Corbin Creek (Robe) and Brownie Creek near Robe Lake. Both bear species frequent garbage dumps and occasionally raid human dwellings (it is well documented that bears have attacked and injured people in the Valdez area). Brown bear, in particular, are known for incompatibility with human activity and, as such, constitute a species of special concern.

5.7 ARCHAEOLOGICAL AND HISTORICAL FEATURES

A three-part program was designed to locate significant historic and prehistoric sites within the proposed project area. A literature search, focused on habitat parameters, was followed by helicopter reconnaissance and an on-the-ground archaeological survey search for significant historic and prehistoric features. In addition, several Valdez residents were questioned concerning their knowledge of possible significant sites in the project area. No significant historic or prehistoric sites were revealed through the literature review, the surveys or the interviews with Valdez residents.

5.7.1 National Register of Historic Places

Consultation with the Alaska State Historic Preservation Office produced confirmation that no sites listed on the National Register of Historic Places, or known to be eligible for listing on the Register, are located within the boundaries of the project area and related offsite facilities.

5.7.2 Archaeological Resources

Archaeological research has demonstrated human presence along the North Pacific Rim since at least early Holocene times (the period since the last major glaciation, roughly the past 10 thousand years) and possibly earlier. Late Holocene times saw the occupation of Pacific Eskimos along the shores of Prince William Sound. Athapaskan speaking Indians (Eyak and Ahtna) inhabited the adjacent interior regions.

Aboriginal population along Prince William Sound remained undisturbed until the search for precious metals brought hundreds of prospectors to Port Valdez. An overland trail quickly became established over the Valdez Glacier, and the Gold Rush of 1898 saw it clogged with men and supplies.

The U. S. Army quickly recognized the need for an alternate route to Interior Alaska, and in 1899 work was begun on what was to become known as the Richardson Trail. Within the first two decades of the Twentieth Century, three unsuccessful attempts were made to construct a rail link between the Port of Valdez and the newly discovered copper fields at the headwaters of the Copper River.

Later gold rushes, farther inland, helped maintain a flow of men and goods through Valdez and along the then-completed Richardson Trail. Hard-rock miners attempted to unlock the minerals from the mountains surrounding Valdez, and fishermen began to fish the rich waters of Prince William Sound.

Valdez tradition, anchored in the historic events just described, is revealed through a well preserved material culture record. Much of this record is housed in the municipal museum. A search of the proposed refinery site and pipeline and access corridors revealed no record of the historical events which created Valdez. A concentrated effort also produced no documentation of the prehistoric peoples presumed to have inhabited the region.

5.8 SOCIOECONOMICS

This section describes baseline conditions dealing with population and employment, public sector revenue and taxation, public services, land use and housing, transportation and utilities. Subjects are discussed at the state, regional and local levels, as appropriate to the probability of impact.

The planning horizon adopted for the study is 1979-1990, a period within which trends can be extrapolated with some degree of confidence. During this time frame, the Alpetco project could have been built and in operation for a period of six years, and nearly all requirements to serve the new population with housing and public services would have been met.

5.8.1 Population Characteristics

The population of Valdez has fluctuated dramatically in the past decade because of the local construction boom associated with the trans-Alaska pipeline and marine terminal. From a town of approximately 1,000 people in 1969, Valdez grew to some 8,000 inhabitants (temporary and permanent) in mid-1976. The 1978 population of Valdez certified by the Alaska Department of Community and Regional Affairs was 4,481, although a recent census and estimates based on such factors as current labor force size, occupied dwellings and school enrollment suggest fewer full-time permanent residents. A base population of 3,350 is assumed in this study. Growth without the proposed project is assumed to occur at 3 percent per year after 1979.

Residents of Valdez are predominantly working age; 89.9 percent are caucasian; 5.4 percent are Alaska Native; and the balance are other minorities.

5.8.2 Employment and Economic Base

In its early years Valdez was an important transportation link to

Interior Alaska. This role diminished with construction of the Alaska Railroad from Seward to Fairbanks, and with the emergence of Anchorage at the largest city in Alaska. In the years immediately preceding construction of the trans-Alaska pipeline, government was by far the largest employer in Valdez (69 percent of total). Government continues to be the largest employer, but its relative importance has declined (now about 29 percent of total). Employment in the transportation sector, which includes approximately 250 full-time Alyeska terminal employees, numbers 283 (22 percent of total) (see Table 5.8-1). The City of Valdez recently has undertaken a major port development project in hopes of recapturing its former role as a transportation center.

5.8.3 Public Revenues and Expenditures

The City of Valdez has a very high assessed value per capita ($372,589 compared with the statewide average assessed value of $47,342) because of the presence of the Alyeska marine terminal and the comparatively small city population. As a result, Valdez supports a comparatively high level of municipal services. For example, in 1978 Valdez spend almost twice as much per capita as did Anchorage on general government, and more than three times as much per capita on capital improvements. While Valdez had more than twice as much bonded debt in 1978 as did Anchorage, this debt represented only .75 percent of its total property valuation, in contrast to 4.38 percent for Anchorage.

5.8.4 Public Service and Facilities

Many of the public services and facilities available in Valdez today were developed to meet needs arising from the pipeline construction boom and its aftermath.

The health care needs of Valdez are met by the 15-bed Valdez Community Hospital, the Valdez Mental Health Center, and the Harborview Developmental Center, which is a state facility for the mentally and physically handicapped. Three physicians, a dentist and an optometrist provide medical care which is supplemented by a public health nurse and by

Table 5.8-1

EMPLOYMENT ESTIMATES

CITY OF VALDEZ 1968 and 1978

Industry	1968 Number	1968 Percent	1978 Number	1978 Percent
Mining	0	-	0	-
Construction	15	4.7	209	16.3
Manufacturing	10	3.1	0	-
*Transportation			35	22.0
	15	4.7	283	22.0
*Communication & Utilities			35	2.7
Wholesale Trade	8	2.5	6	0.4
Retail Trade	23	7.2	218	17.0
Finance, Insurance, Real Estate	3	0.9	28	2.3
Services	26	8.1	102	7.9
Government	220	68.8	404	31.4
Total	320	100	1,285	100

* Transportation, communications and utilities combined in 1968 data.

1968 data source: Alaska Department of Economic Development (now Commerce and Economic Development), Standard Industrial Survey of Valdez, 1969.

1978 data source: City of Valdez, Overall Economic Development Plan, June 1978 (full-time employment).

specialists who visit Valdez periodically. Emergency medical care is provided by the Emergency Service Team, an organization of trained volunteers.

Valdez has grammar, junior high and senior high schools. Since the grammer school has had to rely on 12 modular classroom units to supplement its permanent classrooms, the school board in August 1979 authorized the construction of a 24-classroom elementary school designed for approximately 500 students, and a seven-classroom school to teach approximately 90 residents of Harborview Developmental Center.

The Division of Social Services of the State of Alaska Department of Health and Social Services employs one social worker in Valdez on a part-time basis.

The Fire Department has a full-time paid staff of four, supplemented by 56 volunteers. With fire stations in four locations in the city, the department has adequate capacity to meet current and projected needs, including Alpetco-related population growth.

The size of the Police Department grew to meet the increased demand for service during the pipeline era. At present, the department has 13 full-time officers and five full-time dispatchers. New jail facilities are under construction scheduled to be completed in December 1979.

5.8.5 Land Use

The purpose of this section is to examine land use and development patterns in the region and in Valdez, with an emphasis on long-term changes and emerging patterns of land use in Valdez. This section also describes scenic and recreation resources in the region.

Regional land use and resource development: With the exception of isolated communities, most of the area around Valdez is wilderness (see Figure 3.2-1). Southwest of the city is the Chugach National Forest. To the north and east are mountains and glaciers of the Chugach Moun-

tains, much of which has been selected for ownership by Ahtna Regional Native Corporation. Widely separated communities in the area include Cordova, 72 km (45 mi) southwest, the native village of Tatitlek, 37 km (23 mi) south, and Glennallen, 160 km (100 mi) north of Valdez. A fisheries-related economy supports most residents of towns in Prince William Sound, with secondary support coming from government, tourism, private services, timber and mineral development - not necessarily in that order. Most employment in Valdez is derived from government and the transportation industry (which includes the Alyeska Pipeline Service Company). Because of its isolation from other towns in the region and its ties to state government, Valdez influences and is influenced more by its connections to cities outside of the region, than by any activities within the region.

With respect to resource development feasibility in remote areas, proximity to a nearby community is not normally an important factor. Although there might be significant timber and mineral resources in the area, the actual presence or scarcity of a resource is less important than are other variables. Available export markets, restrictions on land ownership and use, climatic conditions, and transportation problems all affect the feasibility and timing of resource development. Valdez, for example, hopes to overcome some of these limitations by construction of new port facilities for export of agricultural products and timber which could be trucked over the Richardson Highway from inland locations.

Analyses which consider all of these factors, however, indicate little potential for significant new resource development in the region during the assumed 1990 impact horizon of the proposed Alpetco facility. The Alaska Department of Natural Resources estimates that most coastal timber and mineral resources will not be developed for at least 25 years in Price William Sound. With respect to fisheries, historical statistics confirm a major decline in overall numbers of fish (increases in harvest in recent years were not due to an increase in the resource, but to greater numbers of boats operating) (Alaska Department of Transportation and Public Facilities [ADOTPF]). Isolated mineral claims

north of Valdez are mostly inactive, and areas of highest mineral development potential are in the Wrangell Mountains, 160 km (100 mi) to the northeast (ADEC, Division of Water Programs, 1978). Timber development potential, with the exception of approximately 40 hectares (100 acres) southeast of Port Valdez is rated low (ADOTPF, Oct. 1978).

Although some resource development is possible (e.g., timber and mineral development on regional and village-selected lands near Tatitlek, or construction of new fish hatcheries to reverse declining salmon yields), it is not expected to significantly impact settlement patterns in Valdez or in other communities in the region.

Scenic resources: The Prince William Sound region is characterized by steep-walled fjords (Port Valdez) and glaciers, and dense coastal forests. Port Valdez is a 5 km (3 mi)-wide glaciated fjord extending east-west about 22 km (14 mi). At its eastern end, mountains rise quickly to a height of 900 to 1,500 m (3,000 to 5,000 ft) from the river deltas and level glacial moraines which support the built-up and developable portion of the city.

Port Valdez has been given the name "Switzerland of Alaska" because of its fine views of mountains, glaciers and rivers. The most prominent views are generally directed across Port Valdez from either the Richardson Highway or Dayville Road. Consequently, views across the water are obstructed more by development along the water's edge than by inland development. However, the large scale of the mountains tends to diminish the size of even such large installation as the Alyeska marine terminal.

Lower Solomon Gulch Falls, adjacent on the west to the proposed products dock, is one of the major scenic values of the area.

Recreation resources: Numerous opportunities exist for sportfishing, hunting, hiking, camping, skiing, and boating in the vicinity of Valdez. Most activity focuses upon existing and proposed facilities of federal, state or local agencies.

Recreational use patterns in the nearby Chugach National Forest are changing. Access by boat or plane now accounts for an estimated 5,000 user-days per year in the Columbia Glacier Unit of the forest and 12,000 user days per year in the Fidalgo/Gravina Unit. However, the forest service has placed these two management units in a "further planning" category for additional study of the merits of wilderness classification. If the pending Forest Land Management Plan calls for such a designation, the use of snow machines would be prohibited; new cabins, docks or campsites would not be permitted; and existing cabins would be eliminated (USDA Forest Service, June 1978).

The Alaska Division of Parks, however, is proposing a system of marine parks in the National Forest which, if implemented, would increase recreational usage. As of August 1979, none of the four proposed parks in the vicinity of Valdez, of the total of 64 proposed in Southeast and Southcentral Alaska, had been approved by the Forest Service (Johannsen, April 1979).

Within the city limits of Valdez, the State Division of Parks provides campsites west of Valdez Glacier Stream, 101 spaces maintain by the city and three other sites (totaling 12 spaces) in Keystone Canyon, where a new state park is also proposed (ADNR, Parks Division, 1976). While there are not immediate plans to expand the existing campsites, a total of 150 spaces, three picnic areas and trails totaling 110 km (70 mi) are among the proposed park improvements. The city has projected a total of $50 thousand in its 1983-84 budget for development of the park itself, although the Recreation Department believes that the narrow canyon cannot accommodate campgrounds as large as the state has envisioned (Rutherford, 1979). The City of Valdez is in the process of significantly expanding its recreational facilities. Boat slips at the Valdez Small Boat Harbor were increased from 180 to 349 in 1978, in response to a demand for spaces for larger pleasure crafts. Additional expansion is possible within the harbor (100 spaces or at a new location east of the harbor (Valdez Harbormaster, 1979).

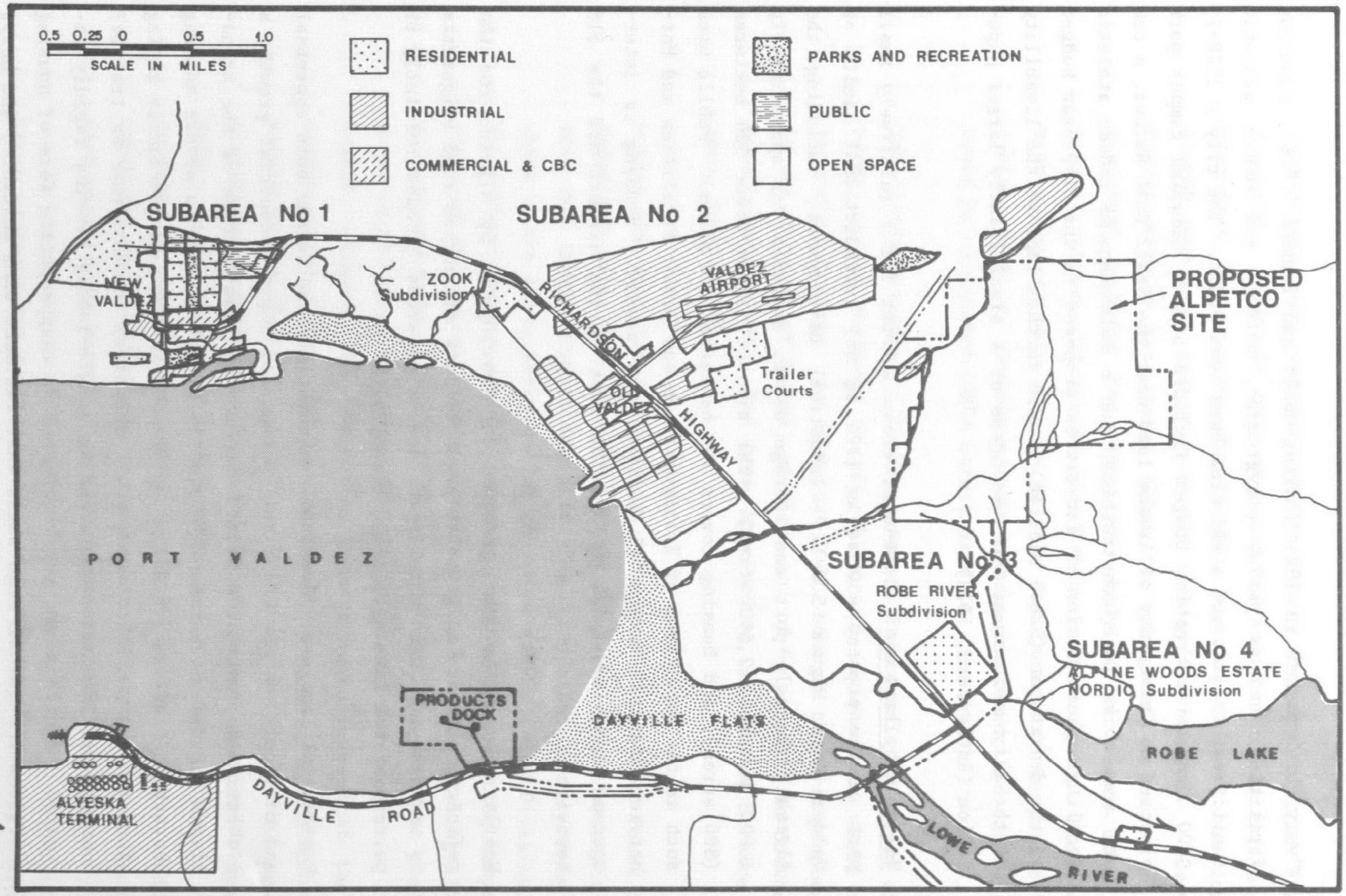
Since recreational facilities were described by community residents as

"very inadequate" in 1975 (Baring-Gould and Bennet, 1976), numerous facilities such as parks, playgrounds, outdoor and indoor athletic facilities, trails, and a ski area have been built. The city's 1978-79 $400 thousand recreation budget includes a $100 thousand camper park proposed on University of Alaska land near the Small Boat Harbor, a new ski area, bike path construction, and a multipurpose indoor athletic facility. Construction of facilities proposed in the five-year budget of the department ($28.5 million) should further improve the livability of the city and accommodate the needs of a significantly larger population (Rutherford, 1979).

Valdez City land use: Developed areas account for a relatively small part of the present 450 sq km (174 sq mi) jurisdictional limits of Valdez (see Figure 5.8-1). Industrial development, including the Alyeska terminal, port and storage depot, accounts for approximately 1,000 hectares (2,500 acres). The airport limits cover 320 hectares (800 acres), and housing covers 185 hectares (460 acres). Public uses such as the Department of Transportation and Public Facilities and Harborview hospital occupy 25 hectares (65 acres). Housing is interspersed with industrial use in the area of the airport and the old townsite.

Nearly all of the land proposed for development by Alpetco for the refinery, pipeline alignments, products dock and access road alignments is undeveloped land. Open space and water areas account for fully 85 percent of the land within the city limits.

Residential land use: Available residential land become both essential and difficult to provide during periods of rapid industrial growth, a problem that confronted Valdez during the construction of the trans-Alaska pipeline. Between 1974 and 1976, Valdez faced a severe housing shortage: trailers "squatted" on available land; single-family zoning often was set aside to accommodate temporary (mobile home or trailer) housing; and the value of existing single-family housing rapidly increased. Mobile homes are considered an inappropriate form of housing in Valdez because of high winds that can make them unstable, and heavy



EXISTING LAND USE

Figure 5.8-1

snow loads which can damage roofs or frames (Schmidt, 1979).

A housing survey undertaken in May 1979 revealed Valdez has 970 occupied housing units, of which 738 are owner-occupied and 232 are rented.

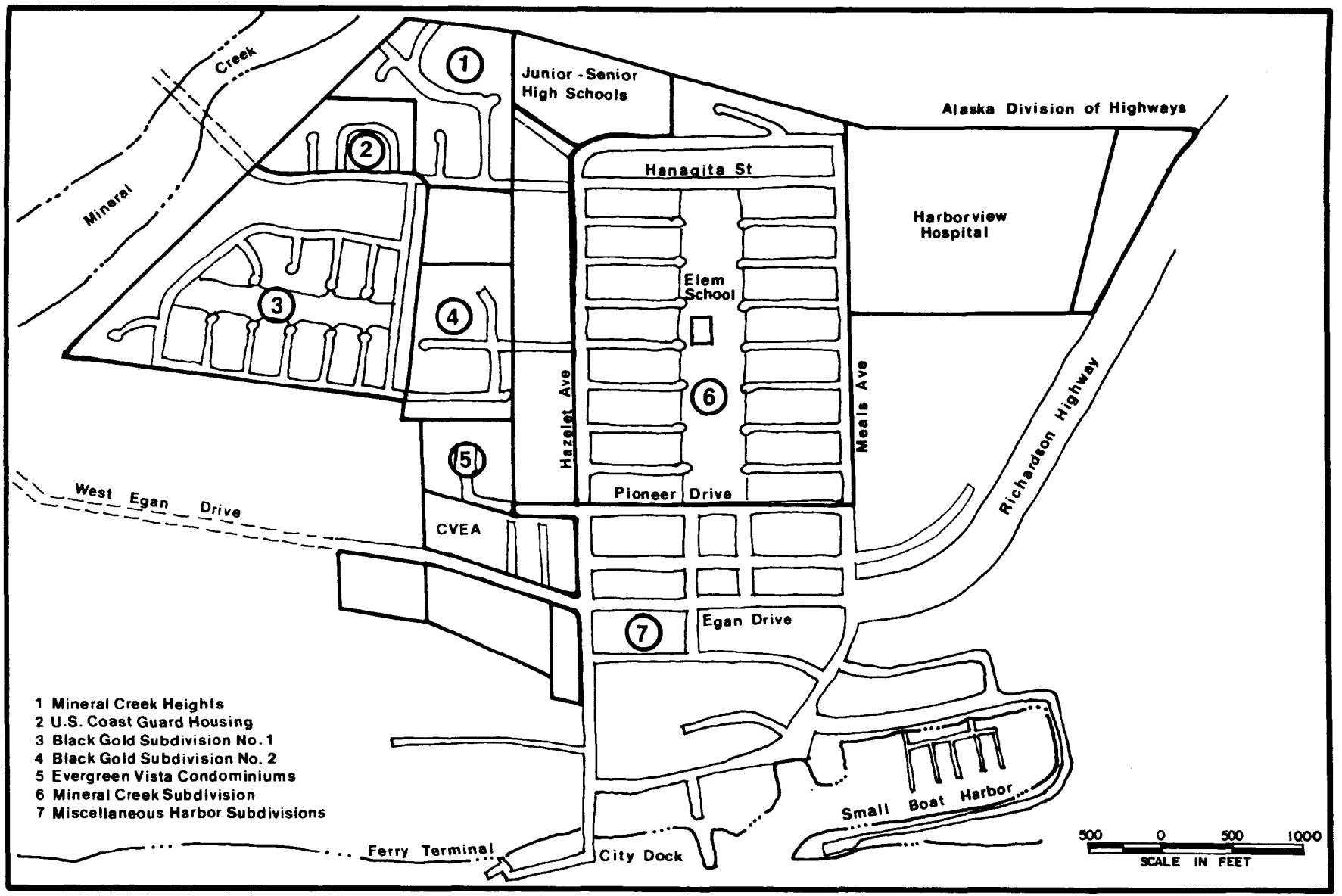
The present vacancy rate is 3.1 percent, which indicates little available housing to accommodate new population growth.

Outside of the new townsite, in the Zook Subdivision and Airport Area (Subarea 2), the Robe River Subdivision (Subarea 3) and the Alpine Woods and Nordic Subdivisions (Subarea 4), single-family mobile homes and trailers are the dominant housing types (see Figure 5.8-2). Details of the housing survey are presented in Appendix Vol. II.

Emerging land use patterns in Valdez: Since the completion of the Alyeska pipeline terminal, the city has sought to encourage new economic growth and development. First, many improvements have been made to roads, utilities, schools and recreational facilities to better serve existing and future residents. Second, the city plans to lease portions of its municipal land entitlement to private developers for residential and industrial development. A total of 1,943 hectares (4,800 acreas) of land are expected to be conveyed to the City of Valdez by the Alaska Department of Natural Resources Lands Division, under authority of the Municipal Entitlement Act (Section 29.18 as amended). Of the 4,800 acres, approximately 1,400 acres comprising the Alpetco site should be conveyed by the end of 1979 (see Figure 5.8-3).

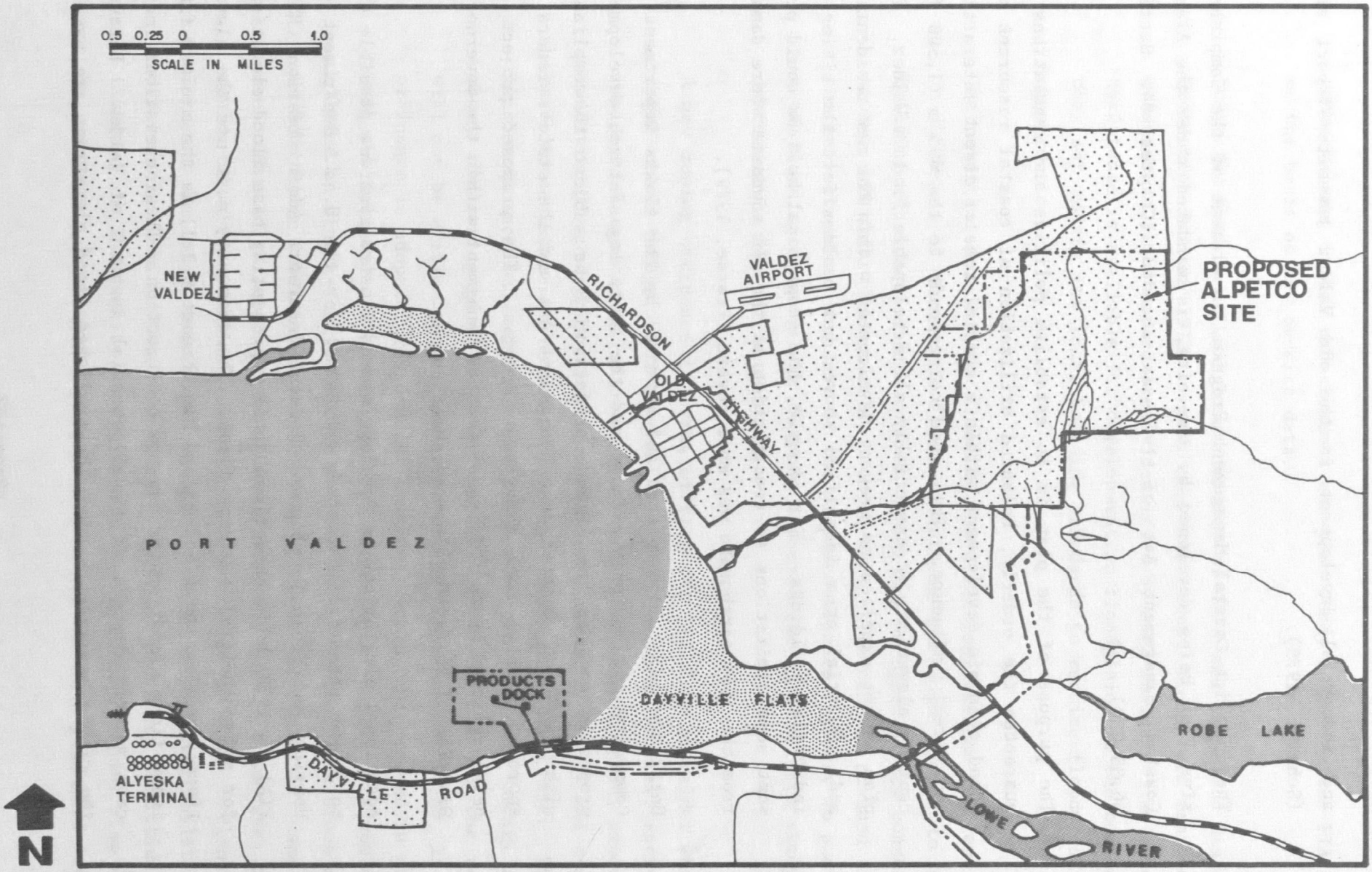
Land use planning: Development of these and other land areas in Valdez will be guided by four land use planning mechanisms which are now being developed: the new City Comprehensive Plan, the City District Coastal Management Program, the federal Flood Hazard Analysis, and the city's new zoning ordinance.

The new Comprehensive Plan is due for completion in the summer of 1980. According to the Planning Director, the plan will project new residential development west of Hazelet Street to and across Mineral Creek,



VALDEZ HOUSING

Figure 5.8-2



EXISTING and PROPOSED CITY OWNED LANDS

Figure 5.8-3

and industrial development in the old Valdez townsite/airport area (Schmidt, 1979).

The District Coastal Management Program, an element of the Comprehensive Plan being developed by the city, is mandated under the Alaska Coastal Management Act of 1977 as amended (Chapter 84, Section 46.35.030).

The purpose of the plan is to establish policies and regulations to guarantee the orderly, balanced utilization of coastal resources and sound economic development within a coastal zone of direct interaction and direct influence. This zone corresponds to the 455 m (1,500 ft) contour elevation, or essentially all developable land in Valdez. The plan is not expected to prevent development within the new residential and industrial area identified above, but could affect the siting of individual buildings. For example, the geophysical hazards could present some limitations to construction at the old townsite where damage from the 1964 earthquake was more severe (Prasse, 1979).

Until the plan is completed and approved by the Alaska Department of Community and Regional Affairs and the state legislature, development proposals such as the Alpetco project will be subject to compliance with the U. S. Coastal Zone Management Act and the state's federally approved Coastal Zone Management Program. The proposed project is being reviewed by the Office of Coastal Managment within the Governor's Division of Policy Development and Planning.

Additional limitations on development and construction are possible due to flood potential. A study conducted for the U. S. Department of Housing and Urban Development Federal Insurance Administration (HUD, FIA) in 1978 delineated flood zones representing base flood elevations for a hypothetical 100-year flood. The community must use the elevations shown on the Flood Hazard Map (Figure 6.2-1) as the minimum finished floor elevation for any new construction. These elevations indicate various degrees of flood potential in much of Valdez. Because the city's position is that the published flood elevations are overly

conservative, it has undertaken a one-year study to refine the FIA maps on the basis on new on-site data.

Under the National Flood Insurance Act of 1978 and the Flood Disaster Protection Act of 1973, communities must adopt floodplain management measures in flood hazard areas identified by such analyses. No federal assistance is available for development in floodplains if the community does not modify its local building standards to require floodproof new construction.

The potential for serious flooding has clear implications for land use in Valdez. If projected flood elevations are high enough to make building construction impractical, areas may be diked or new construction prohibited. For example, a three-meter-high dike is planned along the entire western boundary of the proposed Alpetco refinery to prevent site flooding from Valdez Glacier Stream. The flood hazard study is discussed further in Section 6.2.

A new zoning ordinance is being written for the City of Valdez which, among other things, will respond to the floodplain studies, increase residential densities in areas now zoned for residential use, expedite conditional use applications, create new industrial zones, and eliminate inconsistencies between existing zoning and actual use. While this ordinance will define the parameters for land use within each zone, the zoning plan which establishes the boundaries of the zones will not be written until completion of the Comprehensive Plan. If the ordinance is adopted, residential densities would be increased in areas with public water and sewer service. For example, duplex lots would be allowed on single-family lots in current RA Residential Zone areas such as Robe River Subdivision (south of the proposed Alpetco site), and the area west of Hazelet Street in the downtown area. Townhouses also would be allowed under conditional use in an RA Zone. Plans to increase building densities respond to the limited availability of developable land and to the public cost of providing utilities to isolated or low-density subdivisions. New industrial zones also will be created to accommodate petroleum-related and other potential indus-

tries.

5.8.6 Transportation Systems

Land: The two-lane Richardson Highway is the principal component of the Valdez road system, with an average daily traffic (ADT) in 1978 of 5,200 in central Valdez. Volumes decline to 4,325 ADT at mile 7.0 beyond Dayville Road, and 1,600 ADT at Mile 17, Keystone Canyon. Trucks account for 12.5 percent of traffic close to Valdez and 18 percent east of Dayville Road. Traffic volumes in Valdez are expected to increase at the pre-pipeline rate of about 3 to 5 percent per year (or 2,100 ADT) for all vehicles, in the absence of proposed Alpetco development. These increases would not materially affect the capacity of the Highway, estimated at 1,700 vehicles per hour in both directions.

Planned improvements to the highway include a bridge in Keystone Canyon to bypass the existing narrow tunnel and sharp curves, and acceleration-deceleration lanes at the Valdez Airport Road intersection. Work in Keystone Canyon is under way, scheduled for completion in the summer of 1980.

Air: The Valdez Airport has a 1,515 m (5,000 ft) east-west runway and is located approximately 6.4 km (4 mi) east of downtown. It is owned and maintained by the Alaska Department of Transportation and Public Facilities. The airport handled approximately 20 thousand flight operations in 1978 (70 percent of which took place between April and September), which is well below its estimated capacity of 100-200 thousand per year (FAA, 1979). Three air carriers provide scheduled service between Valdez and Anchorage with one route via Cordova. All use twin-engine aircraft, most of which carry eight to nine passengers. In the summer of 1979, about 53 to 58 direct round trips were made each week to Anchorage, and about seven round trips per week were made to Anchorage by way of Cordova. The carriers operate at about 55 percent of seat capacity during the winter months and 60 percent for the summer (Polar Airlines, 1979).

Improvements to the airport should significantly improve operations. A DMV-VOR instrument landing system was installed in 1979, and a 457 m (1,500 ft) runway extension is planned for the summer of 1980 to bring the total length to 1,981 m (6,500 ft). The planned instrument landing system would not provide for all-weather operations, because the mountains are too close to allow recovery from a missed approach. However, the installation is estimated to reduce the number of cancelled flights due to winter weather from 30 percent to approximately 10 percent.

Experience during 1977, the peak year of airport operations, showed the air carriers were able to accommodate substantial increases in demand as they occurred. One airline operated Boeing 727 jets on a scheduled basis during the peak pipeline construction period. The existing operations schedule would be able to absorb increased demand of about 50 percent.

Marine: The Alaska Marine Highway system provides ferry service to Valdez and five other cities. The MV Bartlett, operating between Valdez and Whittier, has a capacity of 170 passengers and 38 standard passenger vehicles. The Bartlett carries 75 percent of its traffic in June, July and August, when it frequently operates at capacity. Since most of the passengers are tourists who have reserved space long in advance, little opportunity exists for local residents to use the ferry.

The Alaska Railroad, which transports passengers and vehicles between Whittier and Anchorage, also operates near capacity during these months. As current rates of demand increase, ferry capacity on the run is expected to be reached in 1980 or 1981 (ADOTPF, 1978). The state marine highway division has no plans to replace the Bartlett with a larger vessel or to add additional vessels to this route.

5.8.7 Utilities Systems

Valdez's sewer, water, solid waste, power and telephone systems have surplus capacity.

Sanitary sewer: The City of Valdez operates a numicipal sewage treatment plant located in the center of the old Valdez townsite. Beginning operation in 1976, the facility consists of a three-pond aerated lagoon system that provides secondary treatment. Rated capacity of the plant is 1.25 mgd.

The city provides sewer service to all of the new townsite, the airport and adjacent trailer parks, and to the Zook Subdivision (see Figure 5.8-4). The efficiency of the sewage treatment plant declines in winter as a result of increased domestic water use for freeze prevention and reduced bacterial action resulting from low temperatures in the settling lagoons.

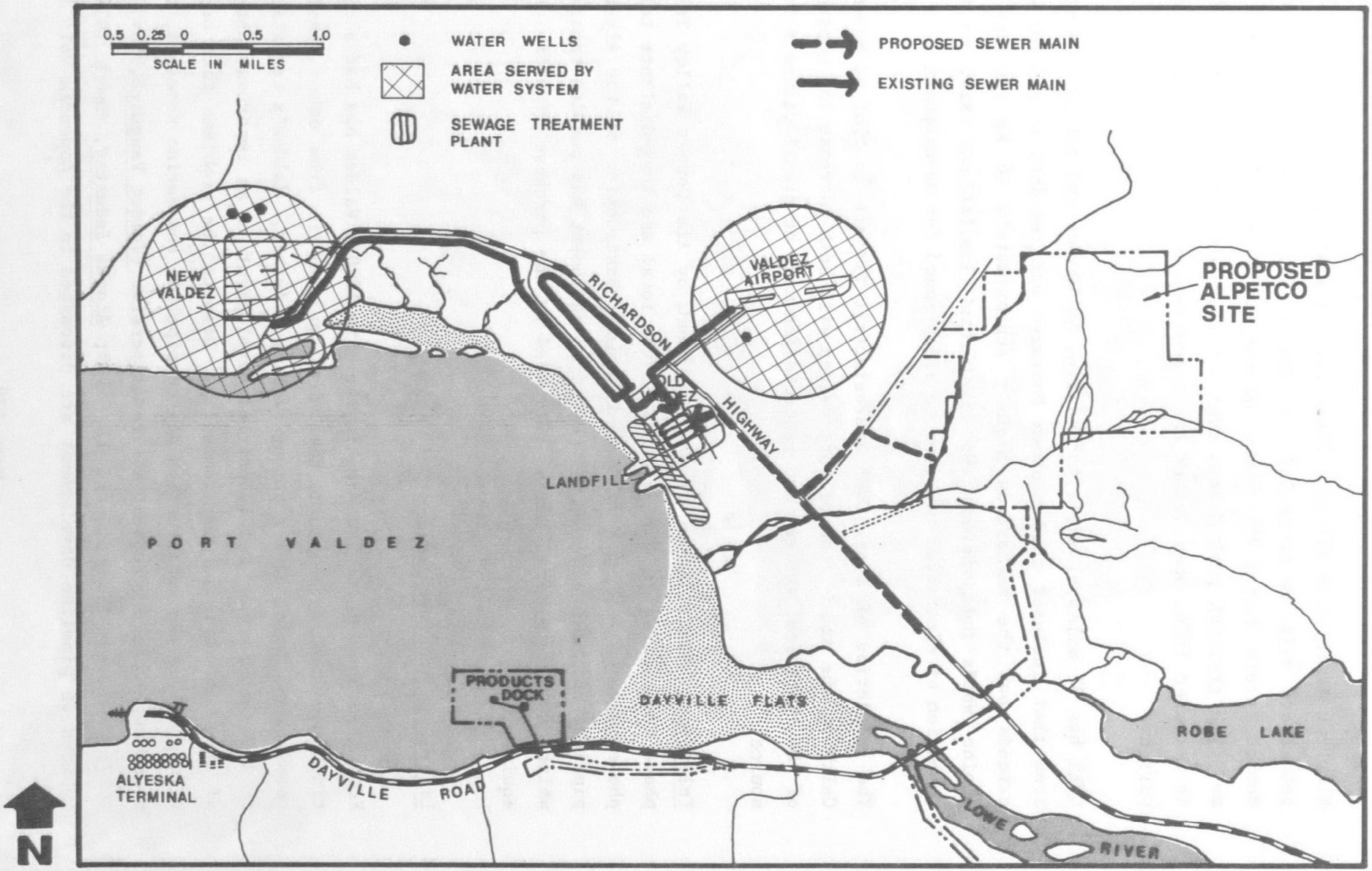
Areas relying on septic tank disposal include the Robe Rive, Alpine Woods and Nordic subdivisions. Because of a high water table, there are periodic problems of well-water contamination (Schmidt, 1979).

Water system: The water system in Valdez is characterized by the availability of enormous quantities of high-quality subsurface water and by a water distribution system that has significant problems. The most important problem is that water lines were not buried at a depth sufficient to prevent freezing in winter. To prevent pipe freezing, Valdez residents keep their water taps partially open, using 200 thousand gpd and so diluting the effluent in the sewer system that it is difficult to treat the sewage.

The city provides water service to both the new townsite and the area surrounding the Valdez airport, as is shown in Figure 5.8-4. Other areas rely on domestic wells.

Solid Waste: Valdez uses city property at the old townsite as a disposal area for solid waste. Since the landfill is nearing capacity, the city is examining other sites, as well as alternative processes of disposal.

Electricity: Electrical service in Valdez is provided by Copper Valley



MUNICIPAL SEWER and WATER SYSTEMS

Figure 5.8-4

Electric Association (CVEA). The source of electricity is seven diesel generators with an installed capacity of 10.1 megawatts (mw). Peak demand occurs during the winter months; in 1979, peak demand was 3.9 mw. The greatest peak demand ever recorded was 4.875 mw and occurred in December 1976, when Valdez had a population of approximately 8,000 persons.

CVEA has 32 miles of distribution line in Valdez and covers a service area that includes the downtown business and residential section and extends out the Richardson Highway approximately 16 km (10 mi) to Alpine Woods Subdivision. No significant limitations exist to the extension of electrical services to areas zoned for development.

The completion of a new CVEA hydroelectric project in 1981 at Solomon Gulch on the south side of Port Valdez will both increase the capacity of the electrical system, and reduce dependence on diesel oil as a fuel source.

Telephone: Installation of new equipment by the Copper Valley Telephone Cooperative in 1977 eliminated the local and long-distance telephone problems Valdez experienced during construction of the Alyeska pipeline and marine terminal. Existing equipment has surplus capacity which, when necessary, can be increased by the purchase of additional equipment.

5.8.8 Life-Style and Culture:

From the time of its founding in the late 1890s, Valdez has had a distinct merchant orientation that distinguishes it from other coastal communities, which have a strong fishing industry. Valdez's commitment to the transportion and industrial development is an important aspect of the life-style of the community. Despite the problems that beset Valdez during the construction of the pipeline and marine terminal, the community's pro-development attitudes persist (Valdez Vanguard, Nov. 9, 1977; Anchorage Times, April 11, 1979; Alaska Industry, March 1979). Impacts of pipeline development are discussed in the Appendix Vol. II.

6 Environmental Consequences

6. ENVIRONMENTAL CONSEQUENCES

6.1 GEOTECHNICAL

6.1.1 Short-Term Effects

The gravel requirement for construction purposes and riprap for dike facing are not expected to exceed 1 million cu m (1.3 million cu yd). Any material excavated from the site and suitable for fill or riprap would be used on site with the balance coming from local commercial sources. No other short-term impacts are expected.

6.1.2 Long-Term Effects

Seasonal frost heave is generally a minimal hazard due to the coarse and well drained nature of the soils found on much of the site. The design and construction should be such that differential movement can be tolerated by and between vessels, pipelines, connections and miscellaneous items whose foundations are not specifically protected from freezing. The site soils generally have a low potential for frost heave.

The response of irregularly shaped alluvial filled valleys to earthquake excitation is varied and complex (Seed and Idriss, 1968; Idriss, Seed, Sherff 1974). Moreover, the various components of the proposed facility (cracking towers, storage tanks, pipelines, etc.) would respond quite differently to the same earthquake motion in both their frequency of vibration and their elastic deformations. If final design studies confirm a potential for liquefaction in the southern and eastern portions of the site, the products pipelines probably would present the greatest risk to the environment. Section 6.8 presents an analysis of spill risks.

No major landslides or rockfalls have been associated with seismic activity in the Valdez region. However, minor rock falls and talus landslides have been reported during past earthquakes (Tarr and Martin, 1912). The natural rock slopes within the site should remain stable

during the expected ground shaking in this area. However, a portion of the pipeline route along the lower bench for approximately 2.4 km (1-1/2 mi) east of the products dock traverses several erosional features which may be susceptible to local slope slippage, minor avalanches and small rockfalls.

Clearing of snow and removal of organic overburden on the site would allow the soil to freeze to a greater depth in the winter, which would affect depth of burial of structure footings and pipelines.

6.1.3 Mitigation Measures

This section presents a list of measures which could be considered to mitigate the effects discussed above.

1. To allay the impact of seismically induced ground motion on the proposed facility, incorporate a ground response analysis in the structural design of refinery components (foundations, structures, pipeline systems, etc.) to assess the dynamic behavior of the coupled site/refinery components. Piping, catwalks and other inter-unit connections should be designed to allow for seismically induced out-of-phase differential motion.

2. If liquefaction is determined to be a significant hazard along any portion of the pipeline corridor, the pipelines could be supported on pilings founded below the zone(s) of liquefaction, or the soil could be stabilized by a deep densification process such as "vibroflotation." The proposed leak detection system on the pipelines and the proper use of valves would minimize any potential leaks.

3. Any potential erosion, avalanche or rockfall hazards to the aboveground segments of the pipelines could be mitigated by maintaining drainage patterns established for the adjacent Alyeska pipeline, and by placement of the pipelines in sound rock wherever site-specific studies confirm soil or surficial rock slope instability. If determined neces-

sary, an alternate design could be considered for these segments of the pipeline route.

4. To the extent possible, seismic design considerations should be included in the design of the containment dikes and pipelines.

6.1.4 Unavoidable Environmental Impacts

No unavoidable adverse environmental impacts are expected.

6.2 HYDROLOGY

6.2.1 Surface Water

Short-term effects: Site preparation and construction activities could result in local surface erosion and increased turbidity in Corbin Creek (Glacier) particularly during periods of high runoff. Soils on the eastern and southern portion of the site are finer than on the western and northern portions, and therefore are more prone to surface erosion at similar flow rates. During periods of particularly heavy precipitation and snowmelt, runoff follows the ruling topography, draining to the south. Additionally, several waterfalls normally appear on the slopes of East Peak, draining into the eastern portion of the site. Due to the granular nature of the soil most of the runoff currently recharges the groundwater system, while the excess forms a drainage course along the perimeter of the foothills, draining toward either Slater Creek or Corbin Creek (Glacier). The natural surface drainage patterns would be altered locally during the various construction phases, which could result in temporary increases in surface runoff.

Within the proposed project area, there are to be several access road and pipeline stream crossings. Localized increases in suspended sediment concentration and turbidity could occur at all stream crossings. The effect would depend on stream flow volumes and velocities. The crossing of Corbin Creek (Robe), which is identified by the Alaska

Department of Fish and Game as a salmon spawning habitat, would be the most sensitive crossing (see Section 6.8.2 for impacts on freshwater fisheries).

An estimated 20-25 million gallons of hydrotest water which would be withdrawn from site wells for initial testing of refinery tanks and pressure vessels would be discharged either directly to Port Valdez through a pipeline, or to the adjacent non-anadromous streams such as Valdez Glacier Stream or Corbin Creek (Glacier). The impact of discharged test water on the receiving waters would be minimal as test water would not contain appreciable amounts of deleterious substances.

Brownie Creek, a salmon spawning stream, would not be affected directly by the construction, as no crossing of this stream would be necessary. In addition, topography of the service road and product pipeline corridor would direct any spills in a southerly direction, away from Brownie Creek.

Moderate siltation potential would exist during construction of the crossing of Corbin Creek (Glacier). However, it probably would not cause significant impacts since this stream is naturally silt-laden part of the year. Any degradation of water quality would be both localized and short-term.

Winter construction activities would require cleanup of accumulated and drifted snow, which could be from 1.8-6 m (6-20 ft) in depth. Clearing of site vegetation would further increase the snow drifting tendency caused by the strong downdrafts coming from the mountain barriers and through Valdez Glacier Valley from the north. Observations in 1978-1979 indicated that the snow tends to drift against the slopes of the bedrock facing north, and to fill most depressions. Drifting snow might impede winter construction activities and general access.

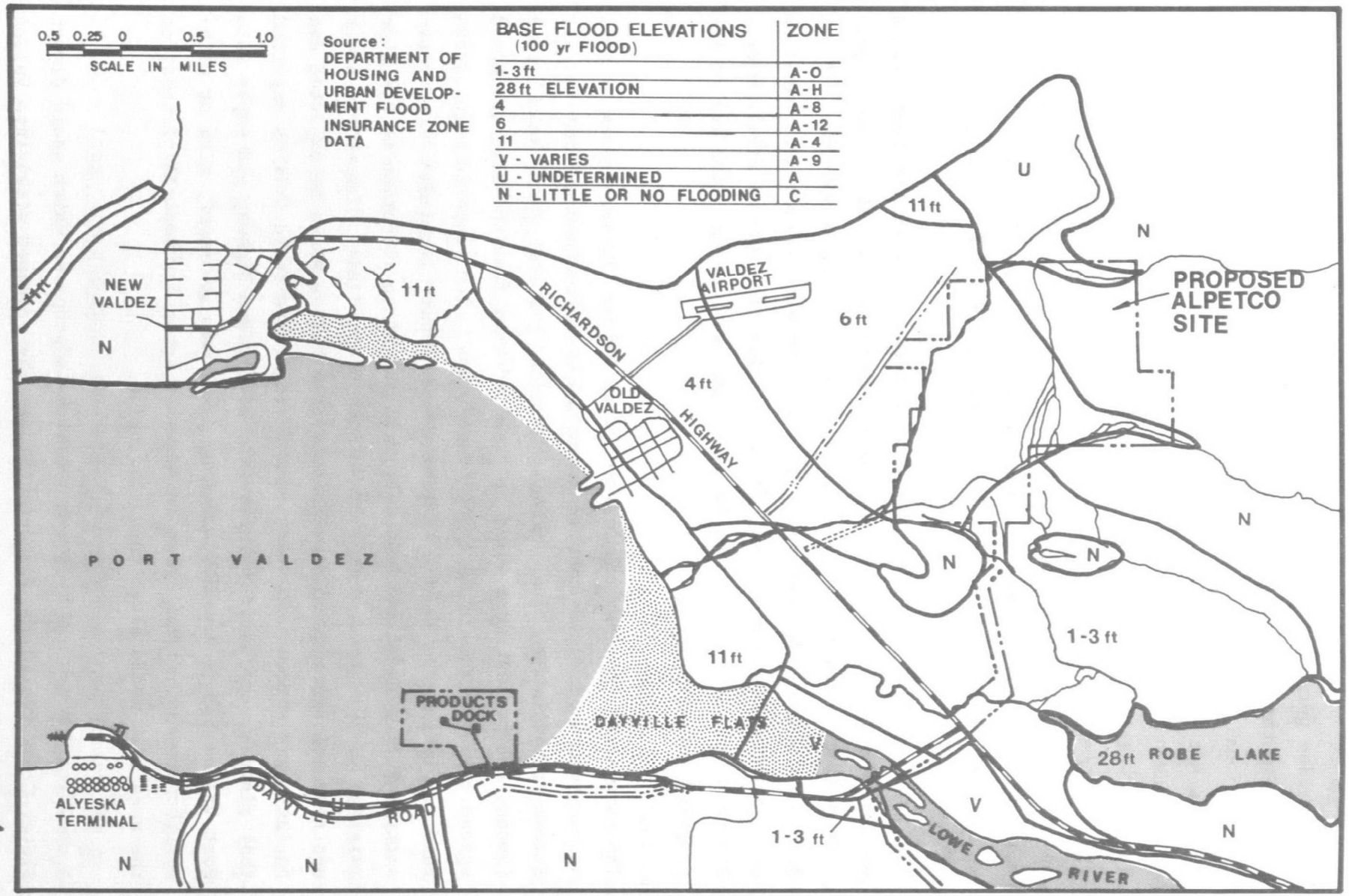
Long-term effects: Assessment of flood potential for the project site is based on a U. S. Department of Housing and Urban Development (HUD) Flood Insurance Administration (FIA) study (Tryck, Nyman and Hayes,

1977). The purpose was to research the existence and severity of flood hazards in the City of Valdez, in order to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The study predicts that the peak discharge level of a 100-year flood in Valdez Glacier Stream would be 6,570 cms (232 thousand cfs). The report predicts that most of the project area may be submerged under an average depth of 1.8 m (6 ft) of water. The magnitude of the 100-year flood is based on cumulative catastrophic events with special consideration given to glacial dammed lake outbursts, which compose about 87 percent of the estimated 100-year flood.

The proposed HUD floodplain management measures stipulate that "where no floodway has been designated, no new construction, etc. can be permitted that would raise the elevation of the base ("100-year") flood more than 1 foot at any point in the community. This determination must consider the cumulative effect of other anticipated development." Figure 6.2-1 shows the flood hazard assessment in the vicinity of the proposed refinery site.

The main access roadway and bridge across Valdez Glacier Stream as well as the proposed flood control levee would encroach into the Glacier Stream floodplain. The portion of flood waters which would have flooded the project area would be diverted away from the site and would spread over the remaining flood-prone areas. The proposed main access road bridge across Valdez Glacier Stream would constrict the cross-sectional flow area, but would be designed at an elevation to preclude raising flood waters above the HUD one-foot limit. Localized scour upstream and aggradation downstream of the bridge would be expected due to increased stream flow velocities during flood stage. It is expected that flood waters would overflow the Richardson Highway and empty into Port Valdez before the HUD one-foot limit was exceeded, with or without the proposed dike. There is no other known development planned for the area that would alter this conclusion.

A modification to the hydrologic system is proposed which would divert Slater Creek (which now meanders through the proposed site) into Valdez



FLOOD HAZARD ZONES **Figure 6.2-1**

Glacier Stream through existing but abandoned and vegetated braided channels of Valdez Glacier Stream. Photographs indicate that Slater Creek historically has discharged a portion of its flow to Valdez Glacier Stream during periods of high flow. This diversion scheme would result in a loss of 2.7-6.8 cms (100-250 cfs) of normal surface flow in Corbin Creek (Glacier) during the four months June through September. It also would mean that the contribution from Slater Creek into groundwater storage would be lost. Conversely, the flood flows of Corbin Creek (Glacier) would be reduced by up to 35 percent during the high flow season, thus decreasing the flood potential of this stream. The proposed diversion should have an insignificant effect on the total amount of subsurface flow during the summer due to the large recharge capabilities, and the fact that Slater Creek normally is dry in the winter.

Greater runoff than now occurs would result from the loss of permeable surface area due to compaction, paving, and erection of structures.

A drainage system would collect any surface water within the process and tankage areas for treatment in the wastewater treatment facility. Uncontaminated water from non-process and vacant lands would be allowed to percolate into the groundwater system. Runoff resulting from snow-melt and heavy precipitation would be collected and diverted around the process and tankage areas, and channeled into Corbin Creek (Glacier).

Since Corbin Creek (Robe) and Brownie Creek are spawning areas for salmon, contamination of runoff entering these streams from the site could cause significant damage to salmon fry.

Mitigation measures: This section presents a list of measures which could be considered to mitigate the effects discussed above.

1. Lateral erosion and eastern migration of Valdez Glacier Stream, as well as floods resulting from glacial outbursts, would be mitigated by the flood control levee proposed along the western boundary of the site. The levee also would prevent Valdez Glacier Stream from breaking

into Corbin Creek (Glacier).

2. Design and proportion the roadway and bridge across Valdez Glacier Stream, as well as the flood control levee, in a manner that any constriction or encroachment into the floodplain would not increase the 100-year flood base elevations more than 0.3 m (1 ft) anywhere in the community.

3. Alpetco's proposed plans to collect runoff and snowmelt originating east of the site and direct it to a discharge point on Corbin Creek (Glacier) would mitigate the potential for contamination of a portion of the surface runoff.

4. Schedule those construction activities which could affect the streams during no-flow, or very low-flow, periods to minimize the problems associated with increases in erosion and turbidity. The period of minimum flow is from late October to mid-April. During this period, dry construction techniques with allowance for ice and snow problems could be utilized.

5. Sediment and erosion control programs for all disturbed soil surfaces would minimize erosion and subsequent siltation into the streams. Furthermore, following completion of construction, revegetation of areas which were stripped of cover would stabilize the soils and aesthetically enhance the environment.

Unavoidable environmental impacts: The proposed diversion of Slater Creek into Valdez Glacier Stream would result in a permanent reduction of surface drainage into Corbin Creek (Glacier), affecting adversely the aquatic environment between the point of diversion and Corbin Creek (Glacier). It could, furthermore, lower the water table elevations somewhat. The degree of impact is discussed further in Section 6.2.2.

During construction in any stream which flows year-round, short-term increases in turbidity and suspended sediment concentrations are likely to occur despite mitigation measures.

6.2.2 Groundwater

Short-term effects: The effects of construction of the proposed facility on the groundwater resources of the area would fall into two main categories: effects on water table, and effects on recharge. Initial estimates of construction water usage average less than 154 thousand gpd for full-scale concrete pouring operations for approximately two years of construction, and up to 4 million gpd for the maximum expected hydrotesting requirements. Since most construction activities would occur during the summer high-recharge period, and are of a short-term nature, this level of water usage should not significantly affect the upper unconfined aquifer.

The high permeability of the surface materials makes it imperative that spills of construction fuels or toxic substances be prevented. The groundwater would be very susceptible to contamination.

Long-term effects: Two 12-inch diameter production wells each with approximately 1,400 gpm capacity are proposed for operation of the refinery. It is anticipated that the proposed withdrawal of approximately 1.7 mgd of water from the unconfined aquifer would have little impact upon the quality and the available quantity of water from that aquifer. The greatest impact on the water table likely would be a slight lowering of the elevations, which normally would be expected during winter months when recharge is at its annual minimum. Available information suggests that this lowering would not exceed 1.8 m (6 ft) average in the site area during winter (assume six months). Barring any major spills of hydrocarbons or toxic substances, the quality of the groundwater would not be affected.

If water for the facility were withdrawn from the lower aquifer, it could deplete that aquifer. However, no such withdrawal is planned. The lower aquifer could be used to meet minor water supply demands or infrequent high capacity demands, but its long-term production capability probably is limited severely by its apparent low recharge rate. Due to its depth and the protective, confining layer of silt, the lower

aquifer should be immune from contamination by surface activities.

It is expected that the wetlands and small creeks, mainly Corbin Creek (Robe), near the southern edge of the site which apparently depend on the unconfined aquifer for their existence, would be affected only slightly by withdrawal of the design flow rates from that aquifer. Whatever drawdown of the aquifer did occur during the winter months due to withdrawal would be expected to cause only a slight down-slope shift of the point at which the stream heads, or first appears. It is estimated that this shift would not exceed 61 m (200 ft) and that it would have little if any effect on total downstream flow. If these effects occur, their magnitude would be greatest in late winter, just prior to spring breakup (thawing).

There is a lack of winter water table monitoring data upon which to base a more conclusive impact determination. The water well, stream flow and snow depth monitoring program which is planned for the 1979-1980 winter period should provide a more definitive basis for predicting effects on the streams.

Due to the gradient, or slope, of the water table of the unconfined aquifer, and its significant elevation above sea level (approximately 21 m [70 ft] on the site), the relatively small drawdown of the water table in the area due to withdrawal of water for refinery operation would not cause intrusion of saltwater into the aquifer. The lower aquifer also has a water pressure level considerably above sea level (approximately 20 m [65 ft]), thus it would be necessary to lower the pressure in that aquifer by nearly 30 m (100 ft) to provide the elevation difference necessary to allow the possibility of saltwater intrusion.

Currently, there are no significant withdrawals of water from the upper aquifer in the general vicinity of the site and no known withdrawals from the confined, or lower, aquifer. Due to the considerable recharge available from Valdez Glacier Stream, rather significant withdrawals (on the order of 10 mgd or more) would be required in the developable

area west of the site to cause any area-wide effect on the groundwater table which could affect the supply available for the proposed facility.

Mitigation measures: This section provides a list of measures which could be considered to mitigate the effects discussed above.

1. Two major facility design features to minimize the effect of pumpage on the water table elevations in that area already are planned. First, wherever feasible, water-saving features are being incorporated in the design, such as re-use of water where possible, and use of air cooled rather than water cooled heat exchangers (see Section 4.4.6). Second, groundwater would be withdrawn near the north edge of the site to minimize drawdown in the vicinity of Brownie and Corbin (Robe) creeks. These measures should hold the effects on the water table in that area to an acceptable level.

2. If the water levels and flow rates in Brownie Creek and Corbin Creek (Robe) become adversely affected by a declining water table, arrangements could be made to replace the flow deficit with well water or storm retention water. This extra pumpage likely would not be required for more than two or three months and would be replenished easily by the high recharge which occurs during the summer months.

3. Enchancement of recharge on the site as discussed above also would assist in maintaining water table levels. In addition, the seeding of all cleared areas which are not covered by buildings, tanks or pavement would minimize runoff and thereby further accentuate infiltration and groundwater recharge.

4. In order to compensate partially for the loss of Slater Creek recharge, the facility design could incorporate provisions to channel runoff from adjacent mountains into undeveloped areas of the site for groundwater recharge.

5. Although pollution of the groundwater source is potentially serious, the possibility of occurrence would be mitigated by the planned provision of impervious diking and surfacing of areas where hazardous materials would be stored or spills would be possible.

Unaviodable environmental impacts: With appropriate mitigating measures, unavoidable impacts would be limited to those listed in Section 6.8.2.

6.3 OCEANOGRAPHY

6.3.1 Construction Effects

Oceanographic conditions within Port Valdez probably would be only slightly and temporarily affected by construction of the proposed facility. The primary impact would be a relatively small increase in the amount of sediment deposited in Port Valdez.

Excavation of the site and construction of the flood control levee could increase sediment runoff into the Valdez Glacier Stream. Once completed, the levee would be expected to prevent erosion and runoff during the remainder of the construction process. The ocean floor would be disturbed temporarily by the driving of piles for both the products dock and the construction barge dock. Barge dock fill material would be clean, well graded sands and gravels to minimize the impact on water quality.

Installation of the effluent outfall system would require trenching across the intertidal area. Sediment that is disturbed by construction of the outfall and by construction of the barge dock probably would move northward toward Island Flats. During construction of the refinery itself, barge traffic probably would stir up sediment and cause a small amount of shoreline erosion at the barge dock site. The estimated suspended sediment which would be created by all the construction activities is very small relative to the normal amount of sediment which is deposited annually by influent rivers and streams.

6.3.2 Operation Effects

Impacts of operating the proposed refinery would result mainly from the discharge of treated effluent into Port Valdez. The operational impacts of mixing and dilution of this discharge and its pollutants, and the transport and dispersion of accidental spills at the products dock and Valdez Narrows, are discussed.

Effluent plume characteristics: When treated effluent is discharged into ocean water, it mixes and forms buoyant plumes which rise toward the surface. During the rise, these plumes mix with ocean water and grow appreciably in size, thereby diluting the effluent. If the ambient density is uniform, these buoyant plumes rise to the surface. Otherwise, the plume reaches neutral buoyancy at some level below the surface. At completion of the rise, the plume spreads horizontally, creating a field of diluted effluent.

Many factors affect the initial dilution of a buoyant jet, such as effluent characteristics, diffuser design, depth of the outfall, ocean water stratification and magnitude of the ocean current. Ocean current plays a significant role in determining initial dilutions and magnitude of the zone of initial dilution (ZID). Depending on the magnitude of the ambient current, the location of the plume can be away from the diffuser and the increase in dilution can be several times the value under stagnant conditions.

When jet buoyancy and momentum-induced fluctuations of velocity and concentrations cease, initial dilution is considered to be complete. The distance from the diffuser where this occurs at the surface under the strongest currents, the weakest density gradients, and the smallest discharge from the diffuser is considered the boundary of the ZID.

Zone of initial dilution: In accordance with the draft NPDES permit the diffuser would be located to obtain a minimum 75:1 dilution at the mixing zone boundary. The proposed effluent outfall used in these preliminary design studies would extend 366 m (1,200 ft) offshore. The

configuration selected for the proposed diffuser consists of a 53 cm (21 in)-diameter, 37 m (120 ft)-long manifold (pipe) with sixteen 10.2 cm (4 in) horizontal ports placed alternately on both sides and spaced at 2.4 m (8 ft) center to center. The depth of water at the proposed location ranges from 50 m (164 ft) at the near-shore end to 55 m (180 ft) at the offshore end.

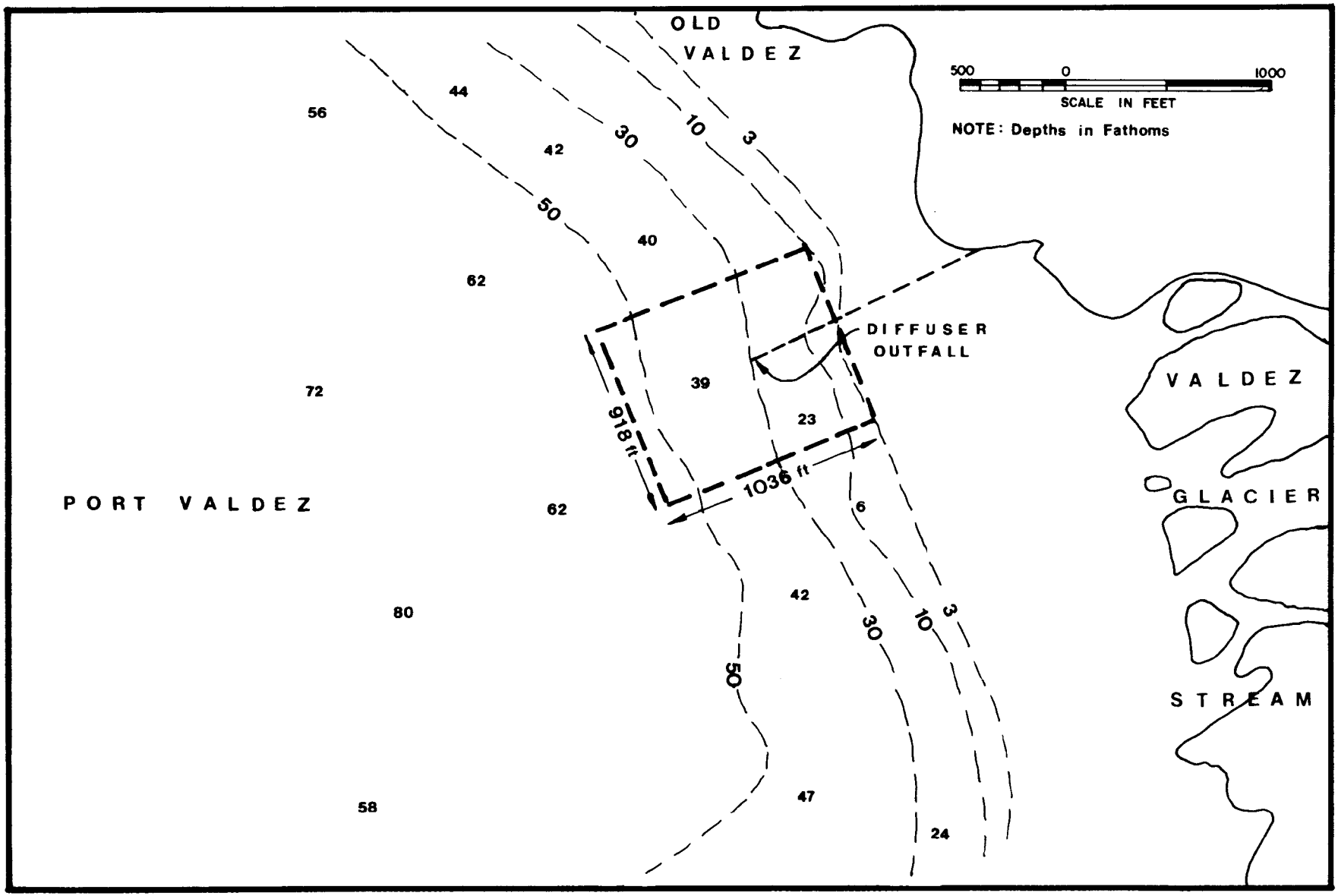
Preliminary studies of effluent behavior were carried out based on the above proposed outfall design and location. Computer models (Fan and Brooks, 1979; EPA, 1976) were used to calculate initial dilution and to determine the ZID for the proposed discharge. The size of the ZID was determined using recorded maximum current of 0.06 m/s (0.20 ft/s) at the proposed diffuser site. The width of the ZID was determined by adding twice the maximum horizontal distance from the diffuser where the plume reaches the surface to the plume diameter at the surface under uniform density stratification. The length of the ZID was determined by adding the length of the diffuser to the ZID width. The length and width of the ZID for the proposed discharge, so calculated, would be 316 m (1,036 ft) and 280 m (918 ft), respectively (see Figure 6.3-1).

Calculated average initial dilutions range from 74 for maximum stratification in stagnant water to 4,368 in unstratified water with the maximum recorded ocean current of 0.06 m/s at the diffuser site. The smallest average initial dilutions under worst case conditions of maximum stratification in stagnant water at all times at various depths on the boundaries of the ZID are presented in Table 6.3-1.

Table 6.3-1

INITIAL DILUTIONS AT ZID BOUNDARY

Location	Calculated Average Dilutions
Surface	310
5 meters below surface at vertical boundary	260
40 meters below surface (trap level)	75

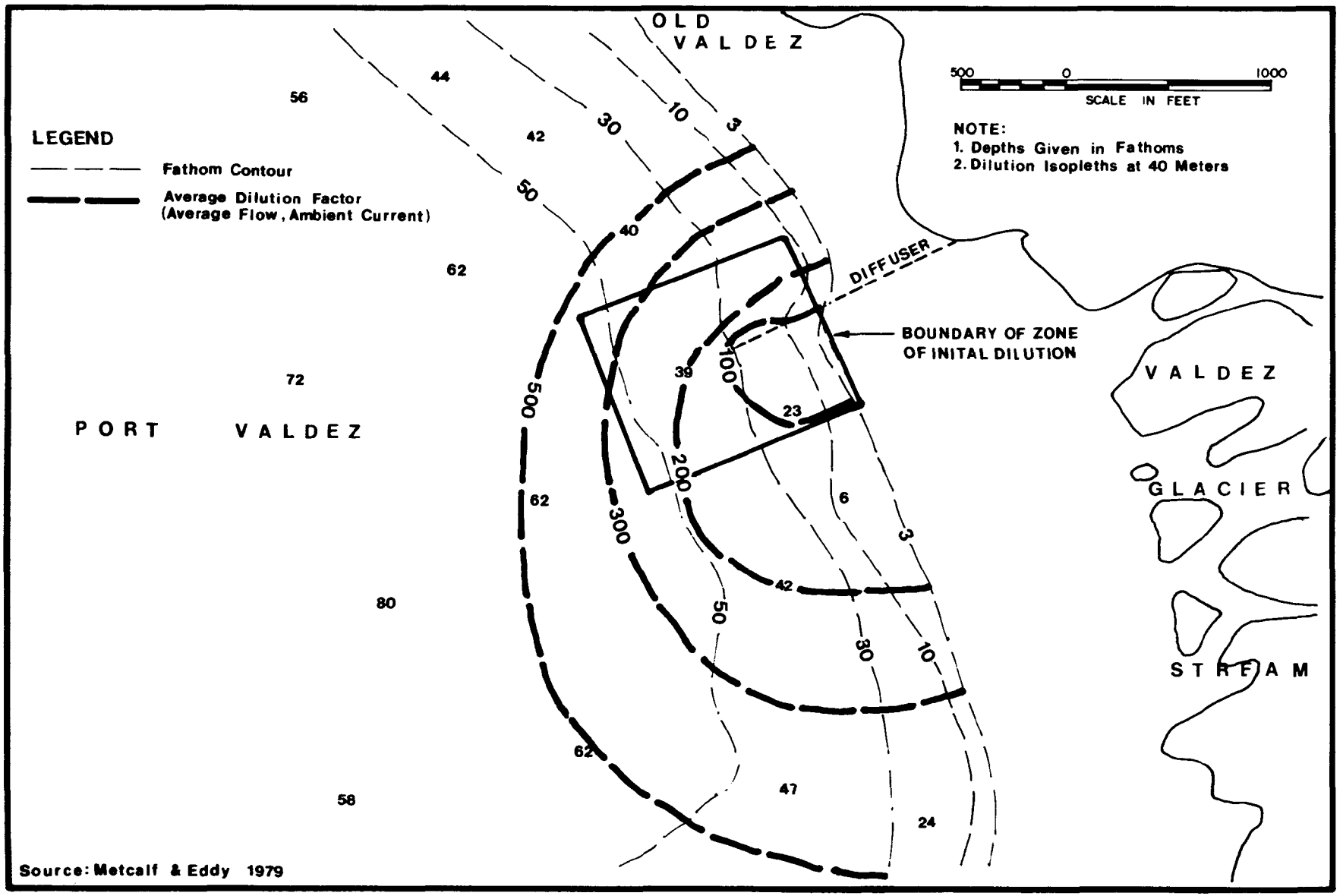


ZONE OF INITIAL DILUTION FOR WASTEWATER DISCHARGE **Figure 6.3-1**

Near-field circulation: To determine pollutant concentrations in the eastern end of the port, outside of the ZID, a circulation model (Adams, et al, 1979) is used. This model accounts for pollutant transport and spreading, and uses near-field model results as input. A simulation for July 5, 1979, is shown in Figure 6.3-2. This date represents summer stratified conditions (the most critical in terms of initial dilution) and low exchange at Valdez Narrows (the most critical in terms of pollutant build-up). Results are presented as contours of dilution of the proposed discharge water; dilutions range from 100 to 500. This is a typical pattern observed with the plume oriented toward the south. The effluent discharge is assumed to be trapped in a constant layer at a depth of about 40 m (131 ft) below the surface to provide conservative results. Additional studies will be undertaken in 1980 to further investigate the circultaion characteristics of eastern Port Valdez in order to determine a final location for the diffuser outfall which will ensure at least a 75:1 dilution of the effluent under worst case conditions at the boundary of the mixing zone.

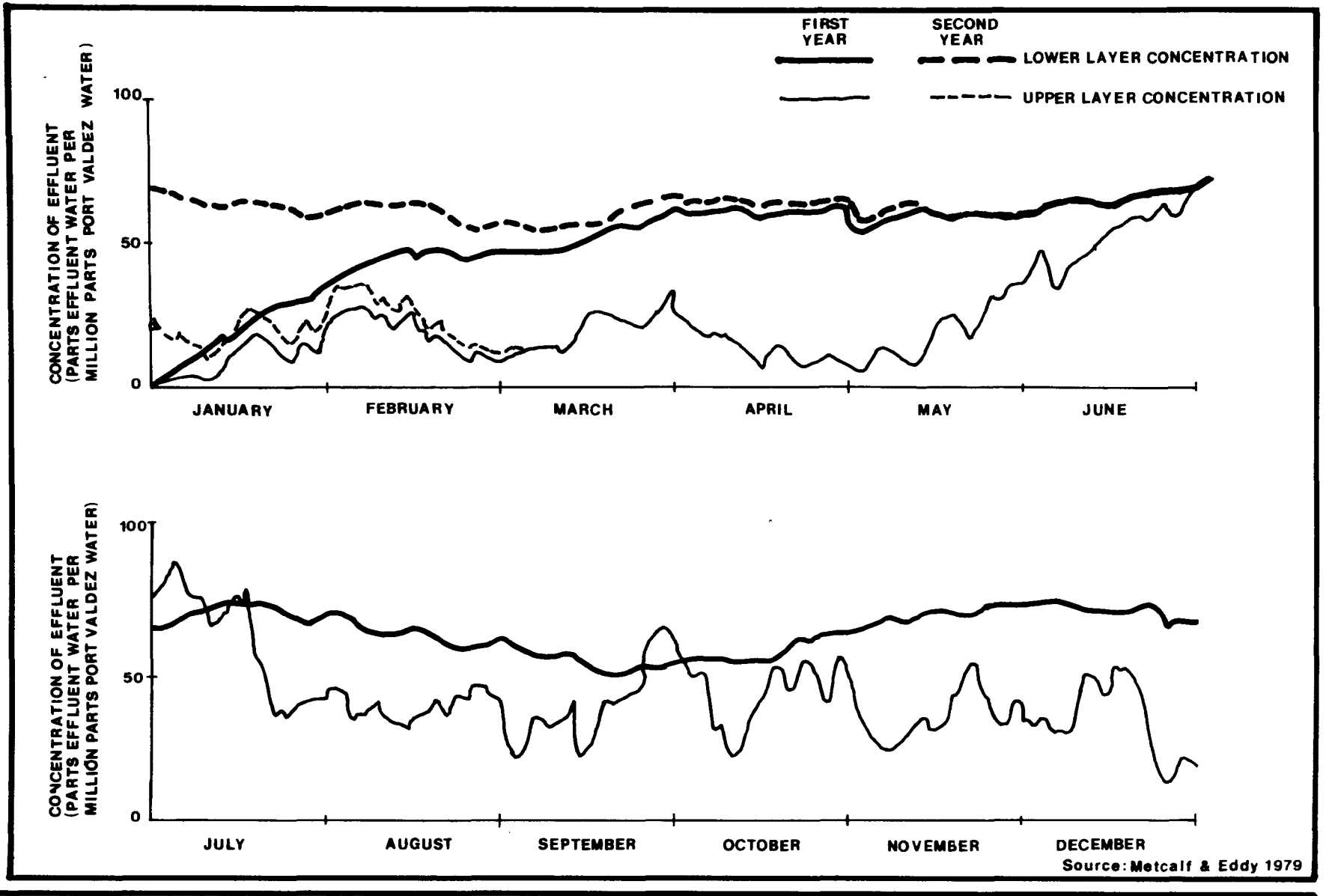
Port Valdez flushing: A two-layer flushing model was developed to observe variations in pollutant concentrations, and to predict critical time periods for pollutant build-up in Port Valdez due to the proposed discharge. The model accounts for the wastewater discharge into the lower layer, freshwater advective flows, and water exchange at Valdez Narrows based on measured currents. The model was run for 1-1/2 years starting from zero concentrations. The simulation represented in Figure 6.3-3 indicates maximum concentrations of about 75 parts effluent per one million parts Port Valdez water, or a dilution of about 13 thousand. The worst period of pollutant build-up in both layers is late June and early July, because of the lack of exchange water, presumably due to calm summer weather. During the worst-case period, the pollutant residence time is calculated at 48 days based on the rate of mass of discharge water entering the port and the mass of the discharge water already in the port.

Discharge water concentrations or their resulting dilutions have been presented for three zones: the ZID (or near field); the circulation



CIRCULATION MODEL SIMULATION FOR JULY 5, 1979

Figure 6.3-2



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MODELED AVERAGE CONCENTRATION OF EFFLUENT IN PORT VALDEZ DURING A SELECTED 1-1/2 YEAR PERIOD

Figure 6.3-3

zone in the eastern end of the port; and the far field (or entire port) flushing zone. Using the described methodology, during worst-case conditions, which implies stratification and lack of exchange at Valdez Narrows, dilutions for these zones are calculated to be 75 to 100, 100 to 500 and 13 thousand respectively.

Effects of accidental spills: The risks of spills due to tanker activities are considered later in Section 6.10.7. The following discussion considers the source and transport of those potential spills. The most likely opportunity for an accidental spill would be at the products dock, either during maneuvering or load transfer operations. Spills also could occur in transit, most commonly due to equipment failures, human error, ballast discharges, structural failures or vessel casualties. However, hazards formerly associated with vessel passage through Valdez Narrows near Middle Rock have been mitigated by implementation of the U. S. Coast Guard Vessel Traffic System.

The two main factors which affect transport of spills are currents and wind. Several mathematical models have been developed to account for oil slick movement under the influence of current and wind. An excellent summary of these models has been prepared by Stolzenbach et al, (1977). An often used "rule of thumb" which relates oil slick transport due to current and wind is known as the "3 percent rule." This rule, incorporated into many oil slick models, states that the speed of the oil slick is 3 percent of the wind speed plus the current speed. The 3 percent rule, which would also be applicable to a distilled products spill, is used here to obtain an approximate estimate of the movement of probable accidental spills in eastern Port Valdez and at Valdez Narrows.

An accidental spill at the proposed products dock is considered first. The currents in this area of the port, as discussed in detail in Section 5.3, are low tend to move along shore parallel to the land boundary. The upper layer of the water body moved both clockwise and counterclockwise during the May to July 1979 measurement period, and a predominance toward counterclockwise motion was observed. A counter-

clockwise motion also has been observed in the landsat photographs of eastern Port Valdez taken during the summer months to study the motion of suspended sediments. Information of this motion is not available for non-summer months.

Available wind data (Dames and Moore, 1979) indicate that the east-west orientation of the Valdez Basin helps funnel winds in those directions. There is a slight predominance of easterly winds (toward the ocean) over westerly winds. This is caused by the flow of air from the high-pressure zones in the interior of the state toward the low-pressure zones in the Gulf of Alaska. Records at Valdez weather service office (WSO) indicate wind magnitudes of 6 knots or less about 76 percent of the time.

Applying the 3 percent rule to eastern Port Valdez, oil movement due to wind would be from 0 to about 9 cm/s. This is about the same order of magnitude as movement due to currents. Thus, slick movement would be due to both current and wind and would respond to specific weather and current patterns occurring on the day of the spill. Movement of the oil spill would be on the order of 1 to 16 km/day and would most likely distribute itself along the south shore from the Lowe River to Valdez Narrows with a tendency to move toward the narrows during certain times of the year. Because distilled products dissipate rapidly, a spill would be less identifiable with distance from the incident.

A spill at Valdez Narrows would move much faster due to higher winds and faster currents. Measured upper layer currents at this location are on the order of 10 to 50 cm/s and change direction due to the tide. The funneling effect of the narrows' geography causes northeast or southwest current motion. The winds also are funneled through the narrows in the same directions due to the mountains on each side, and tend to be faster than those at Valdez WSO.

Net flows at Valdez Narrows (i.e. flow direction and rate without the effect of tidal flows) are inward or outward with direction changes every few days. Outward motion predominates during the summer due to

large freshwater flow and calm weather. Thus, a spill at Valdez Narrows would be equally likely to move into or out of the port, except during summer, when it would most likely move out. Since tidal currents are fast, the time at which a spill occurs is an important factor. A spill during an incoming tide would move rapidly out of the narrows and into Port Valdez. Based on tidal current alone, the spill would move out of the narrows in several hours. Once the spill moved into or out of the port, it would be affected by different current and wind regimes.

6.3.3 Mitigation Measures

The following measures could be considered to minimize effects on the port due to construction and operation of the proposed facility.

1. Discharge of effluent into the port through a diffuser designed for the particular outfall location should mitigate effects from wastewater discharge. Natural currents and proper diffuser design are expected to provide efficient dispersion and movement of the discharge from the port. Under the terms of the draft NPDES permit, the diffuser design and location must be approved by EPA prior to construction.

2. A spill prevention, control and countermeasure plan would be developed to satisfy state and federal requirements. Enforcement of these plans would minimize impacts of any accidental spills of petroleum or petroleum products.

6.3.4 Unavoidable Environmental Impacts

The discharge of treated effluent would be an unavoidable impact resulting from operation of the proposed facility.

6.4 WASTEWATER DISCHARGE

6.4.1 Impacts of Wastewater Discharge

General: The draft NPDES permit and the Fact Sheet containing EPA's rationale for the permit limitations are included in Attachment B of this EIS. The draft NPDES permit establishes effluent limitations for the proposed discharge, defines a mixing zone under state Water Quality Standards and establishes certain state receiving water quality standards which must be met at the boundaries of the mixing zone. A monitoring program also is part of the permit. A comparison of the projected effluents and NSPS was presented in Section 3.4.3. The mixing zone defined in the draft NPDES permit was based on the EIS analysis on the zone of initial dilution. The mixing zone boundaries proposed in the draft permit are very close to those of the ZID, except that the mixing zone has an upper boundary of 5 m below the surface and a lower boundary of 0.5 m above the bottom of the port. In addition, the draft NPDES permit requires a 75:1 dilution at the boundaries of the mixing zone.

Effluents from oil refinery operations and product transfer operations (including ballast water) typically are complex chemical mixtures with continually changing compositions. Assessment of the biological impacts of these various parameters is complicated by the lack of adequate historical information on acute or chronic impacts on local species, and the total lack of information on the combined effects (additive, synergistic or antagonistic) of all of these factors in a single plume.

In addition to the parameters covered by the NPDES permit effluent limitations, the State of Alaska has receiving water quality standards which apply to concentrations of certain parameters at the boundary of the mixing zone. In particular, pH, sediment concentrations, total aromatic hydrocarbons and cyanide limitations at the mixing zone boundaries are specified in the draft NPDES permit. Based upon the State of Alaska water quality standards, effluent limitations for aromatic

hydrocarbons and cyanide were established.

The state has set a total aromatic hydrocarbon standard, in the water column at the boundary of the mixing zone, of not-to-exceed 10 micrograms per liter (μg/ℓ) or 0.01 of a value which would be determined by the state using a formula which considers duration of exposure and concentration of a substance versus the survival rate of specific species (96 hour LC50). There is very little data available industry-wide on the concentration of aromatic hydrocarbons in effluent streams. No attempt has been made to quantify or predict concentrations of such substances in the proposed refinery wastewater. Also, due to different crude properties, processing schemes, processing equipment, age of facilities and other such variables, it is not currently understood how to correlate the priority pollutants, such as hydrocarbons, found in one refinery's waste streams with what might be expected in another refinery's waste stream. However, EPA has analyzed the waste treatment systems of a number of refineries for such substances (EPA/DOE, July 1978). These studies indicate that in no cases were concentrations of individual compounds greater than 10 μg/ℓ found in the final effluent from biological treatment systems which are similar to but older than that proposed for this facility. However, no measure of total aromatics as defined by the State of Alaska in the draft NPDES permit has ever been made. The level of 10 μg/ℓ in this case reflected the limit of detection of the analytic system in use.

Under the terms of the 1976 Consent Decree in NRDC vs Train (8 ERC 2120), EPA must establish water quality criteria for 65 toxic substances (recently expanded to 129). Various aromatic hydrocarbons as well as substances such as cyanide are on that list. EPA is in the process of developing guidelines for these priority pollutants. Proposed guidelines have been published for some of these substances. In its most recent proposed water quality criteria, EPA (1979) states that there are insufficient data to calculate or estimate safe criteria for marine life for exposures to phenols, chlorinated phenols, or cyanide. Criteria for several other parameters are not yet available; therefore, earlier criteria must be used to evaluate wastewater impacts (EPA,

1972, and 1976). The state's water quality criteria for toxic and other deleterious organic and inorganic substances are based on EPA's 1976 Quality Criteria for Water.

Impacts of specific chemical components: Table 6.4-1 summarizes conservatively estimated concentrations of effluent parameters in the draft NPDES permit. Concentrations of these substances in the receiving water following initial dilution are presented under unstratified and stratified conditions. Calculations for stratified conditions used the smallest dilution factor of 74 representing worst case conditions. Effects of some of the various anticipated components of the proposed discharge are discussed individually. State water quality standards are applied at the boundary of the mixing zone. EPA guidelines refer to EPA's effluent guidelines for petroleum refineries.

PH: The effluent would be discharged with a pH ranging between 6.5 and 8.5, compared with a naturally occurring pH range of 8-8.9. State Water Quality Standards applied at the boundary of the mixing zone require that the pH not be less than 6.5 or greater than 8.5 and not vary by more than 0.1 pH units from natural conditions. This range would not create deleterious conditions for marine organisms.

BOD, COD, and TSS: The concentration of oxygen-demanding material in the effluent would be low. The minimum dissolved oxygen (DO) concentration which normally would not be deleterious to fish is 5.0 mg/ℓ (Todd, 1970). Neither the BOD nor the COD concentrations found in the effluent from the proposed refinery would depress the existing DO concentrations of greater than 7.6 mg/ℓ to the harmful level. State water quality standards which require maintaining DO concentrations greater than 5 mg/ℓ would not be violated anywhere in the mixing zone. By way of comparison, EPA allows the discharge of up to 30 mg/ℓ of BOD and suspended solids from domestic sewage treatment plants. The projected BOD and suspended solids (TSS) concentrations would be less than one-half of this value. Discharge of the reported concentrations of BOD, COD and TSS would not adversely affect the marine environment near the diffuser, and would not be measurable at the edge of the mixing zone.

Table 6.4-1

CONCENTRATIONS OF EFFLUENT PARAMETERS AT THREE LOCATIONS AFTER DISCHARGE

		No Ambient Current	
Parameter	At Diffuser	Stratified[1]	Non stratified[2]
pH, pH Units	6.5-8.5	7-8.5	7-8.5
BOD, mg/ℓ	10	0.14	0.03
COD, mg/ℓ	135-250	1.8-3.4	0.4-0.7
T.S.S., mg/ℓ	<5-10	<0.07-0.14	0.03
Ammonia, mg/ℓ	7	0.09	0.02
Aluminum, mg/ℓ	Trace	-	-
Phenol, mg/ℓ	<0.02	<0.0003	<0.0001
Oil and Grease mg/ℓ	<2.0	-	-
Nickel, mg/ℓ	0.5	0.007	0.002
Cyanide, mg/ℓ	0.5	0.006	0.0014
Dilution Factor:	0	74	337

1 Worst case condition - July stratified water column; Trap Level 11 to 13 m above diffuser;

w/o ambient current — dilution 74
w/minimum ambient current 0.15 m/sec — dilution 100

2 Best case condition - March non-stratified water column; plume reaches surface (55 m);

w/o ambient current — dilution 337
w/ambient current 0.015 m/sec — dilution 606

Projected effluent TSS concentrations of less than 5 mg/ℓ are within EPA effluent limitation guidelines.

Oil and grease: Oil and grease from the effluent would not affect the environment at the diffuser. The oil and grease concentration would be less than 2 mg/ℓ, the lowest level of detection, and within the EPA effluent limitation guidelines.

Aluminum: Aluminum would be found only in trace amounts in the effluent and thus would not impact the environment at the diffuser or in the mixing zone. It is assumed that a trace is less than 0.1 mg/ℓ, which is the lower limit of detection for aluminum under standard conditions (EPA, 1974).

Phenols: The U. S. Public Health Service and EPA have set 0.001 mg/ℓ as the limit on phenol (Sawyer and McCarty 1967, EPA 1976), to protect against taste and odor problems and fish flesh tainting. Phenol would be 0.0003 mg/ℓ at the edge of the mixing zone under stratified worst case conditions. The phenol concentrations at the diffuser likely would not be toxic to marine organisms and the effluent concentration would be less than one-tenth of the "safe" level for phenol toxicity (EPA, 1976).

Nickel: Nickel occurs naturally in sea water, ranging between 0.001 mg/ℓ and 0.006 mg/ℓ (Oppenheimer, 1974) or 0.005 mg/ℓ and 0.007 mg/ℓ (EPA, 1976). The proposed refinery effluent would contain 0.5 mg/ℓ at the diffuser, but only 0.007 mg/ℓ at the edge of the mixing zone under worst conditions. The area immediately around the diffuser would pose a hazard to marine organisms, since concentrations of nickel in excess of 0.1 mg/ℓ are considered harmful (EPA, 1976). Nickel concentrations would be below 0.22 mg/ℓ as a 24-hour average, and therefore concentrations in the outer portion of the mixing zone should not be harmful to the indigenous flora and fauna. State water quality standards would not be violated.

Ammonia: Ammonia equal to, or exceeding, 0.4 mg/ℓ constitutes a hazard to the marine biota, and levels less than 0.01 mg/ℓ present minimal risk of deleterious effects (EPA, 1972). A given concentration of ammonia becomes more toxic as pH increases, as with sea water; however, the toxicity decreases with colder temperatures and increased salinity. The relatively cold temperatures and high salinity of Port Valdez may offset the pH factors. The ammonia concentration at the edge of the mixing zone under worst conditions is estimated to be 0.09 mg/ℓ, below the level considered to be acutely hazardous, but above the level that presents chronic risks.

Cyanide: The toxicity of cyanides varies widely with pH, temperature, and dissolved oxygen concentration (EPA, 1972). Cyanides become more toxic as temperature increases and as dissolved oxygen decreases (Hynes, 1966) and as pH decreases (EPA, 1976). Free cyanide concentrations between 0.05 and 0.1 mg/ℓ are usually fatal to many sensitive fishes, and a level as low as 0.01 mg/ℓ is known to have a pronounced, rapid and lasting effect on the swimming ability of salmonid fishes (EPA, 1972). The EPA had set a limit of 0.005 mg/ℓ; however, this criterion was re-evaluated in proposed EPA (1979) criteria due to lack of sufficient data for marine effects. State water quality standards require 0.005 mg/ℓ at the edge of the mixing zone.

The anticipated concentration of cyanide at the mixing zone boundary with no or minimum current and extreme stratified conditions is 0.006 mg/ℓ. Under maximum current stratified conditions, the anticipated concentrations of cyanide would be 0.003 mg/ℓ. Under non-stratified conditions, the anticipated cyanide concentrations would be 0.0014 mg/ℓ under no current conditions and .008 mg/ℓ under minimum current conditions.

Overall ecological impacts: From the available data, the near-field impact of the combined discharge on benthic fauna could be severe. However, because of plume buoyancy the total area directly affected would be small, on the order of a few square meters. Localized effects probably could result from direct toxicity of the discharge or from

consumption of "tainted" residues by the deposit feeding worms. During periods of high sediment loading from the glaciers, the sediment settling through the plume could adsorb some of the effluent constituents, thus widening the eventual distribution in the sediment of some of the effluent constituents. The extent to which this might occur and the magnitude of impact are unpredictable.

The intertidal mud and sand flat region in the vicinity of the zone of initial dilution (see Figure 6.3-1) could be vulnerable. This shallow intertidal zone is populated with clams and mussels and there is considerable bird activity in the area. Salmon are seasonally abundant in the area as adults migrating to nearby Sewage Lagoon Creek and as fry migrating out. However, this area likely would be affected by the plume only in the winter when the water column is not stratified. Dilution of the effluent during this time could be expected to minimize effects on benthic organisms. The only exception might be potential accumulation of pollutants in long-lived intertidal species such as the clam Macoma balthica. This species is estimated to live in excess of 10 years, and also serves as a major food item to various bird and fish species. Seasonal stratification of Port Valdez should prevent the effluent plume from entering the upper layers during the period when major salmon migrations occur.

During the summer under stratified conditions, the projected 40 m trap depth would result in the plume affecting the bottom sediments at that depth on the shoreward side of the diffuser. The sediments there are unstable and the biological community consists principally of burrowing worms. The impacts of the effluent in this area would be minimal.

The effect of the discharge on planktonic organisms entrained in the plume and drifting with it as it dissipates cannot be accurately predicted. Mortalities to organisms entrained in concentrated areas of the plume near the diffuser, while possible, are unlikely due to the depth of the diffuser. The number of organisms that might be affected would not represent a significant percentage of Port Valdez populations.

Fish encountering concentrated areas of the plume would have a natural propensity to avoid the changed condition and therefore significant mortality would not be expected; however, some short-term stress would be likely.

6.4.2 Mitigation Measures

This section presents a list of design features which could minimize effects of the discharge:

1. State-of-the-art in-plant wastewater treatment (described in Section 3.4.3).

2. Location of the discharge offshore and in an area of relatively good circulation and low productivity.

3. A back-pressure sensing system to detect breaking of the diffuser and/or outfall line.

6.4.3 Unavoidable Environmental Impacts

Severe degradation of benthic biota in bottom areas frequently contacted by concentrated portions of the plume would be unavoidable. In the event of a loss of the diffuser, a much larger area would be affected. Lesser population shifts in the local intertidal and shallow subtidal regions would be dependent on the duration and frequency of plume contact in these zones and the degree of dilution achieved before contact.

Chronic exposure to organisms may result in uptake of heavy metals (e.g. nickel) and perhaps hydrocarbons that could adversely affect organism survival or suitability as food for humans or other animals.

6.5 AIR QUALITY

6.5.1 Construction Effects

Construction impacts on air quality would consist mainly of the relatively minor amounts of pollutants emitted from the heavy construction equipment required for site preparation, and from fugitive dust emissions. Exhaust emissions from construction equipment would cause only localized, temporary effects upon existing air quality with no adverse impacts beyond the site boundary.

Fugitive dust emissions are expected to be the most noticeable impact during construction. The amount of dust would vary with the level of activity and the weather. Overall fugitive dust should add only minimally to existing background particulate levels in the area.

6.5.2 Operation Effects

Assessment methods - Primary effects of atmospheric emissions: Significant air emissions which would occur during operation of the proposed facility were analyzed to assess the impact on ambient air quality. The analytical approach taken was to determine compliance with applicable air quality standards using three dispersion models: VALLEY --a screening model; MCRSVAL--a refined model; and RADM--a state-of-the-art model. Modeling was performed for both proposed and existing emission sources in the area using maximum pollutant emissions rates and appropriate meteorological data.

Expected impacts of the proposed facility were assessed in terms of compliance with the NAAQS, the PSD regulations. Details of all input data and the dispersion modeling methodology used to determine compliance with the NAAQS and PSD regulations are presented in Attachment C.

Model input parameters - Primary effects of atmospheric emissions: Analysis of the impact on air quality of the proposed facility required

two primary types of input data, meteorological data, and emission source characteristics.

Two types of meteorological data input files were generated for use in the dispersion modeling analyses. One type is the normalized annual joint frequency distribution of wind direction, wind speed, and atmospheric stability. The second type consists of hourly values of wind direction, wind speed, stability class, and mixing heights. These data files were generated separately for the existing sources and proposed sources since meteorological conditions vary considerably in the Valdez area due to the effects of the complex terrain.

The other type of input data used in the dispersion modeling is emission source characteristics. These data consist of maximum expected pollutant emission rates from significant emission sources, both proposed and existing, and stack design parameters such as height, internal diameter, exit temperature, and exit velocity.

Modeling results - Primary effects of atmospheric emissions: Part C (Prevention of Significant Deterioration) of the Clean Air Act requires the preconstruction review of any major emitting facility. The proposed refinery qualifies as a major emitting facility under the Clean Air Act definition. EPA has received a PSD application from Alpetco.

The PSD regulations require that the applicant demonstrate that the proposed source will apply the best available control technology, and will not cause a violation of any National Ambient Air Quality Standard or PSD increment. In order to demonstrate that no violation of the NAAQS or PSD increments will occur, atmospheric dispersion modeling was conducted.

Dispersion modeling was performed for significant sources of TSP, sulfur dioxide, nitrogen dioxide, and carbon monoxide emissions. Table 6.5-1 presents a summary of dispersion model predictions of PSD increment consumption for the Alpetco facility as well as the Class II maximum allowable increments. Ambient concentrations during operation of

Table 6.5-1

SUMMARY OF PSD INCREMENT CONSUMPTION FOR THE ALPETCO FACILITY
($\mu g/m^3$)

	Pollutant Averaging Period				
	SO_2			TSP	
Increment, Consumption	Annual	24-Hour	3-Hour	Annual	24-Hour
Class II Maximum Allowable Increment	20	91	512	19	37
RADM Consumption	--	65	340	--	--
MCRSVAL Consumption	10	155	727	--	--
Modified MCRSVAL Consumption	--	77	462	--	--
VALLEY	9	103	--	2	31

the proposed facility were determined by adding maximum predicted ground-level concentrations from the existing sources to the maximum predicted ground-level concentrations from the proposed facility. Significant uncertainties exist concerning dispersion processes in the Valdez area due to complexities of terrain and meteorology. These uncertainties translate directly to the model estimates. VALLEY and MCRSVAL indicate possible violations of short-term NAAQS and PSD increments for SO_2 while RADM indicates compliance. The PSD permit application is currently under review by EPA to determine the most representative method for predicting air quality impacts. The results of this determination will be presented in the Final EIS. Until the PSD review is complete it is not possible to conclude that the proposed refinery would not cause or contribute to voilations of NAAQS or PSD increments. Table 6.5-2 presents a summary of dispersion model predictions for the applicable pollutants and averaging periods as well as the applicable National and Alaska Ambient Air Quality Standards.

Effects of fugitive emissions: Fugitive emissions are those emissions which are not confined to a specific vent or stack. Since all roads would be paved, no significant fugitive TSP emissions would be expected. Therefore, the only fugitive emissions from the Alpetco facility would be hydrocarbons, of which there would be approximately 827 tons per year. These emissions would be controlled at this level by a maintenance and monitoring program.

Atmospheric effects of cooling systems: The proposed facility would not contain any cooling system with which there are associated any significant atmospheric air quality effects, such as those which are associated with large nuclear and power plant air cooling towers in the contiguous states.

Visibility effects: Generally, visibility impairment due to pollutant emissions is due to the large number of very small particles (less than 1 micron in diameter) that are directly emitted or are formed by chemical reactions of the emitted gases. Currently, there are no accepted methods available to assess the degree of visibility reduction that

Table 6.5-2

SUMMARY OF NAAQS COMPLIANCE FOR THE ALPETCO FACILITY

($\mu g/m^3$)

Standards, Predictions	Pollutant Averaging Period							
	SO_2			TSP		NO_2	CO	
	Annual	24-Hour	3-Hour	Annual	24-Hour	Annual	8-Hour	1-Hour
National Primary Standard	80	365	--	75	260	100	10,000	40,000
National Secondary and Alaska Standard	80	365	1,300	60	150	100	10,000	40,000
RADM Prediction	--	220	1,200	--	--	--	--	--
MCRSVAL Prediction	28	301	2,637	--	--	--	73	225
Modified MCRSVAL Prediction	--	--	879	--	--	--	--	--
VALLEY Prediction	21	122	--	4	40	28	--	--

might be associated with particular emissions. However, since the estimated TSP emissions from the proposed facility are only 619 tons per year or less than two tons per day, the impact on visibility should be relatively minor. This is particularly probable since the high humidity in the atmosphere at Valdez causes water drop growth on small particulates. In addition, the naturally occurring liquid microdroplets of highly humid air can cause a significant visibility reduction which would far overshadow the small particulate impacts.

Although ice fog is a special visibility concern in Alaska, temperatures at Valdez are seldom cold enough (below about -30°C or -22°F) to cause plumes released from the proposed facility to result in reduced visibility from formation of ice fog.

Health and safety: Health and safety effects are covered by definition in the regulations pertaining to national primary and secondary, and Alaska, ambient air quality standards which have been established to protect the health, safety, and welfare of the general public.

Soils and vegetation effects: No adverse impacts are expected on soils and vegetation.

Acid rains, which occur when rain has fallen through a layer of air with sulfates or nitrates, or as drops of rain form around polluted nuclei, are not expected to occur from emissions from the proposed facility at least in the magnitude they occur in the contiguous states (especially the Northeast). There they are associated with high regional levels of sulfur and nitrogen emissions. In southcentral Alaska, regional levels of sulfur and nitrogen emissions are low insofar as this region is an attainment area for both sulfur dioxide and nitrogen dioxide. There have been no reports of acid rains in the southcentral Alaska region, or Valdez in particular.

6.5.3 Mitigation Measures

The following measures could be considered to minimize the extent and

significance of potential adverse impacts of the proposed refinery on air quality.

Site preparation and construction:

1. Reduce fugitive dust by wetting down dry, exposed soil.

2. Whenever practicable, employ alternate land clearing debris disposal methods in lieu of open burning (e.g. shredding or mulching and landfill).

Operations: Emissions to the atmosphere from the operation of combustion equipment, the sulfur recovery system, the FCCU, the flare, the incinerator, storage tanks, and from fugitive emissions would be controlled by using the best available control technologies as presented in Section 4.4.3.

6.5.4 Unavoidable Environmental Impacts

Impacts on air quality which cannot be avoided despite the application of mitigative measures, are summarized below.

Site preparation and construction: Air quality in the vicinity of the proposed refinery would be only slightly affected by site preparation and construction activities. Impacts would be short-term and confined to a relatively small area. Emission sources include construction equipment and fugitive dust.

Operation: During operation of the proposed Alpetco refinery, pollutant concentrations would increase in the plant vicinity thereby consuming PSD increments. The proposed facility may stimulate further industrial growth in Valdez which can be expected to cause further consumption of the PSD increments.

There would be no adverse impacts expected on PSD Class I areas or on soils and vegetation. Visibility impairment from the pollutant emis-

sions also is expected to be very small. There are no nonattainment areas in the vicinity of the proposed facility.

6.6 ACOUSTIC ENVIRONMENT

6.6.1 Construction Effects

Construction noise would be generated primarily by trucks and heavy equipment; stationary equipment (pumps, generators, compressors); and impact equipment (pile drivers). Due to the high sound levels and impulsive nature of sound associated with impact equipment, these sounds might be noticeable at Robe River Subdivision and Valdez Glacier Wayside campground but the effect would not be serious and would be of short duration. Construction of the southern service road and laying of the pipelines there could increase the Ldn to 79 dB at parts of Robe River Subdivision for short term periods, creating a temporary significant impact. Other construction sounds on the refinery site and traffic between the construction barge dock and the site probably would not affect residential or recreational areas.

At the peak of construction, the increased heavy construction and general vehicular traffic could increase the Ldn by 4-7 dB in some areas. In areas not used by heavy construction equipment, the increase probably would be about 4 dB. Increased air traffic could raise the Ldn by about 3 dB near the airport. These increases would be perceptible at locations near the sources but would not be significant.

6.6.2 Permanent Effects

The proposed refinery would generate fairly high noise levels (85-95 dB) within the immediate processing complex because of equipment such as pumps, compressors, steam jets, flare stacks, etc. During normal atmospheric conditions (approximately 80% of the time), the outdoors noise increase due to refinery operations would be slight or nonexistent at Robe River Subdivision, the only permanent residential area in

the vicinity of the proposed facility. Upset conditions which would cause sufficient flaring for noise to be noticeable could be expected to occur less than five times per year with a probable duration of five to 10 minutes. Such flaring would not be expected to continue more than 30 minutes in any case. A major upset would produce a low pitched rumble resembling a distant run up of a jet engine. The trees and low hills between Robe River Subdivision and the refinery are the primary sound buffer. Without them the refinery operation probably would become the predominant outdoors background noise. This should be considered if plans for an expansion to Robe River Subdivision materialize.

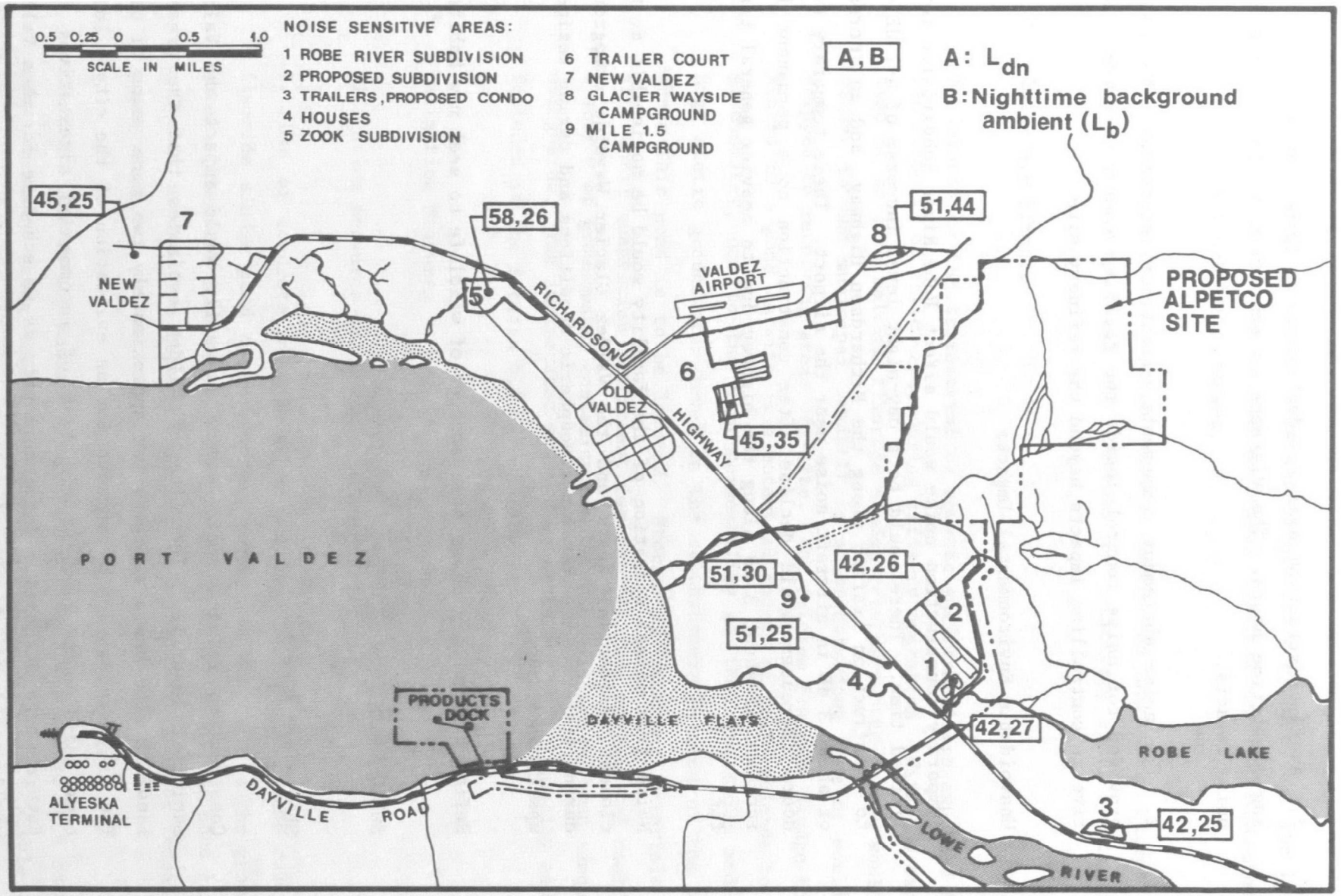
Substantial noise increases of 10 dB or more would be expected outdoors at Southcentral Trailer Court (temporary residential land use) and Valdez Glacier Wayside campground, but noise still would not exceed Ldn of 55 dB, which is considered generally acceptable.

During temperature inversions which are estimated to occur about 20% of the time, refinery noise would be noticeable or predominant at Robe River Subdivision, Southcentral Trailer Court and Valdez Glacier Wayside campground. Background ambient levels could be increased by more than 10 dB outdoors at these locations, but the day-night level probably would not increase by more than 5 dB outdoors at any residential area. These estimates are based on assumptions of worst case conditions (see Figure 6.6-1).

Refinery noise might have some impact on wildlife. There is not sufficient research available on this subject to predict accurately where and how the effects may occur; however, they are likely to be in the form of habitat abandonment.

6.6.3 Mitigation Measures

The following measures could be considered to minimize the noise impacts of refinery construction and operation.



PROJECTED NOISE LEVELS

Figure 6.6-1

1. Avoid construction near residential areas (pipeline corridor) during night-time hours. The distance to residences would mitigate most noise impacts.

2. Use noise abatement components on refinery equipment. Technology provided for noise control inside the facility also will prove effective in controlling impacts beyond the refinery site.

6.6.4 Unavoidable Environmental Impacts

Temporary construction noise would affect Robe River Subdivision for a limited time. There would be a day-night level increase of 4-7 dB due to construction traffic along the Richardson Highway, and an increase of about 3 dB in aircraft noise near the airport. These temporary outdoors increases would decline after construction to a permanent Ldn increase of about 3 dB along the highway due to heavier general traffic.

Noise from normal operation of the facility would be noticeable at the closest residential areas and the Valdez Glacier Wayside campground during temperature inversion atmospheric conditions and during refinery upset conditions.

Refinery noise may cause some species of wildlife to seek new habitat.

6.7 SOLID WASTE

6.7.1 Short-Term Effects

Construction related solid wastes primarily would impact the Valdez municipal landfill. The City of Valdez estimates that the present landfill site has a capacity for approximately two more years of use. The city has awarded a contract for an evaluation of the city's long-term solid waste needs and a list of recommended alternatives for future waste disposal. There currently is no schedule for when Valdez would upgrade the facility but it appears likely the city would be pre-

pared to handle the short-term wastes generated by Alpetco. The latest state permit for the Valdez municipal landfill expired September 1, 1979 and has not been renewed.

There are no construction wastes considered hazardous except for replaced machinery oil and solvents in relatively small quanitities.

6.7.2 Long-Term Effects

No impacts on the terrestrial or aquatic environment are expected from the disposal of solid waste during refinery operation. With the exception of on-site calcium fluoride sludge retention, the wastes would go either to the municipal landfill in a non-hazardous form or would be shipped to receiving areas off-site. The calcium fluoride sludge to be stored in a pond on-site is a potential source of toxic release to the groundwater, due to the high permeability of the site soils and the high static groundwater level in the southwestern portion of the site where this pond is to be located. Storage of hazardous materials on-site until quantities sufficient for removal have accumulated could be a source of groundwater contamination through spillage without adequate safeguards. The incinerator would have an impact on air quality and is included in the Section 6.4 air quality impact evaluation.

6.7.3 Mitigation Measures

Mitigation measures which could be considered are:

1. Use of concrete or some other positive-seal liner in the calcium fluoride sludge pond to prevent any seepage of toxics into the groundwater. Chemical stability of the calcium fluoride bond, the pond liner and soil attenuation capabilities should mitigate a fluoride threat to groundwater.

2. Containerize any hazardous materials temporarily stored in a secure area on-site, using sealed 50-gallon drums or similar sealable and transportable containers in accordance with federal regulations regard-

ing transportation of hazardous materials.

3. Install emission controls on the incinerator.

6.7.4 Unavoidable Environmental Impacts

The following effects would be unavoidable in disposing of the refinery solid wastes:

1. Air emission impacts discussed in Section 6.4.4.

2. A more rapid filling of the Valdez municipal disposal facility.

6.8 ECOSYSTEMS

6.8.1 Marine

Construction impacts

Products dock: At the products dock site, construction impacts would be expected to result mainly from pile driving and steel erection operations. Steel-jacketed piles would be driven from land-based or floating equipment and would not affect the intertidal region except in the immediate vicinity of each pile. At these locations, a distortion of the surface sediments and a resuspending of fine silt components would occur. However, the effects would be localized and relatively minor to the intertidal benthic assemblage. Subtidally, the mud plume would disperse over a slightly larger area but again would have a generally negligible impact.

If pile driving occurred during the "clear" water seasons (spring or winter), then a minor reduction in phytoplankton productivity could occur in the immediate area.

Additionally, Solomon Gulch Creek is utilized as a solmon spawning

stream from April to mid-May. The distance between the proposed construction site and the mouth of the creek, about 606 m (2,000 ft), is considered sufficient to preclude impact on salmon eggs from shock waves during pile driving (see Post et al. 1974). However, turbidity and/or mechanical disturbance during the period of April 15 to May 30 may adversely affect pink salmon fry which are present along the southern shoreline during that period. In-migrating routes of spawning salmon along the south shore would be altered temporarily during pile driving activities.

Construction and operation of a hydroelectric plant at Solomon Gulch by Copper Valley Electric Association should not affect any conditions below Solomon Gulch Falls including the Solomon Creek fishery, so there should be no change in conditions there which Alpetco would need to consider. CVEA is committed (COE Permit 071-OYD-4-780253) to monitor the temperature and flow of waters and to maintain natural conditions; to construct the facility such that fish may not enter or become entrained in the facility; to exercise siltation control measures during construction; and to flush salmon gravel at any time if a need is determined by ADFG.

Noise and activity during initial construction temporarily would displace birds and marine mammals within a local zone of impact. Concentrations of waterfowl utilize the south shoreline during the winter period (October to May), and various species of sea ducks have been observed aggregated in the vicinity of the old wharf ruins offshore from Solomon Gulch Creek in both winter and spring. Harbor seals occasionally haul out at the same location. Barring direct harassment, these animals generally can coexist with moderate human activities.

Accidental spills of hazardous substances (e.g. paints, solvents, or fuels) could have a moderate impact on the immediate area. The degree of impact would depend on the nature and amount of material spilled, physical conditions at the spill site, and the success of cleanup activities.

The National Marine Fisheries Service (NMFS) operates a biological monitoring site, located within the intertidal zone about 0.8 km (1/2 mile) east of the proposed products dock. Populations of marine organisms, particularly the small clam Macoma balthica, are being observed to detect any effects of oil pollution arising from the Alyeska terminal activities. Such monitoring could detect short- and long-term impacts from Alyeska and Alpetco facilities.

Sportfishing for salmon, especially silver salmon, occurs along the south shore of Port Valdez in July and August. The dock construction would eliminate access to a portion of the shoreline.

In summary, localized short-term impacts could be expected during construction at the products dock site. However, with proper controls and scheduling, significant adverse impacts on the Port Valdez ecosystem as a whole would be unlikely.

Effluent pipeline: Placement of the refinery effluent pipeline would require digging of a 3 m (10 ft)-wide trench 366 m (1,200 ft)-long (from MLLW) through the intertidal zone immediately northwest of the mouth of Valdez Glacier Stream. A zone of impact would occur along the trench and for a short distance downstream (generally north) of the immediate site. The intertidal area is relatively sparsely populated by mussels, clams and seaweeds. At approximately 0.3 m (1 ft) MLLW, the shelf area breaks and becomes steeply sloping to approximately 100 m (330 ft). This slope has loosely consolidated sand and silt sediments, is directly affected by glacial silt deposition from Lowe River and Valdez Glacier Stream, and shows evidence of active slumping. Low-level populations of burrowing worms appear to be the dominant biological community. Since the benthic assemblage in this region has already "preadapted" for the heavy seasonal surface water suspended sediment loads from the nearby rivers (1.0 to 421.3 mg/ℓ [or ppm] at Island Flats) (Feder et al 1979), the impact would be minor, with quick recovery anticipated.

Noise and construction activities would temporarily displace local waterfowl and marine mammals.

Construction barge dock: Installation of pilings and riprap and filling behind these bulkheads to form the construction barge dock would cause the destruction of existing benthic fauna in the immediate dock area of approximately 0.3 hectare (1 acre). The fill site is an intertidal area with a gravel and cobble substrate. The area is influenced strongly by turbidity and sediment from the Lowe River. As a result, the area is sparsely populated with the clams *Macoma balthica*, the predominant organism. The impacts would be minimal. A fouling community similar to that found on other hard substrates (e.g. rocks, pilings) at like tide levels in Port Valdez would develop on the bulkheads and partially compensate for lost productivity from the filled area.

Presence of the vertical bulkheads could cause a minor inconvenience for small pink and chum salmon moving along the shoreline. These fish might be subjected to increased predation by larger fish as they pass along in front of the bulkhead.

Operation impacts

Normal operations: The impacts of discharge from the wastewater treatment facility at the proposed refinery are described in Section 6.4.

Normal operations at the products dock should have little impact on water quality and marine biota. There could be some short-term disturbance of finer bottom sediments due to propellor wash; however, this effect would be very local and of negligible significance. Occasional small product spills probably should be considered a normal occurrence (see Section 6.10.7). It is expected that cleanup operations would recover most of the spilled material and prevent it from contaminating the shore. Marine organisms may suffer temporary adverse effects during small spill incidents.

The noise and activity of ship movement and docking could cause a minor disruption of movement patterns of marine fish, birds, and mammals in the area. The impact would be similar to that resulting from shipping

activity at any of the currently active piers in Port Valdez and would not cause significant stress to these species.

The pilings of the products dock would provide a substrate for colonization by marine fouling organisms similar to those found on existing piers in Port Valdez. This colonization can constitute a positive impact on local production of several important species (e.g. crab, shrimp, and several fish species). These organisms either feed directly on organisms on the piles or on debris sloughed from the piles. The proposed dock, like existing piers in the area, could harbor predatory fish (cottids, rockfish) that prey on juvenile salmonids out-migrating along the shorelines of Port Valdez.

The open nature of the design of the pilings under the causeway should allow juvenile salmonids to select water depths where they are capable of avoiding predators that are present, and little increases in overall losses to predation would be likely.

Occasional occurrences: This section contains a brief summary of the anticipated impacts of a petroleum products spill on marine habitats where the risk of spillage is considered greatest. The Appendix Vol. I presents detailed discussions on the impacts of hydrocarbons on each habitat type and discussions of the sensitivities of various types of organisms. The biological communities associated with each habitat are described in Section 5.6 and the Appendix Vol. I. An analysis of the risk of spills is presented in Section 6.10.7.

There are insufficient data available to distinguish impacts among the various products at a significant level of detail; therefore all are considered equally toxic. The biological effects of a product spill would depend on many factors including type and amount of product spilled, season, weather, tide, currents, and type of habitats contacted by the product. Refined products such as fuel oil, diesel, kerosene, and gasoline are widely recognized to be more toxic to marine organisms than are most crudes (Rice et al, 1977; Craddock, 1977). On the other hand, refined products tend to evaporate and dissolve into

water readily and as a result cause lesser long-term physical impacts to organisms.

Those specific habitats most vulnerable to a small product spill that escaped containment at the berth would be the steep coarse beach along the southeastern shore of Port Valdez and the mud and sand habitats and salt marsh on Dayville Flats and at the mouth of Valdez Glacier Stream. A large spill at the berth or due to a grounding or collision in Valdez Narrows, Valdez Arm, or Port Valdez could have an impact on virtually all of the habitat types present.

A product spill contacting mixed cobble, gravel, sand, and shell beaches would cause heavy mortalities of organisms attached to substrate materials (barnacles, limpets, snails), organisms living under rocks (shore crabs, amphipods, isopods), and algae. In addition, petroleum products entering the sediments underlying these beaches could cause mortalities of some sediment dwellers (bivalves, polychaetes). Intertidal fish such as cottids, gunnels, and pricklebacks also would suffer some mortalities. Recovery of these beaches to near prespill conditions could take several years, depending on how rapidly the spill was cleaned and degraded by natural processes and cleanup efforts.

Sand beach areas would have less obvious mortalities. However, loss of organisms in the sediments (bivalves, polychaetes, amphipods, and small organisms) would be likely. Recovery of species which reproduce annually or biannually on the sandy beaches likely would occur within two years after spilled material was cleansed from the sediments.

In the kelp beds lying just offshore of rocky areas, especially to the west, some products could be retained for a time by the floating kelp blades and cause some mortalities among the invertebrates and epiflora of the kelp canopy. Mucous coatings should protect the kelp themselves, and the community should be largely recovered in a year or two. Herring spawn deposited on subtidal kelp in this area could be affected by water-soluble fractions of spilled material, but probably would be

protected by the cleansing action of tides and currents.

In the open water habitat of Port Valdez, Valdez Narrows, Valdez Arm, or northeastern Prince William Sound, the major impact would be on cormorants, gulls, alcids, grebes and ducks using these areas for feeding or resting. Mortalities of planktonic organisms immediately under the spill also could occur. Fish in open water areas and subtidal algae and invertebrates probably would escape harm because of the excellent water circulation and, for some species, their mobility and avoidance reactions.

Small furbearers and marine mammals using these habitats could also be affected if they come in contact with a spilled material or ingest contaminated food.

If spilled products became worked into the sand and mud beaches of Dayville or Island flats, cleansing of the product from the sediments and organisms, and recovery of population in the sediments could take several years. If the wind and wave conditions did not work the spilled product into sediment, subsequent tides would remove the product and weathering would reduce its toxicity, greatly lessening the long-term effects. Regardless of wave conditions, a spill covering these flats during the fall or spring periods of heavy migratory bird usage could cause numerous mortalities and could significantly reduce populations of some species.

The effects of petroleum product coverage on rocky beaches would be similar to those that would occur in the boulder and cobble habitats, with expectations to include heavy mortalities of organisms living on the substrate and of some algae. Recovery to near pre-spill conditions would take one year or more.

In addition to the ecological effects briefly described above, a spill in this region, especially in Prince William Sound, at certain times of the year (particularly spring through fall) would curtail commercial fishing, and in some cases sportfishing, for salmon, herring, bottom

fish, and crab. Fouling of gear and loss of harvest time on transient stock (salmon) could cause a considerable economic burden on fishermen.

Mitigation measures: This section provides a list of measures that could be considered to reduce project impacts on the marine environment.

1. To the extent possible, locate facilities away from nesting areas or resting areas for migrating birds.

2. Schedule construction work at the products dock to avoid the intertidal spawning period for salmon in Solomon Gulch Creek (mid-July to late August).

3. Trenching activities for burial of the effluent pipeline in the intertidal zone should be scheduled to avoid the pink salmon run in nearby Sewage Lagoon Creek.

4. Implementation of a spill prevention, control, and countermeasure plan would reduce the chances of spillage of petroleum hydrocarbons and maximize the effectiveness of control and cleanup measures in the event of a spill.

5. Possibly place containment booms around all vessels, before heavy product transfer begins, to trap any containable potential spill material.

Unavoidable environmental impacts: Despite mitigation measures described above, some adverse impacts on the marine environment would be unavoidable. Most of these impacts have been determined to be relatively minor and/or of short duration.

1. Benthic organisms, fish and wildlife in the vicinity of marine construction areas would be subject to disturbance from noise, increases in suspended sediments, and other human activities.

2. Benthic organisms in the area of direct disturbance by pile driving and trenching for the effluent pipeline would be destroyed, displaced, or otherwise disturbed.

3. Large accidental spills of hydrocarbons could have severe and long-lasting impacts on the marine ecosystem of Port Valdez.

6.8.2 Freshwater

Construction impacts: The proposed diversion of Slater Creek into the Valdez Glacier Stream would eliminate the stream segment that flows south across the site into Corbin Creek (Glacier). This would withdraw from production about 2,163 m (7,095 ft) of marginal seasonal fish habitat.

Some increase in suspended sediments would occur in Corbin Creek (Glacier) during construction of a bridge. Valdez Glacier Stream would be disturbed similarly during bridge and dike construction. During general site development, surface drainage could erode the exposed soils and add to siltation within these streams. All of the above streams are poor fish habitat with high natural sediment loads, and impact on aquatic biota probably would be minor.

The proposed pipeline corridor from the southern boundary of the refinery site to the products dock would cross several streams including a headwater tributary to Corbin Creek (Robe), Corbin Creek (Robe) main channel, Robe River, Lowe River, Abercrombie Slough, Abercrombie Gulch Creek, and Dayville Flats Creek. The wastewater pipeline would cross Valdez Glacier Stream. The buried products pipelines crossings of these streams represent the greatest potential construction impact relative to freshwater habitats. Corbin Creek (Robe) and Robe River are the most sensitive of these streams because of salmon spawning ground at or near the proposed crossing locations and year-round presence of young salmon.

Burial of the 11 pipelines within the corridor would require a ditch 11

m (36-1/2 ft) wide. Depth of burial would vary depending on stream scour potential. Impacts on the stream biota would include blockage of fish passage during ditching, mechanical disruption of streambed habitat, sedimentation that could cover spawning grounds and smother fish food organisms in downstream areas, and possible direct suspended sediment effects on aquatic biota. None of these sediments has a history of contamination by toxic substances. Therefore, resuspension of sediments would not involve resuspension of toxic materials.

The extent of the disturbance would depend heavily on flow conditions, soil characteristics, construction methods, and construction scheduling. Road crossings of Robe River and Corbin Creek (Robe) would be bridged. Some disturbance of stream banks and increased suspended sediments would occur during bridge construction. However, with proper scheduling, effects would be minor and fish passage would not be impeded significantly.

Construction of the proposed products dock would create noise disturbance (pile driving) in front of and about 690 m (2,300 ft) seaward of intertidal salmon spawning habitat at the mouth of Solomon Gulch Creek. Some disturbance could occur to spawning salmon if construction took place during the July 15 to August 15 spawning period. Adverse impacts on salmon eggs or alevins in the gravel due to ground shock from pile driving are unlikely in view of the 690 m buffer distance (Post et al , 1974).

Operation impacts: Little impact on freshwater aquatic ecosystems would be expected during normal operation of the proposed refinery except as discussed below.

Some continuing stream siltation could result from erosion of the various areas depending on the success of revegetation and slope stability activities. The highly permeable soil and minimal surface drainage would minimize these effects.

Continuous use of fresh water drawn from on-site wells might lower

groundwater levels and, consequently, reduce flows in Corbin Creek (Robe) and Brownie Creek. Hydrological studies have shown that effects on the water table would be negligible in the summer. However, no information is available for the winter period, during which time adequate flow is critical to the survival of salmon eggs. Any drop in groundwater level could reduce the length of stream suitable for salmon spawning and/or egg survival.

Continuous disturbance resulting from use of the products dock could adversely affect pink salmon spawning in the intertidal zone at the mouth of Solomon Gulch Creek. Significant effects are unlikely in view of extensive spawning observed in other areas of high disturbance in Port Valdez.

Improved access to the proposed refinery site vicinity could increase human disturbance of salmon spawning streams (Corbin Creek [Robe] and Brownie Creek).

A significant accidental spill of hazardous substances on-site would be most likely to originate at the tank farm. While equipment failures and personnel errors tend to result in more frequent but low volume spills, natural disasters, fires and explosions could result in high volume, more damaging spills. The amount and resulting effect of oil escaping from a tank farm and reaching bodies of water depends upon many factors. The most important is the effectiveness of the containment dike encompassing the storage tanks. The dikes are intended to prevent a spill from contaminating groundwater or reaching streams. Casualty of a dike during a spill incident could have a serious effect on the groundwater and stream drainage systems. Statistical information and methodology used in the U. S. Bureau of Land Management/Oceanographic Institute of Washington oil spill analysis for the proposed Northern Tier Pipeline, indicate a predicted tankage spill for the proposed refinery once every 5.8 years. This computation, with a 95 percent confidence interval, uses total volume stored (10 million barrels in this case) as the exposure variable. The probable size distribution for each predicted spill incident would be: 2.4-10 barrels, 36

percent; 10-100 barrels, 49 percent; 100-1,000 barrels, 14 percent; and 1,000-10,000 barrels, 1 percent.

A leak in any of the pipelines in the vicinity of a stream crossing could have a significant impact. Some of the refined products are highly toxic to aquatic organisms, and salmonid fishes are unusually susceptible (Cote, 1976). The most sensitive spill area would be near Corbin Creek (Robe) since spilled substances would pass through the whole Robe Lake system.

Computations using the BLM Northern Tier analysis methodology indicate a predicted pipeline related spill for the proposed project once every 6.1 years. This computation, with a 95 percent confidence interval, uses the total length of pipeline (75 miles in this case) as the exposure variable. The probable size distribution for each predicted spill incident would be: 2.4-10 barrels, 68 percent; 10-100 barrels, 20 percent; 100-1,000 barrels, 5 percent; 1,000-10,000 barrels, 5 percent; 10-100 thousand barrels, 2 percent.

Mitigation measures: This section provides a list of measures that could be considered to reduce project impacts on the freshwater environment.

1. Plan construction activities in or near streams to minimize instream work and disturbance of stream banks. Rehabilitate disturbed streams to assure fish passage and to replace natural streambed materials. Stabilize disturbed stream banks, dikes, and other areas with vegetation or riprap as soon as possible after construction to prevent excessive erosion and siltation.

2. Construct settling berms as necessary to allow settling of suspended solids before work area runoff enters surface waters.

3. Install buried pipeline stream crossings during the least biologically sensitive time of the year (normally the time between fry emergence and adult escapement to streams; see Table 5, Appendix Vol. I),

employing the construction method that is least damaging for that type of stream. A stream bypass flume could carry stream flows during pipe burial at Corbin Creek (Robe), Robe River, and Dayville Flats Creek. This construction method proved most successful during Alyeska pipeline construction.

4. Align crude oil and products pipelines to minimize the number of stream crossings, and bury pipelines to reduce the risk of hydrocarbon spills from accidental pipeline damage and vandalism.

5. Design culverts, bridges, and other drainage structures on fish streams to assure that water velocities could not impede fish passage, and install culverts in concert with the natural streambed to prevent "perched" conditions which could impede fish passage.

6. Monitor groundwater drawdown on the refinery site during the winter near Corbin Creek (Robe), and develop a contingency plan to supply water to Corbin Creek (Robe) and Brownie Creek if necessary to maintain winter flow.

7. Develop oil spill contingency plans which consider all aspects of refinery and pipeline operation with special emphasis on protection of the Robe Lake drainage.

8. Replace gravel in trenches for pipeline creek crossings to minimize sedimentation, erosion and siltation.

9. Establish setbacks from streams for storage of fuels during construction.

10. Assist in establishing an interdisciplinary team of engineers, fishery biologists and hydrologists to provide early review of construction plans and schedules for stream crossings. The feasibility of such a team was pioneered during recent Alyeska construction. However, in this case, the number of streams is relatively small and the soil conditions are described adequately.

11. Indoctrinate management and construction personnel concerning potential environmental problems.

Unavoidable environmental impacts: Despite the mitigation measures described above, the following impacts on freshwater aquatic ecosystems are considered unavoidable:

1. Slater Creek is not a productive fish stream (see Section 5.6.1) and is dry in the winter; however, the creek would be lost permanently as a potential fish habitat.

2. Short-term disturbance, including increased suspended solids and increased sediment deposition, would occur within the numerous streams affected by pipeline burial and other construction activities.

3. Severe loss of aquatic life would be unavoidable in the unlikely event of a pipeline rupture that introduced substantial quantities of petroleum hydrocarbons into surface waters.

6.8.3 Terrestrial

Construction impacts: The construction activity associated with the proposed refinery would result in the loss of the natural vegetation now occupying the refinery site and associated access road and pipeline corridors.

	Vegetated area lost in hectares (acres)	
Vegetation Types	Refinery Site	Roads/Pipelines
Riparian Woodland	85.0 (210.0)	5.1 (12.6)
Deciduous Woodland	109.2 (269.8)	13.8 (34.1)
Mixed Deciduous and Spruce Forest		3.2 (7.9)
Spruce Forest		4.2 (10.4)
Alder Shrub		2.3 (5.7)
TOTAL	194.2 (479.8)	28.6 (70.7)

The deletion of the natural vegetation would result in the loss of habitat for small mammals, black and brown bears, and birds now utilizing these ecological formations. Displaced animals likely would utilize adjacent habitats except for some small mammals that may be eliminated.

Increased human activities in the area during construction likely would cause disturbance of nesting birds during the summer months. Some bird species such as ravens, magpies, and gulls likely would be attracted to the area. Bald eagles nesting activity also could be affected by the construction of the products and crude oil pipelines in the vicinity of the four eagle nests near Dayville Road (three were inactive in 1979).

The numbers of accidental bird and small mammal kills on the existing road system and on access roads likely would increase due to increased traffic.

Confrontations between humans and bears could be expected to increase with road development and general construction activities. The area has high black bear and brown bear concentrations in the summer, and increased bear mortality and possible injury to humans could occur.

Noise levels during construction of the proposed project could cause birds and mammals to abandon adjacent habitats which are not directly affected by the clearing of vegetation.

Operational impacts: Impacts on the local biota due to operation of the proposed facility would be mainly from increased human activity, noise levels, and air pollution.

Human activity likely would decrease with the completion of construction. Human/bear confrontations still could occur but to a lesser degree. This would depend largely on the sanitary disposal of garbage associated with refinery maintenance.

Noise from the operation of the refinery and associated vehicle traffic would be a chronic disturbance to the animals of the surrounding area.

Toxic emissions (particularly sulfur dioxide) from the operation of the refinery could alter vegetation patterns by inhibiting lichen growth and fern reproduction by a phenomenon which is largely unknown in Alaska, called acid rains. Acid rain is discussed further and the likelihood of its occurrence is analyzed in Section 6.5.2 and Attachment C.

Mitigation measures: This section provides a list of measures that could be considered to reduce adverse effects on the terrestrial environment.

1. Minimize the loss of habitat from erosion of exposed slopes by covering with gravel, mulching, and/or seeding exposed areas.

2. Leave a buffer zone of undisturbed natural vegetation with minimum radius of 91 m (300 ft) around all bald eagle nest sites to reduce disturbance and prevent "blowdown" of nest trees. Also, do not conduct pipeline construction or blasting activities in the vicinity of bald eagle nests during the nesting period if the nests are active.

3. Dispose of construction and fill material only in approved landfill sites.

4. Fences around the construction camp and all permanent facilities and garbage disposal areas would help minimize human/bear interaction.

Unavoidable environmental impacts: This section provides a list of impacts which could not be completely avoided through mitigation measures described in Section 6.8.2 and elsewhere.

1. Destruction or disruption of the existing vegetation in the immediate "work zone" of the refinery site and roads would result in the removal of 260 hectares (650 acres) of wildlife habitat.

2. Additional habitat would be lost and degraded through chronic disturbance from human activity and noise in the area surrounding the

refinery site. A reduction/displacement of wildlife in the vicinity would result.

3. Human/bear confrontations, although sometimes avoidable, likely would result in increased mortality of bears using this area.

6.8.4 Wetlands

Various refinery facilities would affect wetland areas delineated on and adjacent to the proposed refinery site. Bridge and pipeline crossings of Valdez Glacier Stream, Robe River, Corbin Creek (Robe), and Corbin Creek (Glacier) would cross these wetlands. In addition, a flood control levee would be constructed adjacent to Valdez Glacier Stream.

Slater Creek, with seasonal flows from north to south across the site, would be diverted into Valdez Glacier Stream near the northern edge of the site. Storage tanks would occupy portions of the abandoned Slater Creek wetland areas.

Intertidal wetland areas would be affected by construction of the products dock, construction barge dock and effluent outfall pipe. In each case, the impacts would be localized and of short duration. At the products dock, driving of steel-jacketed piles would cause a distortion of surface sediments and resuspending of fine silts in the immediate vicinity of each pile. Dredge and fill operations for the barge dock would cause destruction of the existing benthic fauna in an area of approximately an acre, but the area is populated only sparsely and the impacts would be minimal. Placement of the effluent outfall pipe would require digging a trench through an intertidal area which is populated sparsely with an assemblage accustomed to heavy seasonal suspended sediment loads. Effects there also would be minor.

All other wetlands fall outside of the areas proposed for development and would not be affected.

6.9 ARCHAEOLOGICAL AND HISTORIC FEATURES

6.9.1 Construction Effects

Construction of the proposed Alpetco facility poses no known threat to any property listed in, or eligible for inclusion in, the National Register of Historic Places.

6.9.2 Operation Effects

Operation of the proposed Alpetco facility poses no known threat to any property listed in, or eligible for inclusion in, the National Register of Historic Places.

6.9.3 Mitigation Measures

In the remote possibility that construction or operation activities unveil the presence of a property determined to be potentially significant on a local, state or national level, the Alaska State Historic Preservation Office should be contacted immediately. It is the responsibility, under existing historic perservation law, of the permitting federal agency(s) and the State Historic Preservation Office and Alpetco, to develop appropriate mitigation measures.

1. Such a newly discovered site would almost certainly be very small in area. Avoidance of the area might be the preferred mitigation plan.

2. Any archaeological site could be quickly excavated; and any historic site or object could be as quickly documented and removed to an appropriate repository.

6.9.4 Unavoidable Environmental Impacts

With respect to cultural resources, when appropriate measures are taken, there would not be any unavoidable effects.

6.10 SOCIOECONOMICS

Socioeconomic impacts of the proposed project are described for the construction period 1980 through 1983 and for an operational period 1984 to 1990. Wherever possible, both short- and long-term impacts are discussed with terms relating to population projections through 1990. However, for some subject areas, such as land use, there are inadequate data on which to make detailed projections.

In addition to such direct impacts as Alpetco tax payments, secondary impacts of population growth and housing development are discussed. These secondary effects are among the most important long-term socioeconomic changes anticipated in Valdez. Since no other significant industrial projects are identified which would be affected directly by development of the Alpetco project, no specific cumulative impacts are expected.

6.10.1 Employment and Population

Local: Table 6.10-1 summarizes estimated local employment population impacts of the proposed Alpetco project. During the construction period there would be private and public construction under way, in addition to refinery construction. Therefore, estimates of total incremental employment and population have been made for the construction period as well as estimates of incremental impacts attributable to the proposed project only.

Statewide: Construction and operation of the Alpetco plant would generate new employment at the state level by way of the public and private expenditures described in Section 6.10.2. It is difficult to estimate this employment, and even more difficult to determine if it would cause a population increase. The Alpetco project probably would have a lower employment multiplier than the trans-Alaska pipeline. Peak incremental employment (including that in Valdez) probably would not exceed 6,232 during the construction phase, nor would it be likely to exceed 2,267 during operation. The extent to which this incremental

Table 6.10-1

PEAK EMPLOYMENT AND POPULATION IMPACTS

CONSTRUCTION AND OPERATION

Phase	Incremental Employment	Incremental Population	Incremental Households	Incremental School Enrollment
Construction (Peak)				
Alpetco (a)	3,442	4,130	---	413
Total (b)	3,592	4,310	---	431
Operation (c)	1,180	2,124	708	467

Source: CCC/HOK
See Table 6.10.1-5 and Discussion of Method Used to Derive Employment and Population Impacts, Section 6.10.1-1, Appendix Vol. II

(a) Based on peak primary Alpetco labor force of 2,820, October 1982
(b) Based on peak total primary labor force of 2,935, September, 1982
(c) Based on operations work force of 579; peak = average.

employment would cause a net population increase at the state level depends largely upon the condition of the Alaska economy at the time: a condition of high unemployment would result in minimum population growth, while boom conditions would result in maximum population growth.

6.10.2 Income

Estimates have been made of the total wage payments by Alpetco, of federal and state personal income taxes paid on these wages, of expenditures in Valdez and elsewhere in Alaska by the construction and operations work forces, and of corporate income tax payments by Alpetco. These estimates are presented in Table 6.10-2.

6.10.3 Local Economy

This section discusses in non-quantitative terms the impact the proposed project would have on the Valdez economy. Construction activity would cause a local boom in the private sector. During this period and in the early years of operation, there would be considerable private investment in residential and commercial buildings. Some 708 new residential units would be needed to accommodate the permanent population, and upgrading of the existing housing stock would also occur. Operation of the proposed refinery would create a potential for downstream petrochemical processing and manufacturing facilities to be built in Valdez. However, it seems unlikely that local businesses would be able to provide many of the goods and services required by either the refinery or associated industries. Rather, the private sector would continue to be oriented to the needs of the resident population.

Some temporary shortages of goods and services would occur during the construction period, but these effects would not be as prolonged or as severe as during the trans-Alaska pipeline boom (Valdez is larger and the boom would be smaller than during the Alyeska period). The relatively high cost of living in Valdez should decrease as a result of the permanent growth, because of economies of scale in the distribution and

Table 6.10-2

ESTIMATED PUBLIC AND PRIVATE EXPENDITURES
CONSTRUCTION AND OPERATION
(Millions of 1979 Dollars)

	Construction (Total 42 Mos.)	Operations (Annual)
Wage Payments by Alpetco	624	18.6
Federal Personal Income Tax	62.6	4.3
State Personal Income Tax	12.1	.9
Expenditures in Valdez by Work Force	20.4	6.1
Expenditures in Alaska except Valdez by Work Force	66.1	3.0
Corporate Income Tax (Prior to Investment Tax Credit in years 1984-1988)*		
Federal		61.5
State		13.9

* Annual average over 20-year life of plant (payments increase yearly).

Source: Brown & Root, Alpetco, and CCC/HOK

retail sale of goods. Also, retailers would be able to offer a larger variety of goods than they do now because of expansion of the local market.

6.10.4 Public Fiscal Impacts

The Alpetco project would add some $1.25 billion (1979 dollars) directly to the property tax rolls of the city. With additional residential property valued at $65 million, the city would have a total assessed value of approximately $2.95 billion in 1984 (or about $500 thousand per capita assuming a total population of 6,000). With this property tax resource, plus existing surplus capacity in public sector infrastructure, Valdez would be able to provide all of the public services required by the construction and permanent populations without the need for supplemental impact aid.

Valdez will have some $442 million of bonding capacity in 1984 (the city currently has debts of $70 million, so it would have a debt margin of $372 million in 1984 if no more debt were acquired in the interim). Within existing state statutory limits on the ability of local governments to raise property tax revenue for operating purposes, Valdez could raise a maximum of $19,173,500 with a tax of 30 mills (assuming 6,000 people), or about $3,196 per capita compared with about $1,500 per capita at present. Because it is unlikely that Valdez will need tax revenue of this magnitude, the city probably would choose to lower its tax rate from 6 to 3 mills, which would generate $9 million or $1,500 per capita (assuming 6,000 people) in property tax revenue. There is no limitation on the city's ability to tax real property to raise revenue to retire bonded debt; therefore, the city will be encouraged to fund many capital improvement projects with general obligation bonds.

6.10.5 Public Services and Facilities

Based on their experiences in providing services during trans-Alaska pipeline construction, service providers in Valdez are anticipating

increased demand for social counseling and referral services, including mental health, crisis, marriage, and juvenile counseling; alcohol and drug abuse counseling; fire protection; and criminal justice services. The Valdez Community Hospital has sufficient capacity to serve a population of more than 12 thousand (based on Health Systems Agency Standard). Both the fire and police departments have sufficient personnel and facilities to provide adequate protection during the construction and operation of the proposed Alpetco refinery. The operating refinery would not require city firefighting equipment or personnel. Before the height of the construction phase in 1982, the new elementary school should be complete and have excess capacity; the junior high school (grades 7-8) likely would face slight overcrowding; and the high school (grades 9-12) would be near capacity. By 1990, the school system would require additional facilities to accommodate its student population.

6.10.6 Land Use

This section describes the effects the proposed Alpetco development would have on resource extraction and recreation resources in the region, and on patterns of land use in Valdez. Important land use impacts in Valdez would include a demand for housing which would result in a probable housing shortage, and expansion of the urban area to accommodate the Alpetco project and new housing. Accompanying these effects would be possible construction of temporary housing at the expense of more permanent housing; and pressure for housing development on land planned for another long-term use, such as industry (for instance, in the vicinity of the airport).

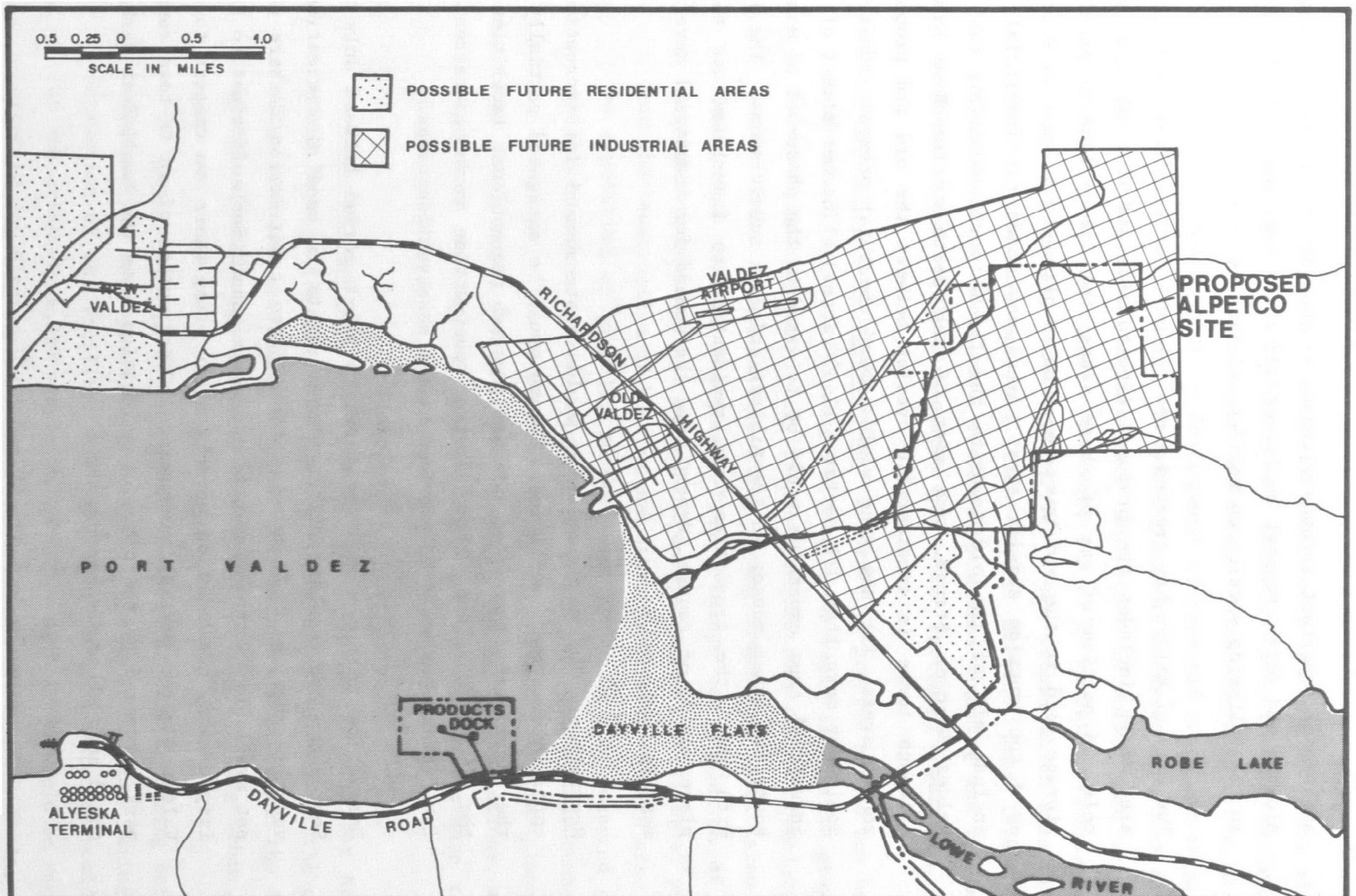
On September 28, 1979, Alpetco certified to the State of Alaska, Division of Policy Development and Planning, that the proposed project complies with the approved Alaska Coastal Management (CZM) Program. Nothing has been identified that is inconsistent with that certification. The local CZM plan currently being drafted specifically identifies the Valdez Industrial Park as a location for facilities such as being proposed by Alpetco.

Regional impacts: Construction and operation of the Alpetco facility probably would have little impact upon land use or economic development in the region outside of Valdez. The development of hard rock minerals, timber, fishing and agriculture is influenced principally by such factors as the inherent value of the resource, export markets for products, and land ownership restrictions. Of secondary importance would be the availability of a larger labor force in Valdez brought about by Alpetco, or the development of new city industrial facilities financed in part by Alpetco tax revenues. Because Valdez is isolated from other communities and areas of known resource development potential, effects of the proposed project on development patterns and resource use would be confined to land areas accessible to the Richardson Highway near Valdez. No specific sites or cumulative impacts can be identified.

Valdez impacts: Implementation of the proposed project would produce important direct and secondary land use impacts in Valdez. Direct impact would include the conversion of approximately 2.4 square miles from open space to industrial use, although the refinery would be located on an isolated site for which few alternative uses exist.

Direct impacts: The direct impacts of the proposed refinery on surrounding land uses, including scenic impacts, are judged to be very modest for a facility of this size. Because the refinery is separated from the community by Valdez Glacier Stream and low hills, construction and operation impacts upon housing near the airport or at Robe River Subdivision should not be significant. Only the construction of the service road and burial of pipelines to the east and north of Robe River Subdivision would temporarily disrupt residents. At the same time, however, land values should rise, as development by Alpetco would bring about a needed sewer connection to the subdivision.

Secondary impacts: Secondary land use impacts include potential industrialization of land areas around the proposed refinery site, demand for additional recreational opportunities and facilities (see Figure 6.10-1), and impacts on city planning functions in Valdez. An



PROJECTED LAND USE IMPACTS

Figure 6.10-1

additional important secondary impact -- the use of land for housing of Alpetco and other support employees and their families -- is discussed in the following section on residential land use.

The City of Valdez has created a new Valdez Industrial Park covering an area which includes the proposed Alpetco site and four adjacent parcels. A portion of one of these sites--the former Alyeska pipeline storage yard in the old townsite--also is planned for lease by Alpetco as a construction staging area. Areas now zoned for industrial use include all of the old townsite and the airport, extending east to Valdez Glacier Stream, and most of the delta of the Lowe River. Although there is considerable overlap between the old and proposed zoning areas, the new zone would expand the total present industrial zoning by more than 931 hectares (2,300 acres). The net effect of the industrial area expansion would be to expedite the phase-out of mobile homes and other houses in the Airport and Zook subdivisions. The pace with which the transition from residential to industrial use takes place would, of course, depend upon the demand for industrial development in that area.

Recreation: The new population would create demand for recreational opportunities and facilities. Demand would be mitigated partially by the significant number of new and planned recreational facilities of the City of Valdez. For Alpetco construction workers, recreation facilities also would be provided at the construction camp.

Demand for temporary housing during a short period between July and September 1982 could conflict with tourists in need of recreational vehicle campsites. If housing for Alpetco construction workers were not available in the construction camp in quantities sufficient to satisfy demand, construction workers might bring their own campers to the Valdez Glacier Wayside campground. Construction of an in-town camper park, proposed by the city for a location near the Small Boat Harbor, could help alleviate overcrowding.

Over the long term, demand for additional recreational boat slips at the boat harbor probably would increase as permanent employees of Alpetco establish residency in Valdez. Boat ownership could, in time, provide added support to development of proposed state marine parks in the vicinity of Valdez. Proposed parks at Anderson Bay, Jack Bay, and Sawmill Bay could include such facilities as docks, mooring floats, campsites and restrooms. However, the U. S. Forest Service is considering wilderness classification for areas within which some of these marine parks are proposed (USDA, Forest Service, June 1978). There also would be additional consumptive demand (hunting and fishing) on the fish and wildlife resources due to the increased population.

Impacts on land using planning: In order to provide needed new housing and other facilities during the period of rapid industrial growth in Valdez, the city would rely upon new regulations due for completion by summer 1980: Comprehensive Plan, Zoning Ordinance, Subdivision Ordinance, and Coastal Management Plan. Delays in completion of these regulations could create procedural delays in the processing of permits and the construction of housing and other facilities. There also could be repetition of granting zoning exceptions, such as occurred during the Alyeska boom, if new approval processes are perceived as cumbersome or ambiguous. The proposed addition of another full-time planner to the city's staff should assist in completion of the regulations, and in processing development applications, but no other assistance to the planning function is expected.

Residential land use: Both short- and long-term demand for housing would be significant. This impact would be felt throughout the community, with the infilling of vacant lots with new housing and the development of whole new subdivisions beyond of the existing urban area.

Construction phase 1980-1984: Demand for housing during both the construction and operation phases would be significant. During construction of the facility, the total incremental population would peak at approximately 4,310 people in 1982, of which 2,820 would be employed directly by Alpetco. Of the Alpetco construction work force, 2,540

would be housed in the on-site construction camp, while the balance of 280 would seek housing in Valdez, or would already be living in Valdez. The remaining support population of 1,490 also would require housing.

Since the present and projected vacancy rate in mobile homes and single-family houses is 3 percent, there would be a housing shortage not long after construction began. It is difficult to project the number of new households needed for primary and support construction workers and their families, because of the short-term nature of contracts, and the fact that two or more construction workers may obtain housing together. Given this situation, the present supply of 390 vacant mobile home spaces would be occupied and additional space would have to be provided. The city may resist the construction of additional mobile home parks to meet short-term demands since such developments have tended to become permanent. There would also be demand for single- and multi-family housing, particularly near the end of the construction period, when some construction workers would decide to make Valdez their permanent home.

Operations phase: At the start-up of the refinery in 1984, Valdez already would be in the midst of a housing shortage. Approximately 708 new permanent housing units would be required for the total new population associated with primary, secondary, and residual employment. About half of the projected demand for new housing in 1984 derives from the housing needs of Alpetco employees. Demand would increase at an estimated 3 percent or 20 units per year after that, representing immigration and latent demand by existing mobile home residents for a more permanent type of housing. It is assumed that mobile homes will be used only until more permanent frame dwellings can be built, and that the city will require the gradual phasing out of mobile home parks after the proposed Alpetco construction period is over.

Demand for housing would not only require infilling existing subdivisions but also the construction of new subdivisions. There now are 390 vacant single-family lots and an undetermined number of multi-family lots. Assuming that 80 percent of the Alpetco-induced demand would be

for single-family houses, approximately 170 new lots would be required in 1984 (.80 x 708 - 390). This estimate may be very conservative because some existing platted lots are located on land which is poorly drained or subject to flooding. Approximately 140 new multi-family units also would be required.

New subdivisions will be developed, primarily in areas west of Hazelet Avenue in the downtown area. A total of approximately 390 hectares (965 acres) of public and private land have been identified for possible residential development by the city (Schmidt, 1979). Of the total, 259 hectares (640 acres) west of Mineral Creek have been selected under the city's Municipal Entitlement (see Figure 5.8-3). Much of this land, however, might be subject to flooding from Mineral Creek (see Figure 6.2-1). The balance of 132 hectares (325 acres) includes land between Hazelet Avenue and Mineral Creek, unimproved platted lots in Robe River Subdivision, and land north of that subdivision. The total amount of land available for housing is more than adequate to meet long-term housing needs associated with the proposed project.

Production of housing: Production of housing to meet demand created by the project would be constrained by the shortness of the time period in which housing must be produced (beginning in 1984 an immediate demand would exist for about 708 units); the availability and productivity of builders, most of whom would be drawn from outside Valdez; reluctance on the part of builders to construct housing much in advance of the actual arrival of refinery operations personnel; and lack of market acceptance in Valdez for multi-family housing, a portion of the housing market important to residents unable to afford or uninterested in owning single-family housing.

6.10.7 Transportation Systems

Land: Direct impacts of Alpetco construction traffic would be related principally to the hauling of construction materials: an estimated 30-50 one-way truck movements per day (assuming five-axle trucks) dur-

ing the period mid-1981 to mid-1983. Additionally, special low-profile crawler transporters would carry 80 - 100 prefabricated refinery modules weighing from 40 to 100 tons (with one unit of 500 tons). These movements would be concentrated on the Glacier Stream Haul Road and at the crossing of the Richardson Highway. The planned reinforcement of the highway segment to be used as a heavy equipment crossing would minimize or eliminate any structural impact on the highway. There would be occasional, short delays of regular highway traffic during highway crossings. Minor damage due to construction traffic would be expected on the Richardson Highway between the Glacier Stream Haul Road and Dayville Road, and on Dayville Road to the products dock, especially during freeze and thaw periods.

Vehicular traffic on the Richardson Highway between the Alpetco site and the downtown area is expected to increase by 2,000-3,000 vehicles per day. This increase can be divided between those trips to or from the Alpetco site (1,400 trips per day) and the general increase in traffic due to population growth (600-1,600 trips per day). Average daily traffic at the highway office at Mile 1 on the Richardson Highway is expected to increase from 7,300 vehicles per day to 9,500-10,500 vehicles with the proposed development. Less than 10 percent of this volume is expected to be truck traffic.

Alpetco would generate approximately 500 vehicles during the peak hour, which would generally occur between 3 and 5 p.m. Peak hour traffic volumes on the highway are projected to increase from 500 to 1,000-1,100 vehicles per hour. These volumes are below the estimated highway capacity of 1,700 vehicles per hour. The increase in volume could, however, result in a reduced average highway operating speed.

Air: Impact on the airport and air carrier operations during construction of the proposed refinery would be expected to be moderate. It is anticipated that work force arrivals/departures could be accommodated within existing carrier schedules. Additional air traffic would be generated by support and ancillary services, and light air freight. The air carriers expect to expand air charter and scheduled services

where necessary. During project construction the probable maximum annual airport operations (take-offs and landings) would be 30-40 thousand, well below the estimated capacity of 100-200 thousand. Planned installation of runway lighting and navigational aids will further improve operations scheduling, particularly in winter.

During operation of the refinery, total air passenger demand should increase by 10-13 thousand annual passenger trips, or a 35-40 percent increase over the current level. Because the average planeload factor would be close to 100 percent on many occasions, carriers might utilize larger planes, but jet service probably would not be justified economically. Total airport operations would be unlikely to exceed 30 thousand a year, from a 1978 base of 20 thousand operations per year.

Marine: Impacts upon the Alaska Marine Highway system due to construction and operation of the proposed project are expected to be minor.

Shipments of sulfur and fluid coke would have a positive economic impact on the proposed new city dock planned for completion in October 1982. The dock would have ample capacity to handle the Alpetco requirements. If the new dock were not operational when needed, the sulfur and coke could be shipped across the existing dock facility with possible material handling improvements being necessary.

Marine transportation of the refined products would introduce product tankers to move an average of 145 thousand bpd of liquid that formerly left Valdez in the form of crude oil. The main differences are vessel size, and the number of port calls necessary to transport the same volume. The product tankers expected to call at the Alpetco facility would average 36,500 dwt in size, requiring an estimated 186 port calls per year (see Section 3.5.5). Currently, the 150 thousand bpd of crude oil that Alpetco would refine is transported from the Alyeska terminal in crude carriers averaging 115,000 dwt, requiring 58 port calls per year compared to 186 to carry essentially the same volume. This difference assumes a conservative average product vessel size at a time when the trend is to use larger vessels. The proposed berths would

accommodate tankers up to 80,000 dwt. The net result is an increase in vessel traffic in Port Valdez.

The increased vessel traffic would be well within the capability of the existing Coast Guard Vessel Traffic System to provide navigational assistance. The risk of spills from marine operations would be attributable primarily to at-berth spills during liquid cargo transfer or to in-transit casualties. Statistical information and methodology from the Milford Haven ports in Wales, U. K., and from the BLM oil spill risk analysis for the proposed Northern Tier Pipeline are used to assess spill risks for the proposed project. Information which is cited frequently on the subject of oil spills at tanker loading terminals was presented by Captain G. Dudley, Harbormaster for the Milford Haven ports area, at a symposium, "The Ecological Effects of Oil Pollution on Littoral Communities" in London, England, in December 1970.

The port of Milford Haven provides a basis for predicting at-berth spill risks. Milford Haven, situated at the entrance to the Bristol Channel, is comparable to U. S. West Coast ports. Prior to 1960 there was no petroleum industry in this area. For this reason all the subsequent pollution incidents were the result of modern petroleum loading and unloading operations. These are reasonably comparable to the operational standards expected in 1984 when the new United States Coast Guard regulations (33 CFR Part 157 - CGD 77-058B) are in force. Since the port of Milford Haven had not handled petroleum products until 1960, it was possible as the result of experience in other ports to set regulations and coordinate activities for recording and dealing with all minor and major oil spills.

The water depths in the Milford Haven petroleum port areas vary from 11-22 m (35-71 ft) at mean high water. The range of the tide varies from 16-26 ft. The tidal currents in this area are very strong (up to 6 knots). The tidal range and currents are greater than those experienced in United States West Coast ports and their physical effects will tend to increase marginally the risk of spills during loading and unloading operations at Milford Haven compared with United States West Coast ports.

An analysis of pollution incidents from vessels calling at Milford Haven is given in Table 6.10-3. Over the nine-year period, 55 percent of all spills were of less than 2.3 barrels and 29 percent were between 2.3 and 4.6 barrels. The remaining 16 percent are only given in the original tables as more than 4.6 barrels. Except for three, these were in the range of 4.6 to 75 barrels. The three special cases were not directly attributable to loading and unloading operations as shown below and could be omitted from the analysis. These are: (1) year 1962 includes one grounding in which about 750 barrels of crude was spilled; (2) year 1967 includes arrival of one vessel with damaged shell plating below the water line which resulted in 1,875 barrels spilled; and (3) year 1968 includes a crude tank in a refinery which overflowed and about 750 barrels escaped into the harbor waters.

At Milford Haven, tank vessels registered in many nations were received and it was observed that this tended to reduce the effectiveness of many vessels as far as pollution was concerned. In the Alpetco case, the majority of vessels would be of American flag and therefore should meet the stringent requirements of the United States Coast Guard. For this reason it is considered that, in practice, for the United States ports it could be possible to reduce the frequency of pollution incidents below the Milford Haven record.

The analysis of the number of vessels calling at the port of Milford Haven to load or discharge cargo shows that the nine-year average was 2.7 pollution incidents per 100 vessels. Based on the Milford Haven example, the following numbers of at-berth pollution incidents would be predicted for the products dock at Valdez and the four main U. S. destination ports (see Table 6.10-4). This statistical prediction of incidents relating to all refined products handling does not represent a net increase in West Coast pollution incidents. The present risks of handling and transporting 150 thousand bpd of crude oil are being replaced with the risks of handling and transporting an average of 145 thousand bpd of refined products.

Table 6.10-3

ANNUAL NUMBER OF TANK VESSELS AND POLLUTIONS

	Tankers		Number of Pollutions				
Year	Number of Vessels	Volume of Cargo Millions of Barrels	Less Than 2.3 Barrels	2.3 to 4.6 Barrels	More Than 4.6 Barrels	Total	Number Per 100 Vessels
1961	1,066	74.25	25	9	11	45	4.2
1962	1,192	86.25	18	4	11	33	2.8
1963	1,236	97.50	18	6	6	30	2.4
1964	1,392	132.75	27	14	2	43	3.1
1965	1,985	186.75	46	28	18	92	4.6
1966	2,378	216.75	42	22	14	78	3.3
1967	2,680	211.50	32	16	7	55	2.1
1968	2,669	225.00	26	25	2	53	2.0
1969	3,266	299.25	34	19	5	58	1.8
Total	17,864	1,530.0	268	143	76	487	2.7
Percent	--	--	55	29	16	100	-

Table 6.10-4

AT-BERTH SPILL PREDICTIONS

Harbor	Duty	Number of Vessels	Annual Pollution Incidents
Valdez	Loading Products	186	5.0
Seattle	Unloading Products	45	1.2
San Francisco	Unloading Products	45	1.2
Los Angeles	Unloading Products	51	1.4
Honolulu	Unloading Products	45	1.2
		TOTAL/YEAR	10.0

Of these, a total of 84 percent or 8.4 at-berth incidents per year would be less than 192 gallons. In Valdez, five incidents per year would be predicted, or 4.2 less than 192 gallons.

Using criteria used for the Puget Sound oil spill risk analysis for the proposed Northern Tier pipeline (BLM/OIW, 1978), risks of at-berth spills of greater than 2.4 barrels can be predicted using the number of port calls as the exposure variable. With a 95 percent confidence interval, two spills per year could be expected. Considering that this calculation excludes spills of less than 2.4 barrels, the prediction reasonably substantiates the level of risk predicted using the Milford Haven data.

Sources and causes of at-berth spills are illustrated by the following data from the first year (1977-1978) of operation of the Alyeska marine terminal in Port Valdez.

Table 6.10-5

AT-BERTH SPILLS

ALYESKA TERMINAL (1977-1978)

Source	Cause of Spill (quantities in barrels)			
	Unknown	Equipment Failure	Maintenance Error	Design
Tankage Subsystem	0	0.95	0	0
Pipe	0	0	0	0
Valves	0	0.29	2.24	0
Loading Subsystems	0.12	0.07	0	0.24
Safety Subsystem	0	2.38	0	0
Tanker	0.05	14.95	0.10	0
TOTAL	0.17	18.64	2.34	0.24

Source: USDOI, Alyeska Pipeline Office (1978), OIW (1978)

The total at-berth spillage for approximately 500 port calls was less than 22 barrels.

With the same BLM/OIW criteria, in-transit spill risks can be predicted using the distance traveled per harbor call as the exposure variable. The in-transit category includes mooring and departing as well as operations while underway. With a 95 percent confidence interval, 9.5 in-transit tanker spills per year could be expected.

6.10.8 Utilities Systems

Sanitary sewer: The City of Valdez is planning a sewer trunk line that would extend municipal sanitary sewer service to Robe River Subdivision and the proposed refinery site (see Section 9.4). The temporary construction work force for the proposed project would generate a maximum average sewage load of about 250 thousand gpd. This would be the highest direct sewage load impact from the project. Volumes during opera-

tion of the proposed refinery would be reduced to that generated by the permanent work force, approximately one-fifth the peak construction work force population.

The primary impact on the municipal treatment plant would result from general city incremental growth attributable to the proposed project. This would amount to 2,124 persons (see Figure 6.10-1) by 1990 or at 150 gpd an increased treatment plant load of about 320 thousand gpd. With an additional average load of about 30 thousand gpd from the refinery operation, the total long-term impact on the municipal treatment plant would be an average of 370 thousand gpd. The average plant load during 1978 was 705 thousand gpd. An additional 370 thousand gpd would raise this to 1.07 mgd. Peak plant load during 1978 was 1.1 mgd (D. Hunt, 1979). The design rated capacity of the existing plant is 1.25 mgd. Based on 1978 average treatment plant loads, it appears that the average refinery long-term population impacts could be accommodated with about 15 percent of rated capacity remaining. In reality, the capacity of the plant might have to be expanded in the mid-1980s to adequately treat peak loads.

At some point along its route between the refinery site and the Valdez sewage treatment plant, the sewer trunk line would be intercepted by a lateral line serving Robe River Subdivision. The provision of sewer service to Robe River Subdivision would diminish problems of well contamination caused by the proximity of wells and septic tanks. The refinery project would be an incentive to earlier construction of the Robe River lateral line.

Water system: Hydrology studies of the proposed Alpetco site indicate that there is sufficient groundwater to meet on-site requirements for both industrial and domestic uses (see Section 5.2.2).

The major impact of the Alpetco project on the city's water system would be felt in the development of new residential areas to accommodate the permanent Alpetco work force. In the downtown area east of Mineral Creek, the city will extend existing water lines to newly

developed areas; west of Mineral Creek, the city will either develop an independent water system or one that is connected to the existing system in the downtown area. Newly developed residential areas outside the downtown area either will rely on an independent water system or on privately owned wells.

Solid waste: The Valdez city engineer estimates that at the present rate of usage, the landfill site at the old townsite can be used for another four years; and with the Alpetco project under way, the site would reach capacity in two years.

In addition to considering alternative disposal sites, the city has commissioned a study to consider future solid waste loads, including wastes generated by the proposed Alpetco facility; to recommend an appropriate waste disposal system that complies with existing environmental regulations; and to identify funding sources. The study is scheduled to be complete by the end of 1979.

Electricity: The Copper Valley Electric Association (CVEA) is expanding its capacity. The cornerstone of the expansion is the Solomon Gulch Hydroelectric Project, currently under construction, supplemented by the possible installation of a generator in the form of a pressure-reducing turbine in the trans-Alaska pipeline.

Alpetco plans to purchase electricity from CVEA during construction of the facility. During operations, Alpetco would own and operate its own electrical generation facility. Therefore, there would be no long-term impacts.

Telephone: Electronic switching equipment which serves the Valdez service area (downtown to Thompson Pass) has a capacity for 2,500 lines; 1,300 lines are in use. The remaining lines can accommodate up to 1,500 new households, so the system is more than adequate to meet demand resulting from the proposed project. The system also can be expanded readily, with equipment which requires four months lead time for delivery.

6.10.9 Life-Style and Culture

Many of the impacts that Valdez could experience during construction of the Alpetco refinery would be similar to, but not as severe as, those experienced during the construction of the Alyeska pipeline and marine terminal.

Compared to circumstances that existed during the pipeline era, factors that would diminish the Alpetco-induced impacts on life-style include community confidence gained from overcoming the inconveniences and problems associated with construction of the pipeline; Valdez has a population three to four times larger than it had during the pipeline era; the peak manpower requirements for the Alpetco project would be 2,820 workers, compared to 4,500 in Valdez for the pipeline; Valdez now offers a greater array of public services; utilities have excess capacity; the city is developing new land use controls to better influence land development patterns; and Valdez, with its great tax base, would not be dependent on the state for impact aid.

Likely changes in the community's life-style include further loss of Valdez's small-town flavor; a severe, temporary housing shortage until supply catches up with demand; some perceived crowding as subdivisions are developed at higher densities; strains on the social service delivery system; tensions between construction workers and longer-term residents; and increased use (and possible overcrowding) of nearby recreational resources.

Positive changes to the life-style of Valdez could include increased retail and recreational opportunities, as well as a better integration of new residents into the community life than occurred during the trans-Alaska pipeline era.

6.10.10 Mitigation Measures

Public services: The City of Valdez has accepted the responsibility of mitigating impacts on local public services. In a letter dated Septem-

ber 28, 1978, Mark Lewis, then Acting City Manager of Valdez, assured the president of Alpetco that "Valdez currently has all the necessary utilities, schools and other community facilities necessary to accommodate the demands of a construction boom followed by additional permanent residents without the need for additional facilities or financial support" (see Section 9.4). The size of the Valdez tax base will make it possible to expand locally funded public services, such as additional staff for the Mental Health Center or a greater number of recreation programs, as required. The city also might consider funding resources for family support such as day care centers.

The State Department of Health and Social Services probably would require additional staff in Valdez during construction of the proposed Alpetco project to accommodate an increased case load during this period.

The president of the community college believes that the college can provide another form of recreation and entertainment. During construction of the Alpetco facility, the college would expand its offerings to include daytime courses to meet the needs of newcomers, particularly women who are not employed.

The administration of Valdez Community College anticipates expansion of its vocational programs to meet the staffing requirements of the proposed facility during its construction and operation. Alpetco has committed $500 thousand to training programs.

Land use: This section discusses measures which could be considered to mitigate impacts on land use.

Recreation: The City of Valdez is prepared to meet demand for new recreation facilities. These needs could include new recreational vehicle campsites, indoor recreation facilities, and parks and recreation boat slips. Provisions for some of these already are included in the city's five-year preliminary budget. Specific programs under which the city might obtain government assistance to acquire land to con-

struct or provide management of facilities include:

1. Coastal Energy Impact Program (CEIP) authorized under the Coastal Zone Management Act of 1976, P. S. 94-370. This program provides grants for the acquisition of recreational facilities to compensate for the loss of recreation resources resulting from the siting, construction, expansion, or operation of any coastal energy facility.

2. Outdoor Recreation Development and Planning authorized by the Land and Water Conservation Fund Act of 1965. Grants are made for the acquisition and development of such projects as picnic areas, city parks, tennis courts, boat launching ramps and campgrounds. A combination of federal and state matching funds leaves 25 percent funding by local government.

3. Community Development Block grants authorized by Title I of the Housing and Community Development Act of 1974, P. E. 93-383. Grants are made which can include the buying or leasing of lands to conserve open space, and provide neighborhood recreational facilities such as parks and playgrounds.

4. Alaska Municipal Entitlement Act of 1978. Some of Valdez's entitlement of 4,805 acres of vacant, unappropriated and unreserved state land could be used for recreation facilities developed in conjunction with projected housing west of Mineral Creek.

5. Legislative appropriations for development of the proposed Keystone Canyon State Park. Campsites could be constructed in the new park to supplement demand from construction workers or others for temporary sites for mobile homes or trailers. Better coordination between the city and state is necessary to bring about a realistic development of the park and its proposed facilities.

Housing: A series of public and private actions could help mitigate the housing shortage that Valdez would face when the facility begins operation. Actions that the City of Valdez could consider include:

1. Make available to builders land that is served by city utilities. The cost of infrastructure per housing unit for large tracts of city-improved land should be less than for small parcels of developer-improved land.

2. Shorten the city's review and approval process so as not to unduly delay the production of needed housing.

3. Permit the placement of modular units on temporary foundations, for a specific time period only. Once demand for housing has abated, the modular units should be resited onto permanent foundations. Utilities should have to meet permanent construction standards.

4. Issue mortgage subsidy bonds, if the U. S. Congress permits the program to continue.

Actions that the State of Alaska could consider:

1. Issue mortgage subsidy bonds through the Alaska State Housing Finance Corporation, if the U. S. Congress permits the program to continue.

2. Produce housing through the Alaska State Housing Authority for low-income families and the elderly in Valdez.

An action that Alpetco could consider:

Intervention directly or indirectly in the production of housing.

Transportation: The following mitigation measures could be considered for the project construction period:

1. To reduce dust on the Glacier Stream Haul Road, undertake heavy watering or applications of a dust retardant.

2. Repair the Richardson Highway and Dayville Road in the vicinity of the Alpetco operations to their preconstruction condition at the close of construction.

3. Reduce the speed limit on the Richardson Highway when trucks are using the highway for construction of the products dock and laying of pipelines.

During operations, the following measures could be considered:

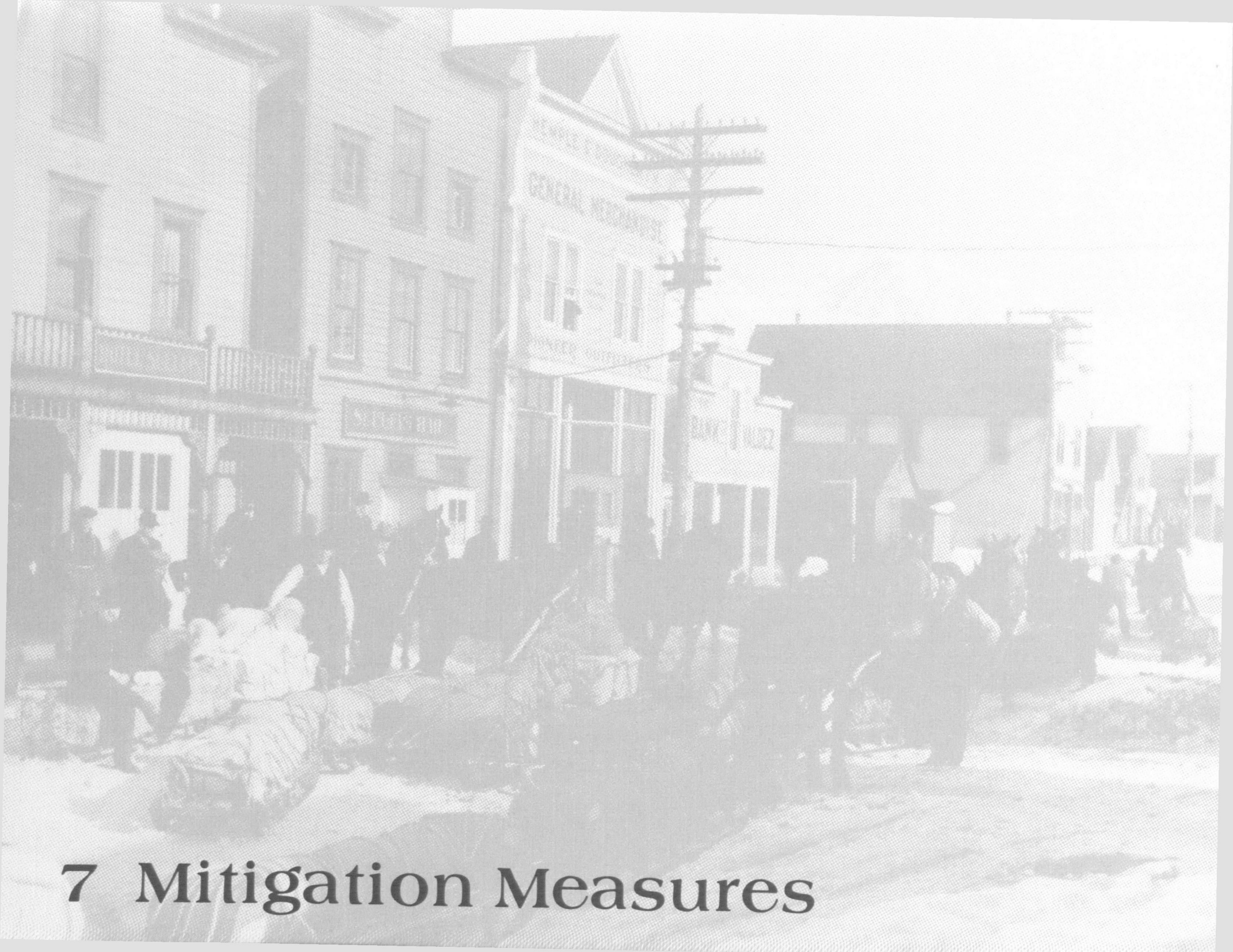
1. Design the four-way intersection of the primary access road (Glacier Stream Haul Road) and the Richardson Highway to accommodate protected left turn lanes on the Richardson and acceleration lanes onto the highway.

2. Use small buses to carry employees to and from the refinery at shift changes. Buses could operate efficiently, providing virtually door-to-door service in the small neighborhoods of Valdez.

6.10.11 Unavoidable Impacts

The long-term economic impacts of the Alpetco project would be positive. Unavoidable adverse economic impacts might occur during the construction period, such as inflationary pressures in the housing market (affecting renters negatively, landlords positively), and shortages of goods and services at the peak of construction. In general, these adverse impacts would be less severe and of shorter duration than similar impacts during the peak of the Alyeska construction era.

Adverse land use effects which could not be avoided if the project were implemented include the commitment of land for urbanization, land speculation, and disruption of existing neighborhoods for the construction of housing. Urbanization includes the direct conversion of open land for the refinery complex, the removal of trees and a modification of the scenic quality of the area (particularly at the site of the products dock), as well as the development of other parts of Valdez for secondary support facilities such as housing and commercial services.



7 Mitigation Measures

7. MITIGATION MEASURES

7.1 IMPLEMENTATION PLAN

During the study programs for this Environmental Impact Statement, Alpetco made several changes in the design concepts of the proposed facility to mitigate certain adverse impacts that were identified. By Alpetco allowing the environmental program to influence facility design criteria at an early planning stage the adverse impacts identified in this EIS were minimized. Following is a summary of the more significant mitigation actions of this type which were implemented.

Original Design and Impact	Mitigation Implemented
The original site plan lay-out placed the tankage farther south than the current proposed southern boundary of the site. However, wetland and marsh areas identified in the area of Corbin Creek (Glacier) unavoidably would have been lost. This area contains the headwaters of Corbin Creek (Robe) and Brownie Creek, and the Robe Lake salmon spawning system.	The site plan was redesigned to locate all refinery facilities north of Corbin Creek (Glacier) and the proposed boundary of the site was realigned to exclude much of the sensitive area. Only the crude and products pipelines and service road now are proposed across this area.
The original route proposed for the primary access road was north from the Richardson Highway along the east side of Robe River Subdivision (route alternative # 1 on Figure 3.3-1). Daily refinery traffic during construction and operations would increase the risk of adverse effects on a sensitive ecosystem and would create potential land use conflicts and noise impacts upon the residential subdivision.	The preferred primary access to the proposed site was changed from the southern alternate route # 1, to the existing Glacier Stream Haul Road (alternate # 3 on Figure 3.3-1). The originally preferred primary access was retained and designated a service road to allow service access to the products pipelines corridor and restricted to emergency access.
Original plans anticipated the proposed facility would be water cooled. Undesirable energy consumption, air quality (visibility) and water requirement effects were identified.	Design criteria was altered early in project planning, to make this largely an air cooled plant. Air cooling reduces internal plant energy consumption, avoids fogging and reduced visibility from evaporative cooling, and substantially lowers the groundwater requirements.

Original Design and Impact

Earlier plans called for location of the temporary construction camp on the far east side of the site. However, it was determined that the camp would partially occupy a wetland area, and would damage an area that would be best left in its natural condition as a groundwater recharge source to help compensate for the proposed realignment of Slater Creek.

Mitigation Implemented

The site plan was revised to locate the camp to the far north of the site, leaving land on the east side of the site unused.

Numerous mitigation measures are suggested in this EIS, many of which are included in the plans for the proposed facility. Commitments may be made to others as the planning and design procedure reaches the appropriate level of detail. Others are beyond the authority of Alpetco to perform. Some items which normally are part of permitting stipulations are not identified below as suggested mitigation measures. The following mitigation measures suggested in the EIS are categorized as described below.

COMMITTED: These are mitigation measures that are included in the project description or that Alpetco has committed to perform.

NOT YET COMMITTED: These are suggested mitigation measures only, that are offered for consideration when project planning reaches the appropriate level of detail.

OTHER AUTHORITY: These are suggested mitigation measures that are beyond the authority of Alpetco to implement.

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
1) Incorporate a ground motion analysis in the structural design of refinery components to assess the dynamic behavior of the coupled site/refinery components.	6.1	X		
2) If liquefaction is determined to be a significant hazard along any portion of the pipeline corridor, the pipeline could be supported on pilings founded below the zone(s) of liquefaction, or the soil could be stabilized by a deep densification process such as "vibroflotation".	6.1		X	
3) The proposed leak detection systems on the pipelines and the proper use of valves would minimize potential spills.	6.1	X		

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
4) Any potential erosion, avalanche or rockfall hazards to the above-ground segments of the pipelines could be mitigated by maintaining drainage patterns established for the adjacent Alyeska pipeline, and by placement of the pipelines in sound rock wherever site-specific studies confirm soil or surficial rock slope instability. If determined necessary, an alternate buried configuration could be considered for these segments of the pipeline route.	6.1		X	
5) Collect rain runoff and snowmelt along the eastern periphery of the site and direct it to a discharge point on Corbin Creek (Glacier) mitigating the potential for contamination of a portion of the surface runoff.	6.2	X		
6) Schedule those construction activities which could affect the streams during no-flow or very low-flow periods to minimize the problems associated with increases in erosion and turbidity.	6.2 6.3 6.8	X		
7) Sediment and erosion control programs for all disturbed soil surfaces would minimize erosion and subsequent siltation into the streams.	6.2 6.8	X		
8) Furthermore, following the completion of construction, revegetation of areas which were stripped of cover would stabilize the soils and aesthetically enhance the environment.	6.2 6.8		X	
9) The point of groundwater withdrawal could be located near the north edge of the site so that drawdown in the vicinity of the Brownie and Corbin (Robe) creeks would be minimized.	6.2	X		
10) Provide additional water to Corbin Creek (Robe) and Brownie Creek if necessary to maintain winter flow. Monitor groundwater drawdown during plant operation to determine need to implement the contingency plan.	6.2 6.8		X	

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
11) Incorporate provisions to retain maximum amounts of precipitation runoff in undeveloped areas of the site to enhance groundwater recharge.	6.2		X	
12) Pollution of the groundwater source could be mitigated by the provision of impervious diking and surfacing of areas where hazardous materials are stored or where spills are possible.	6.2	X		
13) During construction, reduce fugitive dust by wetting down dry, exposed soil.	6.5 6.10		X	
14) Whenever practicable employ alternate land clearing debris disposal methods in lieu of open burning (e.g. shredding and land fill).	6.5		X	
15) Emissions to the atmosphere from the operation of combustion equipment, the sulfur recovery system, the FCCU, the flare, the incinerator, storage tanks, and from fugitive emissions would be controlled by using the best available control technologies as presented in Section 4.3.3.	6.5 6.7	X		
16) Avoid construction near residential areas (pipeline corridor) between 10 p.m. and 7 a.m. The distance to residences would mitigate most noise impacts.	6.6		X	
17) Use noise abatement components on refinery equipment.	6.6	X		
18) Use state-of-the-art in-plant wastewater treatment (described in Section 3.4.3).	6.4	X		
19) Location of the discharge offshore and in an area of relatively good circulation (described in Section 5.3.1).	6.4	X		

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
20) Use a back-pressure sensing system to detect a loss of the wastewater discharge diffuser.	6.4		X	
21) Use positive-seal liners in all ponds containing hazardous materials and in all tank containment structures.	6.7 6.8	X		
22) Containerize any hazardous materials temporarily stored on-site, using sealed 50-gallon drums or similar sealable and transportable containers.	6.7	X		
23) To the extent possible, locate project facilities away from nesting areas or resting areas for migrating birds.	6.8	X		
24) Schedule construction work at the products dock to avoid the intertidal spawning period for salmon in Solomon Gulch Creek (mid-July to late August).	6.8	X		
25) Trenching activities for burial of the effluent pipeline in the intertidal zone should be scheduled to avoid the pink salmon run in nearby Sewage Lagoon Creek.	6.8		X	
26) Implementation of a spill prevention, control and countermeasure plan and oil spill contingency plans for offshore and onshore operations would reduce the chances of spillage of petroleum hydrocarbons and maximize the effectiveness of control and cleanup measures in the event of a spill.	6.8	X		
27) Place containment booms around all vessels before heavy product transfer begins to trap any containable potential spill material.	6.8		X	

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
28) Install buried pipeline stream crossings during the least biologically sensitive time of the year, mid-April to July, employing the construction method that is least damaging for that type of stream. A stream bypass flume could carry stream flows during pipe burial at Corbin Creek (Robe), Robe River, and Dayville Flats Creek.	6.8	X		
29) Align crude oil and product pipelines to minimize the number of stream crossings, and bury pipelines to reduce the risk of hydrocarbon spills from accidental pipeline damage and vandalism.	6.8	X		
30) Assist in establishing an interdisciplinary team of engineers, fishery biologists, and hydrologists to provide early review of construction plans and schedules.	6.8	X		
31) Design culverts, bridges, and other drainage structures on fish streams to assure that water velocities could not impede fish passage, and install culverts in concert with the natural streambed to prevent "perched" conditions which could impede fish passage.	6.8	X		
32) Leave a buffer zone of undisturbed natural vegetation with minimum radius of 91 m (300 ft) around all bald eagle nest sites to reduce disturbance and prevent "blowdown" of nest trees. Do not conduct pipeline construction activities in the vicinity active of bald eagle nests during the nesting period if the nests are active.	6.8	X		
33) Dispose of construction and fill material only in approved landfill sites.	6.8	X		

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
34) Fences around the construction camp and all permanent facilities and garbage disposal areas would help minimize human/bear interaction.	6.8	X		
35) If any historical or archaeological site is discovered, construction work should be stopped at that location and the appropriate authorities contacted.	6.9	X		
36) The state Department of Health and Social Services probably would require additional staff in Valdez during construction of the proposed Alpetco project to accommodate an increased case load during this period.	6.10			X
37) Establish training programs to meet the staffing requirements of the proposed facility during its construction and operations phases.	6.10	X		
38) Specific programs under which the city might obtain government assistance to acquire land to construct or provide management of facilities include: 1) Coastal Energy Impact Program authorized under the Coastal Zone Management Act of 1976. 2) Outdoor Recreation Development and Planning authorized by the Land and Water Conservation Fund Act of 1965. 3) Community Development Block grants. 4) Alaska Municipal Entitlement Act of 1978. 5) Legislative appropriations for development of the proposed Keystone Canyon State Park.	6.10			X
39) The city could make available to builders land that is served by city utilities.	6.10			X
40) The city could shorten the city's review and approval process so as not to unduly delay the production of needed housing.	6.10			X

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
41) The city could permit the placement of modular units on temporary foundations, on the condition that once demand for housing has abated, the modular units would have to be resited onto permanent foundations.	6.10			X
42) The city could issue mortgage subsidy bonds, if the U.S. congress permits the program to continue.	6.10			X
43) The state could issue mortgage subsidy bonds through the Alaska State Housing Finance Corporation, if the U.S. congress permits the program to continue.	6.10			X
44) Intervene directly or indirectly in the production of housing.	6.10		X	
45) Provide a guaranteed buy-back of any housing purchased by an Alpetco employee. In this way, Alpetco would eliminate the risk of home ownership for current employees while guaranteeing the availability of permanent housing for future employees.	6.10		X	
46) Repair any damage to the Richardson Highway and Dayville Road in the vicinity of the Alpetco operations to its preconstruction condition at the close of construction.	6.10	X		
47) Reduce the speed limit on the Richardson Highway when trucks are using the highway for construction of the products dock and laying of pipelines.	6.10			X

MITIGATION MEASURE SUMMARY	FROM EIS SECTION	COMMITTED	NOT YET COMMITTED	OTHER AUTHORITY
48) Design the four-way intersection of the primary access road (Glacier Stream Haul Road) and the Richardson Highway to accommodate protected left turn lanes on the Richardson and acceleration lanes onto the highway.	6.10			X
49) Public transportation to carry employees to and from the refinery at shift changes. Buses could operate efficiently, providing virtually door-to-door service in the small neighborhoods of Valdez.	6.10			X

7.2 MONITORING PROGRAMS

7.2.1 Water Quality

Water quality monitoring programs would be based on the stipulations imposed by the NPDES permit and the State of Alaska's "certificate of reasonable assurance" (ADEC).

7.2.2 Air Quality Monitoring

Experiments with the effects of acid rains on the sexual reproduction in Braken Ferns (Pteridium aquilinum) have shown the acidic solutions have a marked effect on sperm mortality and fertilization (Evans et al., 1977). Although the braken fern is not found in the vicinity, two similar ferns, the Lady Fern (Athyrium Filix-femina) and northern shield fern (Dryopteris dilata), which have similar sexual productive strategy, are common in the vicinity of the proposed refinery. These species could prove valuable as air quality indicators during the operational phase of the proposed project.

Air quality monitoring, however, (both pre- and post-construction) would be based on stipulations imposed by the PSD permit and the State of Alaska's "permit to operate" (ADEC).

7.2.3 Ecosystems

Various species may be suitable as indicators or monitoring species. These would include the abundantly occurring polychaetes, Polydora quadrilobata (suspension feeder), Haploscoloplos panamensis and Lumbrineris luti (deposit feeders). These polychaetes would probably be more sensitive to the effects of pollutants than some larger sessile organisms. In addition, the burrowing deposit feeders would serve to indicate the persistence of a pollutant in the sediments.

Some additional benthic marine species which may be useful as indica-

tors in soft substrates are the intertidal echiuids, and subtidal clam, Macoma obliqua, the subtidal polychaete, Nephtys punctata, and the various benthic cumaceans and amphipods.

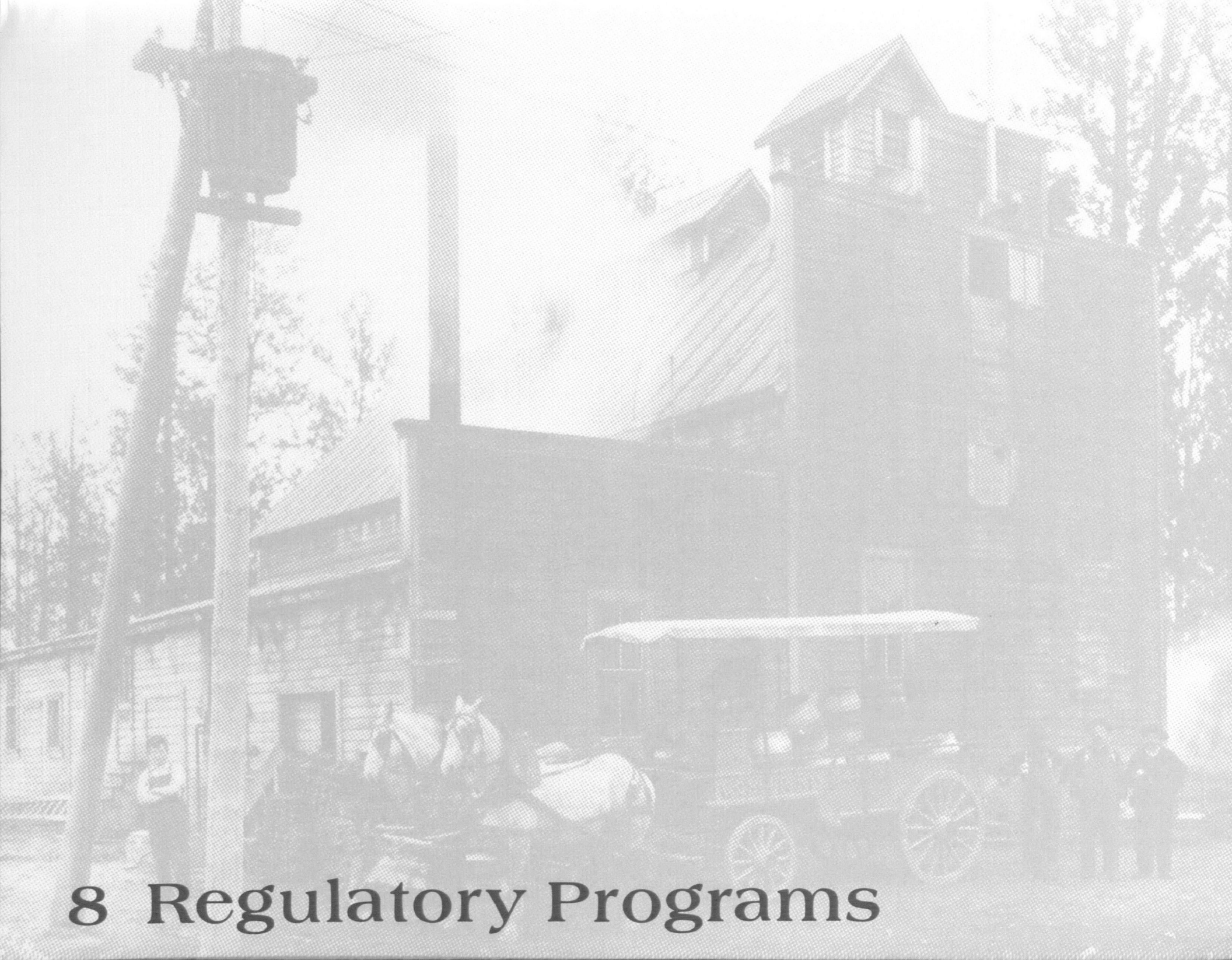
Monitoring of aquatic ecosystems (both pre- and post-construction) would be based on stipulations imposed by the NPDES permit, the "certificate of reasonable assurance" (ADEC), the Anadronomous Fish Act (ADF&G), the pipeline right-of-way lease (ADNR), and Section 10/Section 404 permits (COE).

Monitoring of terrestrial ecosystems is not anticipated as a stipulation of the permits required.

7.2.4 Other

Alpetco is conducting monitoring programs during the present time. These include:

Air Quality Monitoring
Hydrologic Surveys
Goundwater Evaluation
Snow Surveys



8 Regulatory Programs

8. REGULATORY PROGRAMS

8.1 DESCRIPTION OF REGULATORY PROGRAMS

Construction and operation of the proposed refinery would be contingent upon Alpetco securing approximately 110 federal, state and local permits, approvals, or leases. Of these, the following four are major federal permitting actions of either the Environmental Protection Agency or the Corps of Engineers.

EPA - National Pollution Discharge Elimination Systems (NPDES) Permit for discharge of wastewater

EPA - Prevention of Significant Deterioration (PSD) Permit for discharge of air emissions

COE - Federal Water Pollution Control Act Section 404 Permit for discharge of dredged or fill material

COE - River and Harbor Act Section 10 Permit for structures in or affecting navigable waters of the U.S.

As discussed in Section 1.2, Alpetco first submitted an application to EPA for an NPDES Permit in November 1978, and that resulted in the decision by EPA to prepare this Environmental Impact Statement. Under Section 10.2(3)(g) of the Agreement for the sale and purchase of the state's royalty oil, and a letter dated September 27, 1979 from the Commissioner, Alaska Department of Natural Resources, Alpetco has a contractual requirement to file applications for 14 specified permitting actions, including the major permits listed above, by December 18, 1979. Alpetco submitted all required applications, in compliance with this requirement, by November 2, 1979. These permitting requirements are summarized in Section 8.2. All other regulatory and permitting requirements would be fulfilled by Alpetco at the appropriate time during planning and construction of the project.

There are pending new and revised regulatory requirements that may become effective which would impose additional permitting requirements

on the construction or operation of the refinery. The following proposed regulations or guidelines may be anticipated as future permitting requirements.

1. EPA has proposed regulations for hazardous wastes under subtitle C of the Resource Conservation and Recovery Act of 1976. These regulations have been proposed in the Federal Register at various times during 1978 and 1979. Final promulgation of these regulations is expected in 1980.

2. EPA currently is revising its Prevention of Significant Deterioration Regulations under the Clean Air Act. These revisions were proposed in the Federal Register, September 5, 1979 and are expected to be promulgated early in 1980. It is not known at this time whether the new regulations would apply to this facility, or if so, how they would affect it. It does not appear that substantive new issues would be raised; however, that determination would not be made until the final regulations were promulgated.

3. EPA currently is revising its new source NPDES effluent guideline regulations for the petroleum refining category. Proposed regulations may be released for public review late in 1979. Although the proposed facility would be subject only to those regulations if they were proposed, revised if necessary and then promulgated in final form prior to a decision on this application, EPA will re-evaluate the proposed facility in light of those regulations when they become available. EPA may supplement the draft EIS on the basis of that re-evaluation. No decisions on this matter will be made until the regulations are proposed in the Federal Register.

8.2 SUMMARY OF PERMITTING REQUIREMENTS

The following permitting requirements were complied with by November 2, 1979. A tabulation of all other permitting actions is beyond the intent of this section.

FEDERAL AUTHORITY

	Regulated Activity	Regulatory Agency	Authority	Description
1.	Discharge of wastewater (NPDES)	U. S. Environmental Protection Agency	§402 Federal Water Pollution Control Act, Amendments of 1972 P.L. 92-500	The operator of any activity or wastewater system which discharges waste from one or more points into a waterway must obtain a permit for such discharge. This permit is a part of the EPA's National Pollutant Discharge Elimination System.
2.	Prevention of significant deterioration of air quality (PSD)	U. S. Environmental Protection Agency	Part 2, §160-169 Clean Air Act as Amended in 1977	The EPA must review the proposed effect that construction may have on the sources of air emissions to insure that air quality standards will not be violated.
3.	Discharge of dredged or fill material into U. S. waters, including wetlands	U. S. Dept. Defense Dept. of Army, Army Corps of Engineers	33 USC 1344 33 CFR 324 33 CFR 323 §404 of the Federal Water Pollution Control Act, Amendments 1972	The Army Corps of Engineers must authorize the discharge of dredged or fill materials into U.S. waters. This permit would be relevant to the construction of the dike, pipelines, bridges, the products dock and access roads.

FEDERAL AUTHORITY

	Regulated Activity	Regulatory Agency	Authority	Description
4.	Structures or work in or affecting navigable waters of the U.S.	U. S. Dept. of Defense, Dept. of Army, Army Corps of Engineers	33 USC 403 §10, River and Harbor Act of 1899	The Army Corps of Engineers must authorize the construction of any structure in or over navigable waters of the U.S.; the excavation of material in such or the accomplishment of any other work affecting the course, location, condition or capacity of such waters. This permit would be relevant to the products dock.
5.	Permits for bridges over navigable waters	U. S. Dept. of Transportation, U. S. Coast Guard	33 CFR 114 33 CFR 115	The plans and location for construction or alteration of bridges across navigable waters of the United States must be approved by the Coast Guard prior to the start of construction. By a Sept. 25, 1979 letter Alpetco requested a Coast Guard determination as to whether Valdez Glacier Stream is navigable. This permit is relevant to the main access road bridge across Valdez Glacier Stream.

STATE AUTHORITY

	Regulated Activity	Regulatory Agency	Authority	Description
1.	Air quality permit to operate	Alaska State Dept. of Environmental Conservation	AS 46.03.010 AS 46.03.140 AS 46.03.150 AS 46.03.160 AS 46.03.170 18 AAC 15 18 AAC 50	The Department of Environmental Conservation (ADEC) must authorize plans and specifications for construction that will be undertaken and must assess emission standards and possible air contamination resulting from that construction.
2.	Discharge into navigable waters	Alaska State Dept. of Environmental Conservation	P.L. 92-500 18 AAC 15 18 AAC 70.081 to .085	ADEC must issue a certificate of reasonable assurance stating that the proposed activity will comply with the requirements of §401 of the Federal Water Pollution Control Act Amendments of 1972, as modified by the Clean Water Act of 1977. Completion of the federal permit is pending the certification of reasonable assurance.
3.	Solid waste disposal	Alaska State Dept. of Environmental Conservation	AS 46.03.020 18 AAC 15 18 AAC 60	ADEC must authorize the plans and specifications for a facility to dispose of solid waste.

STATE AUTHORITY

	Regulated Activity	Regulatory Agency	Authority	Description
4.	Wastewater disposal	Alaska State Dept. of Environmental Conservation	AS 46.03.100 AS 46.03.110 AS 46.03.090 AS 46.03.720 18 AAC 15 18 AAC 70 18 AAC 72	ADEC must authorize any operation which results in the disposal of wastewater into or upon the waters or surface lands of the State of Alaska. This permit has been waived per a letter dated November 1, 1979 to Alpetco from the ADEC.
5.	Right-of-Way or easement permit	Alaska State Dept. of Natural Resources	AS 38.05.330 11 AAC 58.200	If a road, pipeline, or dock crosses State lands a right-of-way or easement permit is required.
6.	Water use	Alaska State Dept. of Natural Resources	AS 46.15.030-185 11 AAC 72	The appropriation of State water requires a permit.

LOCAL AUTHORITY

	Regulated Activity	Regulatory Agency	Authority	Description
1.	Ground lease from City of Valdez	City of Valdez	Valdez City Code §2-15	Application must be made for lease of City-owned land. This is relevant to the refinery site, the wastewater pipeline route and the staging area.
2.	Tidelands lease from the City	City of Valdez	Valdez City Code §27-4	Application must be made for tidelands lease. This applies to the barge dock site and the wastewater outfall route across the intertidal area.

9 Coordination

9. COORDINATION

9.1 INTRODUCTION

This Environmental Impact Statement was initiated prior to final promulgation of the Council on Environmental Quality (CEQ) regulations on implementation of the National Environmental Policy Act (40 CFR Parts 1500-1508). However, during preparation of the EIS every effort was made to comply with the proposed regulations, particularly with respect to coordination among agencies and groups affected by or interested in the proposed facility. Extensive coordination efforts have been made with federal, state and local agencies and the public throughout the preparation of the draft EIS.

Twenty-three formal meetings were conducted in Anchorage, Valdez, Juneau, Cordova and Seattle for coordination of agency and consultant work and for public participation. In addition to these meetings, there have been continual close coordination and consultation efforts among EPA (both on the local and regional levels), the State of Alaska, CCC/HOK-DOWL (the third-party consultant), and the Applicant (including Alpetco's own administrative and technical staffs). Open channels of communication were maintained throughout preparation of the EIS which allowed expeditious transfer of information and timely consideration of and solutions to questions which arose as a result of environmental studies, and project design development.

Many comments, both written and verbal, have been received from the federal, state and local levels. The EPA thanks those persons who have provided comments and guidance during the past year. Their cooperation is greatly appreciated.

9.2 STATE AND FEDERAL AGENCIES

The staff of EPA, the team of consultants and Alpetco have had numerous informal meetings with various agencies. Formal written requests for information and advice on subjects concerning the proposed project also have been issued. A brief summary of these coordination efforts follows.

At the outset of preparation efforts for this EIS, the State of Alaska designated Glenn Akins, Director of the Division of Environmental Quality Management, as the State Coordinator through whom all communications officially occur. Akins is located in the offices of the Department of Environmental Conservation in Juneau. The state staff has provided the EPA with invaluable help in defining and studying the issues related to the proposed facility.

A scoping meeting for state and federal agencies was conducted on November 9, 1978, to identify major concerns other agencies thought should be addressed in the EIS. The EPA also requested at that time that each agency specify from its staff a single contact person for the EIS. Discussions at that meeting helped to identify some of the issues which would need to be addressed in the EIS, as well as some of the regulatory requirements to which the proposed facility would be subject. Agencies which were not represented at the meeting were contacted later to identify any initial concerns. As a result, agencies which had a regulatory involvement or an active interest in the project were identified. Both formal and informal communications with those agencies continued throughout the preparation of the EIS.

A second state/federal meeting was conducted on August 29, 1979, to update all agencies on the status of the EIS and to discuss issues which had arisen during its preparation.

The U. S. Fish and Wildlife Service and the National Marine Fisheries Service were contacted with regard to endangered species which might be affected by this project (pursuant to Section 7, P.L. 95-632, The Endangered Species Act Amendments of 1979). Their responses appear in Section 9.4.

Upon the request of EPA as the lead agency, the U. S. Army Corps of Engineers (COE) became a cooperating agency in preparing the EIS (see Section 9.4). The COE has jurisdiction by law through Section 404 of the Federal Water Pollution Control Act Amendments of 1972 and Section 10 of the River and Harbor Act of 1899. As a result the COE partici-

pated closely in delineating wetlands and reviewing the scope of the EIS.

The U. S. Coast Guard was informed of the proposed project, specifically in reference to the proposed products dock and associated marine traffic, and of the approach being taken toward a spill risk analysis. Also, a Coast Guard determination of navigability of Valdez Glacier Stream was requested by Alpetco on October 8, 1979. The subsequent determination of non-navigability appears in Section 9.4.

Because of the proximity of the proposed project to an FAA command support facility, the FAA was advised of the project, and the relationship of tall structures to the adjacent Valdez airport was described.

Comments from state and federal agencies have been too extensive and detailed to reproduce here; however, every effort has been made to accommodate suggestions either through Alpetco design changes or through adjustment of the scope of the EIS.

9.3 LOCAL AGENCIES AND GENERAL PUBLIC

Coordination with Valdez public officials has been almost continuous from the early stages of facility planning. This coordination included numerous meetings with the Valdez City Council, the city manager, mayor, engineer, planner, and port director.

In addition to the city officials listed above, other members of the local community were contacted, including banking institutions, the Copper Valley Electric Association, Valdez Community College, Valdez Airport, Valdez Mental Health Center, Valdez Heritage Center, Valdez City Schools, Harborview Developmental Center, Alyeska Pipeline Service Company, Valdez Community Hospital and Valdez Public Library.

9.4 EXHIBITS

Following are letters of commitment and documents showing determinations which have been made regarding the proposed project.

ITEM	DATE	AUTHOR	RECIPIENT	SUBJECT
Letter	8/24/78	LeResche/ADNR	Dagon/Alpetco	state site selection criteria
Letter	9/28/78	Lewis/City of Valdez	Cain/Alpetco	no need for impact aid
Letter	11/17/78	Cain/Alpetco	LeResche/ADNR	notice of site selec-ton
Letter	1/17/79	Mueller/ADEC	Curl/EPA	state/federal coordination
Letter	3/5/79	LeResche/ADNR	Cain/Alpetco	site approval
Letter	5/29/79	Sowl/USFWS	Kirk/EPA	endangered species
Letter	7/18/79	Rietze/NMFS	Kirk/EPA	endangered species
Letter	7/19/79	Hanable/SHPO	Bacon/Alaskarctic	no known historic properties
Letter	10/9/79	Nunn/COE	DuBois/EPA	cooperating agency
Letter	10/9/79	Lewis/City of Valdez	Dagon/Alpetco	sewer service
Letter	10/9/79	Lewis/City of Valdez	Dagon/Alpetco	solid waste disposal
Form	10/11/79	Dagon/Alpetco	FAA	notice of proposed construction
Letter	10/31/79	Moncrief/USCG	Dagon/Alpetco	non-navigability of Valdez Glacier Stream

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE COMMISSIONER

11TH FLOOR, STATE OFFICE BLDG.
POUCH M — JUNEAU 99811

August 24, 1978

RECEIVED
AUG 28 1978

Mr. Ron Dagon
Alaska Petrochemical Company
601 West 5th Avenue
Suite 320
Anchorage, Alaska 99501

Dear Mr. Dagon:

This letter will clarify the type of information the State will require from Alpetco pursuant to the site selection terms of our royalty oil contract.

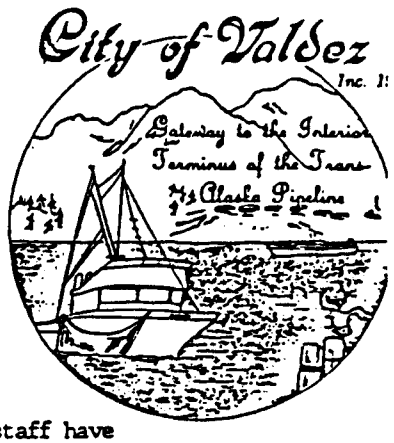
First of all, the purpose for requiring state review of site selection by Alpetco was primarily to insure that the petrochemical facility is sited (1) in a location where local residents support its construction and (2) in a location where there are no insoluble environmental problems that can be foreseen before specific study. The intent in the contract was to leave the commercial and economic aspects of site selection to the discretion of the buyer.

Secondly, the information required in Article 10.2(1)(d) ("...cost estimates of infrastructure, offsite and marine facilities.") should be in great enough detail to allow the State, the local community, and local businesses to accurately plan for and provide for the facilities' impacts. It should give a fairly complete picture of all offsite facilities and services that the project will stimulate, and of how much of the cost and planning will be borne by Alpetco. For example, if your firm intends to make use of municipal bonding capabilities, or state-related financing (e.g., AIDA instruments), the site submission should make this clear.

I hope this clarifies these contractual terms.

Sincerely,

Robert E. DeResche
Commissioner



September 28, 1978

Mr. Gordon A. Cain; President
Alaska Petrochemical Company
601 West 5th Avenue
Suite 320
Anchorage, Alaska 99501

Dear Mr. Cain:

The City of Valdez would like to express its sincere appreciation for the time and consideration you and your staff have given Valdez in your activities to select a site to locate your petrochemical complex.

As you know, the city has expressed a strong desire to have you locate your facility in Valdez. We firmly believe that the combination of the economics of oil transport, accecptable site, community infrastructure and community support will make Valdez your location for the development of a petrochemical complex. Please let me review some of these factors for you.

1. Economics

A. Project Financing - The city of Valdez stands ready to aid in the financing of the project; possibly by:

1. Constructing pol dock and support facilities financed by the sale of city revenue bonds;

2. The use of tax-exempt revenue bonds similar to those that were used to finance the pipeline marine terminal.

B. Low local taxes - Valdez enjoys very low taxes.

1. No personal property tax.

2. No sales tax.

3. Real property millage of 5.32.

C. Oil Transport Economics - Oil transport costs from Valdez to Kenai range from .40 to .50 per barrel or an estimated 18,000,000 to 20,000,000 per year.

D. No impact aid need - Valdez currently has all the necessary utilities, schools and other community facilities necessary to accomodate the demands of a construction boom followed by additional permanent residents without the need for additional facilities or financial support.

P. O. BOX 307 . . . VALDEZ, ALASKA 99686 . . . TELEPHONE (907) 835-4

2. Acceptable site location - The City will lease to Alpetco at least 1900 acres of land as previously described for 99 years at $1.00 per year. The proposed site is flat, has more than adequate water supply and has road access to the Richardson Highway. Additionally, there are construction camps available near the proposed cite along with proposed city constructed pol dock facilities.

3. Ice-free port - Valdez has one of the finest ports in the world. Depth average is 800 feet with deep water access to facilities close to natural shorelines. Additionally, major airport improvements have been financed by the state and city.

4. Environmental Assurances - The City of Valdez has received assurances from DEC that the necessary permits for a project can be issued in the Valdez area.

Finally, community support for the project documented by the city industrial development poll, is firm. The support for the project will grow with the designation of Valdez as your site. Thank you for your interest in our community; we stand ready to assist you in reaching your goal in any way we can.

Sincerely,

Mark Lewis
City Manager
(Acting)

ALASKA PETROCHEMICAL COMPANY

601 WEST 5TH AVE., SUITE 320
ANCHORAGE, ALASKA 99501
(907) 272-1517

P. O. BOX 6554
HOUSTON, TEXAS 77005
(713) 621-8710

November 17, 1978

Dr. Robert E. LeResche
Commissioner
Department of Natural Resources
Pouch "M"
Juneau, Alaska 99811

RE: Agreement for the Sale and Purchase of State Royalty Oil between Alaska Petrochemical Company and the State of Alaska dated February 22, 1978 (the Agreement)

Dear Commissioner LeResche:

In accordance with the terms of Articles 4.2.2 and 10.2(1)(d) of the Agreement, I hereby notify you that we have chosen Valdez as the site of Alpetco's proposed refinery-petrochemical facility.

Within the next two weeks, Alpetco will provide to you a report on site selection prepared by Brown & Root, Inc., in which cost estimates for the infrastructure, offsites and marine facilities, a summary of the major factors that went into the selection and a tentative plant and offsites layout will be included.

As stated in your letter of August 24, 1978 to Alpetco, "the purpose for requiring state review of site selection by Alpetco was primarily to insure that the petrochemical facility is sited (1) in a location where local residents support its construction and (2) in a location where there are no insoluble environmental problems that can be foreseen before specific study."

The Valdez site as well as several other sites in Southcentral Alaska meets these requirements. Consequently, the choice of the site was dictated primarily by economic considerations.

While the subject of air quality in Valdez relating to sulfur dioxide emissions had been previously raised as an issue, Alpetco is confident it can design and build this facility under the general guidelines outlined by the Department of Environmental Conservation in correspondence between both Alpetco and the City of Valdez. The detailed meteorological and air quality data program needed to comply with federal Prevention of Significant Deterioration requirements is already underway.

As to the general suitability of the site, Northern Technical Services of Anchorage in a report to Brown & Root indicated "On the basis of information developed in the preliminary site and soils investigation conducted on this site, we conclude that soil and foundation conditions are suitable for the proposed development."

The major economic consideration involved in site selection is that the crude is available at Valdez. Transportation of the crude from Valdez to any other acceptable site would cost some $20,000,000 a year. After extensive study, Alpetco could not find any economic advantages to any other acceptable site that would overcome the cost of moving the crude from Valdez.

The estimated costs of the infrastructure, offsite and marine facilities are:

Infrastructure	70 to 80 million dollars
Offsite facilities	195 to 205 million dollars
Marine facilities	80 to 90 million dollars

Alpetco will be responsible for providing these facilities. However, the fact that the City of Valdez has the ability and the willingness to finance some of these facilities by revenue bond financing was an additional factor in our choice of Valdez. Alpetco will not make a decision on the extent to which we will use revenue bond financing until we have evaluated the cost of other sources of financing and its availability.

An additional consideration involved in this site selection was the fact the City of Valdez had indicated to Alpetco in a letter dated September 6, 1978 that "With regard to our community infrastructure, Valdez currently has all the necessary utilities, schools and other community facilities necessary to accommodate the demands of a construction boom followed by additional permanent residents without the need for additional facilities or financial support." This position of the city was restated in a letter dated October 25, 1978 "Because of our present infrastructure, there would be <u>no</u> need for impact aid."

Alpetco executed a "Memorandum of Understanding" with the United States Environmental Protection Agency-Region X on November 3, 1978 to provide a draft Environmental Impact Statement on or about October 18, 1979. With the concurrence of the Department of Environmental Conservation, the firm of Crittenden Cassetta & Cannon/Hellmuth Obata & Kassabaum - Dickinson·Oswald·Walch·Lee (CCC/HOK-DOWL) of Anchorage has been selected as the consultant to prepare this impact statement.

Following your receipt of Brown & Root's report on site selection which highlights the site selection activities over the past five months, Alpetco would be most willing to discuss these topics with you further if that should be necessary. The City of Valdez is prepared to host a public hearing at your earliest convenience; we understand that you would like to hold such a hearing as soon as possible after this nomination of a site as is convenient to all parties. It is also our understanding that EPA-Region X would also participate in that hearing in order to provide public input into the proposed scope of work for the draft Environmental Impact Statement. The Alpetco organization also would be available for the public hearing in any capacity you might require.

The cooperation of both the Department of Natural Resources and the Department of Environmental Conservation during the past few months is gratefully acknowledged.

Sincerely yours,

Gordon A. Cain

Gordon A. Cain
President

GAC:br

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPT. OF ENVIRONMENTAL CONSERVATION

POUCH O – JUNEAU 99811

January 17, 1979

Mrs. Deborah Curl
EPA, Region X
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mrs. Curl:

Alaska state agencies have completed review of the "Scope of Work" for preparation of the Environmental Impact Statement for the proposed ALPETCO petrochemical facility in Valdez, Alaska.

We find the "Scope of Work" to be an adequate list of topics which must be addressed to process environmental permits and other authorizations necessary for approval of the ALPETCO facility.

We recommend proceeding to the next stage of EIS preparation, the drafting of the "Plan of Study."

As you know, several Alaska state agencies recommended revisions in early drafts of the "Scope of Work." The final draft provided to us had been changed to include our recommendations.

State agencies consistently recommended that the "Scope of Work" include comprehensive and detailed descriptions of the EIS work tasks. You have assured us that the "Plan of Study" will add the desired level of detail. We believe the best way for specific state agency concerns to be addressed in preparation of the EIS will be through review and revision of the "Plan of Study."

BACKGROUND

The Commissioner of the Alaska Department of Natural Resources is responsible for the state performance under the terms of the contract between ALPETCO and the State of Alaska. The Commissioner of Natural Resources, and the Governor, have designated the Commissioner of Environmental Conservation to coordinate state agency processing of environmental permits and other approvals necessary for the ALPETCO petrochemical facility.

Therefore, DEC is responsible for fulfilling that part of the contract with ALPETCO which requires the state to " . . . support, lend aid and facilitate the grant or approval" of permits and other authorizations required by ALPETCO, consistent with all applicable laws and regulations.

In a series of meetings between the State, ALPETCO, and the U. S. Environmental Protection Agency, it was agreed that the EIS would be prepared consistent with new regulations for EIS preparation, issued by the U. S. Council on Environmental Quality. The initiation of the ALPETCO EIS pre-dates the adoption of these regulations, and therefore, the EIS is not required to comply. However, the regulations provide for the inclusion of all state and federal permit requirements within the draft EIS. This offers an excellent tool for inter-agency coordination.

The "Memorandum of Understanding" between ALPETCO and the U. S. Environmental Protection Agency provides for review of the "Plan of Study" and subsequent products leading to the draft EIS by the State of Alaska, through the Department of Environmental Conservation.

DEC participation, on behalf of the state agencies, began with a meeting on July 31, 1978, attended by DEC, chief executives of ALPETCO, and representatives of the EPA and the U. S. Army Corps of Engineers. On October 20, ALPETCO and EPA met with DEC in Juneau to recommend revisions to the first draft of the "Scope of Work." Further revisions were completed in a meeting in Seattle on November 2 and 3, 1978. A third meeting was held in Anchorage on December 12, 1978. At this meeting, DEC stated that the "Scope of Work" had been revised sufficiently to incorporate state agency concerns. Further, DEC recommended that work begin on preparation of the "Plan of Study" because of increasing state interest in more detailed descriptions of the EIS work tasks.

We look forward to working with you on the next stage of this process.

Sincerely,

Ernst W. Mueller
Commissioner

cc: Commissioner Robert LeResche, DNR
Tom Cook, DNR
State Agency & Legislative Contacts on ALPETCO
Ron Dagon, ALPETCO

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE COMMISSIONER / POUCH M – JUNEAU 99811

March 5, 1979

Mr. Gordon Cain
President
Alaska Petrochemical Company
P. O. Box 6554
Houston, Texas 77005

Dear Mr. Cain:

In accordance with the terms of Article 4.2.2 of the Agreement for the Sale and Purchase of State Royalty Oil between Alaska Petrochemical Company and the State of Alaska dated February 22, 1978, the Commissioner of Natural Resources must approve the site selected for the petrochemical facility. This letter constitutes that approval.

Upon receipt of your formal notice of your choice of Valdez as the site for the Alpetco facility, I forwarded copies of the Site Report to all concerned departments of State Government for their review and comments. I have enclosed copies of those comments for your information. In summary, the Department of Environmental Conservation indicated that while there was much work to be done to secure approval of air and water discharge permits, there were no insurmountable environmental problems evident from knowledge present at this time which would prevent location of the plant at Valdez. The Department of Fish and Game approved of the selection of Valdez because (1) no additional tanker transport of crude oil would be required and (2) navigation for tankers carrying products was relatively safe because of the sophisticated ship traffic control system in the area. Fish and Game felt there was a possibility of water quality problems resulting from discharge of refinery effluent into Port Valdez but did not feel that the potential for water quality deterioration was grounds for rejecting the Valdez site. The Department of Community and Regional Affairs brought up the matter of the potential flood hazards at the proposed site and the fact that the site would be subject to initial consideration under the Valdez Coastal

Zone Program. The Department of Community and Regional Affairs has conferred with the City of Valdez Planning Director on these matters.

On January 2, 1979, notices of a public hearing to be held in Valdez concerning its selection as the facility site were sent to ten major newspapers in Alaska to be published several times during the month of January. Also on that date Legislative leaders and the Legislators representing the Valdez area were notified of the scheduled hearing and invited to attend or comment.

On January 29, 1979, at 7 p.m. I conducted the public hearing in Valdez for the purpose of gathering information regarding the selection of Valdez as the site for the petrochemical facility and to determine public acceptance of the proposed facility by the residents of the Valdez area. Approximately 180 citizens attended the public hearing as well as several state and federal officials and officials from the Alaska Petrochemical Company. The responses from the sixteen people who testified were unanimously in favor of the selection of Valdez as the site for the facility.

In view of the favorable response received by the Department of Natural Resources from State and local officials and the residents of Valdez, your selection of Valdez as the site for the petrochemical facility to be built under the terms of the Agreement for the Sale and Purchase of State Royalty Oil between Alaska Petrochemical Company and the State of Alaska is hereby approved.

Sincerely,

Robert E. LeResche
Commissioner

Enclosures

cc: Jay S. Hammond

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503
(907) 276-3800

IN REPLY REFER TO: AAD/AW (FA/SE)

RECEIVED
MAY 29 1979
ENVIRONMENTAL EVALUATION BRANCH

Deborah Kirk
U.S. Environmental Protection Agency, Region X
Environmental Evaluation Branch
1200 Sixth Avenue
Seattle, Washington 98101

Dear Ms. Kirk:

Thank you for your letter requesting information on listed and proposed endangered species or their habitats in the area of Alpetco's proposed oil refinery at Port Valdez. Having reviewed the information you provided and the available data on the distribution of listed and proposed endangered species, we conclude that neither are present in the proposed project area.

Sincerely,

LeRoy W Gorrell
Area Director

R7-1

U.S. DEPARTMENT OF COMMERCE
National Ocean and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
P. O. BOX 1668 - JUNEAU, ALASKA 99802

July 18, 1979

RECEIVED
JUL 23 1979
EPA-EIS

Deborah K. Kirk
Environmental Evaluation Branch
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Dear Ms. Kirk:

This is in response to your June 25, 1979, letter pursuant to Section 7 of the Endangered Species Act, requesting information on endangered species that may be affected by the proposed Alpetco oil refinery in Port Valdez.

The only endangered species likely to occur in the area of the proposed refinery is the humpback whale. Humpback whales are seen so infrequently in Port Valdez that we do not anticipate any harmful impacts from the proposed facility and dock, providing that there is no pollutant run-off from the onshore facility which might adversely affect species which comprise their diet (mainly herring, capelin, pollock and sand lance in Prince William Sound).

We would appreciate the opportunity to comment on your draft EIS.

Sincerely,

Harry L. Rietze
Director, Alaska Region

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS

JAY S. HAMMOND, GOVERNOR

619 Warehouse Dr., Suite 210
Anchorage, Alaska 99501

July 19, 1979

Re: 1130-13

Mr. Glenn Bacon
Consultant Archaeologist
Alaskarctic
P. O. Box 397
Fairbanks, AK 99707

Dear Glenn:

Reference our telephone conversation yesterday concerning the ALPETCO project and historic preservation concerns. This will confirm that there are no known properties which are eligible for the National Register of Historic Places located in the project area, nor are there any properties which are already listed on the Register located in that area.

Should we be able to provide any further assistance, please do not hesitate to contact us.

Sincerely,

Douglas Reger, Deputy SHPO

for William S. Hanable
State Historic Preservation Officer

TLD:tld

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, CORPS OF ENGINEERS
P.O. BOX 7002
ANCHORAGE, ALASKA 99510

REPLY TO
ATTENTION OF:

NPAEN-PL-EN

RECEIVED
OCT 12 1979
OFFICE OF
REGIONAL ADMINISTRATOR

9 OCT 1979

Mr. Donald P. Dubois
Regional Administrator
U.S. Environmental Protection
Agency
1200 Sixth Avenue
Seattle, Washington 98101

RECEIVED
EPA - REGION 10
OCT 18 1979
WATER DIVISION

Dear Mr. Dubois:

This is in reference to your letter of 27 August 1979 concerning the proposal by the Alaska Petrochemical Company to build a refinery in Valdez. The Alaska District is pleased to act as a cooperating agency, under current Council on Environmental Quality Regulations, in preparing the Environmental Impact Statement for the project. We are presently working toward making the Draft Environmental Impact Statement adequate for our needs and are adjusting our work to meet your established schedule.

I fully support your proposal that we consolidate, as much as possible, agency requirements for public notification and review of the proposal. In this regard I would appreciate timely notification of your needs and staff discussion toward arriving at appropriate time saving procedures. Your staff's continued coordination with Mr. Jim Caruth, Chief, Regulatory Functions Branch and Mr. Ben Kutscheid, Ecologist, Environmental Section, on these matters is encouraged.

I am looking forward to meeting you and hope your duties bring you to Anchorage in the near future. We indeed share many responsibilities in the public trust for wise economic development and the conservation of a finite environmental resource base.

Sincerely,

Lee R. Nunn

LEE R. NUNN
Colonel, Corps of Engineers
District Engineer

RECEIVED
OCT 18 1979
EPA-FIS

OCT 11 1979

OCT 11 1979

City of Valdez

Inc. 1901

Gateway to the Interior
Terminus of the Trans-Alaska Pipeline

OFFICE OF ADMINISTRATION
October 9, 1979

Ronald R. Dagon
Manager, Environmental Programs and Permitting
Alaska Petrochemical Company
601 West 5th, Suite 320
Anchorage, Alaska 99501

Dear Mr. Dagon:

The City of Valdez is prepared to provide sewer service from the proposed Alpetco site within the Valdez "industrial zone" to the Valdez Wastewater Treatment Plant. I understand from your revised NPDES Permit Application No.: AK-oo2763-4 dated September 19, 1979 that the estimated sanitary water from this facility is 30,000 gpd.

Alpetco has already received a January 18, 1979 City of Valdez memorandum (Alexander to Lewis) relating to "Alpetco sewer service" that could serve as a planning document to estimate the costs of this service to Alpetco. The actual costs of and the mechanism for providing this service will be charged to Alpetco.

As indicated in other City of Valdez-Alpetco correspondence, I would expect Alpetco to keep the City of Valdez administration informed of any significant changes to the proposed facility design and operation which could impact the City's physical and fiscal planning.

Sincerely yours,

Mark

Mark Lewis
City Manager

cc: Homer Alexander
Dave Hunt

P. O. BOX 307 . . . VALDEZ, ALASKA 99686 . . . TELEPHONE (907) 835-4313

OCT 15 1979

City of Valdez
Inc. 1901

Gateway to the Interior
Terminus of the Trans-Alaska Pipeline

OFFICE OF ADMINISTRATION
October 9, 1979

Ronald R. Dagon
Manager, Environmental Programs
and Permitting
Alaska Petrochemical Company
601 West 5th, Suite 320
Anchorage, Alaska 99501

Dear Mr. Dagon:

The City of Valdez is willing to accept the solid wastes indicated on enclosure #1 to this letter during the period of plant construction and operation. I have asked our consultants, Woodward-Clyde, to consider these quantities in its on-going study efforts.

The rate for accepting this material will be determined at a later date.

You recognize, of course, that the City of Valdez will not accept any material for disposal in its facilities that under any circumstances can be considered toxic and/or hazardous.

I expect Alpetco to keep both the administration of the City of Valdez and the Alaska Department of Environmental Conservation current on your anticipated needs and any significant changes in the material quantities indicated on the enclosed table.

Sincerely yours,

Mark

Mark Lewis
City Manager

Enclosure

cc: Woodward-Clyde

P. O. BOX 307 . . . VALDEZ, ALASKA 99686 . . . TELEPHONE (907) 835-4313

Enclosure #1 (Lewis to Dagon, October 9, 1979)

SOLID WASTES

(Alpetco to City of Valdez)

construction (late 1980 to mid 1983)

scrap and excess construction material	1,500 tons - total*
shipping cartons	600 tons - total**
garbage	9,200 tons - total***

operation (early 1983 and onward)

inert solid wastes (ash, spent clay, and spent alumina) following incineration by Alpetco	6,600 tons per year***

* may be necessary for Alpetco to ship some from Port of Valdez for disposal (metals, etc.)
** pre-incineration
*** 6,600 tons per year has the following equivalents (approximate):

18 tons per day
38 cubic yards per day
4 dump trucks per day

Before completing this form it is recommended that the following excerpts from the Federal Aviation Regulations, Part 77, Subchapter B below be reviewed.
USE BACK OF THIS SHEET AS WORKSHEET

DO NOT REMOVE CARBONS

Form Approved O.M.B. No. 04-R0001

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

FOR FAA USE ONLY

AERONAUTICAL STUDY NO.

FAA will either return this form or issue a separate acknowledgement.

A. The proposed structure:

☐ Does not require a notice to FAA.

☐ Would not exceed any obstruction standard of Part 77 and would not be a hazard to air navigation.

☐ Should be obstruction ☐ marked ☐ lighted per FAA Advisory Circular 70/7460-1, Chapter(s) _____

☐ Obstruction marking and lighting are not necessary.

☐ Requires supplemental notice. Use FAA form enclosed.

B. FCC ☐ was ☐ was not advised.

REMARKS:

ISSUING OFFICE:

REVIEWING OFFICER | DATE

1. NATURE OF STRUCTURE

A. TYPE: [X] NEW CONSTRUCTION [ ] ALTERATION

B. CLASS: [X] PERMANENT [ ] TEMPORARY

C. PROPOSED LENGTH OF TIME TO COMPLETE (*Months*): 30 - 36

2. NAME AND ADDRESS OF INDIVIDUAL, COMPANY, CORPORATION, ETC. PROPOSING THE CONSTRUCTION OR ALTERATION (*Number, Street, City, State and Zip Code*)

TO

ALASKA PETROCHEMICAL COMPANY
601 West 5th Avenue, #320
Anchorage, Alaska 99501

3. COMPLETE DESCRIPTION OF STRUCTURE (*Include effective radiated power of proposed or modified AM, FM or TV station and assigned frequency; size and configuration of power transmission line in vicinity of FAA facilities as appropriate*).

The structure is a 300 foot flare stack associated with a 150,000 BPD refinery and petrochemical facility; numerous other heater stacks and towers less than 300 foot (175-250) will be within the plant site and suitably marked and lighted.

4. LOCATION OF STRUCTURE

A. COORDINATES (*To nearest second*)

LATITUDE			LONGITUDE		
61°	7'	55"	146°	11'	30"

B. NEAREST CITY OR TOWN, AND STATE: Valdez, Alaska

(1) DISTANCE FROM 4B: 6+ MILES

(2) DIRECTION FROM 4B: East

C. NAME OF NEAREST AIRPORT, HELIPORT, OR SEAPLANE BASE: Valdez

(1) DISTANCE FROM NEAREST POINT OF NEAREST RUNWAY: 6,000+ feet

(2) DIRECTION FROM AIRPORT: East

D. DESCRIPTION OF LOCATION OF SITE WITH RESPECT TO HIGHWAYS, STREETS, AIRPORTS, PROMINENT TERRAIN FEATURES, EXISTING STRUCTURES, ETC. (*Attach a highway, street, or any other appropriate map or scaled drawing showing the relationship of construction site to nearest airport(s). If more space is required, continue on a separate sheet of paper and attach to this notice.*)

Project site is located between Slater and Corbin Creeks east of Valdez Glacier Stream in the outwash plain of Valdez Glacier (see attached map for appropriate relationships). The flare stack is located in the northern portion of the site (see attached site plan).

5. HEIGHT AND ELEVATION (*Complete A, B and C to the nearest foot*)

A. ELEVATION OF SITE ABOVE MEAN SEA LEVEL	Average	145
B. HEIGHT OF STRUCTURE INCLUDING APPURTENANCES AND LIGHTING (*if any*) ABOVE GROUND, OR WATER IF SO SITUATED		300
C. OVERALL HEIGHT ABOVE MEAN SEA LEVEL (*A + B*)		445

6. WORK SCHEDULE DATES

A. BEGINNING: 1981

B. END: 1983

7. OBSTRUCTION MARKED AND/OR LIGHTED IN ACCORDANCE WITH CURRENT FAA ADVISORY CIRCULAR 70/7460-1, OBSTRUCTION MARKING AND LIGHTING

	YES	NO
A. MARKED	X	
B. AVIATION RED OBSTRUCTION LIGHTS		
C. HIGH INTENSITY WHITE OBSTRUCTION LIGHTS		
D. DUAL LIGHTING SYSTEM	X	

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge.

DATE	TEL. NO. (*Give area code*)	TYPED NAME/TITLE OF PERSON FILING NOTICE	SIGNATURE
10/11/79	(907)272-1517	Ronald R. Dagon, Manager Environmental Program & Permitting	Ronald R. Dagon

Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Section 1101 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1101). Persons who knowingly and willfully violate the Notice requirements of Part 77 are subject to a fine (criminal penalty) of not more than $500 for the first offense and not more than $2,000 for subsequent offenses, pursuant to Section 902(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1472(a)).

FAA Form 7460-1 (1-78) SUPERSEDES PREVIOUS EDITION

DO NOT REMOVE CARBONS

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
ALASKAN REGION
701 C STREET, BOX 14
ANCHORAGE, ALASKA 99513

IN REPLY REFER TO
AERONAUTICAL STUDY
NO. 79-AAL-142-OE

AERONAUTICAL STUDY OF PROPOSED CONSTRUCTION OR ALTERATION

SPONSOR	Alaska Petrochemical Company 601 West 5th Avenue, #320 Anchorage, Alaska 99501	CONSTRUCTION LOCATION PLACE NAME Valdez, Alaska	
		LATITUDE 61°07'55"N	LONGITUDE 146°11'30"W
CONSTRUCTION PROPOSED	DESCRIPTION Refinery Flare Stack approximately 7000' east-southeast of Valdez Airport.	HEIGHT (IN FEET) ABOVE GROUND 300'	ABOVE MSL .445'

A notice has been filed with the Federal Aviation Administration that the above described structure is proposed for construction. As proposed the structure would exceed the standards of Subpart C of Part 77 of the Federal Aviation Regulations and would be identified as an obstruction to air navigation. Accordingly, the FAA is conducting an aeronautical study of the proposal to determine its effect upon the safe and efficient use of the navigable airspace by aircraft and on the operation of air navigation facilities.

In the study, consideration will be given to all facts relevant to the effect of the proposal on existing and planned airspace use; air navigation facilities; airports; aircraft operations, procedures and minimum flight altitudes; and the air traffic control system. However, only those plans on file with the FAA, on the date the notice concerning the above described proposed construction was received, will be considered.

Interested persons are invited to participate in the aeronautical study by submitting comments to the FAA office issuing this notice. To be eligible for consideration, comments must be relevant to the effect the proposed construction would have on aviation, provide sufficient detail to permit a clear understanding, and be received on or before December 8, 1979. Please refer to the aeronautical study number printed in the upper right hand corner of this notice.

This notice may be reproduced and recirculated by any interested person.

The proposed structure would exceed the obstruction standards of Part 77 of the Federal Aviation Regulations as follows:

1. Section 77.23(a)(2) by 125 feet, the height above 200 feet within 3 miles of an airport.

2. Section 77.25(b) by 97.5 feet, the height above a conical surface sloping outward from the horizontal surface by a 20:1 ratio.

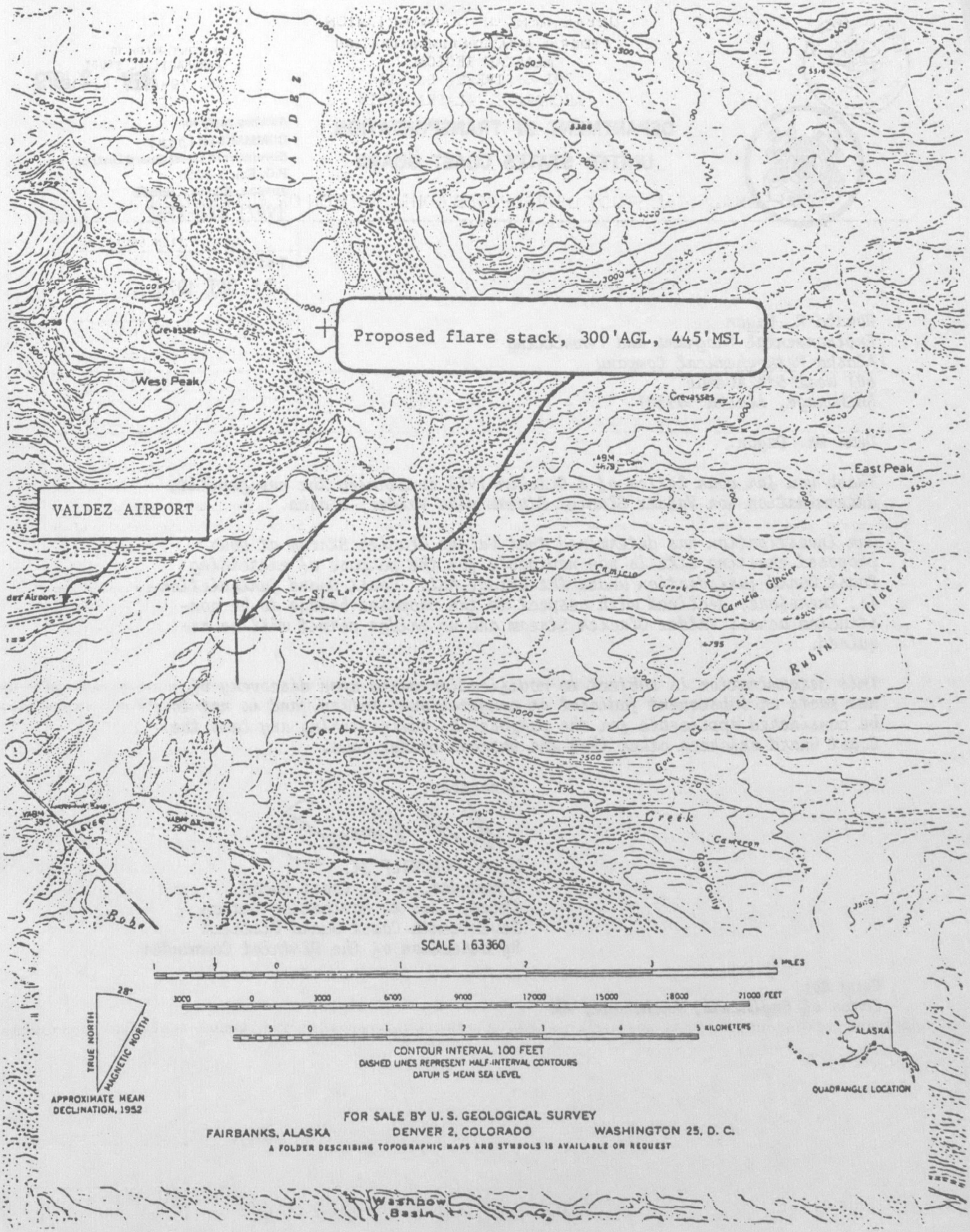
The proposed structure would not require revision to any Instrument Flight Rule (IFR) altitudes or procedures.

See chart on reverse.

SIGNED Robert F. Harik TITLE Chief, Operations, Procedures & Airspace Branch
ROBERT F. HARIK

ISSUED IN Anchorage, Alaska ON November 8, 1979

FAA Form 7460-8 (4-71) AIRPORT MANAGERS - PLEASE POST (OVER) GPO 910-227


Proposed flare stack, 300'AGL, 445'MSL
VALDEZ AIRPORT
VALDEZ
West Peak
East Peak
Crevasses
Camicia Creek
Camicia Glacier
Rubin Glacier
Corbin
Creek
Cameron Creek
Goat Gully
Bobs
Washbow Basin
SCALE 1:63360
4 MILES
21000 FEET
5 KILOMETERS
CONTOUR INTERVAL 100 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL
TRUE NORTH
MAGNETIC NORTH
28°
APPROXIMATE MEAN DECLINATION, 1952
ALASKA
QUADRANGLE LOCATION
FOR SALE BY U. S. GEOLOGICAL SURVEY
FAIRBANKS, ALASKA
DENVER 2, COLORADO
WASHINGTON 25, D. C.
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

NOV 2 1979

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (oan)
Seventeenth Coast Guard District
P.O. Box 3-5000
Juneau, Alaska 99802
(907) 586-7368

16590
31 OCT 1979

Ronald R. Dagon
Environmental Programs and Permitting
Alaska Petrochemical Company
601 West 5th Avenue
Anchorage, Alaska 99501

Dear Mr. Dagon:

Thank you for your letter of 8 October 1979 concerning the navigability determination for Valdez Glacier Stream near Valdez, Alaska.

Our investigation has determined that Valdez Glacier Stream at your proposed crossing site is non-navigable for the purpose of exercising Coast Guard jurisdiction under the Bridge Act. Coast Guard jurisdiction is, therefore, declined with respect to the proposed bridge to be constructed across Valdez Glacier Stream and no bridge permit will be required.

This determination is subject to modification based upon discovery of new facts or subsequent judicial or congressional action, and is not to be considered applicable for the purposes of administering any laws the Coast Guard enforces other than the various bridge laws.

Sincerely,

W. M. MONCRIEF JR.
Commander, U. S. Coast Guard
Chief, Aids to Navigation Branch
Seventeenth Coast Guard District
By direction of the District Commander

Copy to:
Corps of Engineers, Anchorage, AK