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United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

Alaska
Idaho
Oregon
Washington

Water Division

June, 1988

EPA 10-AK Chuitna-NPDES-88

EPA

Diamond Chuitna Coal Project

Draft Environmental Impact Statement

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO
ATTN OF: WD-136

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, the U.S. Environmental Protection Agency (EPA) is forwarding for your review and comment this Draft Environmental Impact Statement (DEIS) for the proposed Diamond Chuitna Coal Project. The project sponsor, Diamond Alaska Coal Company, proposes to develop a twelve million ton per year coal mine in the Beluga region of upper Cook Inlet, approximately 45 miles west of Anchorage, Alaska. The project would consist of an open pit mine and associated coal transportation and port facilities, service facilities, and housing accommodations.

Diamond Alaska Coal Company, in association with Granite Point Coal Port, Inc. and Tidewater Services Company has applied to EPA for National Pollutant Discharge Elimination System (NPDES) permits to discharge pollutants from the mine, port, coal loading, and housing facilities to navigable waters pursuant to the Clean Water Act. These facilities have been determined to be New Sources under Section 306 of the Clean Water Act and, according to Section 511(c)(1) of the Clean Water Act, are subject to the provisions of the National Environmental Policy Act. The draft NPDES permits have been released for public review concurrent with this DEIS (Appendix D).

The U.S. Department of the Army, Corps of Engineers (Corps), and the State of Alaska Department of Natural Resources (DNR) are cooperating agencies for the environmental impact statement. The Corps, under the authority of Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act, will evaluate proposed project-related activities in waters of the United States. Appendix C of this DEIS contains a complete description of the proposed activities requiring the Corps authorization. The DNR is authorized to review, pursuant to the Alaska Surface Coal Mining Control and Reclamation Act (AS27.21, 11 AAC Ch. 90), Diamond Alaska Coal Company's detailed application for a permit to conduct surface mining. This application is the subject of a separate review process.

Comments are invited on the DEIS, Draft NPDES permits, and the Corps authorization. These comments will be considered in the preparation of the Final Environmental Impact Statement and the applicable permits.

Combined public hearings on the DEIS, Draft NPDES permits, and the Corps authorization are scheduled for the following locations and times.

Anchorage	Tyonek
August 17, 1988 7:00 p.m. to 10:00 p.m. Federal Building Conference Room (1st Floor) 701 "C" Street Anchorage, Alaska	August 18, 1988 7:00 p.m. to 10:00 p.m. Tyonek Community Center Tyonek, Alaska

EPA will announce the availability of this document in the Federal Register on July 15, 1988, initiating a 60-day review and comment period. Written comments pertaining to the DEIS should be submitted by September 13, 1988, to:

Rick Seaborne
EIS Project Officer
Environmental Evaluation Branch, M/S WD-136
Environmental Protection Agency
1200 6th Avenue
Seattle, Washington 98101

Telephone: (206)442-8510
FTS 399-8510

Addresses for submittal of comments pertaining to the NPDES permit or State Certification are indicated in the public notice included with the draft NPDES permits in Appendix D of this document.

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

DIAMOND CHUITNA COAL PROJECT

Prepared by

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 10

Cooperating Agencies

U.S. Department of the Army
Corps of Engineers

Alaska Department of Natural Resources

With Technical Assistance From

Dames & Moore

RESPONSIBLE OFFICIAL:

Robie G. Russell
Regional Administrator
Environmental Protection Agency
Region 10

Date: 6-9-92

COVER SHEET

DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
DIAMOND CHUITNA COAL PROJECT
SOUTHCENTRAL ALASKA

Lead Agency	U.S. Environmental Protection Agency (EPA)
Responsible Official:	Robie G. Russell Regional Administrator Environmental Protection Agency 1200 Sixth Avenue Seattle, Washington 98101
Cooperating Agencies:	U.S. Army Corps of Engineers,(Corps) Alaska District, Regulatory Branch Alaska Department of Natural Resources (DNR)

Abstract of DEIS

The actions to be considered are the approvals of permits for the proposed Diamond Chuitna Coal Project located on the west side of Cook Inlet in southcentral Alaska. The project would consist of a surface coal mine, haul road, a method of transporting coal to a port facility on Cook Inlet, dock facilities, and other ancillary facilities. Three action alternatives and a No Action Alternative are discussed in detail. Rationale for eliminating various options is given. The preferred alternative would include construction of a port site at Ladd, an eastern transportation corridor, development of a housing facility at Lone Creek, and a conveyor system which would parallel the haul road and transport coal to the port site. The impacts of the proposed project are considered in terms of vegetation, fish, wildlife, wetlands, water quality and hydrology (both surface and subsurface), physical and chemical oceanography, air quality, visual resources, cultural resources, subsistence, socioeconomics, recreation, technical feasibility, and future uses of facilities.

Public DEIS Review and Comment Process

This DEIS is offered for review and comment to members of the public, special interest groups, and public agencies. Public hearings will be held to solicit comments on the DEIS, draft EPA National Pollutant Discharge Elimination System (NPDES) permits, and the Corps authorized activities (see attached notice regarding hearing locations, dates, and times). Comments received on the DEIS will be addressed in the Final Environmental Impact Statement (FEIS).

Location of DEIS or Technical and Reference Reports and Appendice

Copies of this DEIS and/or the major reports relating to the Diamond Chuitna Coal EIS are available at the following locations:

Seattle

EPA Region 10 Headquarters
1200 Sixth Avenue
Seattle, WA 98101

Anchorage

Dames & Moore
5761 Silverado Way, Bldg. P
Anchorage, AK 99518-1657

Division of Mining
Dept. of Natural Resources
Eighth Floor
3601 'C' Street (Frontier Bldg.)
Anchorage, AK

Dimond Alaska Coal Company
550 West 7th Avenue, Suite 1900
Anchorage, AK

Z.J. Loussac Library
3600 Denali Street
Anchorage, AK 99503

Kenai Peninsula Borough

Kenai Peninsula Borough*
Resource Development Dept.
147 N. Binkley
Soldotna, AK

Kenai Community Library**
163 Main Street Loop
Kenai, AK

Tyonek Community Center**
Tyonek, AK

Deadline for Comments: September 13, 1988

Address all Comments to:

Rick Seaborne
EIS Project Officer
Environmental Evaluation Branch (W/D 136)
Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-8510

*27 volume permit application only
**All reports except permit application

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Summary

SUMMARY

Purpose of and Need for Action

Diamond Alaska Coal Company (Diamond Alaska) proposes to develop a coal mine in the Beluga region of upper Cook Inlet, Alaska. The project would consist of a surface mine and associated transportation, shipping, and housing facilities. Diamond Alaska is proceeding with applications for the various permits and approvals needed for such a development.

The U.S. Environmental Protection Agency (EPA) has the responsibility for issuing New Source National Pollutant Discharge Elimination System (NPDES) Permits for wastewater discharges from the proposed Diamond Chuitna Coal project. EPA's NPDES regulations [40 CFR 122.29(c)(2)] require that the Environmental Impact Statement (EIS) include a recommendation on whether the NPDES Permit should be issued or denied. They also require that such action shall occur only after a complete evaluation of the projected impacts and recommendations contained in the final EIS (FEIS) [40 CFR 122.29(c)(3)].

In addition, the U.S. Department of the Army Corps of Engineers (Corps), Alaska District, has jurisdiction over this action under Section 10 of the River and Harbor Act of 1899 which provides for control over structures or work in or affecting navigable waters of the U.S.; and under Section 404 of the Clean Water Act which provides for regulation of the discharge of dredged or fill material into U.S. waters, including wetlands. The Corps intends to adopt this EIS to fulfill its National Environmental Policy Act (NEPA) obligations if its concerns are satisfied in the document.

Pursuant to NEPA and implementing regulations issued by the Council on Environmental Quality (CEQ), EPA, and the Corps, this EIS has been prepared to evaluate the potential impacts of the proposed actions on the environment and to fulfill the permitting requirements of EPA and the Corps. EPA has the lead responsibility for preparing this document and the Corps is a cooperating agency. The Alaska Department of Natural Resources (DNR) is also a cooperating agency because of its role in implementing the federal Surface Mining Control and Reclamation Act (SMCRA) through the Alaska Surface Coal Mining Program.

Project Description

Full development of the Diamond Chuitna coal project would involve a 10.9 million Mt (12 million short ton) per year surface coal mine in the Beluga area approximately 72 km (45 mi) west of Anchorage. The coal is sub-bituminous, low sulphur, low ash, high moisture steam coal with an average of 4,250 kilocalories per kilogram (7650 BTU per lb). The actual area to be mined during the projected 34-year life of the project would be approximately 2,029 ha (5,014 ac) with a maximum of 182 ha (450 ac) of pit being open at any one time.

Mining methods would employ shovels, draglines, hydraulic backhoes, front-end loaders, and haul trucks. Coal would be initially crushed at the mine and carried to a 22 ha (55 ac) mine service area by conveyor for further crushing and weighing. It would then be transported approximately 17.6 km (11 mi) by a single-span, 1.2 m (48 in) wide conventional conveyor to a port site on Cook Inlet either at Granite Point south of the mine or at Ladd east of the mine.

The entire conveyor structure would be supported by a horizontal steel pipe elevated about 0.6 m (2 ft) above the ground and would be about 2.9 m (9.6 ft) high overall. It would be enclosed on the top and one side except at stream crossings where the underside would also be enclosed. At appropriate locations, the conveyor would be raised or buried to permit human and large mammal passage across the corridor. The conveyor would be paralleled by a light duty maintenance road and an all-weather gravel/access haul road.

The onshore port facilities would occupy approximately 121 ha (300 ac) on the bluff above Cook Inlet at either Granite Point or Ladd. No one would be housed there. Up to 1.1 million Mt (1.2 million short tons) of coal would be stockpiled at the port for shipment. At full production, the offshore port facility would consist of an elevated trestle up to 3,810 m (12,500 ft) long, depending upon the port site, and would support twin conveyors for loading coal ships. At maximum length, the trestle would have a berthing depth of between 15.2 and 18.2 m (50 and 60 ft) and could service ships up to 108,864 Mt (120,000 dwt).

The workforce would be housed in permanent single-status housing and community facilities on an 8 ha (20 ac) site north of the Chuitna River near the mine (Lone Creek site), south of the Chuitna River midway between the mine and Granite Point (Congahbuna site), or northeast of the mine site (Threemile Creek site). The facilities would accommodate a total of 540 people at full production. A new gravel airstrip with a main runway of 1,524 m (5,000 ft) would be constructed adjacent to the housing site.

Average-load electrical power demands would be approximately 35 Mw with a maximum of 50 Mw. Power would be purchased from the existing Chugach Electric Association natural gas generating station at Beluga. Water for all facilities would be supplied by wells.

Construction employment would peak at approximately 1,300 and the permanent work force would total about 848 workers. Half of that total (424) would be at the project site at any one time working two 11-hour shifts per day. Employees would work a four-day-on, four-day-off schedule, and would be flown back to their homes in Anchorage or on the Kenai Peninsula during their off-work periods.

Construction would take approximately three years. Production would begin at a level of about 1.8 million Mt (2 million short tons) and increase to full production capacity as economics permit. The minimum time to full production would be four years from construction completion.

Existing Environment

The project area is largely undeveloped except for a system of primitive roadways that remain as a result of past oil, logging, and coal exploration activities. Most of the project area, including all the Diamond Chuitna coal lease area, is state land as is the Trading Bay State Game Refuge to the south. Most of the land east of the project area is owned or selected by the Tyonek Native Corporation, while Cook Inlet Region, Inc. owns the majority of the remainder of the land on the northeast, north, and west. The Kenai Peninsula Borough has either selected or received selection approval to land at or near both potential port sites.

Most of the project area consists of a broad, gently sloping plateau characterized by irregular ridges and depressions. The southern edge of the plateau terminates at a coastal bluff rising from the gravelly beaches of Cook Inlet. Much of the area is poorly drained with bogs and ponds. Vegetation on the area consists primarily of spruce-birch forest intermixed with open, muskeg terrain.

A major portion of the area provides moderate to high quality habitat for moose, brown bear, and black bear. A portion of a moose rutting concentration area is located within the northern half of the mine site; moose winter in a narrow zone along the coast. Birds occupying the project area include bald eagles, as well as small numbers of trumpeter swans and sandhill cranes.

The Chuitna River, which originates in the Alaska Range and enters Cook Inlet north of the village of Tyonek, bisects the project area and is the major drainage system within the project area. Several major tributaries to the Chuitna River are within or adjacent to the proposed mine area. Ground water originating within shallow aquifers in the mine area contributes significantly to the flow of the area streams. Tyonek and Old Tyonek Creeks are separate systems that drain the southern portion of the project area. Water resources are unpolluted and water quality is high.

Important fish resources in the Chuitna River include rainbow trout, chinook, coho, pink, and chum salmon. The river supports a small but high quality sport fishery and contributes salmon to commercial and subsistence fisheries within Cook Inlet.

Cook Inlet adjacent to the project area is characterized by high tides, strong currents, and high turbidity. Important marine life occupying the coastal area includes belukha whales and all 5 species of eastern Pacific salmon.

Air quality is high within the project area; noise pollution is low.

The closest development to the project area is the village of Tyonek, about 11 miles southeast of the mine area. About 95 percent of the approximately 270 residents of Tyonek are Alaska Natives. The village is accessible only by air or sea as there are no road connections to the more populated areas of southcentral Alaska. Subsistence hunting and fishing are important to the economic, cultural, social, and nutritional well-being of most of the permanent residents within the area.

Scoping

The EIS scoping process identified the following 10 issues of concern for the project:

- Maintain the integrity of the Chuitna River watershed by minimizing impacts to water quality and maintaining proper flows
- Maintain the quality of fish habitats in the Chuitna River system and minimize impacts to resident and anadromous fish
- Minimize disruption of wildlife and wildlife habitats, including important seasonal use areas and migration routes
- Assure successful reclamation of project components
- Minimize impacts to the commercial set net fishery and marine life movements near the port trestle
- Minimize impacts to subsistence resources, including access to those resources, as traditionally used by local residents
- Minimize the social, cultural, and economic impacts on local residents

- Maintain a regional perspective to minimize the cumulative impacts of this and other potential development projects

- Minimize chances of system failure by incorporating technically feasible component siting, design, and mitigation features

- Component siting, design, and mitigation features should be cost effective

Options Screening Process

To address the 10 issues, the scoping process identified 31 options for the 12 project components. A two-step options screening process was conducted to determine reasonable options. In the first step, all options were reviewed to eliminate from further consideration those which were clearly unreasonable or infeasible primarily for environmental or technical reasons. Nine options were eliminated.

In the second step, the remaining options were individually evaluated. Since all the options in the applicant's Proposed Projects were environmentally and technically reasonable and feasible, all of those options were retained so that the applicant's Proposed Projects would constitute formal alternatives to be analyzed during the analysis of alternatives process. Then, for each component where at least one option other than the applicant's choices remained, options were individually evaluated from the perspective of each resource or technical discipline (e.g., water quality, subsistence, technical feasibility). If it was determined that one of the other options was as good as, or better than, an applicant's option on an overall basis or if it addressed one or more of the 10 scoping issues in a significantly more favorable manner than did the applicant's option, that option was retained for the analysis of alternatives process.

Following the options screening process, the best options for all but two of the project components were relatively easy to identify. However, two components (transportation corridor/port site location and housing site location) had three options each that adequately addressed one or more of the 10 issues. These options were therefore retained and, with the other nine options, were used to form the alternatives (Table 1).

Identification and Description of Alternatives

The identification of action alternatives process was relatively straightforward as only three alternatives (combinations of options) were necessary to address the issues raised by the two components with more than one option remaining (transportation/port site location and

Table 1

OPTIONS USED TO FORM ALTERNATIVES

Component[1]	Option(s)
Mine Location	Fixed
Overburden Stockpile Location	Southeast
Mine Service Area	Fixed
Transportation System	
o Corridor Location[2]	Southern/Granite Point Northern/Ladd Eastern/Ladd
o Mode	Conveyor
Loading Facility	Elevated Trestle
Housing	
o Location(2)	Lone Creek Congahbuna Threemile Creek
o Type	Single Status
Airstrip	New
Water Supply	Wells
Power	Purchase

(1) One of original 12 components was dropped during option screening process.

(2) Component with more than one option remaining.

housing site location). Since the applicant wishes to retain two transportation corridor/port site options (southern/Granite Point and northern/Ladd), two alternatives using three options were identified as the applicant's Proposed Project. A third alternative, using the eastern/ Ladd option, was also identified. The three action alternatives and the No Action Alternative for the Diamond Chuitna coal project are described below.

Southern/Granite Point Alternative

In addition to the fixed mine and mine service area locations, this alternative would site the overburden stockpile southeast of the mining limit. It includes a conveyor system within the southern transportation corridor to the port site at Granite Point. The coal-loading facility at the port would be an elevated trestle. A single-status housing facility with associated new airstrip would be located at the Lone Creek site. Water would be supplied to all facilities by wells, and power would be purchased from the Chugach Electric Association natural gas power station at Beluga.

Northern/Ladd Alternative

This alternative is the same as the southern/Granite Point alternative except the northern transportation corridor to a port site at Ladd would be used (Fig. 2-1).

Eastern/Ladd Alternative

This alternative would be the same as the northern/Ladd alternative except that the eastern transportation corridor to a port site at Ladd would be used (Fig. 2-1).

No Action Alternative

The No Action Alternative means that development of the Diamond Chuitna project would not occur. This would result from denial of one or more of the federal or state permits necessary for project development or from a decision by the applicant not to undertake the project.

Comparison of Alternatives

The impacts of each of the three action alternatives were compared against the 10 issue criteria identified during the scoping process. Then the impacts of each alternative relative to one another (Table 2) were compared for identification of the preferred alternative. The Congahbuna and Threemile housing/airstrip options were then compared with the Lone Creek option to determine whether either option provided a significant advantage over the Lone Creek site such that it could substitute for the Lone Creek option in one or more of the alternatives.

TABLE 2

EVALUATION CRITERIA MATRIX SHOWING RELATIVE TOTAL IMPACT VALUES ASSIGNED TO THE THREE ACTION ALTERNATIVES

Evaluation Criteria	Southern/ Granite Pt.	Northern/ Ladd	Eastern/ Ladd
1. Minimize risk of water quality degradation and alteration to flows	Moderate	Moderate	Low
2. Minimize impacts to fish and fish habitat	Moderate	Moderate	Low
3. Minimize impacts to wildlife and wildlife habitats	Moderate	High	Low
4. Minimize potential reclamation problems	Low	Low	Low
5. Minimize impacts to set net fishery	Moderate	High	High
6. Minimize impacts to traditional subsistence harvest activities	High	Low	Low
7. Minimize social, cultural, and economic impact upon local residents	Moderate	Moderate	Low
8. Minimize cumulative regional use impacts	Low	Moderate	Moderate
9. Minimize technical complexity	Low	Low	Low
10. Minimize cost	No Data	No Data	No Data

Identification of Preferred Alternative

The eastern/Ladd alternative, using the Lone Creek housing site, clearly had the least overall relative total impact value and was identified as the primary preferred alternative. Whether the applicant could develop an eastern corridor, however, is not certain since the corridor would cross private land owned by Tyonek Native Corporation. To date, the applicant has been unable to negotiate a right-of-way across that land. Thus, since there is no assurance that an eastern corridor could be developed even though identified as the preferred alternative, the southern Granite Point alternative was identified as the secondary preferred alternative.

Environmental Consequences of the Preferred Alternative

Overall environmental consequences would be similar regardless of whether the primary or secondary preferred alternative were developed. At maximum mine extent, project components would disturb about 2,029 ha (5,014 ac) of vegetated terrain. However, because of the ongoing reclamation of mined out areas, the actual unvegetated surface area at any one time in the mine life would be substantially less. About 24 percent of the area to be disturbed is classified as wetland.

Wildlife impacts would include loss of habitat during the mine life and for a period thereafter. Moose, brown bear, and black bear would be affected, as well as small mammals and birds. Loss of moose winter range at the proposed port site and a portion of a rutting area in the mine vicinity would be among the more important impacts. Movement of large mammals would be partially impeded by the conveyor system, although the presence of wildlife crossing areas would assure access across the transportation corridor. Reclamation of disturbed terrain would return wildlife values in the long term to near the premining condition.

Water quality and hydrology of Chuitna River tributaries within and adjacent to the mine site would be significantly altered during mine operation, for a period thereafter, and possibly over the long term depending on postmining hydrological characteristics and on the success of stream reclamation. Impacts would include increased suspended solids concentrations, higher turbidity, and reduced flow in some stream segments. A substantial portion of one tributary would be mined through causing direct habitat loss.

Loss of fish productivity, including such key species as chinook and coho salmon, would occur during mine operation and for a period thereafter. It is questionable whether mined-through streams could be returned to premining productivity; therefore, fish productivity loss could be a long term impact. Loss in productivity would have a small adverse impact on the Chuitna River sport fishery and a very small effect on commercial and subsistence fisheries in the marine environment.

Air quality would be degraded only locally with no significant impact to populated areas.

Socioeconomic impacts to the Anchorage and Kenai Peninsula population centers would be minor or insignificant. Tyonek residents would receive both beneficial and adverse impacts from the project. Increased employment opportunities and village income would be potential benefits while the increased development and human intrusion into the area would likely cause disruption to traditional Native lifestyles and loss of subsistence hunting and fishing opportunities.

Chapter 1.0

Purpose of and Need for Action

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

1.1.1 The EIS Process

The National Environmental Policy Act (NEPA) of 1969 requires the preparation of an Environmental Impact Statement (EIS) whenever a proposed major federal action could significantly affect the quality of the human environment. Large development projects, such as the Diamond Chuitna Coal Project, normally require permits from one or more federal agencies. The issuance of these permits can be considered a major federal action if the range of anticipated impacts is of sufficient magnitude to potentially create significant effects. The agency or agencies involved make a determination regarding significant impacts and can elect to prepare an EIS if needed. The agency can either prepare the EIS itself or contract the preparation of all or part of the document (under the agency's supervision).

The NEPA regulations which outline the purpose, requirements, and procedures for the EIS process may be found in the Code of Federal Regulations at 40 CFR Parts 1500 to 1508. NEPA regulations also require that the EIS address, to the fullest extent possible, state and local planning requirements in addition to the federal permitting actions. An EIS provides an information base which assists state and local agencies in addressing their permitting and other regulatory actions.

The primary purpose of the EIS process is to ensure that environmental information is available to public officials and citizens before permit decisions are made and before actions are taken. The process must encourage and facilitate public involvement in the decisions affecting the quality of the human environment.

"Scoping" is the first step of the EIS process. The purpose of the scoping process is to provide an opportunity for members of the public, interest groups, and agencies to assist in defining the significant environmental issues related to the proposed project. Once these specific issues are identified, they are described in a document called the Responsiveness Summary that is distributed to all interested agencies and parties. These issues form the primary basis for determining the range of alternatives considered in the EIS.

Following scoping, the lead agency or agencies must ensure that sufficient environmental information is available to adequately address the significant issues raised during the scoping process. Alternative means of achieving the proposed project's objectives are developed and the environmental impacts are studied and compared. Finally, the EIS document is prepared and distributed to the public in draft form (DEIS) for a minimum of 45 days for formal review. During this period, public hearings or meetings are held to discuss the DEIS and to receive comments. Submission of written comments is also encouraged.

Comments are evaluated following public review and the DEIS is changed accordingly. All written comments received during the review period are either reproduced in the final EIS (FEIS) or summarized (depending on the number of comments) and the points raised are individually addressed in that document. The FEIS is then distributed for another public review period of at least 30 days before any decisions about the project can be implemented. This is to allow for additional public comments on the FEIS.

Once a permit decision has been made, a formal public record of decision is prepared by each permitting federal agency. The Record of Decision (ROD) states what major permit decision was made, identifies all alternatives considered (including those considered environmentally preferable), and may discuss preferences among alternatives based on factors such as economic, technical, national policy and agency mission considerations. The ROD also states what means to avoid or minimize environmental harm were adopted and the rationale.

1.1.2 <u>EIS Document Structure</u>

The basic format for an EIS is prescribed by the NEPA regulations. Each section has a specific purpose and often is required to include certain kinds of information. Following is a brief description of the major sections of this EIS.

- <u>Summary</u> - A summary of the EIS stressing major conclusions, areas of controversy, and the issues to be resolved is presented in this section.

- <u>Purpose of and Need for Action</u> - This chapter (1.0) specifies the underlying purpose of the action for which the EIS is being written and why the action is needed.

- <u>The Proposed Project</u> - This chapter (2.0) describes the individual components of the project as proposed by the applicant and the specific options being considered for each component. It tells how the project will be developed.

- <u>Alternatives Including the Proposed Action</u> - Chapter 3.0 is the heart of the EIS. It describes all the initial options that were considered for the project, why many of them were eliminated, and how the final options and alternatives (set of options comprising a total project) were selected. Then, based on the information and analyses presented in the chapters that follow (Affected Environment and Environmental Consequences), the chapter presents the environmental impacts of the proposed project alternatives in comparative form, sharply defining the issues and providing a clear basis for choice by the decision-makers and the public. It also identifies and describes the preferred alternative.

- Affected Environment - Chapter 4.0 succinctly describes the existing environment of the area which would be affected by development of the project. It explains the environment as it currently exists before project development begins.

- Environmental Consequences - This chapter (5.0) forms the scientific and analytic basis for the comparison of alternatives in Chapter 3.0. It details the potential environmental impacts which could be expected for each alternative considering the mitigation, monitoring, and reclamation procedures which would be used. In addition, it describes unavoidable impacts, discusses any irreversible or irretrievable commitments of resources, and describes the relationship between short- and long-term productivity.

- Mitigation, Reclamation and Monitoring - Chapter 6.0 outlines potential mitigation and reclamation measures planned relative to each environmental component and describes the proposed program to monitor the effectiveness of those measures.

- Consultation and Coordination - This chapter (7.0) describes the process for soliciting input from agencies and the public and how the process is coordinated with the agencies' permitting processes.

- Public Response to the DEIS - Chapter 10.0 includes a response to comments received during the DEIS review, both at public hearings and as written comments. Responses indicate how the final document was changed or why no changes were made.

- Appendices - These sections incorporate important supplementary material prepared in connection with the EIS which is more appropriately presented separately from the body of the document.

1.2 DESCRIPTION OF THE PROPOSED ADMINISTRATIVE ACTIONS

This section describes the proposed federal administrative actions that have created the need for this EIS.

Diamond Alaska Coal Company (Diamond Alaska) proposes to develop a 10.9 million Mt (12 million short tons) per year coal mine in the Beluga region of upper Cook Inlet, Alaska. The project would consist of a surface mine and associated transportation, shipping, and housing facilities. Diamond Alaska has initiated the process of applying for the various permits and approvals needed for such a development.

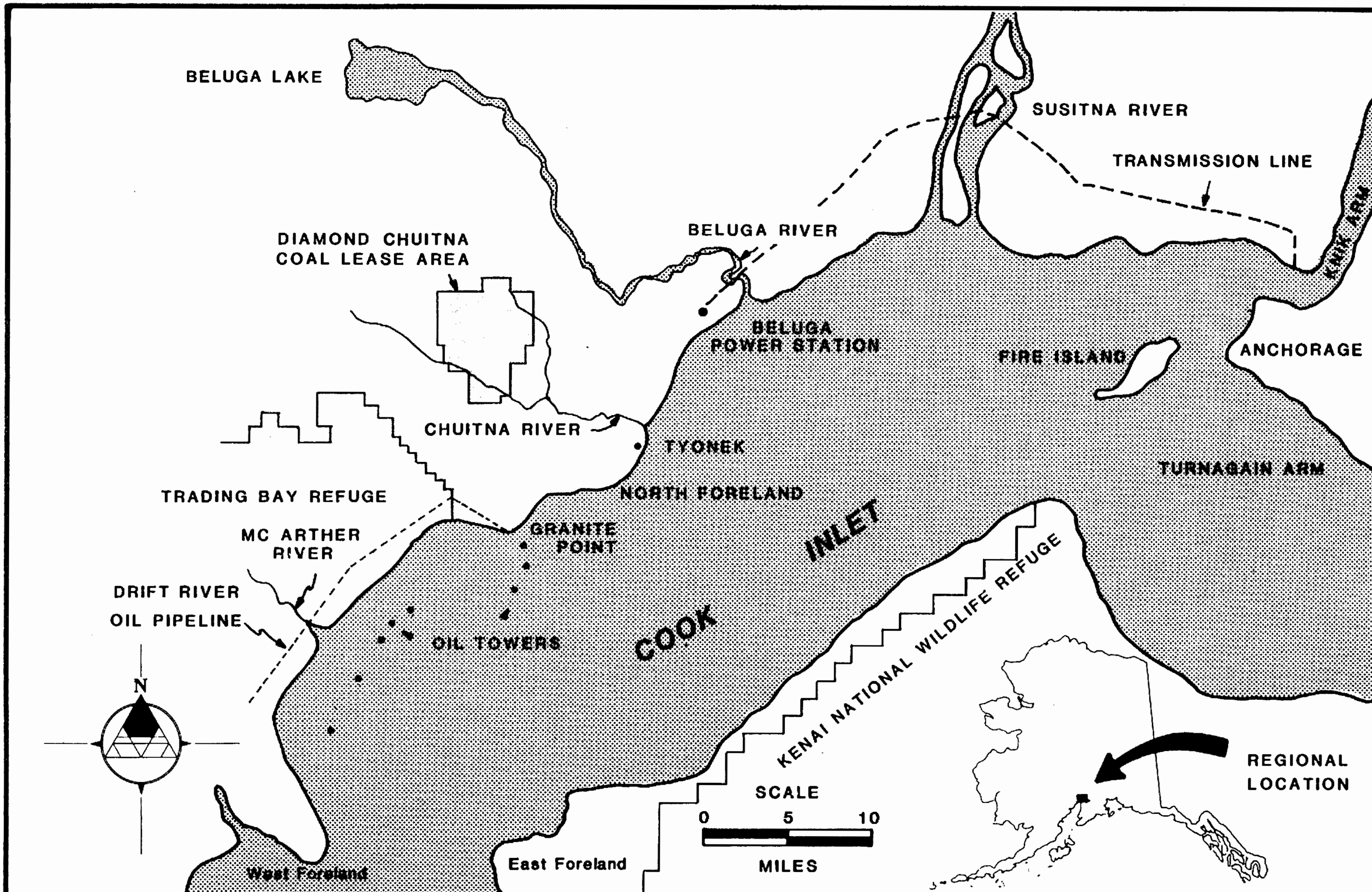
The U.S. Environmental Protection Agency (EPA) has been considering the issuance of New Source National Pollutant Discharge Elimination System (NPDES) Permits for wastewater discharges from the proposed Diamond Chuitna Coal Project. In addition, the U.S. Department of the Army Corps of Engineers (Corps), Alaska District, has jurisdiction over this action under Section 10 of the River and Harbor Act of 1899 which provides for control over structures or work in or affecting navigable waters of the U.S.; and under Section 404 of the Clean Water Act which provides for regulation of the discharge of dredged or fill material into U.S. waters, including wetlands. Action by the Corps could result in denial of the permit, issuance of the permit, or issuance of the permit with stipulations. The Corps intends to adopt this EIS to fulfill its NEPA obligations if its concerns are satisfied in the document.

EPA's NPDES regulations [40 CFR 122.29(c)(2)] require that the EIS include a recommendation on whether the NPDES Permit should be issued or denied. They also require that such action shall occur only after a complete evaluation of the projected impacts and recommendations contained in the final EIS (FEIS)[40 CFR 122.29(c)(3)].

Pursuant to NEPA and implementing regulations issued by the Council on Environmental Quality (CEQ), EPA, and the Corps, this EIS has been prepared to evaluate the potential impacts of the proposed actions on the environment and to fulfill the permitting requirements of EPA and the Corps. EPA has the lead responsibility for preparing this document and the Corps is a cooperating agency. The Alaska Department of Natural Resources is also a cooperating agency because of its role in implementing the federal Surface Mining Control and Reclamation Act through the Alaska Surface Coal Mining Program (see Section 1.5).

1.3 PROJECT LOCATION, HISTORY, AND STATUS

The proposed project would be located on the northwest side of upper Cook Inlet, approximately 72 km (45 mi) west of Anchorage and 12.8 km (8 mi) west of the Native community of Tyonek (Fig. 1-1). The area is bounded by the Beluga



DIAMOND CHUITNA PROJECT LOCATION

Diamond Chuitna Environmental Impact Statement

FIGURE 1-1

River on the north, the Alaska Range on the west, the flats of Trading Bay State Game Refuge on the southwest, and Cook Inlet on the south and east.

The mine would be situated north of the Chuitna River at an elevation of approximately 229 m (750 ft) and would be 19.2 km (12 mi) from tidewater at Granite Point (Fig. 1-2). Topography of the project area consists of gently undulating hills and ridges at the mine site interspersed with small streams, ponds, and muskegs, becoming flatter south of the Chuitna River as elevation slowly decreases toward Granite Point. Mixed coniferous and deciduous forests and woodlands extend over most of the project area.

The presence of coal outcrops in the Beluga region of upper Cook Inlet has been known for decades. The area containing these outcrops was selected soon after statehood by the State of Alaska under the federal government's mental health land grant entitlement. The five coal leases affected by the proposed project were issued by the State to the Bass, Hunt, Wilson Group between 1972 and 1978. Coal leases in the area have also been issued to other companies.

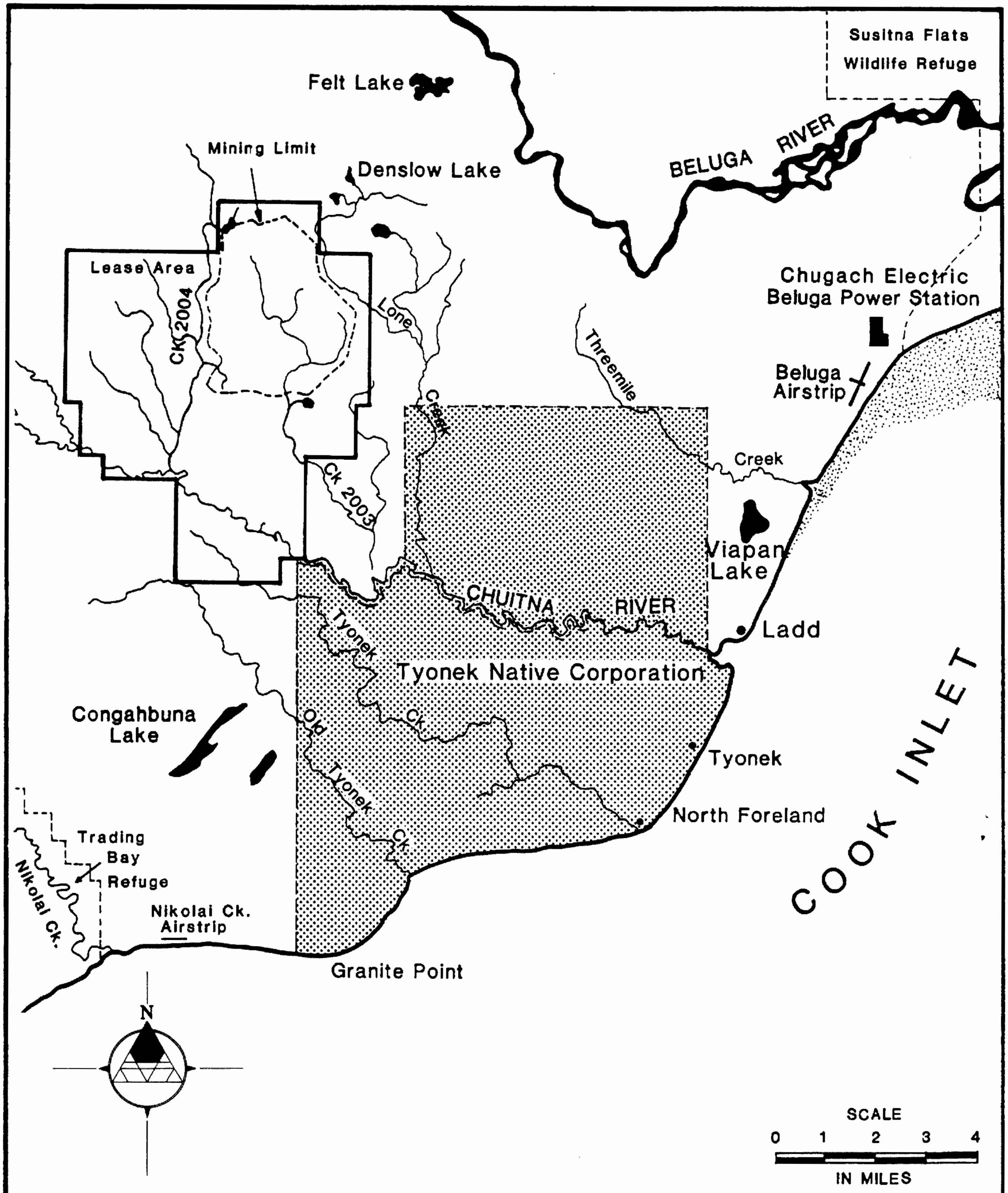
Throughout the 1970s, further exploration occurred on the leases, including core drilling to define the reserves. In 1981, the Diamond Shamrock Chuitna Coal Joint Venture was formed to develop the project. The venture partners are Maxus Energy Corporation, a large integrated natural resources company, and the Lone Creek Coal Company. The operating arm of the joint venture is Diamond Alaska Coal Company of Anchorage, a subsidiary of Maxus Energy Corporation. The joint venture holds sublease agreements to the five leases (ADL nos. 36911, 36913, 36914, 37002, and 59502) which constitute the entire lease area.

Diamond Alaska has overseen an intensified drilling program and the completion of many engineering and economic studies, which included a detailed Preliminary Design Phase Study. Environmental baseline studies were begun in 1982 and largely completed in 1984. Limited preconstruction monitoring has also begun.

The coal is sub-bituminous, low sulphur, low ash, high moisture steam coal with an average of 4,250 kilocalories per kilogram (7,650 BTU per pound). Diamond Alaska has been marketing the coal to electric utilities, cement, and industrial users in the Pacific states of the United States and to Pacific rim countries, primarily Japan, Taiwan, and Korea.

1.4 SCOPING ISSUES

During the scoping process, which involved the full participation of Diamond Alaska, members of the public, special interest groups, and agencies involved in the EIS pro-



DIAMOND CHUITNA PROJECT AREA

Diamond Chuitna Environmental Impact Statement	FIGURE 1-2

cess, the following 10 issues were identified as being of major concern if the project is developed:

Issue 1: Maintain the integrity of the Chuitna River watershed by minimizing impacts to water quality and maintaining proper flows

The proposed project has the potential to alter the characteristics of the Chuitna River watershed in a number of ways:

- Direct disturbance of stream courses in mined areas
- Interruption or diversion of ground water regimes which could alter input to surface drainages
- Diversion of surface water flow from one subbasin to another
- Degradation of water quality as a result of sediment load from disturbed areas, chemical leaching from coal or overburden, or pollution from sanitary facilities

Issue 2: Maintain the quality of fish habitats in the Chuitna River system and minimize impacts to resident and anadromous fish

Fish habitats could be affected by direct disturbance of stream courses, reduced flows, or water quality degradation.

Issue 3: Minimize disruption of wildlife and wildlife habitats, including important seasonal use and migration areas

The proposed project has the potential to alter the nature and productivity of wildlife habitats and to impede the movements of wildlife.

Issue 4: Assure successful reclamation of project components

The surface mine and other components of the proposed project would temporarily disturb substantial areas of vegetated terrain and existing stream courses. Returning these disturbed areas to a biologically productive condition is a significant concern.

Issue 5: Minimize impacts to the commercial set net fishery human user and marine life movements near the port trestle

The existence of port facilities would have the potential to impede various coastal activities engaged in by humans and to alter the movement of fish and marine mammals.

Issue 6: Minimize impacts to subsistence resources, including access to those resources, as traditionally used by local residents

Hunting, fishing, and trapping activities required by local residents for their subsistence could be affected by either reduced numbers of fish and wildlife in existing use areas or by restricted access to traditional use areas.

Issue 7: Minimize the social, cultural, and economic impacts on local residents

Development of the proposed mine and its housing and transportation infrastructure could affect the lifestyles and livelihoods of local residents, particularly residents of Tyonek.

Issue 8: Maintain a regional perspective to minimize the cumulative impacts of this and other potential development projects

Facilities developed for the proposed project could influence the future development of the area and the extent of cumulative impacts. Therefore, a regional perspective for facility planning should be employed to minimize the range of cumulative impacts that could occur.

Issue 9: Minimize chances of system failure by incorporating technically feasible component siting, design, and mitigation features

If components or mitigation and reclamation measures become too complex or utilize uncertain technology, then an increased risk of failure could result.

Issue 10: Component siting, design, and mitigation features should be cost effective

If project costs exceed reasonable or practical limits then economic feasibility could become an issue.

1.5 STATUS OF PERMITS AND APPROVALS

One of the purposes of the EIS process is to address the environmental and other concerns of federal, state, and local agencies responsible for the various regulatory functions associated with ultimate approval of a project. The EIS process recognizes the informational needs of these agencies as they proceed through their permitting processes and seeks to incorporate relevant information to assist those agencies in their permitting decisions. The public hearings, which are an integral part of the EIS process and cover all concerns pertinent to the project, also serve as public participation forums for state and federal permitting processes.

The reader should take note, however, that concurrent with the EIS process, the Alaska Department of Natural Resources (DNR) has conducted a thorough review of Diamond Alaska's 27-volume application for a permit to conduct surface mining. This permit process, conducted pursuant to the Alaska Surface Coal Mining Control and Reclamation Act (AS27.21,11AAC Chapt. 90), entailed a much more thorough and detailed analysis of Diamond Alaska's proposed 10-year mining plan than this EIS can reasonably accommodate. Through delegated authority, compliance with the state surface mining laws assures compliance with the federal laws governing surface mining under the Surface Mining Control and Reclamation Act. The EIS serves as an overall planning tool that addresses component siting and operations over the 34-year life of the project and beyond. While certain important aspects of the 10-year mining plan are discussed and analyzed in the EIS, the reader is encouraged to contact the DNR at the address shown on page 7-8 for information related to the surface mining permits.

Diamond Alaska is pursuing the full range of other permits and approvals required for their proposed project. Table 1-1 lists the major permits required and their current status. Superimposed on the individual permit application procedures are two more or less separate but interrelated environmental review processes. The first is the NEPA review process of which this EIS is a part. As discussed in Section 1.2, this EIS provides the background and documentation necessary for processing the major federal permits. In addition, the State of Alaska, through a centralized permit review process administered by the Office of Management and Budget (OMB), reviews all the state permits with individual regulatory agencies. Although each agency issues its own permits, permit decisions are coordinated through OMB on any projects which affect the State's coastal zone. OMB makes the final determination of consistency with the Alaska Coastal Management Program.

Table 1-1

STATUS OF MAJOR PERMITS AND APPROVALS

Project Component	Lease/Permit/Approval	Regulatory Agency	Application Submittal Date	Status
Prior to Alaska Coastal Management Program (ACMP)				
Transportation	Right-of-Way Permit and Easement, ADL 200680 (to Granite Point) - joint application with Beluga Coal Company	ADNR (state)	July 12, 1978 Amended April 15, 1982	In adjudication
Port	Land Lease, ADL 66114 (Granite Point uplands) - joint application with Beluga Coal Company	ADNR (state)	October 24, 1974 Amended November 25, 1981	In adjudication
Port	Tide and Submerged Lands Lease, ADL 66115 (Granite Point) - joint application with Beluga Coal Company	ADNR (state)	October 24, 1974 Amended November 25, 1981	In adjudication
Alaska Coastal Management Program (ACMP) - Phase I				
	AK860218-26A (Mine) AK860218-27A (Trans/Housing) AK860218-28A (Port)	Determined Consistent with the ACMP August 21, 1987		
Mine	Permit to conduct surface mining, No. 01-85-796	ADNR/DOM	January 15, 1985	August 21, 1987, Positive Decision
Port	Water Rights, LAS No. 5558 (Granite Point)	ADNR/DLWM	February 7, 1986	Review in Progress
Housing	Water Rights, LAS No. 5556	ADNR/DLWM	February 7, 1986	Review in Progress
Mine	Water Rights, LAS No. 5557	ADNR/DLWM	February 7, 1986	Review in Progress
Housing	Land Lease, ADL 221186 (includes solid water site)	ADNR/DLWM	May 16, 1985	In adjudication
Housing	Solid Waste Disposal Permit, No. 8623-BA003	ADEC	February 7, 1986	Review in Progress
Transportation	Anadromous Fish Protection Permit, Title 16 (Granite Point, housing, landing strip)	ADF&G	February 7, 1986	Review in Progress
Mine	Land Lease, ADL 222752 (Permanent Solid Waste Disposal Site)	ADNR/DLWM	February 14, 1986	In adjudication
Mine	Solid Waste Disposal Permit, No. 8623-BA002 (Permanent Site)	ADEC	February 7, 1986	Review in Progress
Mine	Land Lease, ADL 222753 (Temporary Solid Waste Disposal Site)	ADNR/DLWM	February 14, 1986	In adjudication
Mine	Solid Waste Disposal Permit, No. 8623-BA001 (Temporary Site)	ADEC	February 7, 1986	Review in Progress

Table 1-1

STATUS OF MAJOR PERMITS AND APPROVALS
(continued)

Project Component	Lease/Permit/Approval	Regulatory Agency	Application Submittal Date	Status
Transportation/ Housing	Land Lease, ADL 221187 (Landing Strip)	ADNR/DLWM	May 16, 1985	In adjudication
Mine	Rights-of-Way (5 separate approvals for vegetation analysis plots)	ADNR/DLWM	May 16, 1985	Review in Progress
Mine	Anadromous Fish Protection Permit, Title 16	ADF&G	February 7, 1986	Review in Progress
Transportation	Material Sites, ADL 221188 through 221190 (3 sites)(Granite Point)	ADNR/DLWM	May 16, 1985	Review in Progress
Alaska Coastal Management Program (ACMP) - Phase II includes NEPA Process, federal approvals and state permits for Ladd				
		Begins with distribution of DEIS		
Mine	National Pollutant Discharge Elimination System (NPDES)(19 discharges)	U.S. EPA	July 26, 1985 Amend	Under review - pending completion of the NEPA process
Port (Granite Point)	National Pollutant Discharge Elimination System (NPDES)(2 discharges)	U.S. EPA	July 26, 1985 Amend	Under review - pending completion of the NEPA process
Housing	National Pollutant Discharge Elimination System (NPDES)(3 discharges)	U.S. EPA	July 26, 1985 Amend	Under review - pending completion of the NEPA process
Port (Ladd)	National Pollutant Discharge Elimination System (NPDES)(1 discharge)	U.S. EPA	January 1987	Under review - pending completion of the NEPA process
Mine, Housing, Transportaton and both Ports	Department of the Army Permit (Sections 10 & 404)	COE	June 5, 1987 Revised	Under review - pending completion of the NEPA process
Mine, Housing, and both Port Sites	Certificate of Reasonable Assurance (Water Quality Certification)	ADEC	Review of NPDES Applications	Review in Progress
Transportation	Right-of-Way Permit and Easement, ADL 223706 (Ladd)	ADNR/DLWM	June 5, 1987	In adjudication
Port	Tide and Submerged Lands Lease, ADL 223707 (Ladd)	ADNR/DLWM	June 5, 1987	In adjudication

Table 1-1

STATUS OF MAJOR PERMITS AND APPROVALS
(continued)

Project Component	Lease/Permit/Approval	Regulatory Agency	Application Submittal Date	Status
Port	Water Rights, LAS No. to be assigned (Ladd)	ADNR/DLWM	June 5, 1987	Review in Progress
Transportation	Material Sites, ADL 223708 through 223717 (10 sites)(Ladd)	ADNR/DLWM	June 5, 1987	Review in Progress
Transportation	Anadromous Fish Protection Permit, Title 16 (Ladd)	ADF&G	June 5, 1987	Review in Progress
Port	Wastewater Disposal Permit (Ladd)	ADEC	June 5, 1987	Review in Progress
Other Permits and Approvals (ACMP - Phase III for Final Design and Construction) applied for as needed				
Transportation	Right-of-Way Easement	KPB	April 24, 1987	In adjudication
Mine, Port & Housing	Plan review for sewerage systems of water and wastewater treatment works	ADEC	---	To be submitted
Mine, Transportation, Port & Housing	Plan approval drainage/erosion	KPB	---	To be submitted
Mine, Housing, Transportation and Port	Air Quality Control Permit to Operate	ADEC	December 1986 Amended	Review in Progress
Mine	Miscellaneous Burning Permits	ADEC	---	To be submitted

Chapter 2.0

The Proposed Project

2.0 THE PROPOSED PROJECT

2.1 INTRODUCTION

This chapter describes the Diamond Chuitna coal project -- what the various parts (components) of the project are, where they would be located, and how they would function. The applicant's plans for construction and operation of each component (e.g., power source, worker housing, etc.) are described. For some components (e.g., location of the transportation corridor), the EIS scoping process, the third party EIS team, a federal or state agency or the applicant itself have identified more than one option. In these cases, each of the other options is described in addition to the applicant's proposed option.

The applicant has proposed mitigation measures for each component to reduce adverse impacts. These measures are described in this chapter. The discussions of environmental consequences (Chapter 5.0) assume these mitigation measures will be in place if the project is constructed. Mitigation measures other than (or in addition to) those which have been proposed by the applicant are described in Chapter 6.0. These other mitigation measures could be required of the applicant as stipulations to permits issued by federal and state agencies.

The applicant's proposed mitigation measures for the mine itself are only for the first ten years of the project. A new mitigation plan, based upon experience, would be developed toward the end of that period to be applied to the next mining increment.

The Alaska Surface Coal Mining Control and Reclamation Act (AS 27.21) and pertinent regulations (11 AAC Chapter 90) require very detailed information about several aspects of an applicant's proposed plan of operation (e.g., water drainage control and treatment, reclamation). The volume of this information makes it impractical to incorporate it into this EIS. Therefore, this chapter only summarizes the major aspects of the proposed project. However, references to the location of this detailed information in Diamond Alaska Coal Company's 27-volume Permit Application to Conduct Surface Coal Mining (1985) are given for readers who wish to pursue more specific details (see Section 7.7 for locations of the permit application).

2.2 PROJECT OVERVIEW AND COMPONENTS

2.2.1 Introduction

Since the applicant has not yet concluded a final contract for sale of coal, the length of time it would take to develop the project to its full production capacity of 10.9 million Mt (12 million short tons) is unknown, but would occur in stages depending upon economics. As coal production increased, staged development of the mine, housing site, overland coal transportation system, port site, and loading trestle would occur commensurate with production requirements. Under optimal conditions, full production capacity could be reached after four years of operation. However, it is likely that full production would take longer than four years to reach and, thus, the full impacts of the completed project would not occur until some undetermined time in the future.

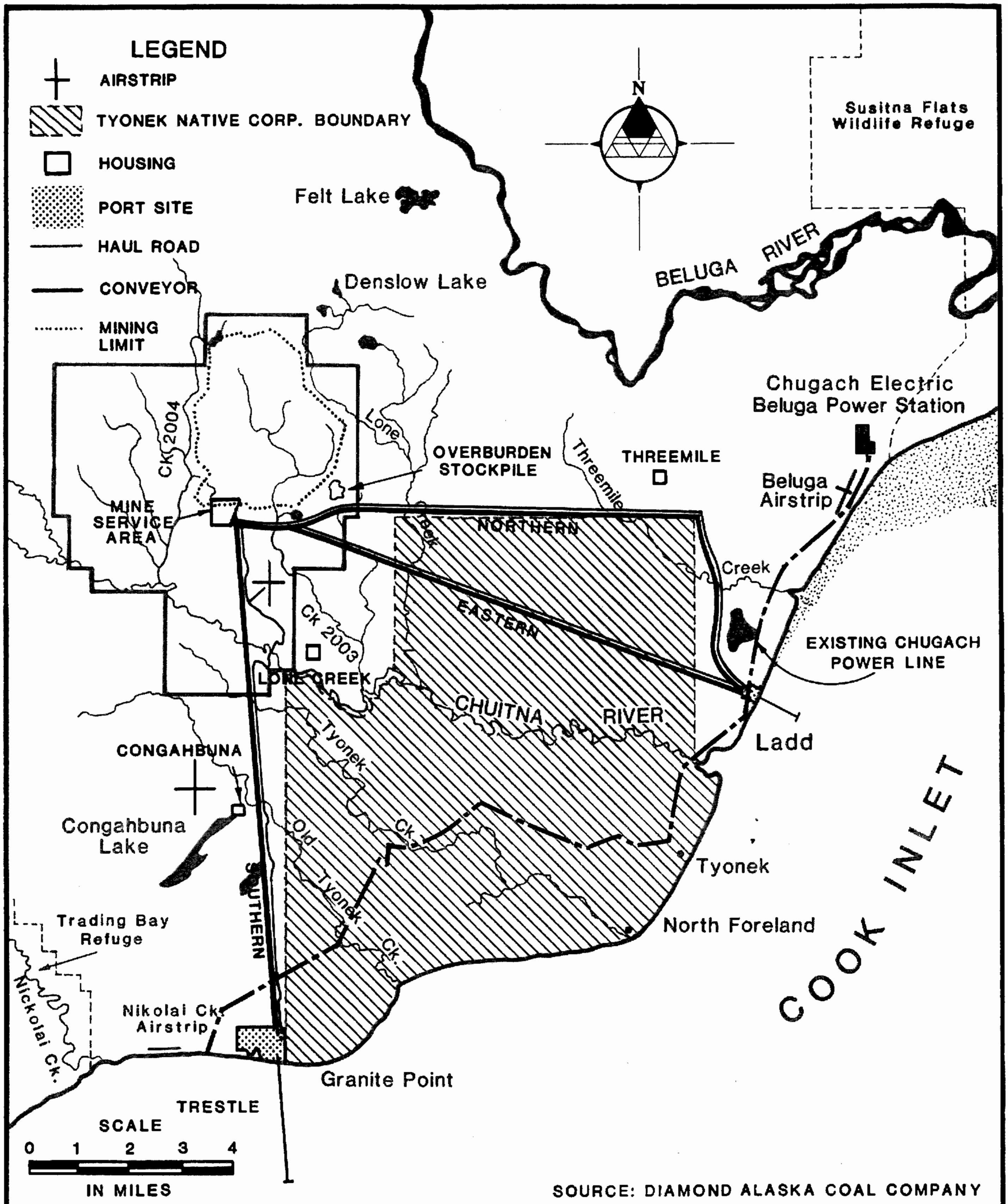
The project overview below generally describes the project at full production. Most mine development impacts would be of lower magnitude before full production is reached. The exceptions would be short-term activities such as hauling coal by truck. This would occur only during the early years of the project and may cause greater impacts than transporting coal by conveyor.

2.2.2 Project Overview

Development of the Diamond Chuitna project would involve a surface coal mine located approximately 72 km (45 mi) west of Anchorage (Fig. 1-1). The coal would be strip mined by large shovels and draglines and hauled by trucks to a nearby mine area conveyor for transport to a mine service area for crushing. The crushed coal initially would be hauled in trucks from the mine service area to a port on Cook Inlet. After two years of mine operation, coal would be moved from the mine service area to the port on a conveyor. At lower production levels, the coal would be loaded from a short trestle at the port onto barges for transport to market. At higher production levels, coal would be loaded from a long trestle onto ships.

Under the optimal, four-year full production development schedule, production in the first year of mine operation would be approximately 1.8 million Mt (2 million short tons). Production would increase to about 3.6 Mt (4 million short tons) in the second year. In the third year, production would increase to approximately 5.4 million Mt (6 million short tons), reaching 10.9 million Mt (12 million short tons) per year by the fourth year of mine operation.

Figure 2-1 shows the locations of the project component options used to formulate the action alternatives. The mine, overburden stockpile, and mine service area all would be located on land owned by the State of Alaska (Fig. 4-1).



FINAL PROJECT OPTIONS LOCATIONS

Diamond Chuitna Environmental Impact Statement	FIGURE 2-1

There are three transportation corridor options: northern/Ladd, eastern/Ladd, and southern/Granite Point (Fig. 2-1). The northern corridor would run east from the mine service area across state land toward the Beluga airstrip, then turn south southeast across land owned by Cook Inlet Region Native Corporation to a port site at Ladd on land owned by the Kenai Peninsula Borough (KPB). The eastern corridor would run in a straight line southeast from the mine service area across state land and land owned by the Tyonek Native Corporation (TNC) to the same port site at Ladd. The southern corridor would run in a straight line south from the mine service area across state and KPB land to a port site on state land at Granite Point. The Lone Creek and Threemile housing sites are located on state land, while the Congahbuna housing site and airstrip are located on KPB land.

2.2.3 Project Components and Options

In reviewing this document, it is important that the reader understand the relationship among the terms "component", "option", and "alternative." The project has several <u>components</u>, each one a necessary part of an entire viable mining project (e.g., the mine, transportation system, port site, housing site, etc.). For each component there may be one or more <u>options</u> (e.g., a southern or a southeastern transportation corridor location option). An <u>alternative</u> is a combination of options (one for each component) that consititutes an entire functioning project.

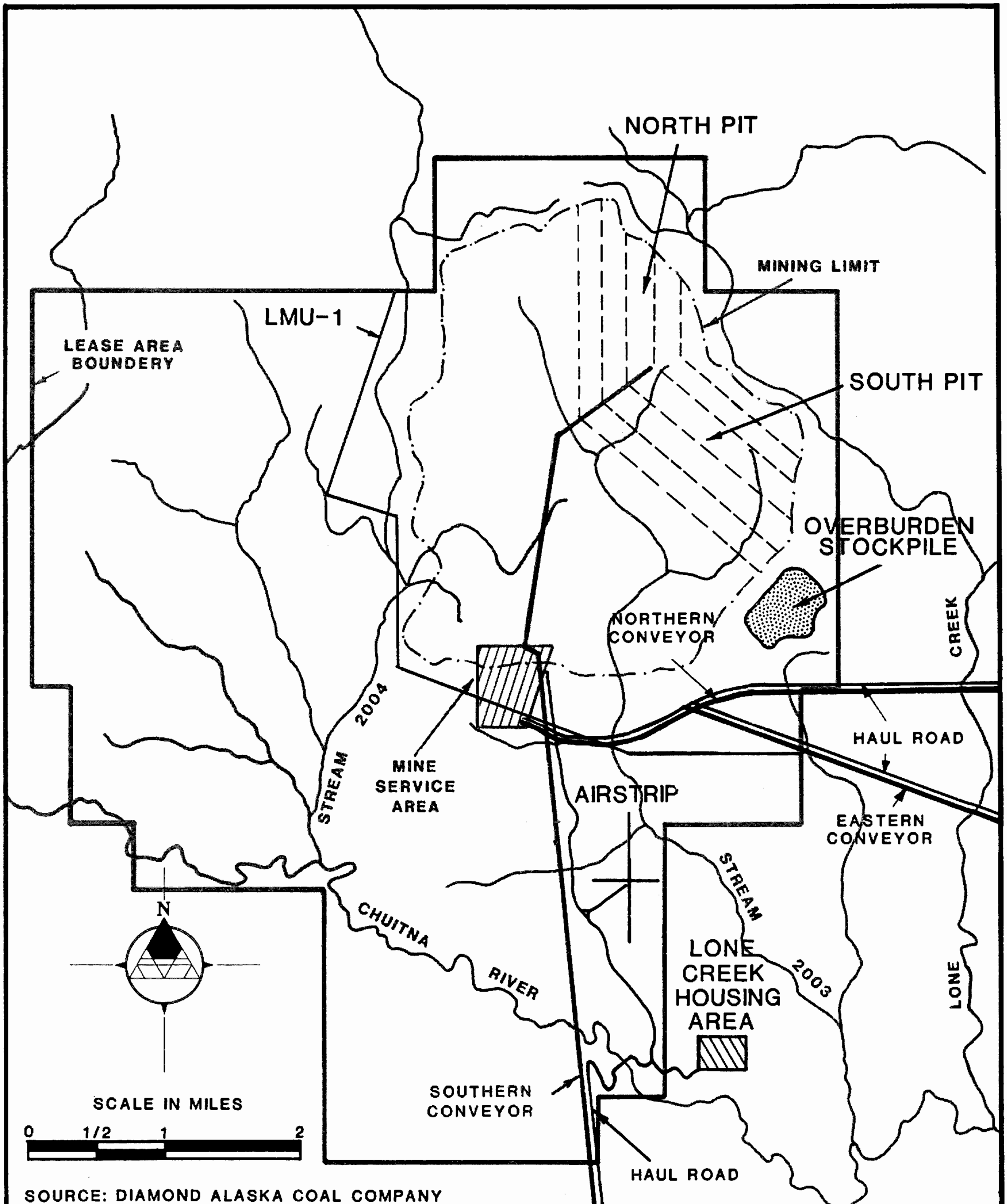
For most components the EIS scoping process initially identified at least two options. The process by which this large number of options was screened to reduce the number to a manageable level and how the ultimate project alternatives were selected is described in detail in Chapter 3.0. The descriptions below for each project component, therefore, address only those component options which were ultimately retained and which are specifically addressed in at least one of the action alternatives for each scenario. For each component where more than one option remains, the applicant's preferred option is described first.

2.3 MINE AREA FACILITIES

2.3.1 Location and Size

The mine would be located entirely within logical mining unit no. 1 (LMU-1), one of three units within the lease area and the only one involved in the proposed 34-year project (Fig. 2-2). LMU-1 covers approximately 4,047 ha (10,000 ac) and contains a minimum of 299 million Mt (330 million short tons) of coal.

The sizes and locations of the coal seams, the nature of the overburden* and interburden*, and the economics



FINAL MINE AREA OPTIONS LOCATIONS

Diamond Chuitna Environmental Impact Statement | FIGURE 2-2

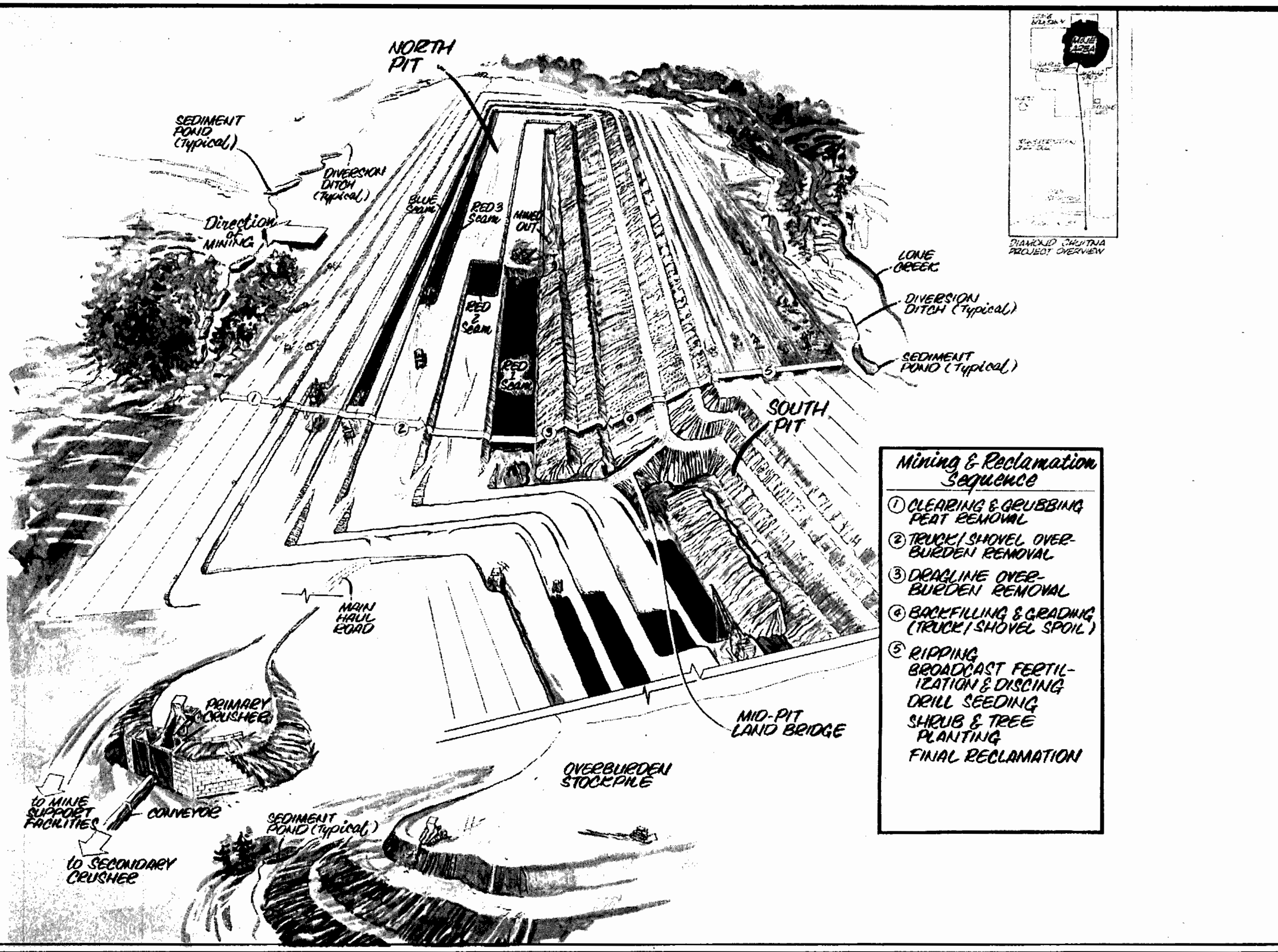
involved in mining the coal are such that only surface mining would be feasible. The coal is contained in five major seams, each varying in thickness between 1.8 and 6.1 m (6-20 ft), with a cumulative stripping ratio of 3.9:1 (i.e., 3.9 m^3 of overburden to 1 Mt of recoverable coal [4.6:1, or 4.6 yd^3 per short ton]). The actual area to be mined (mining limit) would be approximately 2,029 ha (5,014 ac) in size and would be divided into north and south pits (Fig. 2-2) which would be mined simultaneously but in separate operations during the life of the project. These pits would begin on the northeast edge of the mining limit and proceed generally west and southwest, respectively, during the life of the project.

A maximum of 182 ha (450 ac) of pit would be open at any one time. An additional maximum of 61 ha (150 ac) around the pit would be disturbed at any one time in clearing and grubbing vegetation in preparation for stripping overburden, or recontouring in preparation for revegetation. A total of approximately 63 ha (155 ac) per year would be cleared for mining in two periods - most likely spring and fall. Maximum depth of the pit would range from 6.1 m (20 ft) during the first year of production to approximately 122 m (400 ft) in the final years of the project. Average pit depth would be about 61 m (200 ft).

2.3.2 Mining Sequence and Methods

Mining activities would begin with the clearing and grubbing of all trees, brush, stumps, and other vegetation. This slash material would be burned, if conditions allowed, or buried under adequate spoil in the mine pit if burning were not possible. Topsoil would be removed and stored in a separate pile for use during revegetation. Then, approximately 16.8 million m^3 (22 million yd^3) of overburden, excluding topsoil, initially would be excavated (the "box cut"*) and permanently placed in an overburden stockpile (Fig. 2-2). After completion of the box cut, as new topsoil and overburden are excavated from the pit's advancing face to expose the coal, the overburden would be put onto the trailing edge of the pit from which the coal would have already been removed (Fig. 2-3). This area would then be reclaimed by regrading it to its approximate premining contours, including stream locations and drainages, covering it with topsoil, and then revegetating it. Because of an approximate 18 percent swell factor associated with the reclaimed overburden, the original surface contours could be approximated without use of the material in the permanent overburden stockpile.

During the first year of production, mining methods would employ shovels (15-19 m^3 [20-25 yd^3] capacity), overburden haul trucks (136-154 Mt [150-170 short ton] payloads), and coal haul trucks (91-136 Mt [100-150 short ton]) for stripping and coal recovery. A 44 m^3 (57 yd^3) dragline



ARTIST'S ILLUSTRATION – MINING AND RECLAMATION SEQUENCE

Diamond Chuitna Environmental Impact Statement

FIGURE 2-3

would be added later with a smaller 27 m^3 (35 yd^3) dragline added when full production was resumed. At full production capacity, the draglines would be used for overburden and interburden removal while the shovels and haul trucks would be used for prestripping of overburden.

Coal would be loaded onto trucks directly from the seams by hydraulic backhoes, shovels, or front end loaders. Because of the unconsolidated nature of both the overburden and interburden and the tendency of the coal to crumble, no major blasting is anticipated. Some infrequent secondary blasting would be required, primarily to move large glacial erratic boulders which are scattered throughout the overburden. Such blasting would occur an average of once per week.

Run-of-the-mine coal would be hauled by truck to a primary crusher located in front of the advancing mine face between the north and south pits (Fig. 2-3). The primary crusher would be moved every three to five years. The coal would be crushed to a maximum size of 15 cm (6 in) and carried about 3,962 m (13,000 ft) by a 1.4 m (54 in), two-span partially enclosed mine area conveyor system to a secondary crusher (located in the mine service area outside the mining limit) where it would be crushed to a maximum size of 5 cm (2 in) and then weighed. The mine area conveyor would be elevated in at least four locations so that the bottom of the horizontal steel support pipe would be a minimum of 2.4 m (8 ft) above ground level to permit crossing by moose and bears.

2.3.3 Water Control and Treatment

The discussion below summarizes the major aspects of the proposed water drainage control and treatment system. More detailed information may be found in Vol. XVII, Sec. 4.12, of the state surface mine permit application (Diamond Alaska Coal Company 1985). The two water control processes needed in the mine area to handle surface and ground-water flows both within and around the active mine pit are described below. During the initial 10 years of operation, portions of streams 200304 and 200305 would be mined and a sediment pond would be located in stream 200305. A major portion of stream 2003 (Fig. 2-2) would be displaced during the later years of the project.

2.3.3.1 Runoff from Areas Outside the Active Mine Pit

The area to be mined during initial 10 years of operation is topographically situated such that it would receive little natural runoff from surrounding undisturbed areas. Thus, little runoff would have to be diverted around the mining area for discharge into existing drainages.

The primary collection ditch and sediment pond system for runoff from within the area to be mined would be constructed prior to mining and would be maintained until completion of reclamation (Fig. 2-4). Note that this system covers only the first 10 years of operation (7 years of mining). The collection ditches would carry runoff from disturbed and undisturbed areas within the area to be mined, the overburden stockpile, and mine service area to sediment ponds. These ponds would function by retaining the water to allow suspended solids to settle out prior to discharge to existing drainages. Depending upon the location, amount and quality of the collected water, it might also be handled or controlled by various other methods including sediment treatment structures, dugout pond/filter dams, sediment filter fabrics, gravel pads, and vegetation barriers.

All discharges would meet applicable water quality standards. Where other treatment was necessary before discharge, e.g., flocculation, additional treatment facilities would be built in conjunction with the sediment ponds. Figure 2-5 shows a typical two-structure sediment pond system with flocculant building. The collection ditch/sediment pond system would be redesigned and rebuilt at intervals to accommodate drainage needs using the experience gained during the first 10 years of operation.

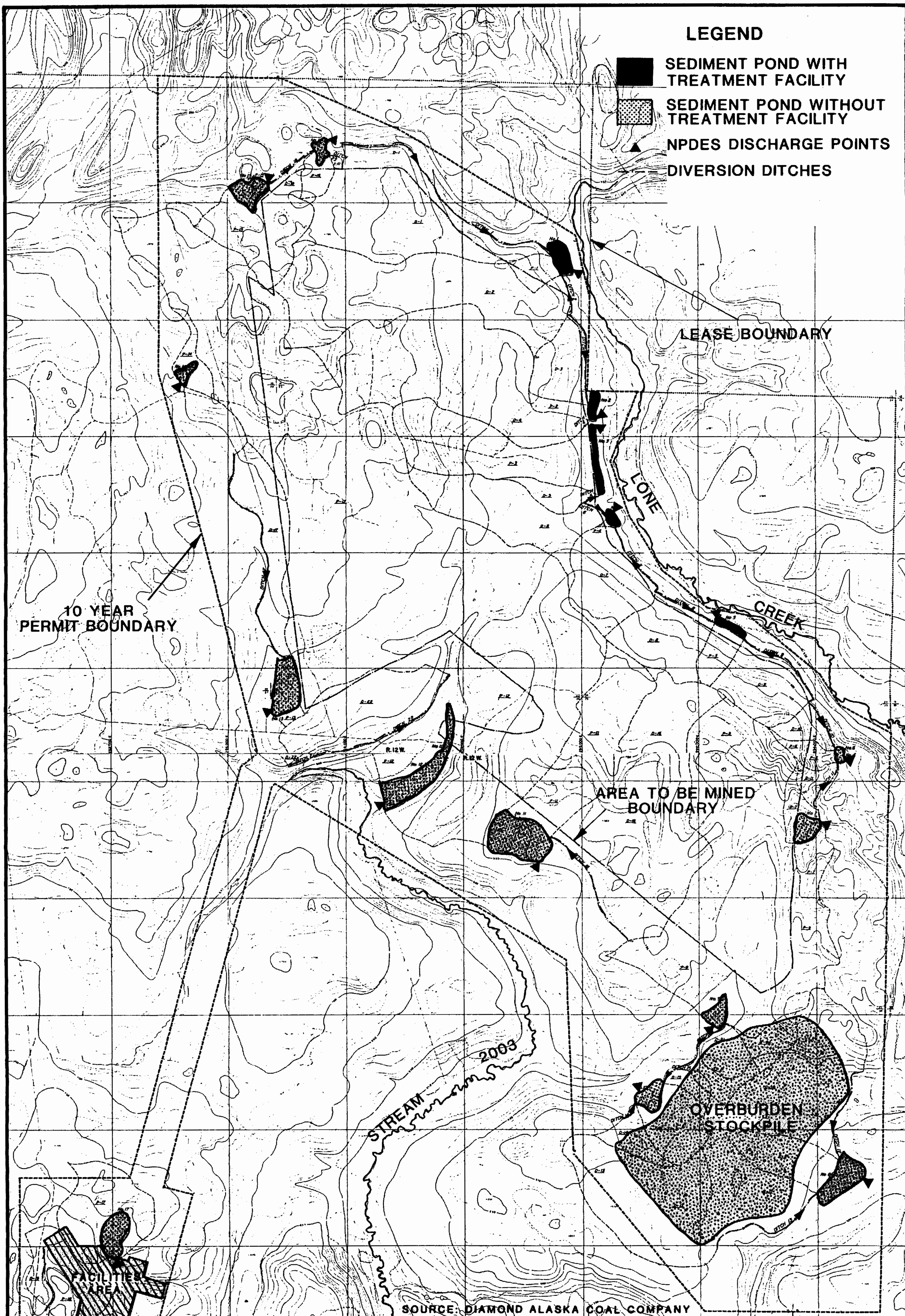
On the northwestern and western sides of the mine area, space is available for location of adequately sized sediment ponds to handle sediment loads with little or no additional treatment. However, on the northeastern and eastern sides of the mine area, space would be limited between the mine pit and Lone Creek. In these areas, sediment ponds with additional sediment treatment structures would be necessary during periods of high runoff. These treatment structures would consist of a series of excavations and embankments using baffles and selective routing to control, treat, and allow monitoring of runoff prior to discharge into Lone Creek.

Once the water is treated, it would be released from the ponds into natural drainages at the 18 points shown in Figure 2-4. Outflow from sediment pond concrete spillways would be controlled by a riprap energy dissipator to minimize potential erosion.

The sediment ponds would be dredged periodically with the dredged material put into the mine pit and covered by at least 1.2 m (4 ft) of nontoxic spoil material.

2.3.3.2 Active Mine Pit Water

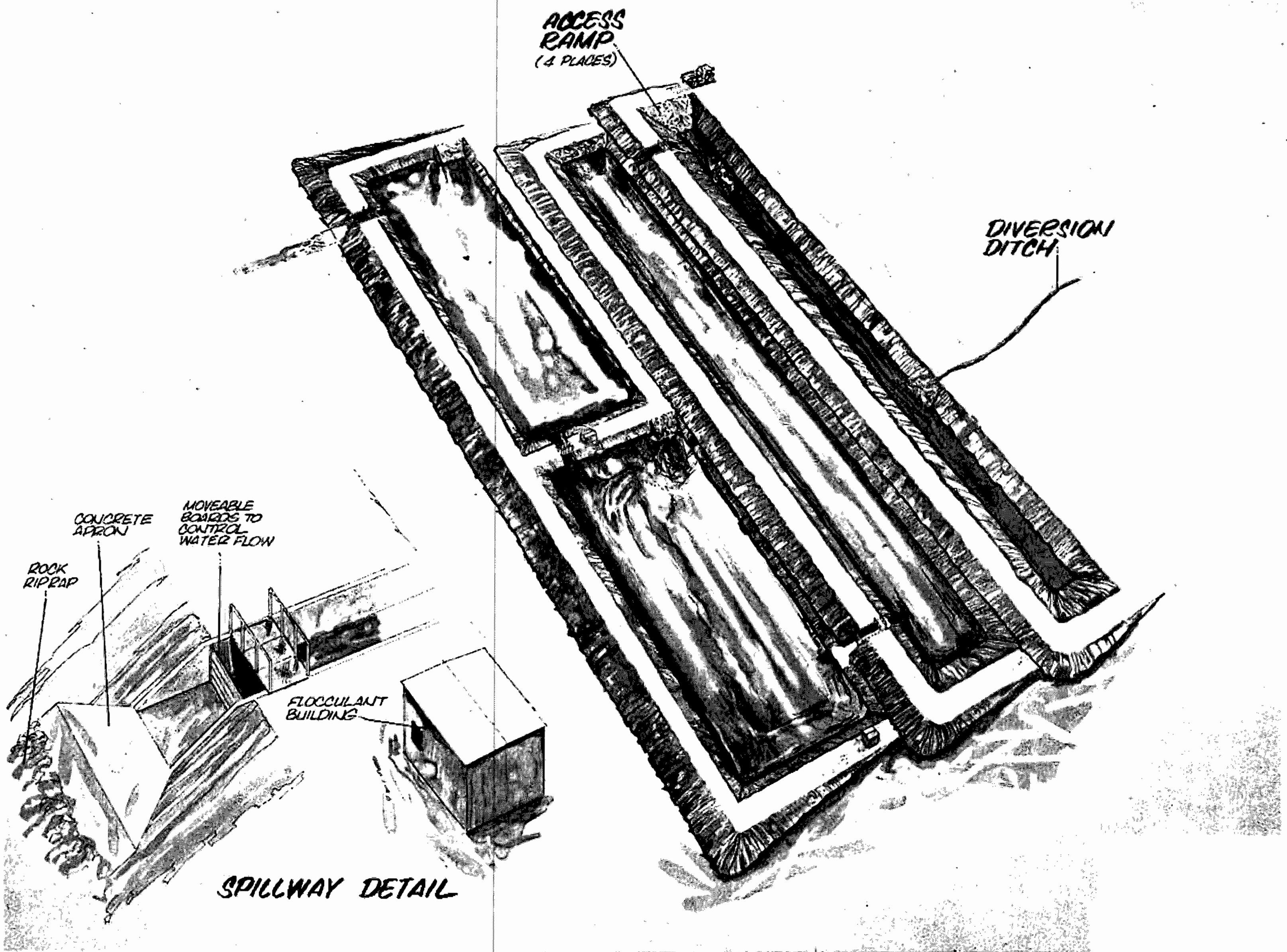
Control of surface runoff from rainfall and snowmelt within the active mine pit and ground water that would drain into the pit during the mining process would be handled in the same manner. Water would be collected in sumps* with a reserve storage capacity to allow initial settling of suspended solids and any additional treatment which might be



MINE AREA DRAINAGE CONTROL AND TREATMENT FACILITIES

Diamond Chuitna Environmental Impact Statement

FIGURE 2-4



ARTIST'S ILLUSTRATION – TYPICAL SEDIMENT POND

Diamond Chuitna Environmental Impact Statement

FIGURE 2-5

necessary (e.g., buffering, flocculation). The water would then be pumped from the active mining areas to the adjacent larger sediment control ponds for treatment, monitoring, and discharge into drainages of Lone Creek and stream 2003. During a given year (within the first 10 years), approximately 50 percent of the water pumped from the active mine pit ultimately would be discharged into the Lone Creek drainage. At any time, however, discharges into either creek, or both simultaneously, could occur depending upon the active mining pit location.

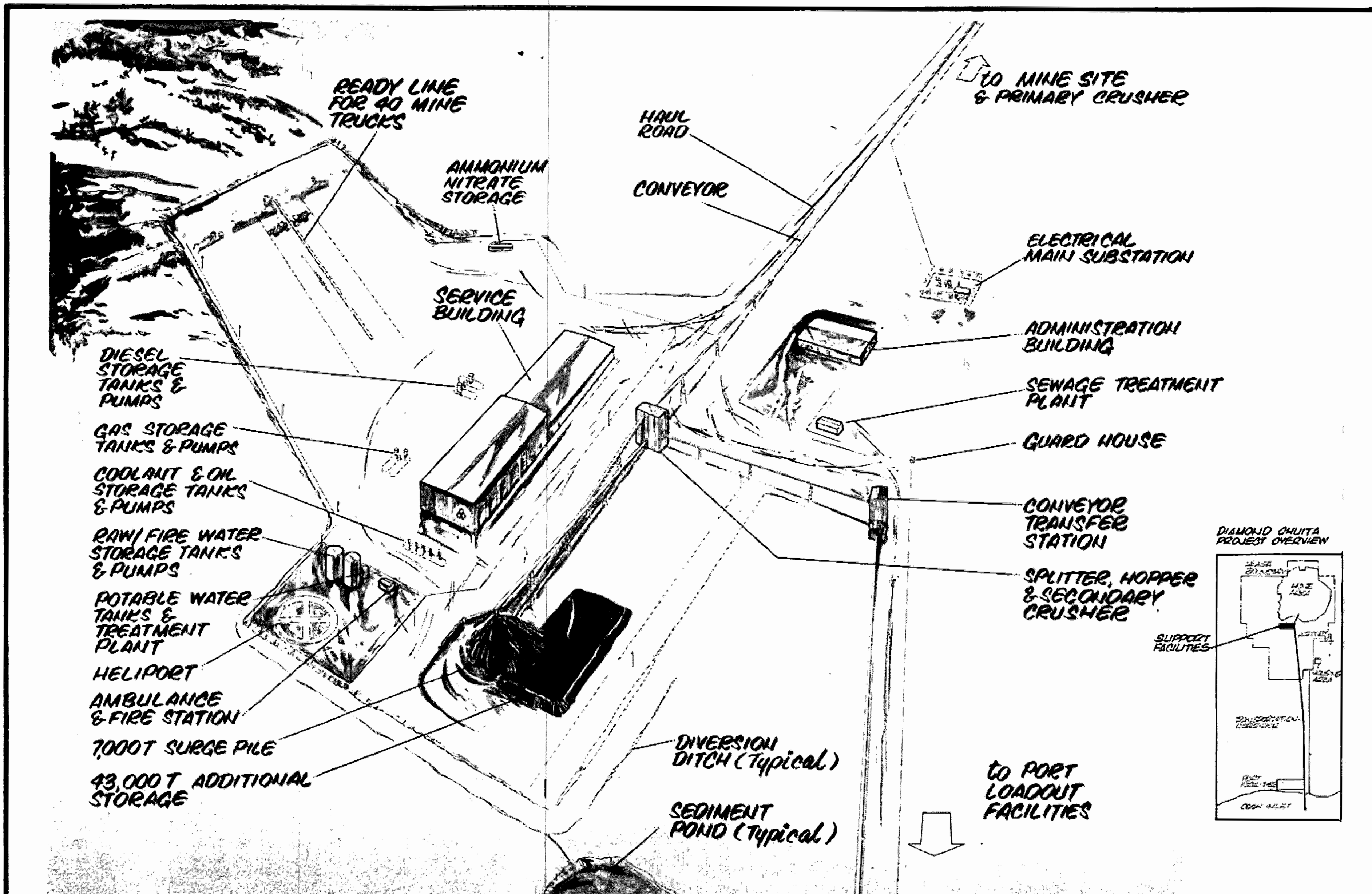
2.3.4 Overburden Stockpile

At the start of operations, approximately 16.8 million m^3 (22 million yd^3) of overburden from the box cut (excluding topsoil) would be excavated and permanently placed in an overburden stockpile (Fig. 2-2). Because of an approximate 18 percent swell factor associated with the reclaimed overburden, the original surface contours could be duplicated without use of the material in the permanent overburden stockpile. This stockpile would be approximately 61 m (200 ft) high, 1,280 m (4,200 ft) long and 670 m (2,200 ft) wide and would cover about 81 ha (200 ac). No further material would be added. The stockpile would be stabilized, graded and then revegetated to prevent erosion. Runoff from the stockpile would be handled in the same manner as described above for the mine area using a treatment system consisting of collection ditches and three sediment ponds (Fig. 2-4). Topsoil from the box cut would be stockpiled in a separate area.

2.3.5 Mine Service Area

The permanent mine service area would be located on the southern edge of the mining limit (Fig. 2-2). The approximately 22 ha (55 ac) area would include the main administration building, a service building housing the principal maintenance, warehouse and service facilities; equipment ready lines; water, diesel fuel, gasoline and lubricant storage; electrical substation; ambulance and fire station; water and sewage treatment plants; emergency power system; explosives magazine; heliport; and emergency and safety facilities (Fig. 2-6). The area would not be fenced. No one would be housed at the mine service area.

Coal from the primary crusher at the mine would enter the mine service area by conveyor and pass through a splitter-hopper* which would feed coal to either the secondary crusher (and thence by conveyor to the port) or to a surge pile or an emergency storage pile in the service area. The coal would not be washed or otherwise processed. The two coal piles would have a combined capacity of approximately 45,360 Mt (50,000 short tons) and would serve to offset differences in conveyor capacities and compensate for downtime in mining operations.



ARTIST'S ILLUSTRATION – MINE SERVICE AREA

Diamond Chuitna Environmental Impact Statement

FIGURE 2-6

Runoff from the mine facilities area itself, including any water used for dust control spraying, would be collected by a ditch system and sent to two sediment ponds (Fig. 2-4) for settling and treatment to meet water quality standards before being released into the stream 2003 drainage.

Sanitary waste water generated at the facility would be treated in a packaged treatment plant at primary and secondary levels. Effluent would be carried in a pipeline buried next to the road to the housing area where it would join the treated effluent pipeline from the housing site and be discharged into the Chuitna River directly south of the housing site.

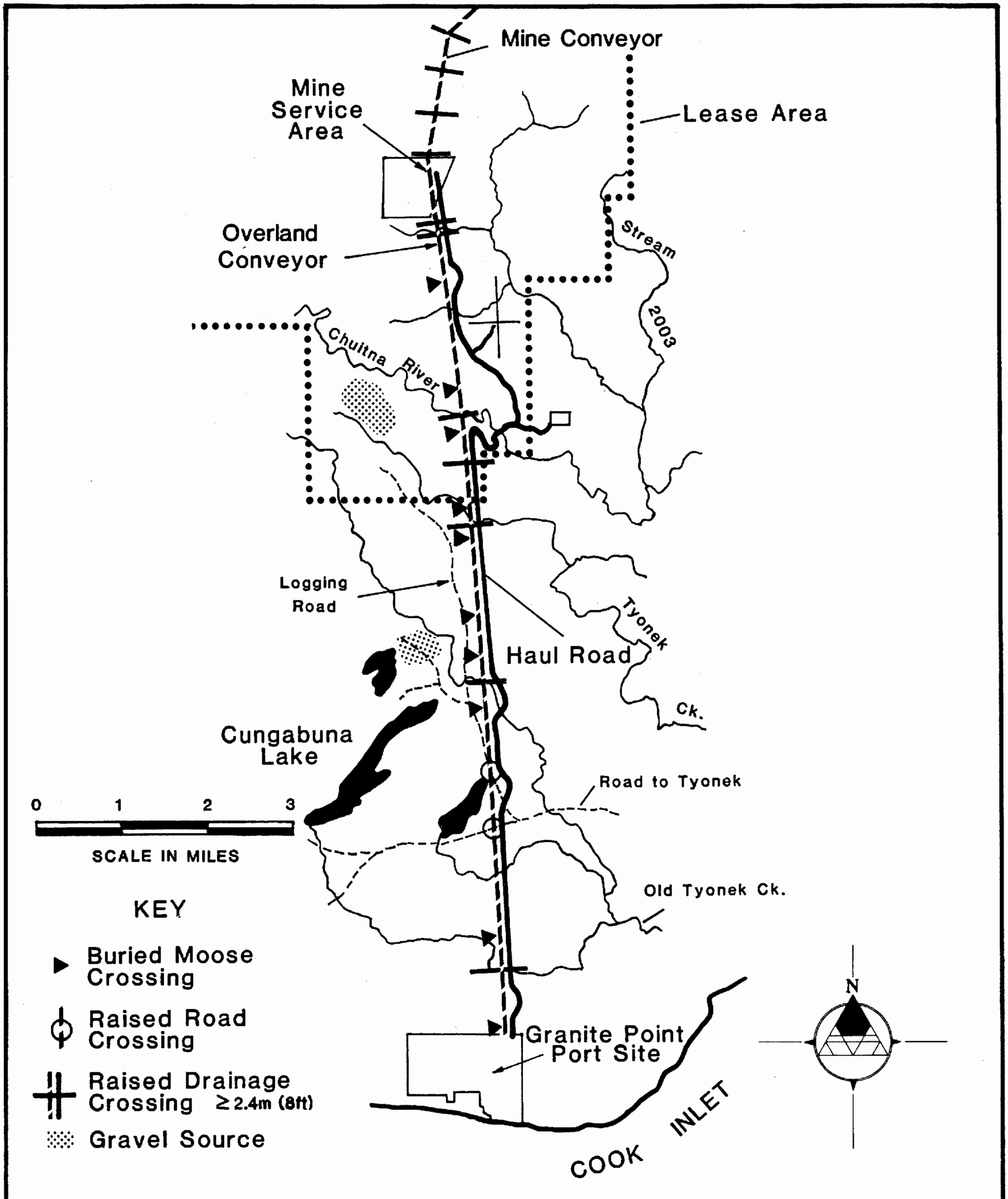
Nonorganic solid wastes would be deposited in fenced and enclosed dumpsters located throughout the service area and collected on a regular basis. A temporary fenced landfill near the mine site would be used for solid waste disposal only during construction, and would then be closed. After that, these wastes would be trucked to a large, permanent, fenced disposal site in the vicinity of the mine. Solid wastes would not be put into the mine pit itself. Organic wastes would be deposited in separate fenced and enclosed dumpsters within the service area and hauled to the housing area organic waste incinerator. Hazardous wastes would be handled completely separately and would be removed from the project area entirely for disposal at an authorized hazardous waste site.

2.4 TRANSPORTATION SYSTEM

2.4.1 Conveyor

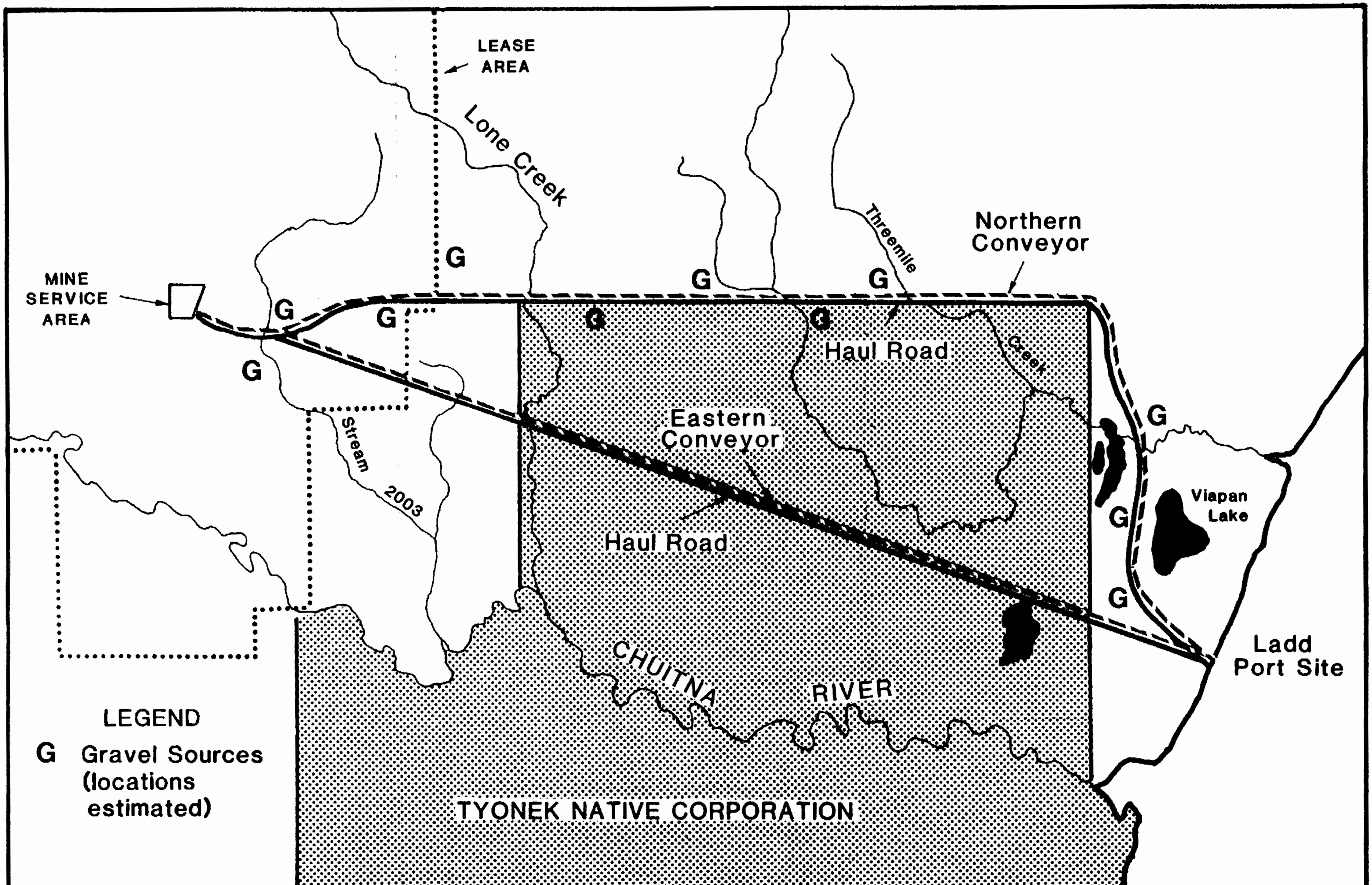
If either the southern or eastern transportation corridor is selected, an approximatley 17.6 km (11 mi) single-span conventional continuous belt conveyor would transport coal from the mine service area to a port on Cook Inlet (Figs. 2-7 and 2-8). The northern corridor would require an approximately 22 km (13.8 mi) two-span conveyor (Fig. 2-9). The southern corridor would have six minor stream crossings (two unnamed tributaries to stream 2003 north of the Chuitna River, Tyonek Creek, Old Tyonek Creek, and two unnamed tributaries to Old Tyonek Creek) and one major stream crossing (Chuitna River). The northern corridor would also cross six small streams including two tributaries to stream 2003, Lone Creek, two tributaries to Threemile Creek, and the Threemile Creek mainstem. The eastern corridor would cross 3-4 streams including two tributaries to stream 2003 and Lone Creek.

The entire conveyor structure would be supported by a horizontal steel pipe typically elevated about 0.6 m (2 ft) above the ground surface on pedestal support piers spaced approximately 6.1 m (20 ft) apart (Figs. 2-9 and 2-10). The entire structure typically would be 2.9 m (9.6 ft) tall and



SOUTHERN CORRIDOR CONVEYOR AND HAUL ROAD LOCATIONS

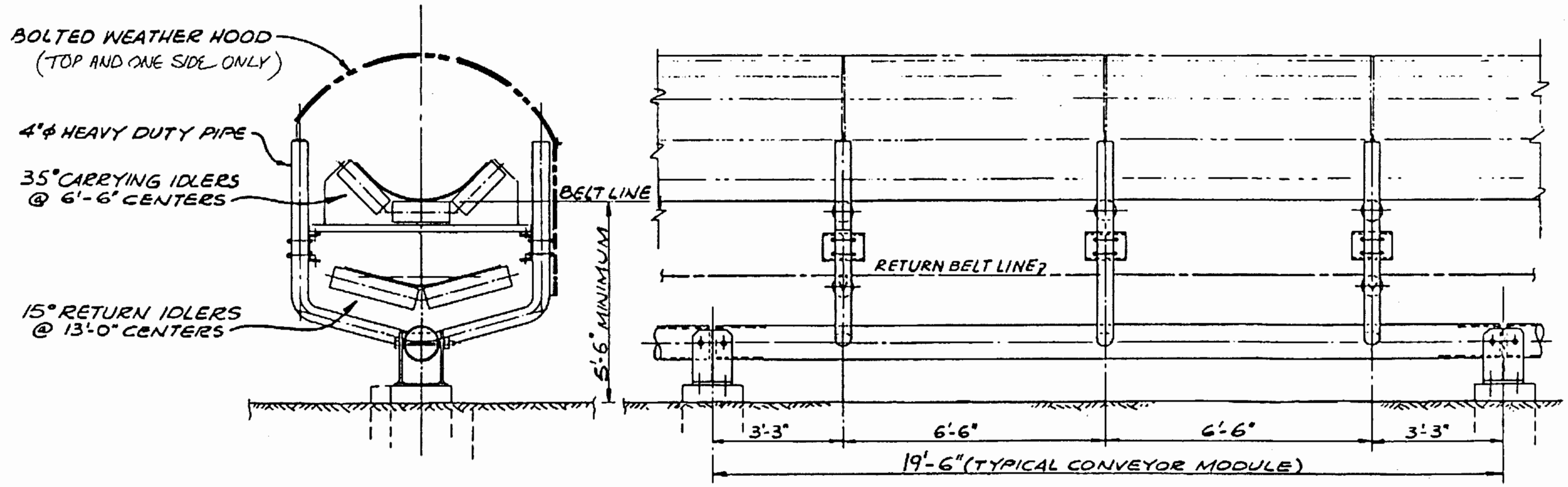
Diamond Chuitna Environmental Impact Statement | FIGURE 2-7



EASTERN AND NORTHERN CONVEYOR AND ACCESS/HAUL ROAD LOCATIONS

Diamond Chuitna Environmental Impact Statement

FIGURE 2-8

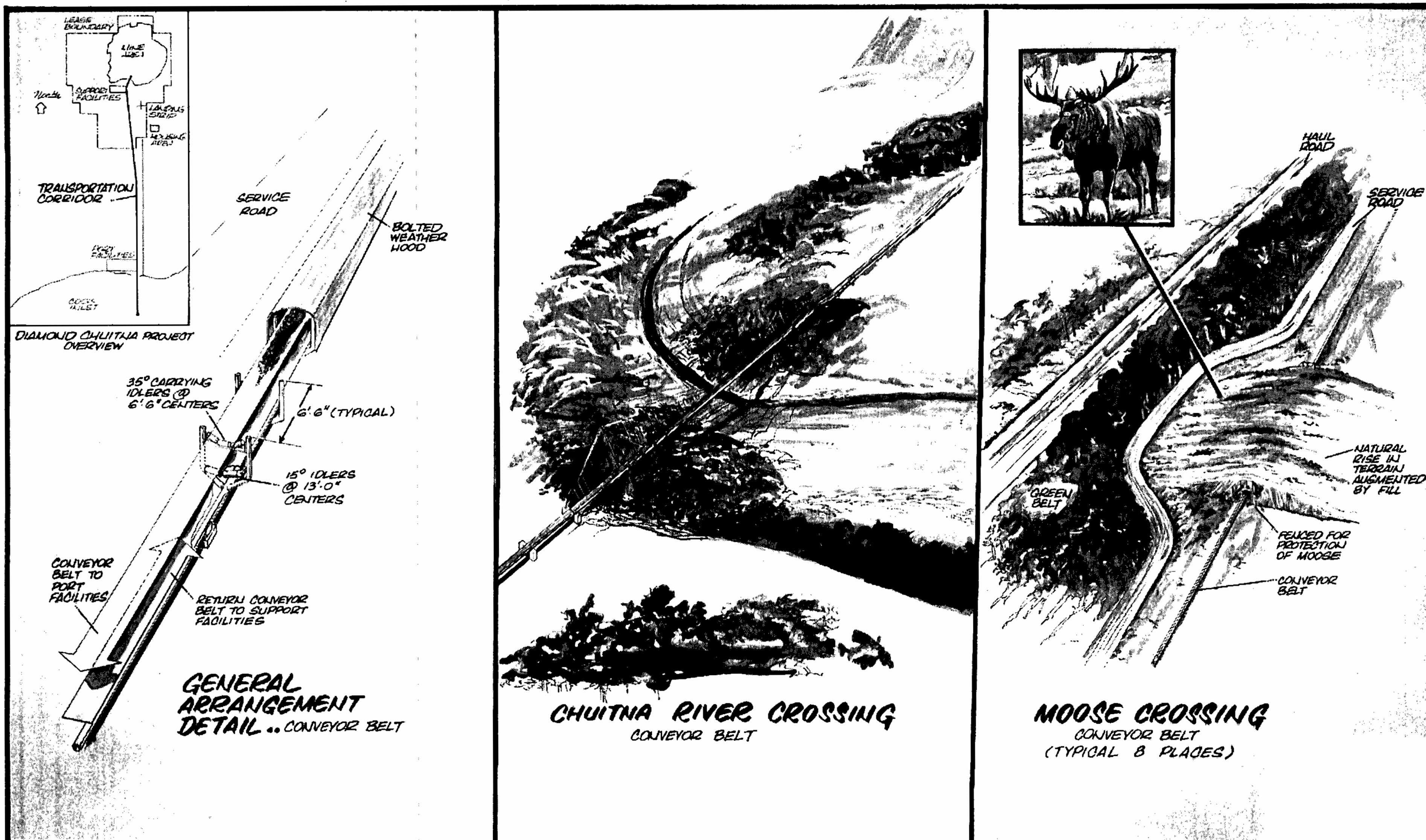


SOURCE: Diamond Alaska Coal Company

TYPICAL CONVEYOR MODULE AND CROSS SECTION

Diamond Chuitna Environmental Impact Statement

FIGURE 2-9



ARTIST'S ILLUSTRATION – CONVEYOR SYSTEM DESIGN

Diamond Chuitna Environmental Impact Statement

FIGURE 2-10

2.2 m (7.3 ft) wide. The coal-carrying belt would be a minimum of 1.7 m (5.5 ft) above the ground and would be supported by heavy duty pipe yokes attached to the horizontal steel pipe at 2 m (6.5 ft) intervals. The conveyor belt would be 1.2 m (48 in) wide and capable of moving about 1,633 Mt (1,800 short tons) of coal per hour. The conveyor belt would be enclosed on top and one side with a weatherhood to protect the coal from moisture and to reduce coal dust emissions from wind. The open side would permit access to the rollers for maintenance purposes. Wherever the conveyor crosses streams, it would be partially enclosed on the underside (underpanning) to prevent coal or dust from entering the stream. If a conveyor were built across the Chuitna River (southern corridor), it would be totally enclosed and suspended about 52 m (170 ft) above the river by cables (Fig. 2-9).

To permit moose, bears, and people to cross the conveyor, at appropriate locations it would be buried for a minimum of 61 m (200 ft) in large diameter culverts or arch spans (Fig. 2-10). At other locations, e.g., stream crossings, the conveyor would be elevated a minimum of 2.4 m (8 ft) above ground level. There would also be places where the conveyor would be raised to permit existing roads to pass underneath (Fig. 2-7). The conveyor would be gradually elevated to a clearance of 9.4 m (30 ft) at these road crossings, taking about 61 m (200 ft) on each side of the road to rise to that height from its normal elevation. In combination along any corridor, the maximum distance between crossings (underpass or overpass) would be approximately 2,000 m (2,187 yd), with an average center-to-center distance between crossings of approximately 880 m (962 yd).

While the specific locations for the conveyor crossings have been identified for the southern corridor (Fig. 2-7), data are not available to permit such specificity for the northern and eastern corridors. Such crossings would be identified, as data become available, within the maximum distance criteria set out above.

A light duty, minimally improved 3.7 m (12 ft) service/access road suitable for four-wheel drive vehicles would be built immediately adjacent to the conveyor for maintenance purposes. It would be separated from the substantially improved access haul road primarily for safety reasons (to reduce risk of vehicle/conveyor collisions). The separation would also provide a greenbelt between the more heavily traveled access/haul road and the conveyor to increase ease of big game movements across the corridor. Drainage and sediment control measures for the conveyor would be the same as those described below for the main access/haul road. Brush within the conveyor right-of-way would be mechanically controlled; no herbicides would be used.

2.4.2 Access/Haul Road

A private, all-weather access/haul road would be constructed that would generally parallel the conveyor (Figs. 2-7 and 2-8). The road would be gravel surfaced, crowned to promote drainage, and would have two 10.7 m (35 ft) wide traffic lanes with 3.7 m (12 ft) wide gravel shoulders on each side (Fig. 2-11). Grades would be maintained at a maximum of 6 percent.

Over most of its length, the road would be separated from the conveyor by approximately 61 m (200 ft). At river crossings or other natural features, the road would have an independent alignment to maintain grade.

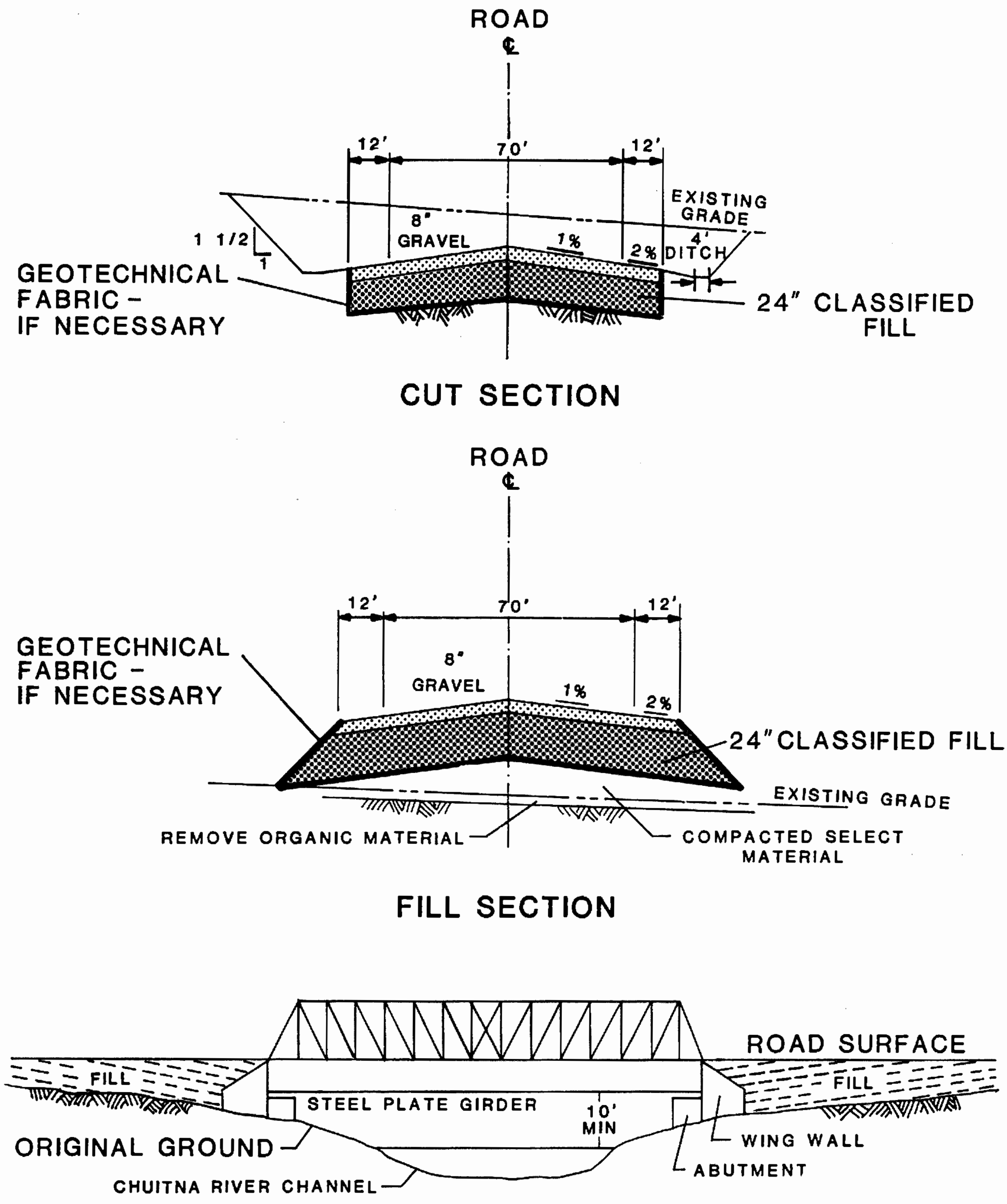
Drainage and sediment control measures would include: (1) construction of ditches to divert runoff from undisturbed areas around operational areas; (2) construction of collection ditches; (3) installation of culverts under roads to collect and control runoff from road surfaces, embankments, and adjacent areas; (4) surfacing of main roads and facility areas with gravel material; (5) revegetation of road cuts, embankments and other disturbed areas as soon as possible after construction; and (6) use of specific localized sediment control measures in sensitive areas. In sensitive areas such as those adjacent to stream channels, localized sediment control measures would include ditches with rock filter dams, gradient terraces with dugout filter ponds, rock drainage-ways, placement of sediment filter fabric, and use of straw or vegetative sediment filters.

2.5 PORT FACILITIES

2.5.1 Onshore Port Facilities

The onshore port facilities at either Ladd or Granite Point would ultimately be capable of accommodating an annual capacity of 10.9 million Mt (12 million short tons) of coal (Fig. 2-1). Either onshore site would occupy approximately 121 ha (300 ac) on the bluff above Cook Inlet. The site would be connected to a supply barge staging area at tidewater about 30 m (100 ft) below the bluff by a 7.3 m (24 ft) wide beach access road. Figure 2-12 is an artist's illustration of the port facilities if built at Granite Point. A facility at Ladd would be similar.

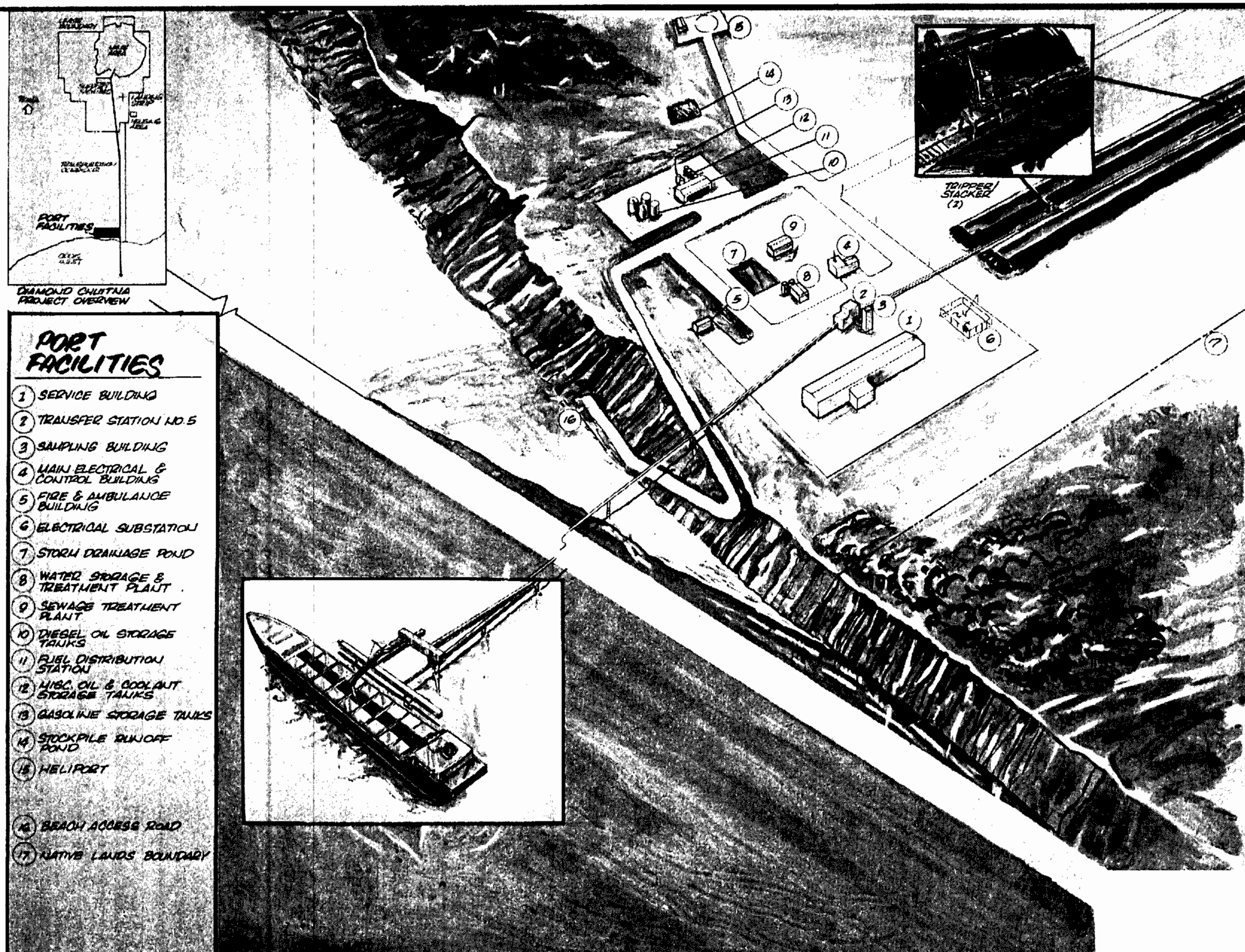
Major facilities at the onshore site would include a large service building, coal transfer station, sampling building (to sample coal heating value, moisture, ash and sulphur content), main electrical and control building, fire and ambulance building, electrical substation, water storage and treatment plant, sewage treatment plant, diesel fuel and gasoline storage and distribution area, and a heliport. The site would be fenced to minimize human/wildlife encounters. No one would be housed at the port site during project operations.



SOURCE: DIAMOND ALASKA COAL CO.

TYPICAL HAUL ROAD AND BRIDGE DESIGN

Diamond Chuitna Environmental Impact Statement | FIGURE 2-11



ARTIST'S ILLUSTRATION – PORT SITE FACILITIES

Diamond Chuitna Environmental Impact Statement

FIGURE 2-12

Coal would enter the onshore port facility on the overland conveyor and be transferred to one of the two 1.8 m (72 in) yard conveyors. It would then be sent directly to the shiploader on the approach trestle if a barge or ship were being loaded. If loading were not in progress, coal would be stored in two large parallel stockpiles on either side of the conveyor (Fig. 2-12). The amount of coal stored at the port site would vary depending upon shipping schedules, marine weather conditions, and downtime in mining operations. At full production, up to 1.1 million Mt (1.2 million short tons) of coal could be stored, but a minimum of 90,720 Mt (100,000 short tons) always would be stockpiled. A 30 to 45 day turnover of coal in the stockpiles would be anticipated. Tests on the spontaneous combustion potential of the coal indicated no susceptibility to firing while exposed to the atmosphere. The coal piles would be unlined and would sit upon a gravel fill pad. Alignment of the piles would be approximately north-south at Granite Point to minimize contact with the prevailing winds. Alignment at Ladd has not yet been determined. The maximum dimensions of these stockpiles would be approximately 945 m (3,100 ft) by 61 m (200 ft) by 15 m (50 ft) high. During barge- or shiploading, coal would be taken from these stockpiles and placed on the conveyors to the approach trestle.

Coal would be transferred from the conveyor to the stockpiles, or taken from the stockpiles and placed onto the conveyor, by two large railmounted stacker-reclaimer units which would move parallel to the conveyor (Fig. 2-11). These machines would have a bucketwheel at the end of their booms which would be able to break through a frozen crust of coal up to 0.6 m (2 ft) thick when reclaiming coal for shiploading.

A packaged commercial sewage treatment plant would be used to treat all sewage generated at the port facility. Following treatment to meet applicable standards, the effluent would be carried by pipeline along the elevated trestle and discharged into Cook Inlet at Granite Point or discharged into an onsite leach field at Ladd.

Nonorganic solid wastes would be deposited in fenced and enclosed dumpsters located throughout the port facility and collected on a regular basis. Initially, these wastes would be hauled to a temporary fenced landfill near the mine site which would be closed following completion of construction. For the first five to ten years of project operation, these wastes would be buried in a fenced landfill near the port facility. After that, the wastes would be hauled to the large permanent landfill in the vicinity of the mine. Solid wastes would not be put into the mine pit itself. Organic wastes would be deposited in separate fenced and enclosed dumpsters within the port facility and hauled to the housing area organic waste incinerator. Hazardous wastes would be handled completely separately and would be removed from the project area entirely for disposal at an authorized hazardous waste site.

Drainage and sediment control would be accomplished by drainage ditches which would collect all surface runoff from the disturbed area of the port site and divert it into sediment ponds. This would include storm runoff and water sprayed on coal stockpiles for dust control. Treatment methods would vary depending upon the water quality of the runoff. Following treatment, the water would be carried by pipeline on the approach trestle for discharge directly into Cook Inlet. All discharges would meet state and federal water quality standards (see the draft NPDES permit - Appendix D). The drainage and treatment system would be designed to accommodate volumes from the 10-year, 24-hour precipitation event. Likewise, all culverts and diversion ditches would be designed to contain the peak flow from a 10-year, 24-hour event.

2.5.2 Offshore Port Facilities

If full production is anticipated, a port could be developed at either Granite Point or Ladd. At either location, a trestle could be built to the deep water needed for accommodation of large coal ships. For less than full production, coal would be loaded onto ocean-going barges. Barges can operate in shallower waters than can the coal ships. Appropriate depths can be reached substantially closer to shore at Ladd than at Granite Point; therefore, if bargeloading only is required, a port would be developed at Ladd.

Offshore facilities for either port location would consist of an approach trestle with ship breasting and mooring dolphins (Fig. 2-12). The trestle length at Granite Point would be either 2,277 m (7,470 ft) or 3,810 m (12,500 ft) depending on the size of the ships which would be used.

Approximately 287 m (940 ft) of either trestle would be upland of the mean high tide line, thus reducing the length of the trestle extending into the inlet. The trestle would be 7.9 m (26 ft) wide, 9.1 m (30 ft) high and supported by single piles up to 3.7 m (12 ft) in diameter. The piles would be approximately 122 m (400 ft) apart and the trestle would be a minimum of 6.1 m (20 ft) vertically above the water at mean higher high water (MHHW). The structure would be designed to withstand the greater than 9.1 m (30 ft) tides, 3.6 m/s (7 knot) currents and 1.1 m (42 in) thick ice floes of upper Cook Inlet. One of the mooring dolphins would support a helipad.

At Granite Point, smaller "Panamax class" vessels (54,432 to 72,576 Mt [60,000 to 80,000 dwt]) with drafts of 11.9 m (39 ft) capable of passing through the Panama Canal could be loaded at the shorter trestle with a berthing depth of 14 m (45 ft) at mean lower low water (MLLW). Larger vessels up to 108,864 Mt (120,000 dwt) would require the longer trestle with a berthing depth of between 15.2 and 18.2 m (50 and 60 ft).

At Ladd, to accommodate lower production levels, the 9,072 to 13,609 Mt (10,000 to 15,000 dwt) barges would require a trestle of approximately 168 m (550 ft) in length to reach a berthing depth of 1.2 m (4 ft) at MLLW. This would require tidally controlled berthing where barges would be moved into the dock, loaded and then moved away to take advantage of water depths at higher tide levels. At full production, the trestle would be approximately 3,505 m (11,500 ft) long to load large ships at a berthing depth up to 18.2 m (60 ft). The trestle specifications would be the same as described above for Granite Point.

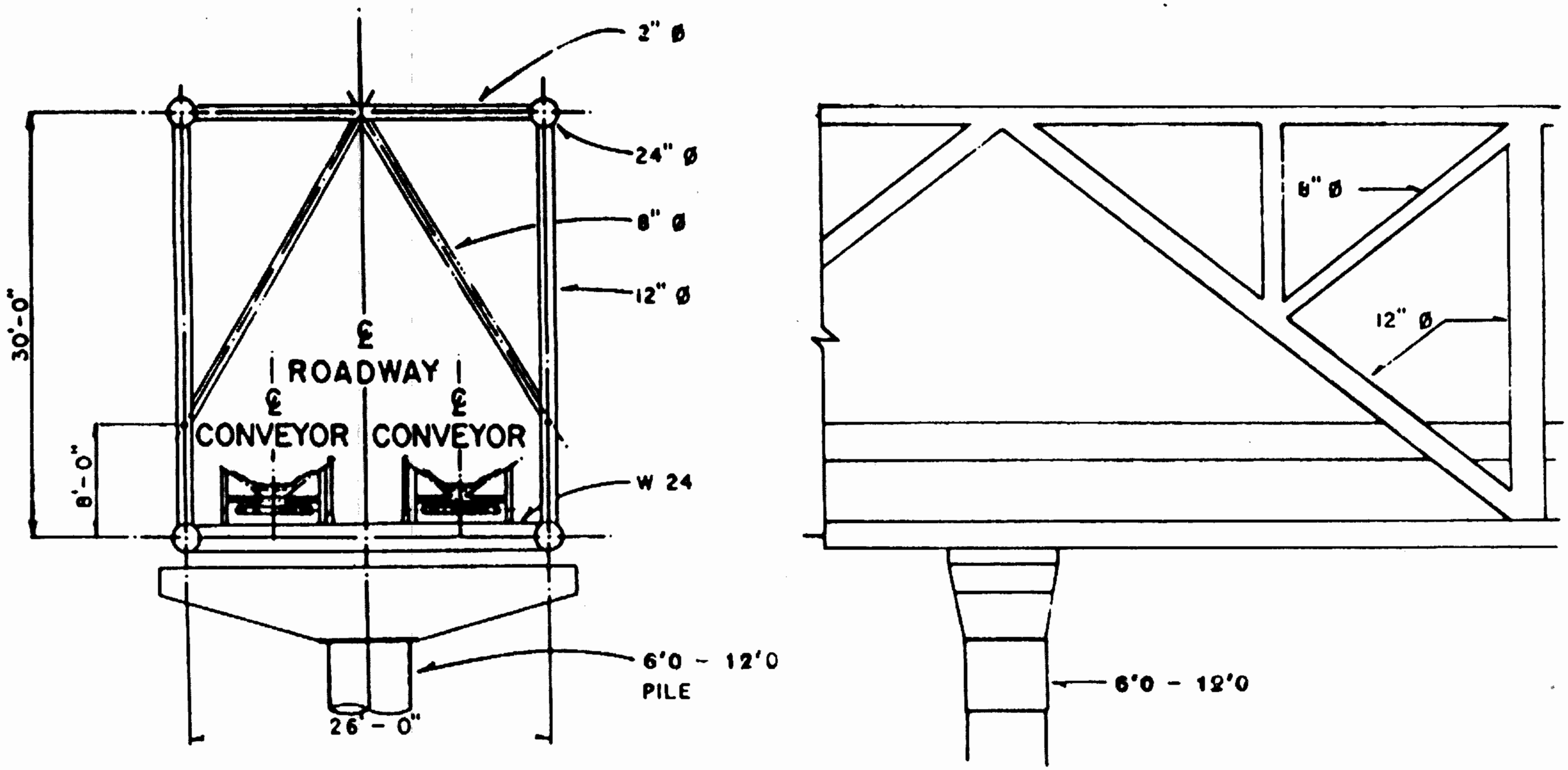
Coal would be transported from the onshore port to a linear shiploader facility at the end of the approach trestle on two covered conveyors each 1.8 m (72 in) wide (Fig. 2-13). At full production, the shiploader would have an effective loading rate of 3,629 to 4,536 Mt (4,000 to 5,000 short tons) per hour. It would have a boom capable of swinging to reach all compartments of a coal barge or ship, with the spout being lowered into the hold to reduce dust generation. The trestle conveyors would be paralleled by a 1.5 m (5 ft) wide walkway that would be used to transport operating and maintenance personnel and equipment. Coal could be loaded 24 hours per day throughout the year, affected only by weather and ice conditions in Cook Inlet.

The trestle would not be used for receiving supplies for the project. Freight, bulk materials, small quantities of certain fuels and other supplies would be brought in by barge, unloaded at the barge staging area on the beach, and trucked up the beach access road (Fig. 2-12) to the onshore port facility, housing site or the mine area as required. Major quantities of diesel fuel and gasoline would arrive by tanker and be pumped through a pipeline supported by the elevated trestle to the onshore port facility. Fuel would be stored in tanks at the onshore port site (which would hold a four-month supply) and be trucked by tractor/trailer units to the housing site or mine area as required (see Sect. 2.10.3). When ice conditions prohibited use of barges, food and miscellaneous supplies would be transported to the project area by aircraft.

2.6 HOUSING AND AIRPORT FACILITIES

2.6.1 Housing

The workforce would be housed in permanent single-status housing and community facilities on an 8 ha (20 ac) site. The entire housing area would be fenced to minimize human/animal contacts. Full production facilities would



FRONT VIEW

RIGHT VIEW

SOURCE: Diamond Alaska Coal Company

TRESTLE AND PIER DESIGN

Diamond Chultna Environmental Impact Statement

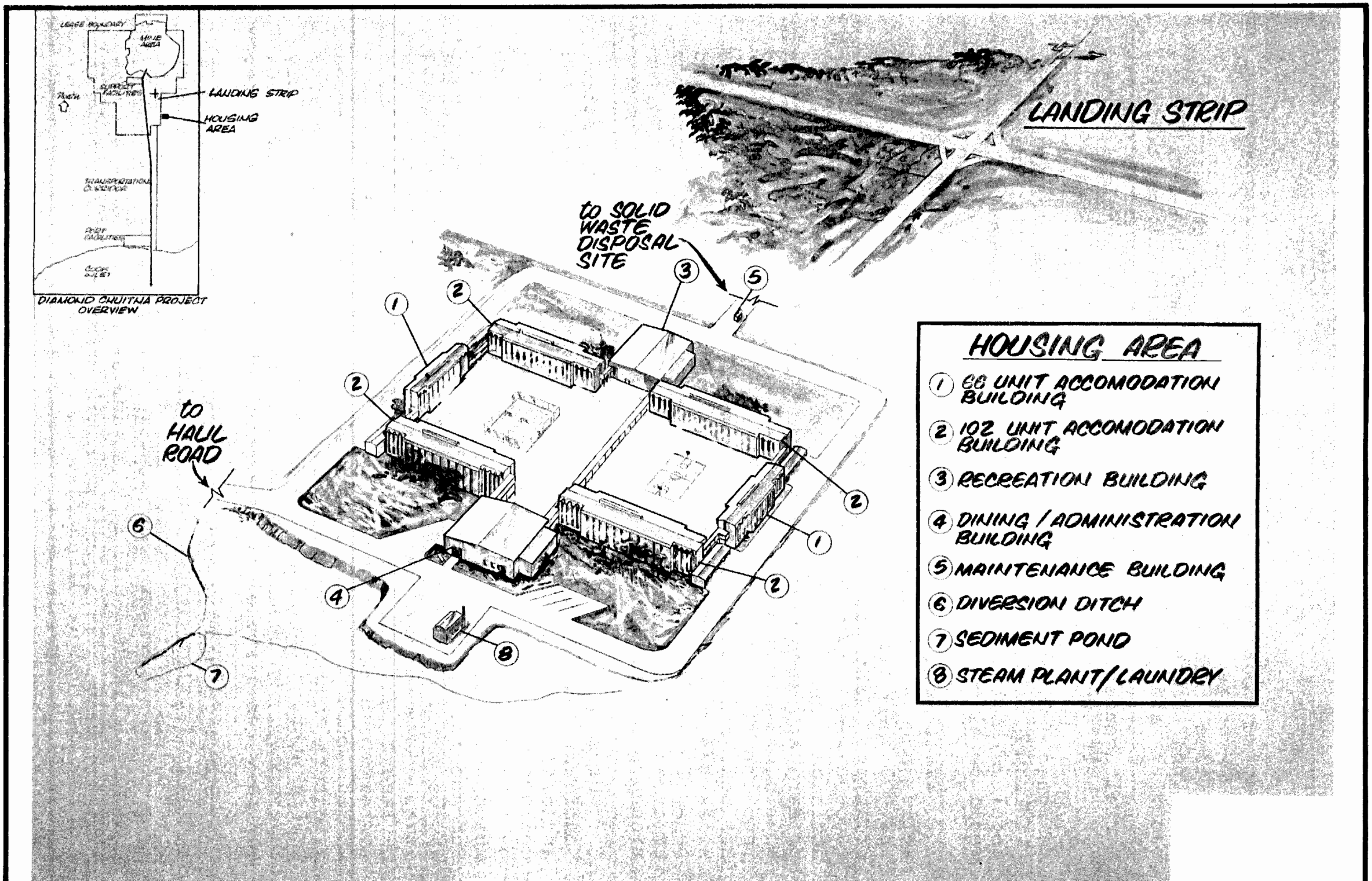
FIGURE 2-13

consist of four buildings with 102 units and two buildings with 66 units connected by all-weather corridors. Other facilities would include a dining hall/administration building, recreation center, laundry, medical facilities, security and fire services, and a maintenance building (Fig. 2-14). The facilities would be operated on the "motel" concept with employees checking into available rooms for their four-day stay at the project site. There would be no town at the housing site. The facilities would be designed for the actual number of employees on site (424) with a 27 percent contingency for weather conditions for a total of 540 beds. No employee-owned firearms or alcohol would be allowed at the housing facilities.

Water would be obtained from a series of ground-water wells with a storage capacity of approximately 302,800 l (80,000 gal) at the site. A packaged commercial sewage treatment plant with a capacity of approximately 189,270 l (50,000 gal) per day would handle sanitary and other drainage from the housing complex. Treatment would be at primary and secondary levels. Effluent from the Lone Creek housing area would be carried in a pipeline and discharged into the Chuitna River directly south of the housing site. Effluent discharge from the Threemile and Congahbuna housing sites has not been designed but would conform to state and federal regulations. The sludge effluent generated from treatment plants at any housing site would be hauled to the mine pit for burial.

Disposal of all wastes would be in approved sites. Nonorganic solid wastes would be deposited in fenced and enclosed dumpsters located throughout the housing area and collected on a regular basis. Initially, these wastes would be hauled to a temporary fenced landfill near the mine site which would be closed following completion of construction. For the first five to ten years of project operation, these wastes would be buried in a fenced landfill near the housing area. After that, the wastes would be hauled to the large permanent landfill in the vicinity of the mine. Solid wastes would not be put into the mine pit itself. Organic wastes would be deposited in separate fenced and enclosed dumpsters within the housing area and burned in a nearby incinerator. Hazardous wastes would be handled completely separately and would be removed from the project area entirely for disposal at an authorized hazardous waste site.

Drainage and sediment control would be handled by a ditch collecting system which would surround the facility and collect surface runoff and carry it to two sediment ponds for treatment and release to existing drainages. Treatment methods would be the same as for the mine service area and port site facilities, and water quality standards would be met before discharge.



ARTIST'S ILLUSTRATION – HOUSING AND AIRSTRIP FACILITIES

Diamond Chuitna Environmental Impact Statement

FIGURE 2-14

2.6.2 Airstrip

A private gravel landing strip would be located close to the housing facility (Fig. 2-2). The main runway, 1,524 m (5,000 ft) long and 30 m (100 ft) wide, would be oriented in a north-south direction with a smaller 914 m (3,000 ft) east-west runway. The airstrip would have navigation lights, but would not be capable of handling instrument approaches in bad weather. A small terminal building and a maintenance building would be located at the site. Water requirements would be small and water would be hauled to the terminal building by truck. Chemical toilets would be used with sewage being hauled and dumped into the housing facilities' treatment plant. Gray water from the terminal would be treated to meet water quality standards and then released into the airstrip's drainage system which would discharge to existing drainages. There would be no sediment ponds. Solid wastes would be kept in an enclosed, fenced dumpster which would be regularly emptied and disposed of in the same manner as that for the housing area.

2.7 POWER GENERATION

Estimated average-load electrical power demands for the project at full operation would be approximately 35 Mw, with a maximum demand of 50 Mw. Power would be purchased from the existing Chugach Electric Association natural gas power station at Beluga (Fig. 2-1) and transported to the project site by a 69 kv line on wooden poles. If the Granite Point port site were selected, the powerline would follow the existing powerline right-of-way running from the power plant to the oil tank farm about 2.4 km (1.5 mi) west of the proposed Granite Point port site (Fig. 2-1). This existing right-of-way would not have to be widened and would connect with a wooden pole transmission line within the transportation corridor between the port site and the mine.

If the Ladd port site were selected, the powerline would follow the existing right-of-way until it intersected the transportation corridor where it would split to provide power to both the port site and the mine.

2.8 RECLAMATION PLAN

The discussion below summarizes the major aspects of the proposed reclamation plan. References are given to the location of more detailed information in the state surface mine permit application (Diamond Alaska Coal Company 1985).

2.8.1 Mine Pit

The reclamation plan for the mine area would have short-term as well as long-term goals. The short-term goal would be the immediate stabilization of the disturbed site through control of erosion and sedimentation. The long-term goals would be to: 1) establish wildlife habitat that would be at least as useful and productive as the premining environment; and 2) create an aesthetically acceptable site that blends with the surrounding terrain and vegetation. These goals would be met using the methods described below.

During the initial 10 years of operation, a total area of approximately 583 ha (1,440 ac) would be mined. Reclamation of disturbed sites would begin during the second year of mining (year five of the permit) and would follow, but not interrupt, mining annually until all acreage disturbed by mining and associated activities is reclaimed. No disturbed acreage would be unclaimed.

During the first year of reclamation, 1 ha (3 ac) would be reclaimed. During the next five years, 51 ha (125 ac), 56 ha (139 ac), 143 ha (354 ac), 61 ha (151 ac) and 75 ha (186 ac) would be reclaimed, respectively, for a total of 387 ha (958 ac) reclaimed after six years of mining. More detailed information may be found in Vol. XVI, Sec. 4.08, of the permit application.

2.8.1.1 Backfilling and Grading

After the initial box cuts have opened the pits for mining operations, the overburden and interburden material from the active mine areas would be backfilled by draglines and truck and shovel operations into the mined out areas (Fig. 2-3). Grading and stabilization then would be done by bulldozers and graders. The final topography would match the premining contours as closely as possible and would not exceed original slope grades. Slopes would be designed to minimize erosion and maintain adequate water retention for vegetative growth. Gradient terraces would be used to control sheet runoff.

Postmining surface drainage channels would be located to minimize erosion and slumping. Major reconstructed surface drainage channels would be lined with riprap* material as necessary to limit bank erosion and scour. The drainages would be reconstructed with gradients, meanders, and habitats similar to premining drainages to provide habitat for anadromous fish species.

No exposed coal seams would be left on the reclaimed surfaces. A minimum of 1.2 m (4 ft) of nontoxic and noncombustible spoil material would be used to cover any exposed seams that remained after mining. Any soil which does not meet the applicant's standards for revegetation also would be covered with a minimum of 1.2 m (4 ft) of nontoxic and noncombustible spoil material. No known acid-forming or toxin-forming spoil materials are present at the mine site and, therefore, no special handling techniques for these types of materials are anticipated.

2.8.1.2 Topsoil Handling Plan

Suitable topsoil material would be recovered from areas to be affected by mining and related operations prior to disturbance. The recovered topsoil would be either stockpiled for later use or redistributed directly on backfilled and graded areas. When possible, the topsoil would be immediately redistributed in preference to stockpiling. Topsoil removal, stockpiling, and replacement would be scheduled to coincide with the overall mining sequence.

Stockpiles would be designed to minimize wind and water erosion, and topsoil would not be disturbed or rehandled after stabilization unless the soil were to be redistributed on a graded surface. Unnecessary compaction and contamination of stockpiles would be eliminated and they would be protected from waste disposal, construction, and other such disturbances to maintain integrity. All stockpiles would be located within the mining limit and would be as small as possible.

Planting specifications to control stockpile erosion would differ depending on the life of the stockpile. Stockpiles remaining in place less than 30 days during the growing season would not be revegetated but would be left in roughened condition to retard erosion. Stockpiles remaining in place longer than 30 days during the growing season, but less than one calendar year, would be seeded with an annual seed mixture. Stockpiles to remain in place over one growing season and into or through additional growing seasons would be seeded with a permanent grass mixture and mulched.

Topsoil would be redistributed in a manner and at such time that: (1) achieves an average soil thickness of 15.2 cm (6 in) consistent with the revegetation goals, contours, and surface drainage systems; (2) minimizes compaction, contamination, and erosion; (3) conserves soil moisture and promotes revegetation; and (4) minimizes deterioration of the biological, chemical, and physical properties of the soil.

Following replacement and final grading of topsoil, but before seeding, a sampling plan would be implemented to evaluate the preparation of backfill and seedbed materials. This plan would include analysis of samples by a designated analytical laboratory.

Peat would be salvaged in advance of mining operations for recreating peat-filled wetland habitats on regraded soils. To the extent possible, stockpiling of peat would be avoided and no long-term (greater than 30 days) stockpiles would be established. Temporary peat stockpiles would remain isolated from topsoil stockpiles and would not be sited in drainage ways. More detailed information may be found on Vol. XVI, Sec. 4.10, of the permit application.

2.8.1.3 Revegetation

To determine which plant species would be used for revegetation, certain criteria were established:

- Native species would be used wherever possible.
- Seed mixtures and planting rates would reflect consideration of the relationship between herbaceous species and woody species in terms of competition for soil moisture, nutrients, and sunlight. For example, heavy seeding rates of vigorous, introduced grass species were considered inadvisable because of undesirable competition with wood species.
- Wildlife value would be a prime consideration in the selection of plant species and development of seeding and planting rates.

With the above goals in mind, preliminary seed mixtures and stocking selections were developed based on species characteristics, potential success, commercial availability, and availability of seed or cuttings stock on or near the permit area.

As soon as practicable after a disturbed area is returned to the proper contour and grade, topsoil would be spread and the site would be stabilized. Erosion and sedimentation would be minimized by construction of sediment control and retention structures, proper seedbed preparation, fertilization, and planting of rapidly establishing species. The longer-term goals of establishing productive wildlife habitat would be accomplished through additional planting of seedlings and cuttings of woody species.

Sediment ponds and associated diversion ditches would be removed at the completion of mining when the upstream drainage areas are stabilized, revegetation standards met, and acceptable water quality attained. Prior to regrading, ponds would be dewatered and the sediment material tested for toxicity. If unsuitable for use in the revegetation program, the material would be removed and buried under 1.2 m (4 ft) of nontoxic fill. Sediments should be stable in the landfill. No additional undue leaching should occur. Remaining ponds and associated drainage ditches would then be backfilled, graded, and revegetated. More detailed information may be found in Vol. XVI, Sec. 4.11 of the permit application.

2.8.2 Overburden Stockpile

The size, shape, and slope of the overburden stockpile would be such that stability would be assured once vegetation had been established. Though the topography of the stockpile would differ from the surface of the mined areas, slope angles would permit the use of agricultural equipment. Thus, the techniques described above for the mine area would also be used on the stockpile. Once a portion of the surface is no longer disturbed by stockpiling activities, revegetation would be completed during the next planting season using the same procedures described in Section 2.8.1.3.

2.8.3 Mine Service Area

All steel and fabricated buildings would be dismantled and removed for salvage. Structures and equipment of no salvage value would be buried in the mine pit. Other components, including concrete footings, slabs, and foundations would be removed at ground level before being buried in the pit. Gravel pad and road surfacing materials and all coal debris would also be disposed of in the mine pit. Sedimentation ponds and associated drainage ditches would be reclaimed as described for the mine pit area.

Once cleared, all excavations at the site would be filled and the site graded to the approved postmining topography. Areas exhibiting compaction detrimental to plant establishment would be ripped. Revegetation would be done in the same manner as described for the mine pit area.

2.8.4 Transportation Corridor

Any transportation facilities which could not be beneficially used for other purposes would be dismantled and salvaged. Any facilities not salvaged would be removed, foundation structures broken up, and the resulting rubble buried in an approved landfill. Disturbance to the land under the conveyor would be limited to a denuding of the ground surface where poles and conveyor braces had been located. These disturbed areas would be revegetated where more than 50 percent of the predisturbance vegetative cover is eliminated.

If the main haul road were not left intact for other users, road surfacing and culvert materials would be removed and buried in an approved landfill. The road bed would be ripped to relieve compaction and the roadbed and embankments would be graded to blend with adjacent undisturbed terrain. Temporary drainage features would be built to control runoff and erosion until revegetation of regraded areas occurs.

2.8.5 Port Site

Structures which would serve a useful purpose for continued activities would be left in place. The trestle might serve future coal mining or other mineral or natural resource development operations in the region. The facilities might also provide a source of revenue for other future businesses. In any event, all facilities which would not be retained for other beneficial uses would be appropriately reclaimed and the disturbed areas revegetated in the same manner as described above for the mine service area facilities. Instead of using the mine pit, any burial would take place in approved landfills.

2.8.6 Housing Area and Airstrip

All improvements would be dismantled and removed for salvage value. Foundations, roads, gravel pads, etc., would be appropriately reclaimed and the disturbed area revegetated as described above for the mine service area facilities. If the State did not want the airstrip to remain usable, it would be reclaimed and revegetated also.

2.9 FISH MITIGATION PLAN

The applicant has proposed several mitigation measures for the protection of fish resources during development and operation of the mine itself. These include construction and operational procedures, monitoring studies, and a restoration plan. Table 2-1 outlines the major proposed fish mitigation measures and associated monitoring programs. More detailed information may be found in Vol. XV, Sec. 4.07.1 of the permit application.

2.10 CONSTRUCTION

2.10.1 Schedule and Sequence

Once project construction is begun, it would take approximately three years to complete. Most construction would take place each year during the May through October period.

2.10.1.1 First Year

The first step would be establishment of a barge staging area at the base of the bluff below the port site (Fig. 2-12) and construction of a road up the bluff to the onshore port facilities site. The onshore port site would serve as the main construction camp and would have housing and dining facilities, construction offices, fuel tanks, sewage treatment plant, and temporary equipment service, repair and warehousing facilities. Vegetation clearing and grubbing would begin at the port site in preparation for the major civil work to be completed in the second year.

Because of its importance in development of the project, construction of the mine access/haul road would begin as soon as the initial facilities were established at the port site. Regardless of which port site were chosen, road construction equipment would be landed at the existing Ladd

TABLE 2-1
MAJOR PROPOSED FISH MITIGATION MEASURES AND MONITORING PROGRAMS DURING FIRST TEN YEARS OF PROJECT

IMPACT	MITIGATION	MONITORING
1) Increased sedimentation due to mining	A - Construct settling ponds designed to catch mine dewatering until sediment settles out.	NPDES permit compliance.
	B - Whenever possible, minimize use of construction and mining in streams other than those designated for mining.	Environmental coordinator would periodically check construction and mining areas for compliance.
	C - Prior to the construction of settling ponds, no mining in streams would occur during spawning periods of salmon species potentially using the mainstem section of watershed 2003.	Environmental coordinator would monitor construction activities to ensure compliance.
2) Habitat loss due to mining in streams	A - Rebuild sections of tributaries 200304 and 200305 to approximate premining conditions as much as possible.	Conduct fish habitat characterization studies once after restoration in order to determine value of streams in terms of potential fish use.
	B - Revegetate mined areas to minimize increased erosion rates and loss of overhanging vegetation in vicinity of streams.	Environmental coordinator would monitor revegetation efforts to determine program effectiveness.
3) Habitat loss due to altered flows in streams	A - Return water form sediment ponds into lower sections of tributary 200305 and 200304 and mainstem portions of watersheds 2003 and 2002.	Conduct an instream flow survey at stream location(s) exhibiting potential significant losses of salmon habitat. Survey would be conducted once after mined stream segments were restored.
4) Increased sedimentation and habitat alteration due to conveyor system and road crossing watershed 2003	A - Staging areas for stream crossings would be located outside of riparian zone to minimize amount of sediment entering stream and reduce disturbance to riparian vegetation and aquatic habitats.	Environmental coordinator would inspect stream crossing activity for compliance.
	B - A maximum ROW of 30 m (100 ft) would be used at the stream crossing to reduce disturbance.	Environmental coordinator would inspect design plans and construction activities.

TABLE 2-1
MAJOR PROPOSED FISH MITIGATION MEASURES AND MONITORING PROGRAMS DURING FIRST TEN YEARS OF PROJECT
(continued)

IMPACT	MITIGATION	MONITORING
	C - Construction methods would employ latest state-of-the-art techniques. (Examples of bank and stream bottom protection measures would include riprapping, upland storage of excavated riverbed materials, importing clean backfill, backfilling with previously excavated riverbed materials, and revegetation.	Environmental coordinator would review proposed construction methods and make suggestions on bank and stream bottom protection measures at each crossing. After construction, the coordinator would inspect condition of stream bank and bottom substrate and other fish habitat characteristics at an immediately downstream of the proposed crossing.
	D - Road crossing would be constructed and maintained to prevent obstructions to movements of adult and juvenile salmon.	Environmental coordinator would inspect construction activities and make observations during different flow regimes.
	E - Construction activities would be scheduled to avoid spawning periods of salmon if possible.	Environmental coordinator would review construction timing plans and inspect construction activities.
5) Alter water quality due to mine dewatering and relase of water from settling ponds.	A - NPDES permit compliance.	NPDES permit compliance.
6) Fuel or lubricant spills	A - Fueling and lubrication of equipment would not occur within approximately 201 m (660 ft) of streams. Equipment would be properly maintained and checked for leaks periodically. Spills would be reported immediately to the environmental coordinator.	Environmental coordinator would approve fueling locations and routinely check for compliance. Affected streams would be immediately surveyed for fish kills following a spill.

beach barge site and transported over the existing Ladd road to the mine area so road construction could be simultaneously carried out from both ends. Completion of the road would take about 18 months.

Clearing, grubbing, site grading, and electrical distribution networking would be completed at the housing facilities site, and the dining hall, recreation center and about one-fourth of the housing units would be constructed. The airstrip would also be constructed and made operational.

2.10.1.2 Second Year

The major civil and building construction work would be completed at the onshore port site. Pilings for the offshore elevated trestle would be driven and the conveyors at the onshore port site would be built. The mine access haul road would be completed and additional housing units, the boiler plant and communication facilities would be constructed at the housing area.

At the mine service area, most civil work would be done and the electrical system completed. Limited building construction would be initiated. Construction of the water control and treatment facilities for the whole mine area would also begin.

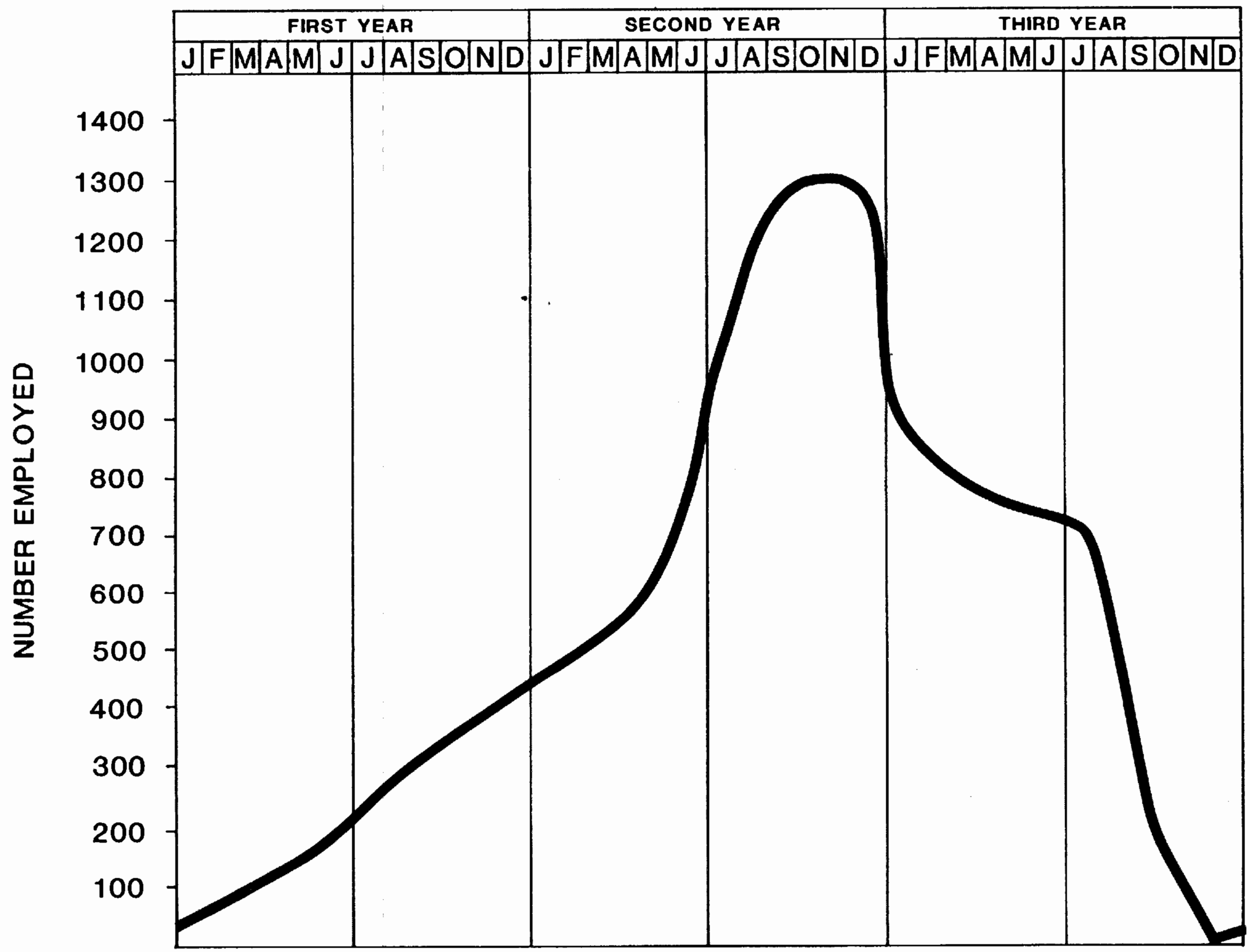
2.10.1.3 Third Year

The offshore trestle would be assembled on the pilings and the shiploader erected. The stacker-reclaimer would be erected at the onshore port site and the remainder of the housing units would be completed.

At the mine service area, facilities construction would be completed. Clearing and grubbing would begin at the mine site with initial stripping of overburden beginning late in the third year or early in the fourth.

2.10.2 Construction Employment

The estimated number of workers to be employed during construction is shown in Figure 2-15. Construction employment would gradually increase to approximately 430 at the end of the first year, then rise quickly to a peak of about 1,300 workers in October and November of the second year. Employment would then decrease quickly to approximately 750 between March and July of the third year. By the end of the third year, construction employment would drop to well below 100 when production would begin.



NUMBER OF WORKERS EMPLOYED, BY MONTH, DURING PROJECT CONSTRUCTION

Diamond Chuitna Environmental Impact Statement

FIGURE 2-15

2.10.3 Construction Methods

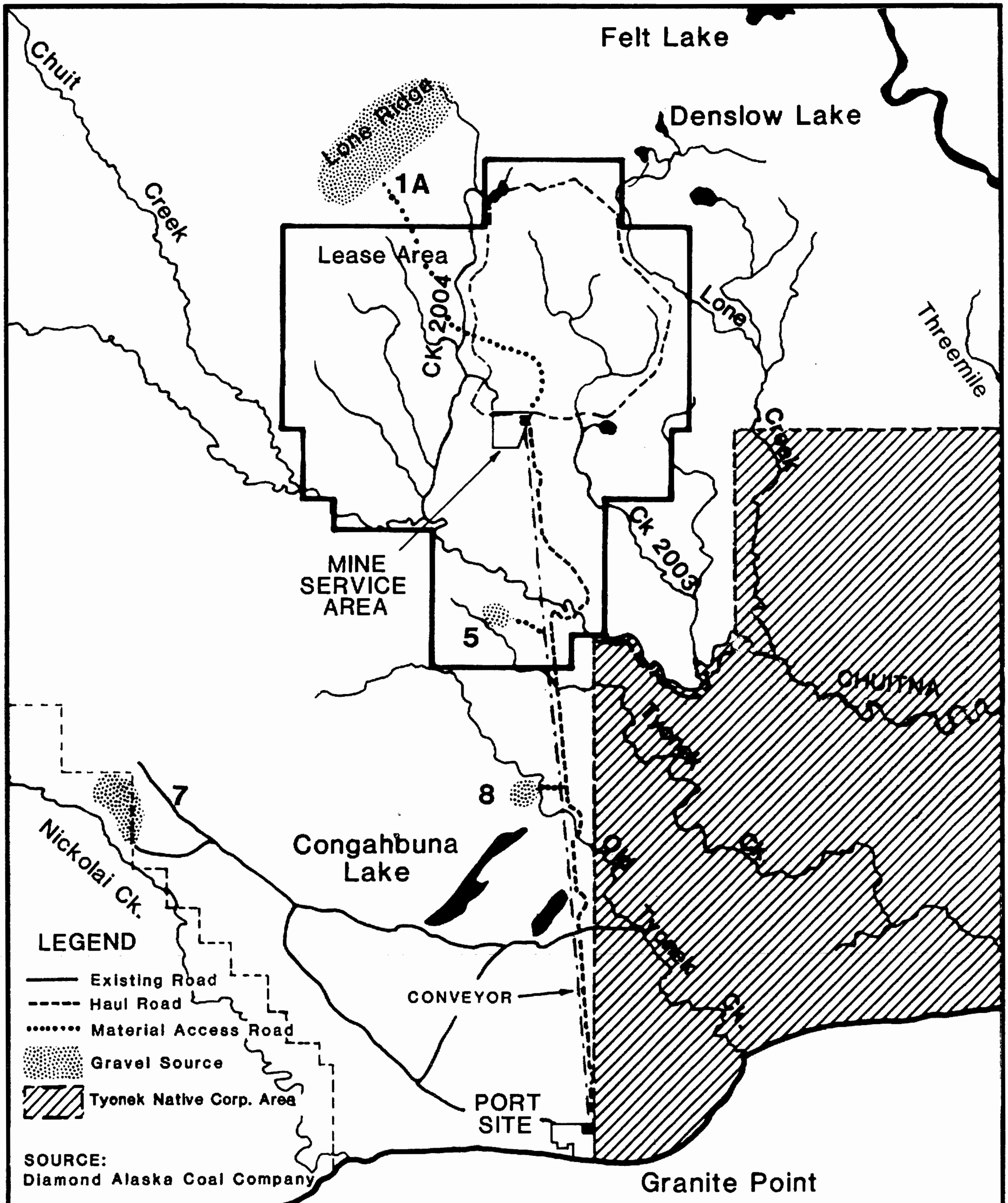
2.10.3.1 Facilities Sites

Construction methods for the three major facilities sites (the mine service area, onshore port site, and the housing area and airstrip) would be similar. Prior to actual construction, access roads to each facility would be installed. In general, fabrication of most facilities would be completed at factory locations with the modules being shipped by barge to the port for offloading, transportation to the site, assembling, and erection.

Site work would begin at each facility with clearing and grubbing of all trees and brush. This material would be put into windrows for burning, if conditions allowed, or buried under an adequate depth of spoil in the mine pit if burning were not possible. Areas with peat or muskeg deposits would be drained by ditches to facilitate removal. The peat would be hauled to a nearby disposal site which would be revegetated after it had served its purpose. Diversion ditches and sediment ponds would be constructed around the perimeter of the facilities to control and treat water runoff. Ditch sizes and sedimentation control methods would be similar to those described below for the haul road. After the facility sites were "final" graded, the modules would be trucked to the sites and actual construction of the buildings and other facilities would begin.

All subgrade and final grade gravel material, including that used for construction of the conveyor and haul road, would come from the areas shown in Figure 2-16, if the southern corridor is utilized. Probable gravel sites along the northern corridor are indicated in Figure 2-8. Gravel sites for use along the eastern corridor have not been investigated. Approximately 3.82 million m^3 (5 million yd^3) of borrow* material would be used for all project facilities. Of this total, approximately 458,760 m^3 (600,000 yd^3) would be gravel and 3,058 m^3 (4,000 yd) would be riprap or armor rock. The remainder would be any suitable fill material.

The material sources would be accessed by two-lane gravel roads suitable for heavy equipment. They would be located to maximize use of the existing logging and oil exploration road systems in the project area. Prior to any activity at the material sites, small diversion ditches, and berms would be constructed around the perimeter to divert surface runoff away from the area. Vegetation within the material pit boundaries would be cleared and disposed of in the same manner as described above for the facility sites. All surface material would then be removed and stockpiled in a suitable nearby location. Erosion control measures, including temporary seeding, would be used as appropriate to stabilize the stockpiles.



GRAVEL SOURCE LOCATIONS, SOUTHERN CORRIDOR

Diamond Chuitna Environmental Impact Statement	FIGURE 2-16

In wet areas, sumps would be constructed at a low point on the pit bottom to collect water. Some small-scale blasting may be required to establish these drainage sumps. Small submersible pumps would be used to remove the water for discharge to the surface drainage system. Sediment fences, fabric filters, and straw bale dikes would be used as needed to remove sediment from the pumped water as well as to control sediment in and around the pit.

A tracked-dozer would be used to rip material and a front-end loader would feed it into a crusher hopper. The crushed material would be screened and stockpiled by size in the pit area prior to being hauled by scrapers or rear-dump trucks to use areas. During construction of the project facilities, the crushing and screening operation would be continuous. Following construction, the operation would occur on an intermittent basis.

When a material source is exhausted or when operation is impractical due to low demand or haulage distance, an area would be reclaimed to a condition compatible with, and similar to, the surrounding terrain. The pit would be backsloped either through placement of the stockpiled overburden material or through ripping and dozing to provide a stable slope to minimize erosion and blend with surrounding terrain. Suitable surface material would be replaced in a uniform thickness over the disturbed area and erosion control measures would be taken including contour furrowing, terracing, and construction of rock drains. The entire area would then be revegetated using a suitable seed mix of indigenous and introduced species.

No dredging or filling would be necessary for either the trestle or berthing offshore port facilities. Each monopile would be driven with hammers to a predetermined depth in the inlet floor for support of the approach trestle, shiploader and berthing dolphins. Structural steel trusses would then be placed on top of the monopiles with barge-mounted cranes to serve as the platform to support the conveyors and shiploading equipment.

2.10.3.2 Conveyor and Access/Haul Road

Conveyor construction would occur in two phases. In the first phase, clearing and grubbing work would remove all vegetation from the approximately 10.7 m (35 ft) right-of-way for windrowing and burning under permits from DNR and DEC. Then, only limited cut and fill operations would be necessary since generally both the conveyor and its adjacent service road would follow the natural terrain. The rigidity of the conveyor structure and the inherent design flexibility would allow localized topographic features such as small drainage channels to be effectively bridged. Upon completion of site preparation work, the conveyor support piers would be placed. In phase two, mobile cranes would lift prefabricated conveyor framework sections into place for attachment to the support piers.

Construction of the access/haul road would require some cut and fill operations which would occur simultaneously with placement of culverts. Where the road would cross a surface drainage channel, culverts designed to pass the peak discharge from a 10-year, 24-hour precipitation event, with no ponding on the upstream end, would be used. All culverts would be placed on suitable bedding material and appropriate riprap material would be incorporated at the inlet and outlet to minimize erosion. "Trash rack" structures would be installed at culvert inlets to prevent clogging due to debris.

In areas where adverse surface conditions exist for building roads (e.g., muskegs), a special construction technique would be used which would effectively "float" the road on the less competent underlying material. In this method, a flotation material, typically wood chips or logs, is placed directly on top of the undisturbed surface vegetative mat. A layer of minimally compacted fill material is then laid down followed by a geotechnical fabric which would provide lateral stability, distribute bearing loads over a large area, and allow drainage through the road base. Normal construction methods would then follow until the designed grade was achieved.

Permanent bridges would be of truss and girder construction supported by concrete piers (Fig. 2-11). Construction would be timed to minimize impacts upon spawning salmon or other fish movements and temporary pontoon bridges or stream fords would be used to provide equipment access.

During construction of the facility sites, conveyor and road, both temporary and permanent diversion ditches would be constructed to divert runoff from undisturbed areas either around the construction sites or through culverts installed under the road. These would be maintained until disturbed areas were effectively controlled. Additional drainage and sediment control measures would include surfacing of main roads and facility areas with gravel, and revegetation of road cuts, embankments and other disturbed areas as soon as possible after construction to minimize erosion. In sensitive areas, e.g., adjacent to stream channels, localized sediment control measures would be used, including rock filter dams, gradient terraces with filter ponds, rock drainageways, placement of sediment filter ponds and use of straw or vegetation sediment filters. All disturbed areas would be revegetated and mulched, if necessary, as soon as possible after completion of construction activities.

The access/haul road would be maintained on a regular basis. Maintenance would include grading, bridge, culvert and drainage ditch inspection, repair of any localized erosion on embankments, wetting of the road surface by water trucks to control dust during dry periods, and snow removal by snowblower to prevent buildup of high snow berms which would impede animal movements across the right-of-way.

2.11 OPERATION

2.11.1 Coal Production and Shipping Schedules

Under the optimal four-year full production development schedule, initial production would begin at a low level and build to full production. During the initial year of operation, approximately 1.8 million Mt (2 million short tons) of coal would be produced using two shifts of mine workers per day and truck/shovel operations in the pit. The coal would be transported to the port site on the access/haul road using truck tractors, each hauling two, 45.4 Mt (50 ton) uncovered trailers. The tractors would make approximately 55 round trips per day.

During the second year of operation, production would be increased to about 3.6 million Mt (4 million short tons) per year by adding a second work shift at the mine. The coal would still be hauled by trucks to the port site in approximately 99 round trips per day. Early in the second year, the first dragline would begin working. Later in the second year, the main overland conveyor would commence operation. This would eliminate the need to haul coal by truck to the port site. Production would increase in the third year to approximately 5.4 million Mt (6 million short tons) per year. In the fourth year, full production of 10.9 million Mt (12 million short tons) per year would be reached. In the fifth year, the second dragline would begin operation.

Shipping schedules and frequency would depend upon the size of the ships to be loaded. Table 2-2 shows approximate shipping characteristics for two sizes of ships at full production.

At lower production levels not requiring ships, barges would be berthed at the Ladd trestle for up to approximately 200 days per year.

Table 2-2

APPROXIMATE SHIPPING CHARACTERISTICS AT FULL PRODUCTION
FOR TWO SIZES OF COAL SHIPS

Characteristics	100,000 dwt	60,000 dwt
Ship arrivals/yr	150	250
Interval between arrivals (days)	2.3	1.4
Berth loading time (hours)	25	15
Approximate berth occupancy	52%	57%

Source: Diamond Alaska Coal Company

2.11.2 Job Skills and Shift Schedules

An estimated total of 848 permanent employees would be employed by the project at full production, with half that total (424) being at the project site at any one time. There would be two 11-hour shifts each day. Thus, half the employees on site (212) would be working and half eating or sleeping at any given time. Employees would work a four-day-on, four-day-off schedule and would be flown back to their homes in Anchorage or on the Kenai Peninsula during their off-work periods. All operations except ship loading would be scheduled for 362 days per year (three-day holiday allowance). Shiploading would be scheduled for 350 days per year to allow 12 days for down time due to weather and ice conditions.

Table 2-3 shows the estimated buildup of new permanent project employees (excluding construction personnel) under the optimal, four-year full production development schedule.

Of these 848 employees, approximately 218 would be heavy equipment operators; 125 operators for trucks, light equipment and other machinery; 289 mechanics, shop hands, electricians, plumbers and other maintenance personnel; 110 miscellaneous personnel including cooks, bakers, housekeepers, dishwashers, and other life support functions; and 106 administrative personnel.

2.11.3 Fuel Handling

Because the project would receive, store, and use sizable quantities of diesel fuel, lubricating oils, and other liquids at various facilities, a Spill Prevention, Control and Countermeasure (SPCC) Plan would be prepared for each facility. Copies of that plan would be kept on file at each facility. Each plan would specify the methods which would be used to prevent and control spills which might occur during transportation, unloading, storage, or use of petroleum products. All personnel at each facility would be trained in spill prevention and appropriate personnel would be trained in the execution of the SPCC plan in case of a spill. Each facility would have adequate equipment available to complete cleanup operations. During construction each contractor would also be instructed in SPCC plan compliance and cleanup methods.

Table 2-3

NEW PERMANENT PROJECT EMPLOYEES
(EXCLUDING CONSTRUCTION PERSONNEL)
UNDER THE OPTIMAL, FOUR-YEAR FULL PRODUCTION
DEVELOPMENT SCHEDULE

	Project Year	New Employees
	1	--
	2	98
Construction	3	276
Mining Begins	4	140
	5	96
	6	86
	7	122
	8	30
Total		848

Source: Diamond Alaska Coal Company

Runoff water from the equipment washdown areas would contain oils, grease, solvents, and other hydrocarbon materials. The runoff pond receiving this water would be equipped with a skimming device to separate these materials and route them to storage areas.

Waste oil and other used hydrocarbon materials would be collected, stored, and removed from the project area for recycling or for disposal in approved waste disposal sites. Other hazardous waste materials (e.g., paint, solvents) would be handled and stored separately and shipped from the project area for disposal in approved waste disposal sites.

2.11.4 Air Quality Considerations

Burning of slash material from clearing and grubbing operations would occur only under favorable weather conditions and when permitted by DEC. Otherwise, slash would be buried under an adequate depth of spoil in the mine pit.

At all facilities, operations would be conducted to minimize coal dust, fugitive dust, and other emissions which might affect air quality. At the mine service area and the onshore port site, the coal stockpiles would be oriented to minimize contact with the prevailing north-south winds. Usually, no water would be sprayed onto the stockpiles because of the normal water content of the coal and because the coal would be regularly stacked and recovered and would not remain in the stockpile for long periods. If coal did remain in a stockpile for an extended length of time, periodic applications of water or water with a chemical dust retardant would be used. Tests on the spontaneous combustion potential of the coal indicated no susceptibility to firing while exposed to the atmosphere.

The coal stacking and recovery units would use water sprays to control dust during those operations. All conveyor systems would be designed to minimize wind effects. Both the mine conveyors and the main overland conveyor would be partially enclosed. The transfer points, including the second crusher in the mine service area, would use negative pressure systems, water sprays and/or other technology to capture as much coal dust as possible. Coal dust collected from the negative pressure systems would be put back onto the coal conveyors. The first crusher, in the mine area, would not have a negative pressure system since it would be open at the top to permit the trucks to dump coal into it.

Once the coal reached the shiploader, it would be discharged into the barge or ship holds through a fixed downspout. Coal would not be subjected to wind since the downspout would extend into the ship's hold, keeping most of the dust within the hold.

Fugitive dust would be minimized in several ways. Ground disturbance would be kept to a minimum with disturbed areas being revegetated as soon as possible. Exposed areas which would be continuously used, e.g., roads, pads, laydown areas, would be surfaced with aggregate material. When dry or windy conditions occur, these surfaces would be watered to keep dust down, and truck speeds would be reduced to lower fugitive dust emissions. During the early years of operations when coal would be hauled to the port site by trucks, road watering and use of a chemical dust suppressant, if required, would keep fugitive dust emissions to a minimum. Trucks would be properly loaded to prevent spillage when turning or braking. Spillage which did occur would be cleaned up to minimize coal fines on the road surface.

2.11.5 Environmental Training Program

An environmental training program designed to promote environmental awareness and highlight environmental protection and mitigation measures would be developed for contractors and employees. The program would include a description of existing environmental resources, identification of potential environmental impacts related to project operations, and a discussion of environmental protection and mitigation measures with emphasis on employee involvement.

2.11.6 Environmental Coordinator

An environmental coordinator would be located in Anchorage during the construction phase. Through onsite monitoring, the coordinator would assure adherence to project stipulations. During the operational phase, the coordinator would continue to ensure that environmental permit stipulations were met, direct the worker environmental training program, investigate human/wildlife contacts (including road collisions), oversee the various environmental mitigation and monitoring programs, and serve as agency contact for project status reports and site inspections. The environmental coordinator would be represented in the field by a full-time, on-site environmental supervisor with a support team made up of personnel from the revegetation and reclamation staff.

Chapter 3.0

Alternatives

3.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 INTRODUCTION

Three types of alternatives exist for the Diamond Chuitna Coal Project: 1) alternatives that are available to the applicant (action alternatives); 2) alternatives that are available to the agencies which must act upon the applicant's various permit applications (agency alternatives); and 3) the No Action Alternative.

A description of the process of identifying and comparing the action alternatives and selecting the preferred alternatives constitutes the bulk of this chapter. The process is designed to avoid significant adverse project impacts. Identification of agency alternatives, which largely involves minimization of unavoidable adverse impacts is summarized in this chapter and detailed in Chapter 6.0. The No Action Alternative is discussed in this chapter.

3.2 ALTERNATIVES AVAILABLE TO THE APPLICANT

Identifying and comparing the alternatives available to the applicant (action alternatives) and selecting the preferred alternative is a process of systematically and rationally reducing a large number of options to a smaller number that ultimately represents the alternative with the fewest adverse impacts. It begins with the EIS scoping process which identified the range of options and then proceeds through screening and analysis stages as described below until the preferred alternative is identified.

3.2.1 Options Initially Considered

The EIS scoping process, described in Chapter 7.0, established important cornerstones for this EIS. First, it identified 10 issues of major concern to be addressed during the EIS process. These issues are described in Section 1.4 and were the bases for ultimately determining the action alternatives. Second, to address the 10 issues, the scoping process identified a full range of options for the project components (Table 3-1). The initial options considered the major technical, environmental, and economic issues associated with the project. These initial options are described below.

Thirty-one options were identified for the 12 project components (Table 3-1). One component, the mine, had only one option since the coal deposit, and therefore the mine location, was fixed. A second component, the mine service

Table 3-1

COMPONENT OPTIONS IDENTIFIED DURING THE SCOPING PROCESS

Component	Option
Mine Location	Fixed
Overburden Stockpile Location	North of mining limit Center Northeast Southeast
Mine Service Area Location	Fixed
Transportation System	
o Corridor/port Location	Northern/Ladd Eastern/Ladd Southeastern/North Foreland Southern/Granite Point
o Mode	Pneumo-train Coarse coal-water slurry Coal-carbon dioxide slurry Road Railroad Conveyor
Loading Facility	
o Type	Filled causeway Elevated trestle
o Length	Short Long
Housing	
o Location	Nikolai Congahbuna Lone Creek Threemile Creek
o Type	Townsite Single status
Airstrip	Existing New
Water Supply	Surface impoundments Wells
Power Supply	Purchase power from Chugach Electric Association

area (Fig. 3-1), was also relatively fixed because of its dependence upon the mine location and because it would be located at the approximate center of the three logical mining units within the lease area, thus allowing its use during future development of other coal resources. For a third component, power supply, the only option considered was purchase of power from the existing Chugach Electric Association power plant at nearby Beluga (Fig. 2-1). Since an existing powerline right-of-way from the Beluga Station would intersect each of the transportation corridor options, this option was clearly more environmentally favorable than any on-site generation option.

3.2.1.1 Overburden Stockpile Location

Four locations for the overburden stockpile were identified: north of the mining limit, in the center of the mining limit, northeast, and southeast (Fig. 3-1).

3.2.1.2 Transportation Corridor/Port Location

Four corridor options were identified (northern, eastern, southeastern, and southern) between the mine site and Cook Inlet (Fig. 3-2).

Northern/Ladd

This corridor would extend approximately 14.4 km (9 mi) east from the mine service area toward the Beluga airstrip, then turn south southeast for approximately 8 km (5 mi) to a port site at Ladd just north of the mouth of the Chuitna River, about 5.6 km (3.5 mi) north northeast of Tyonek.

Eastern/Ladd

This corridor would extend approximately 17.6 km (11 mi) east southeast from the mine service area to the same port site at Ladd.

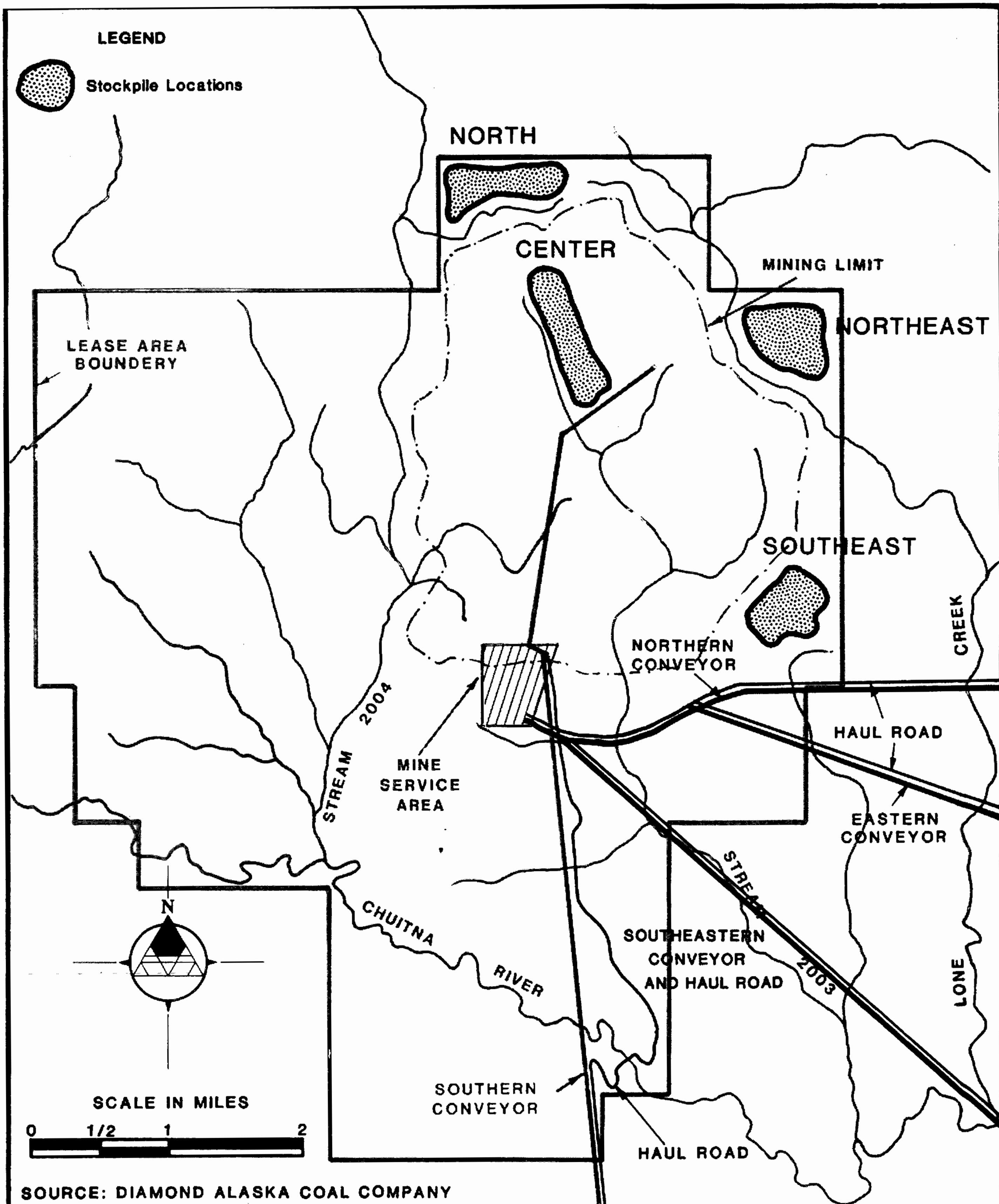
Southeastern/North Foreland

This corridor would extend approximately 18.4 km (11.5 mi) southeast from the mine service area to a port site at the North Foreland, about 2.4 km (1.5 mi) southwest of Tyonek.

Southern/Granite Point

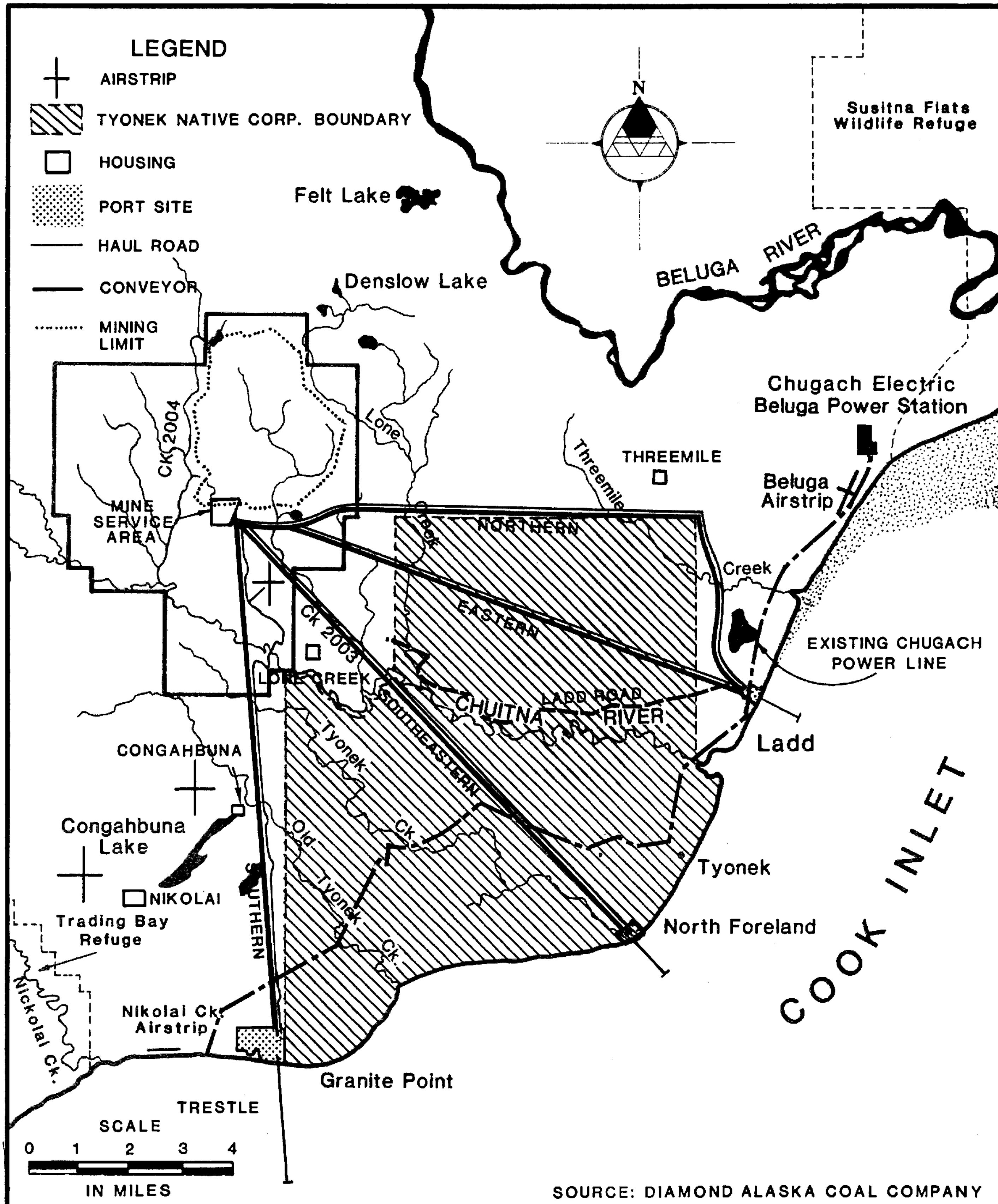
This corridor would extend approximately 17.6 km (11 mi) south from the mine service area to a port site at Granite Point, about 14.4 km (9 mi) southwest of Tyonek.

The existing Ladd Road (Fig. 3-2), primarily used in winter for moving heavy equipment in the region, was not considered since its alignment and condition are such that



INITIAL MINE AREA OPTIONS LOCATIONS

Diamond Chuitna Environmental Impact Statement | FIGURE 3-1



INITIAL TRANSPORTATION CORRIDOR, HOUSING AND AIRSTRIP OPTIONS LOCATIONS

Diamond Chuitna Environmental Impact Statement | **FIGURE 3-2** it would have to be totally rebuilt with no significant environmental or economic savings.

3.2.1.3 Transportation Mode

Six options were identified for the method of transporting coal from the mine to the port site.

Pneumo-train

In this option, open-top, wheeled capsules would be loaded continuously with crushed coal at the mine and propelled down a buried pipeline by compressed air to the port. There the coal would be dumped and the cars returned to the mine via a second pipeline. The coal would be stored at the port for ship loading.

Coarse Coal-Water Slurry

The coal would be crushed, mixed with water, and pushed through a slurry pipeline to the port. There the coal would be separated from the water, dried, and loaded directly onto ships. The slurry pipeline would operate only when a ship was available for loading, thus eliminating the need for coal storage at the port. Slurry water would be processed and recycled back to the mine in a closed system.

Coal-Carbon Dioxide Slurry

In this option, coal would be washed, crushed to a fine powder, and dried at the mine site. The powdered coal would be mixed with liquid carbon dioxide (CO_2) and transported via pipeline to the port. At the port, the CO_2 would be heated and flashed, thus separating the coal for direct loading onto a waiting ship. No coal would be stockpiled at the port. The CO_2 would be recompressed and returned to the mine.

Road

For this option, the haul road initially built to supply the mine area, which would be used to transport coal to the port for the first years of production, would continue to serve as the transportation mode throughout the life of the project. At full production, approximately twenty-three truck tractors, each hauling two 45.4 Mt (50 ton) uncovered trailers, would make about 311 round trips per day between the mine and the port. Coal would be stockpiled until a ship arrived.

Railroad

Crushed coal would be loaded at the mine for transport by rail to the port. Approximately 3.3 round trips per day would be made using 100-car trains over 1.6 km (1 mi) in length. Coal would be unloaded from the heavy duty bottom-dump hopper cars and stockpiled until a ship arrived.

Conveyor

For this option, coal would be crushed, placed on a single span, covered, conventional belt conveyor, and carried to the port. Coal would be delivered directly to a ship or taken from the conveyor and stockpiled until a ship arrived.

3.2.1.4 Loading Facility Type

Two options for the coal loading facility were identified.

Filled Causeway

The causeway would be earth-filled and armored with rock. It would support the conveyor and shiploader structures as well as a road for operations and maintenance personnel. The causeway would be used for unloading barges and other fuel and supply ships.

Elevated Trestle

An elevated, pile-supported approach trestle would support the conveyor and shiploader as well as a narrow roadway for operations and maintenance personnel and equipment. While it would not serve supply barges (there would be a separate barge staging area on the beach), it would support a pipeline to move fuel from tankers or barges to storage tanks at the onshore port area.

3.2.1.5 Loading Facility Length

Both short and long loading facilities for full production were considered for each port location. The options represent the facility lengths necessary to reach water depths that would allow use by either smaller (60,000 dwt) or larger (up to 120,000 dwt) vessels. The smaller vessels would require a berthing depth of about 14 m (46 ft) at mean lower low water (MLLW) while the larger vessels would require between 15.2 to 18.3 m (50 to 60 ft) of depth.

3.2.1.6 Housing Location

Four options for the location of worker housing were identified (Fig. 2-1).

Nikolai Site

The Nikolai site is about 9.6 km (6 mi) northwest of Granite Point and 14.4 km (9 mi) south of the mine site. The housing area would be located on the edge of the Nikolai escarpment with a southerly exposure overlooking Trading Bay State Game Refuge.

Congahbuna Site

The Congahbuna site is immediately northeast of Congahbuna Lake, about 8 km (5 mi) north of Granite Point and 9.6 km (6 mi) south of the mine site. This site would be located in the middle of the southern transportation corridor option.

Lone Creek Site

The Lone Creek site is immediately north of the Chuitna River about 12.8 km (8 mi) north of Granite Point. It would be west of Lone Creek and about 4.8 km (3 mi) southeast of the mine site.

Threemile Site

The Threemile site is north of Threemile Creek and south of the Beluga River about 6.4 km (4 mi) west of the Chugach Electric Association Beluga Power Plant. This site is located just north of the northern corridor.

3.2.1.7 Housing Type

Two options for worker housing were identified.

Townsite

The townsite would have a large proportion of individual houses and apartments for workers and their families. Additional community facilities would include schools, hospital, recreation center, religious facilities, town administration offices, police and fire stations, supermarket, and department store. The townsite would function as a largely self-contained entity with workers commuting to work daily from their homes as do most workers in Alaska. No transportation to the townsite from Anchorage would be provided and workers would live and recreate in and around the townsite.

Single Status Housing

Single status housing facilities would provide individual rooms for workers in a camp-type housing complex which would include a dining hall/administration building, recreation center, laundry, medical facilities, and security and fire services. Minimal emphasis would be placed on shopping and commercial facilities since the personal needs of the workers, including routine health care, would be served during their off-work, off-site periods. Workers would be flown to the project area from Anchorage and Kenai for their time on the job and then be returned home for their off-work periods.

3.2.1.8 Airstrip

Two options for location of an airstrip were identified: an existing airstrip in the region or a new one in proximity to the housing area.

3.2.1.9 Water Supply

Two options were considered for supplying both the industrial and domestic water needs of the project: surface impoundments and wells.

3.2.2 Options Screening Process

The options screening process was conducted in two steps. First, all 31 options identified during the scoping process were initially evaluated to eliminate those options which were clearly unreasonable or infeasible for environmental, technical, or other reasons. In the second step, all remaining options not eliminated in step one were evaluated in greater detail.

3.2.2.1 Initial Options Evaluation

Each of the 31 component options identified during the scoping process was individually reviewed from environmental and technical perspectives. If an option was environmentally and technically reasonable and feasible, it was retained for further analysis. If, however, the option was determined to be unreasonable or infeasible, and if other options retained for that component adequately addressed the 10 scoping issues, it was eliminated. Table 3-2 identifies the nine options eliminated during this initial options review, and outlines the major reasons why each was eliminated. Table 3-3 summarizes the results of the initial options evaluation process and shows which options were retained or eliminated.

The elimination of the southeastern/North Foreland transportation corridor/port location option requires some amplification. The North Foreland port site is located on land owned by TNC and was considered as an option because there is an existing port at the site, including a pier, which was used in the 1970s for loading wood chips aboard vessels for transport to market. An analysis of the pier, as well as tidal currents and ice conditions, was conducted by the applicant (Soros Associates 1986) to determine the feasibility of using the North Foreland site. That study, as reviewed by Dames & Moore, showed low ship berthing availability due to tidal currents and ice for any pier located at that site. While berthing availability would probably be adequate to load coal during the lower coal production levels early in the project, serious difficulties and vessel delay could be expected during full coal production levels of 10.9 million Mt (12 million short tons).

Table 3-2

MAJOR REASONS FOR ELIMINATION OF INDIVIDUAL OPTIONS
DURING INITIAL OPTIONS EVALUATION

Component	Option Eliminated	Major Reasons for Elimination
Overburden Stockpile	Center	o Inside mining limit (stockpiled material would have to be rehandled to mine under stockpile)
	Northeast	o Would require a bridge across Lone Creek o Visual impacts
Transportation Corridor/Port Location	Southeastern/ North Foreland	o Port site tidal currents and ice conditions prevent ship berthing/loading to full project production capacity
Transporation Mode	Pneumo-train	o Demonstration plant technology only
	Coarse coal-water slurry	o Moderate product degradation (10% BTU loss from water) o Unproven Arctic technology o Spill hazard
	Coal-carbon dioxide slurry	o Pilot plant technology only o Spill hazard o Final product not presently marketable
Loading Facility	Filled causeway	o Large quantities of fill and armor rock required o Constant protection from tidal and ice scour required o Interference with anadromous fish movements and local set net fishery
Housing Type	Townsite	o Substantially greater infrastructure required (water, sewer, housing, etc.) o Adverse to local autonomy o Less adaptable to traditional regional lifestyles o Competition with subsistence activities o Greater land area impact o Greater impacts on fish and wildlife (increased hunting & fishing; human/wildlife contacts; etc.)
Water Supply	Surface impoundments	o Block free-flowing streams o Interference with fish movements o High dams to store water in winter

Table 3-3

OPTIONS ELIMINATED OR RETAINED FOR FURTHER ANALYSIS
DURING INITIAL OPTIONS EVALUATION

Component	Options Retained	Options Eliminated
Mine Location	Fixed[1]	
Overburden Stockpile Location	North Southeast	Center Northeast
Mine Service Area	Fixed[1]	
Transporation System		
o Corridor/Port Location	Northern/Ladd Eastern/Ladd Southern/Granite Point	Southeastern/North Foreland
o Mode	Road Railroad Conveyor	Pneumo-Train Coarse Coal-Water Slurry Coal-Carbon Dioxide Slurry
Loading Facility		
o Type	Elevated Trestle[1]	Filled Causeway
o Length	Short Long	
Housing		
o Location	Nikolai Congahbuna Lone Creek Threemile Creek	
o Type	Single Status[1]	Townsite
Airstrip	Existing New	
Water Supply	Wells[1]	Surface Impoundments
Power Generation	Purchase[1]	

1 Sole option remaining for this component

The existing pier was also judged inadequate since water depth is not sufficient to accommodate vessels of 72,576 Mt (60,000 dwt) or larger needed at full production. Further, it is misaligned with respect to dominant ebb and flood current direction, it has an inadequate fender system and sedimentation at the berth, and it is structurally inadequate to support a movable type shiploader needed to load ships at full coal production levels.

As a result of the initial options screening, the number of components with only one option to be considered increased to six. Housing type, water supply, and type of loading facility joined the mine location, mine service area location, and power supply as single option components.

3.2.2.2 Remaining Options Evaluation

Since all options in the applicant's Proposed Projects were environmentally and technically reasonable and feasible, each of those options was retained so that the applicant's Proposed Projects would constitute formal alternatives to be analyzed during the analysis of alternatives process. Then, for each component where at least one option other than the applicant's choice remained, all options were individually evaluated from the perspective of each resource or technical discipline (e.g., water quality, subsistence, technical feasibility, etc.). If it was determined that one of the other options was as good as, or better than, the applicant's option on an overall basis, or if it addressed one or more of the 10 scoping issues in a significantly more favorable manner than did the applicant's proposed option, that option was retained for the analysis of alternatives process.

The following discussions summarize the results of these more detailed analyses and describe why an additional seven options and one component were eliminated from consideration. Generally, only those disciplines which would likely have a reasonable difference in impacts between options are discussed.

Overburden Stockpile

The two remaining stockpile locations, north and southeast (Fig. 3-1), would have similar impacts on water quality and vegetation, but the north site would be closer to fish spawning habitat and would be in the southern portion of a fall moose rutting* area. Also, use of the north site would subject drainage 2004 to project-related disturbance immediately rather than 22 years into the project. The north site would have poorer foundation conditions and would cause greater negative visual impacts than the southeast. On the basis of this analysis, and since it did not address any of the 10 scoping issues more favorably than the southeast site (the applicant's proposed option), the north site was eliminated, leaving the southeast site as the single option for location of the overburden stockpile.

Transportation Corridor/Port Location

Initial analysis of the three options showed that all were environmentally and technically reasonable and feasible. Because of the complicated nature of a discipline-by-discipline comparison among all three options, and since the northern/Ladd option and the eastern/Ladd option shared the same port site, it was logical to do a comparative analysis between these two options to determine if one option could be eliminated.

To compare these options, a specific set of "options screening criteria" was developed to evaluate potential impacts (Table 3-4). Table 3-5 summarizes the comparative resource discipline analyses for the northern/Ladd and the eastern/Ladd transportation corridor/port site options based upon the options screening criteria in Table 3-4. For each of the 10 disciplines, the potential adverse impacts for each option are shown relative to those for the other option. Generally, only those screening criteria having a reasonable difference in adverse impacts between options are discussed.

Analysis of relative potential for adverse impact to water quality showed that since the eastern/Ladd option would be shorter and make fewer stream crossings, it was considered to have a relatively low potential for adverse impact from sediment production during construction, operation, and reclamation. The northern/Ladd option was judged to have a relatively moderate potential for adverse impact.

From a vegetation standpoint, the longer northern/Ladd option would directly affect a larger acreage of vegetation and 44 percent more wetlands. Indirectly, the northern/Ladd option would potentially impact a greater area of vegetation due to traffic-generated dust. Therefore, the northern/Ladd option was judged to have a relatively moderate potential for impact while the eastern/Ladd option was judged to have a relatively low potential.

Analysis of the relative potential impact to fish showed that the eastern/Ladd option would involve four stream crossings with two crossings being in areas of high fish value. The northern/Ladd option would involve five to eight stream crossings with at least two crossings being in areas of high fish value. Thus, the overall relative potential for adverse impact for the eastern/Ladd option was judged to be low, while that for the northern/Ladd option was judged to be moderate.

From a wildlife perspective, the northern/Ladd option would directly impact more wetlands and riparian habitats

Table 3-4

TRANSPORTATION CORRIDOR/PORT LOCATION INDIVIDUAL DISCIPLINE OPTIONS SCREENING CRITERIA

Discipline[1]	Options Screening Criteria
Water Quality	Sediment production from road surfaces, cuts, fills, sideslopes and stream crossings Reclamation difficulty Spill Hazard (includes offshore port)
Vegetation	Direct vegetation loss Indirect loss from dust and vehicle or foot traffic Relative value of wetlands lost
Fish	Presence or absence of fish Value in terms of spawning, rearing or migration Number of stream crossings
Wildlife	Direct habitat loss Indirect habitat loss due to noise, other disturbance or human contacts Effects on animal movements
Socioeconomics	Local resident control of, or input to, project through land ownership Proximity of port site to Tyonek Income from corridor and port site leases
Subsistence	Interference with access to traditional use areas Interference with existing harvest activities Changes in resource availability (increased competition, reduced populations, changes in movement patterns)
Recreation	Impacts on existing recreation
Regional Use	Flexibility for other regional uses Size and location of component sites adequate for expansion Preclusion of other users or uses Consolidation with existing facilities
Technical Feasibility	Availability of adequate construction technology Relative complexity of design, construction and operation
Reclamation	Reclamation difficulty

[1] Includes only disciplines having a reasonable difference in impacts among the options

Table 3-5

COMPARATIVE RESOURCE DISCIPLINE ANALYSIS OF
RELATIVE POTENTIAL ADVERSE IMPACTS FOR THE NORTHERN/LADD AND
EASTERN/LADD TRANSPORATION CORRIDOR/PORT SITE LOCATION OPTIONS

	Northern/Ladd			Eastern/Ladd		
Discipline[1]	Low	Moderate	High	Low	Moderate	High
Water Quality		M		L		
Vegetation		M		L		
Fish		M		L		
Wildlife			H		M	
Socioeconomics		M		L		
Subsistence	L			L		
Recreation		M		L		
Regional Use		M			M	
Technical Feasibility	L			L		
Reclamation		M		L		

[1] Includes only disciplines having a reasonable difference in adverse impacts between the options.

important to waterfowl and bears, respectively. Indirect habitat loss for swan nesting and rearing would be equally high for both options, but the northern/Ladd option would pass within 457 m (500 yd) of an eagle nest. Effects upon animal movements for both options would be similarly moderate. Therefore, the northern/Ladd option was judged to have a relatively high potential for adverse impacts upon wildlife while the eastern/Ladd option was considered to have a relatively moderate potential.

Analysis of the socioeconomic impacts upon residents of Tyonek showed that the eastern/Ladd option would cross lands owned by TNC, thereby giving Tyonek residents some degree of control over project design and location as well as direct income from a corridor right-of-way lease. The northern/Ladd option would not cross any TNC lands. Both options would offer the same benefits of proximity to jobs as well as the disadvantages of the port site being relatively close to the village. Thus, the eastern/Ladd option was judged to have a relatively low potential for adverse impact while the northern/Ladd option was judged to have a moderate potential.

From a subsistence perspective, the potential for adverse impact to residents of Tyonek from either the eastern/Ladd option or the northern/Ladd option was considered to be low since Tyonek residents make relatively little use of lands affected by those options. The level of impact to the small number of residents between the Ladd port site and the Beluga power station is unknown, but would likely not differ significantly between the two options.

Analysis of relative potential impact to recreation showed that the northern/Ladd option crossed more streams than did the eastern/Ladd option, including three or four crossings of Threemile Creek. The northern/Ladd option would also pass very close to Viapan and Tukallah Lakes. Thus, the northern/Ladd option was judged to have a relatively moderate potential for adverse impact while the eastern/Ladd option was judged to have a relatively low potential.

From a regional use perspective, there was no significant difference between the options relating to size or ability to expand to accommodate other users, nor was there a difference in consolidation with existing facilities. Both options would cross private land which might restrict other potential uses in the future. The northern/Ladd option would cross the southern extreme of another state coal lease (Fig. 4-1), thus making development more economically feasible by having a road and conveyor right on the lease. This was not judged, however, to be a significant difference considering the relatively small advantage this would provide to the lease holder. Thus, on an overall regional use basis, both options were considered to have moderate potential for adverse impact.

Analysis of technical feasibility showed adequate construction technology exists for both options, with neither having significant complexity of design, construction, or operation. Thus, both options were judged to have a relatively low potential for adverse impacts.

From a reclamation perspective, the northern/Ladd option, with its greater length and acreage of wetlands and higher number of stream crossings, was considered to be more difficult to reclaim. Thus, the eastern/Ladd option was judged to have a relatively low potential for adverse impacts while the northern/Ladd option was judged to have a moderate potential.

Overall analysis of the 10 resource disciplines for the two transportation corridor/port site options showed (Table 3-5) that the eastern/Ladd option clearly had a lower overall potential for adverse impacts than did the northern/Ladd option. The eastern/Ladd option was judged to have a low potential for adverse impacts for eight of the 10 disciplines with none rated as having a high potential, while the northern/Ladd option was judged to have a low potential for impacts for only two disciplines and rated as having a high potential for one.

In final analysis, the eastern/Ladd option was judged superior to the northern/Ladd option. However, despite its inferior rating, the northern/Ladd option could not be eliminated at this early option screening stage because it is one of the applicant's alternatives. Therefore, both options were retained and specifically addressed in the comparison of action alternatives process.

Transportation Mode

Table 3-6 summarizes the resource discipline analysis of the three remaining transportation modes for moving coal from the mine to the port: road, railroad, and conveyor (the applicant's proposed option).

For each discipline, the potential adverse impacts for each option are shown relative to the potential impacts for the other two options. For the road option, it is important to keep in mind that a road from the port to the mine would still exist in any event, i.e., the road would be there whether or not another coal transportation mode was constructed. Therefore, cumulative adverse impacts were considered for construction of the other transportation modes. For example, the road would have a lower adverse impact than the railroad or conveyor on vegetation because their construction would destroy additional vegetation, while use of the existing road to haul the coal would

Table 3-6

RESOURCE DISCIPLINE ANALYSES OF THE RELATIVE
POTENTIAL ADVERSE IMPACTS OF TRANSPORTATION MODE OPTIONS

	Mode								
	Road			Railroad			Conveyor		
Discipline[1]	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
Water Quality			H	L			L		
Air Quality			H		M		L		
Vegetation	L					H			H
Fish		M		L			L		
Wildlife			H		M		L		
Subsistence		M				H			H
Visual			H		M			M	
Noise			H		M		L		
Recreation			H		M		L		
Economics		M				H	L		
Reclamation	L					H		M	
Regional Use		M		L				M	

[1] Includes only disciplines having a reasonable difference in adverse impacts among the options.

cause no additional vegetation destruction (assuming adequate dust control measures). The following discussion addresses only resource discipline analyses which showed a reasonable difference in adverse impacts among the options.

Because of the high level of truck traffic necessary to transport the coal by road at full production (approximately 331 round trips per day), erosion problems, hence potential adverse water quality impacts, would be significantly greater than for either the railroad or conveyor options, both of which were rated as relatively low.

By the same reasoning, the road option rated high for potential adverse air quality impacts. The railroad, which would generate a diesel smoke plume and some dust, was rated as moderate. The conveyor option was rated as low.

From a vegetation perspective, the road option rated relatively low since the road would already exist and only moderate additional vegetation destruction would occur if it continued to be used to haul coal throughout the life of the project. Potential adverse railroad impacts were rated as relatively high due to the necessity to clear and maintain another right-of-way. Although the conveyor itself would sit on elevated supports, it would need an adjacent service road throughout its length which would also require clearing and maintenance of another right-of-way. The conveyor option was also rated as having a relatively high potential for adverse impacts to vegetation.

The greater potential adverse water quality impacts identified for the road option, discussed above, resulted in a relatively moderate rating for potential adverse fish impacts while the railroad and conveyor options were rated as relatively low for this discipline.

From a wildlife perspective, the road option possesses a relatively high level of potential for adverse impacts because of disturbance from noise and vehicle movements associated with the 331 round trips per day (an average of one truck with two trailers passing a given point every 2 minutes, 22 hours per day, 362 days per year). Also, deep snow in winter would cause moose to use the cleared road to move about, resulting in more frequent vehicle/moose collisions. The railroad option would generate substantially less noise and movement on a continuous basis than would the road, but it would have the same problems with moose collisions in winter. It was rated as having a relatively moderate potential for adverse impact. The conveyor would be stationary and would generate significantly less noise. Its main potential adverse impact would be physical blockage of animal movements, a problem not associated with either the road or railroad. Since large animal crossings would be designed into the conveyor option, it was rated as having a relatively low potential for adverse impact.

The road and railroad would potentially have direct adverse impacts upon subsistence resources. The moose population, especially, would be expected to be adversely affected as a result of collisions with vehicles. The railroad and conveyor could also have direct impacts upon subsistence use because they could physically block access across the transportation corridor. With the conveyor generally elevated only 0.6 m (2 ft) above the ground (with no clearance in winter due to snow), traditional winter travel across the corridor could be limited to the road and large animal crossings. The railroad right-of-way could pose a similar though less formidable obstacle, especially to snow machines. Thus, the road was considered to have a relatively moderate potential for adverse impacts on subsistence while the railroad and the conveyor were considered to have relatively high potential for adverse impacts.

Visually, the road, with its frequent truck traffic and associated dust, was judged to have a relatively high level of potential for adverse impact. The railroad, with its 5.5 m (18 ft) high engines and 1.6 km (1 mi) long trains was judged to have a relatively moderate level of potential for adverse impact. The conveyor would be stationary and stand about 2.7 m (9 ft) above the ground and was also judged to have a relatively moderate level of potential for adverse impacts.

The road option was determined to have a relatively high potential for adverse impacts from noise associated with truck traffic. The railroad was judged to have a moderate relative potential impact for noise, while the conveyor was determined to have a relatively low potential impact.

From a recreation perspective, noise and visual considerations (including dust) were the primary factors used to determine effects upon the quality of the recreation experience. On that basis, the road was determined to have a relatively high potential for adverse impact while the railroad was judged to have a relatively moderate potential. The conveyor, with its stationary nature and lower noise level, was judged to have a relatively low level of potential impact.

On the basis of initial capital as well as operation and maintenance costs, the road option was judged to be of moderate overall economic impact while the railroad was determined as having a relatively high economic impact. The conveyor was judged to have an overall relatively low economic impact.

From a reclamation perspective, the road, which would exist in any event, was considered to have a relatively low potential for adverse impacts. The railroad was judged to have a relatively high potential impact because of the necessity to reclaim the greater cuts and fills necessary to maintain grade and to remove the large bridge across the Chuitna River if the southern corridor option were selected. The conveyor, which would largely be elevated above the ground on pilings, was considered to have a relatively moderate potential for adverse impacts from reclamation.

The railroad seemed to possess some possible advantage over the other two options when considering future regional uses. The road option would exist for other potential users regardless of which other coal transportation mode was built. The conveyor system would be sized for the output of the Diamond Chuitna project only. If another coal development commenced operations during the life of the Diamond Chuitna project or if another large development occurred after the coal mine was terminated, the conveyor system would not have the capacity or geographic flexibility to handle additional coal. The railroad option could provide some advantage for another coal development project favorably located with respect to the right-of-way. However, another project of similar size to the Diamond Chuitna project would probably have to substantially upgrade the size of any existing railroad system to meet its needs. Thus, both the road and the conveyor options were judged to have a relatively high potential for adverse impacts from a regional perspective (i.e., both would have no significant positive effect on promoting a regional coal transportation system), while the railroad was judged to have a relatively moderate level of adverse impacts.

Overall analysis of the three options (Table 3-6) clearly showed that the conveyor option had the lowest levels of relative adverse impacts for the twelve disciplines considered. The conveyor option showed relatively high potential for adverse impacts for only three disciplines: vegetation, subsistence and regional perspective. The relative differences among the three options for potential impacts to vegetation were not judged to be significant. The relatively high adverse impact rating for the regional use discipline was also judged not to be significant because it merely means that the conveyor would not have a positive effect on promoting a regional coal transportation system, but it would not in any way preclude such a system from being developed in the future.

The one major discipline concern for the conveyor was the relatively high potential impact of blocking access to traditional subsistence use areas if the southern corridor/Granite Point option were selected. This concern could be addressed by providing enough crossings to permit subsistence users reasonable access to traditional use areas. It was felt that this potential problem could be adequately handled in the design of that option, and thus the conveyor system (the applicant's proposed option) was judged the best overall transportation mode option for addressing the 10 scoping issues.

Loading Facility Length

Both full production options identified, i.e., a short trestle and a long trestle, were dependent upon vessel draft and water depth. The greatest difference between these options would occur at the Granite Point port site where the shorter trestle would be approximately 2,277 m (7,470 ft) and the longer trestle 3,810 m (12,500 ft). Analysis showed only three areas where a reasonable difference between the options would exist. Visually, the longer facility would have a greater adverse impact. It would also require somewhat greater travel time for a larger boat moving along the coast to pass around it. Smaller boats, which make up the majority of existing use, could sail through the 122 m (400 ft) openings between the trestle supports. From a regional use perspective, however, the longer facility could be considered more favorable because of its increased flexibility for other potential users. None of these three differences was considered significant and neither option addressed any of the 10 scoping issues in a significantly more favorable manner than the other. Thus, it was judged that length of the loading facility was not of significant importance and it was dropped as a component.

Housing Location

Initial analysis of the four housing location options, Nikolai, Congahbuna, Lone Creek (the applicant's proposed option), and Threemile, showed that three of the four sites were corridor specific (Fig. 3-2). Lone Creek was the only option which could be used regardless of which transportation corridor was selected. Both the Nikolai and Congahbuna sites are located well south of the mine area near Granite Point and would be practical only if the southern corridor were selected. The Threemile site is just north of the northern corridor near the Beluga power station and would be practical only if the northern corridor were selected. Since all four sites had already been determined to be environmentally and technically reasonable and feasible, it was decided to retain each corridor-specific option for alternative analysis with its respective corridor. This was predicated on the assumption that the option was the best one for that corridor and that it addressed at least one scoping issue more favorably than did the Lone Creek site. The Lone Creek site would be retained in any event because it is the applicant's proposed option and it is not corridor specific.

Analysis of the Nikolai and Congahbuna options showed that they are within 4.8 km (3 mi) of each other and have many similarities. Because the two sites are so similar, it appeared most logical to compare them to one another to select the more favorable for retention.

Although the Nikolai and Congahbuna sites showed few significant differences among potential adverse resource discipline impacts, the Nikolai site was considered to have more potential for adverse impacts upon both fish and wildlife because it is closer to Nikolai Creek and Trading Bay Refuge. Also, Nikolai would have a greater adverse visual impact because it would be located apart from the conveyor and the haul road whereas Congahbuna would be in the transportation corridor immediately adjacent to the conveyor and haul road. The Nikolai site, being further from the mine site, would also increase the daily cost of transporting the majority of workers to their work stations. From the subsistence perspective, however, there does not appear to be much use of the Nikolai site by local residents while the area in the vicinity of Congahbuna Lake receives some use for hunting, picnicking, and berry picking. Taking all potential impacts into account, the Congahbuna site collectively was judged to be more favorable than the Nikolai site.

A further analysis between the Lone Creek and Congahbuna housing site options showed that the Congahbuna option addressed at least two scoping issues (fish and socioeconomics) in a significantly more favorable manner than did the Lone Creek option. Therefore, the Congahbuna option was retained for alternatives analysis.

Analysis of the Threemile housing site showed this option addressed at least one scoping issue (regional use) in a more favorable manner than did the Lone Creek option. Therefore, the Threemile option was retained for the alternative analysis process.

Airstrip Location

Two options were identified for locating the airstrip to be used to shuttle workers between the project area and their homes in Anchorage and on the Kenai Peninsula: use of a presently existing airstrip in the vicinity of the project area or construction of a new airstrip adjacent to the housing site ultimately selected. The latter is the applicant's preferred option.

Using an existing airstrip would offer the advantages of lower capital costs for construction and less environmental impact at the site of the proposed new airstrip. Disadvantages would include: the possible need to construct additional roads and bridges to access an existing strip; greater operational costs and environmental impacts from transporting workers and equipment significantly greater distances; the necessity to substantially upgrade an existing airstrip; and the possibility of more marginal operating conditions because the existing runway alignment might not be optimum. Other disadvantages related to the operation of an existing airstrip at greater distances from the housing site would include the need to construct larger terminal facilities to shelter workers waiting for planes, the increased risk and liability from unauthorized use of a previously public airstrip by private pilots, hunters or fishermen, and vandalism.

On a more site-specific basis, all currently usable airstrips in the vicinity of the project area which might be upgraded to handle traffic needs for the Diamond Chuitna Project are private. Thus, their availability for use by the project would be uncertain. The major airstrips (Beluga, Tyonek, and Nikolai Creek) would be located approximately 19.2 to 28.8 km (12 to 18 mi) from the mine site. While the Beluga airstrip is presently capable of handling the traffic needs of the project, Tyonek and Nikolai Creek are not. They both would require lengthening and construction of a cross runway. This would probably not be possible at Nikolai Creek because of space limitations and the substantial adverse wetlands impacts which would occur. Whether residents of Tyonek would consent to a major upgrading and operation of a busier airstrip immediately adjacent to the village is doubtful.

Other airstrips in the vicinity are mostly smaller ones built to support short term oil and gas drilling operations. Some are presently useable by small aircraft, but all would require substantial upgrading and construction of a cross runway before being capable of supporting the project's operational needs. From a strictly geographical standpoint, the "Pan Am" airstrip, located only 0.6 km (0.4 mi) east of the Lone Creek housing site, would appear to be the most logical location because it would be close to the mine site. However, its location on the bluff above stream 2003 would prevent it from being upgraded to sufficient size.

On the basis of the advantages and disadvantages discussed above, it was judged that use of an existing airstrip in the vicinity of the project area, as opposed to construction of a new airstrip immediately adjacent to the housing site, would not address any of the 10 issues in a significantly more favorable manner. This option was therefore eliminated.

At the completion of the options screening process, a total of one component and 15 options had been eliminated. The options that were retained and used to form the action alternatives are shown in Table 3-7.

3.2.3 Identification and Description of Action Alternatives

The options screening process left only two components with more than one option remaining: the transportation corridor/port site location and the housing site location. Since the applicant wishes to retain two transportation corridor/port site options (southern/Granite Point and northern/Ladd), two alternatives using these options were identified as the applicant's proposed projects. A third

Table 3-7

OPTIONS USED TO FORM ALTERNATIVES

Component	Option(s)
Mine Location	Fixed
Overburden Stockpile Location	Southeast
Mine Service Area	Fixed
Transportation System	
o Corridor Location	Southern/Granite Point Northern/Ladd Eastern/Ladd
o Mode	Conveyor
Loading Facility	Elevated Trestle
Housing	
o Location	Lone Creek Congahbuna Threemile Creek
o Type	Single Status
Airstrip	New
Water Supply	Wells
Power Generation	Purchase

alternative, using the eastern/Ladd option, is also discussed. Finally, two housing/airstrip options other than the applicant's proposed option at Lone Creek were identified. The following sections describe the action alternatives that have been selected for detailed consideration in this EIS. Table 3-8 presents a matrix showing which components are included in each alternative.

3.2.3.1 Southern/Granite Point Alternative

In addition to the fixed mine and mine service area locations, this alternative would site the overburden stockpile southeast of the mining limit. It includes a conveyor system within the southern transportation corridor to the site at Granite Point (Figs. 2-1 and 3-1). The port coal-loading facility would be an elevated trestle. A single-status housing facility with associated new airstrip would be located at the Lone Creek site. Water would be supplied by wells and power would be purchased from the Chugach Electric Association natural gas power station at Beluga.

3.2.3.2 Northern/Ladd Alternative

This alternative is the same as the southern/Granite Point alternative except the northern transportation corridor to a port site at Ladd would be used (Fig. 2-1).

3.2.3.3 Eastern/Ladd Alternative

This alternative would be the same as the northern/Ladd alternative except that the eastern corridor to a port site at Ladd would be used (Fig. 2-1).

3.2.3.4 Housing/Airstrip Options

Congahbuna Housing/Airstrip Option

This option would be substituted for the Lone Creek housing/airstrip site in the southern/Granite Point alternative with the housing area and the airstrip being located at the Congahbuna site (Fig. 2-1).

Threemile Housing/Airstrip Option

This option would be substituted for the Lone Creek housing/airstrip site in the northern/Ladd alternative with the housing area and the airstrip being located at the Threemile site (Fig. 2-1).

3.2.4 Comparison of Action Alternatives

The three action alternatives were compared to determine the preferred alternative. The Congahbuna and Threemile housing/airstrip options were then compared with the Lone Creek option to determine whether either option

Table 3-8

DIAMOND CHUITNA PROJECT ACTION ALTERNATIVES

Project Components and Options	Action Alternatives		
	Southern/ Granite Pt.	Northern/ Ladd	Eastern/ Ladd
Mine Location* - Fixed	X	X	X
Overburden Stockpile Location* - Southeast	X	X	X
Mine Service Area* - South of Mining Limit	X	X	X
Transportation			
a) Corridor/Portsite			
1. Southern/Granite Point	X		
2. Northern/Ladd		X	
3. Eastern/Ladd			X
b) Mode* - Conveyor	X	X	X
Loading Facility* - Trestle	X	X	X
Worker Housing			
a) Location			
1. Lone Creek	X	X	X
2. Congahbuna			
3. Threemile			
b) Type* - Single Status	X	X	X
Airstrip* - New Construction	X	X	X
Water Supply* - Wells	X	X	X
Power Generation* - Purchase Gas	X	X	X

*Components with only one option.

provided a significant advantage over the Lone Creek site such that it could substitute for the Lone Creek option in one or more of the alternatives. The analytical basis for the comparisons in this section is provided in the detailed impact discussions in Chapter 5.0. The reader is encouraged to consult Chapter 5.0 for more extensive examination of the major issues.

Evaluation criteria based on the ten issues identified during scoping (Section 1.4) were developed to compare the three action alternatives and the housing options. The criteria are shown in the first column of Table 3-9. For each scenario, the evaluation criteria were applied separately to each alternative to determine the relative values for the total potential impacts for that alternative. It is important to note that the "relative total impact value" assigned to a given alternative for a specific criterion was derived only by evaluation of that alternative relative to the other alternatives for that scenario. The relative values used were low, moderate, and high.

For example, using the third evaluation criterion (Table 3-9), i.e., "Minimize impacts to wildlife and wildlife habitats," each alternative was analyzed from the standpoint of its total potential for impacts to wildlife and wildlife habitat and a relative value (compared to the other two alternatives) was assigned. Only significant differences in potential impacts were considered. Thus the southern/Granite Point alternative had a relatively moderate value for total potential wildlife and wildlife habitat impacts compared to the northern/Ladd and eastern/Ladd alternatives which had relative values of high and low, respectively. Table 3-9 summarizes the relative total impact values for each evaluation criterion. This allows a consistent comparison of alternatives to be made.

It must be emphasized that while a particular alternative might be assigned a high relative total impact value when compared with the other alternatives, it does not necessarily mean that the alternative would have a high absolute impact. In this chapter, therefore, alternatives were assigned a total impact value relative to one another while the actual significance of the alternatives' impacts are described in Chapter 5.0.

Analysis showed that, because of the specific nature of the project and the make-up of the action alternatives, most of the significant potential impacts were associated directly with activities at the mine and that there were relatively few significant differences in potential impacts among the other project components. Since all impacts associated directly with the mine and its attendant operations were common to all alternatives, the comparison of alternatives process addresses only potential impacts associated with the components of the project other than the mine. The locations of the transportation

Table 3-9

EVALUATION CRITERIA MATRIX SHOWING RELATIVE TOTAL IMPACT VALUES ASSIGNED TO THE THREE ACTION ALTERNATIVES

Evaluation Criteria	Southern/ Granite Pt.	Northern/ Ladd	Eastern/ Ladd
1. Minimize risk of water quality degradation and alteration to flows	Moderate	Moderate	Low
2. Minimize impacts to fish and fish habitat	Moderate	Moderate	Low
3. Minimize impacts to wildlife and wildlife habitats	Moderate	High	Low
4. Minimize potential reclamation problems	Low	Low	Low
5. Minimize impacts to set net fishery	Moderate	High	High
6. Minimize impacts to traditional subsistence harvest activities	High	Low	Low
7. Minimize social, cultural, and economic impact upon local residents	Moderate	Moderate	Low
8. Minimize cumulative regional use impacts	Low	Moderate	Moderate
9. Minimize technical complexity	Low	Low	Low
10. Minimize cost	No Data	No Data	No Data

corridor, port site, and the housing and airstrip sites were the only components creating significant differences in potential impacts among alternatives.

Water Quality

Potential water quality impacts were evaluated primarily on the basis of the risk of petroleum product spills and sediment production from road surfaces, pads, cuts, fills, and stream crossings. No significant differences in potential impacts were identified between the southern/Granite Point and northern/Ladd alternatives. The eastern/Ladd alternative would have fewer potential impacts since it would be shorter and cross no major streams as would the southern/Granite Point alternative. It would also cross flatter terrain than either of the others. Therefore, the southern/Granite Point and northern/Ladd alternatives were assigned moderate relative total impacts values for water quality while the eastern/Ladd alternative was assigned a low value.

Fish

Potential impacts to fish and fish habitat were evaluated primarily on the basis of the presence or absence of fish, the number of stream crossings, and the value of potentially affected streams for fish spawning, rearing or migration.

No significant differences in potential impacts were identified between the southern/Granite Point and northern/Ladd alternatives. The eastern/Ladd alternative would have fewer potential impacts since it would cross fewer streams than the northern/Ladd alternative and would cross no major streams as would the southern/Granite Point alternative. It would also impact fewer lakes than either of the other alternatives. Therefore, the southern/Granite Point and northern/Ladd alternatives were assigned moderate relative total impact values for fish while the eastern/Ladd alternative was assigned a lower value.

Wildlife

Potential impacts upon wildlife were evaluated primarily on the basis of direct and indirect habitat loss since potential impacts arising from interference with movements across the corridors could be largely mitigated by proper design, construction, and operation of animal crossings.

The northern/Ladd alternative was considered to have greater potential impacts than either of the others because it is longer and would cross riparian habitat important to brown bears feeding upon salmon. The southern/Granite Point and northern/Ladd alternatives would have similar impacts to wetlands important to wildlife, but the eastern/Ladd alternative would cross fewer important wetlands than either of them. The eastern/Ladd alternative, unlike the other two alternatives, would also avoid eagle nests. Thus, the eastern/Ladd alternative was assigned a low relative total impact value while the southern/Granite Point and northern/Ladd alternatives were assigned values of moderate and high, respectively.

Reclamation

Essentially all of the major reclamation concerns identified during the scoping process were focused on the mine and its surrounding area. Technology for successful reclamation of the other project components exists and has been demonstrated to be effective for other Alaska projects. Since reclamation procedures that would be used at the mine and its surrounding area would be common to all three alternatives, no significant differences were identified among the three alternatives for this criterion and all were assigned a low relative total impact value.

Set Net Fishery

Potential adverse impacts to the commercial set net fisheries near the port sites were evaluated primarily on the basis of interference with fish movements and existing set net sites caused by the supply barge unloading facility, the approach threstle, and coal vessel traffic.

The Ladd port site and supply barge unloading facility were judged to have a significantly greater potential for impact upon set net sites since they are located in the midst of one of the most productive set netting areas in upper Cook Inlet. The Granite Point site would also impact some set net sites, but to a lesser extent. Both the northern/Ladd and eastern/Ladd alternatives were thus assigned a high relative total impact value while the southern/Granite Point alternative was assigned a moderate value.

Subsistence

Potential subsistence impacts were evaluated primarily on the basis of: 1) effects on access to, and use of, traditional use areas; 2) changes in fish and wildlife abundance; 3) interference with fish and wildlife cycles or movements; 4) increased nonresident harvest of subsistence resources; and 5) the possibility of increasingly restrictive harvest regulations.

The southern/Granite Point alternative was judged to have a significantly greater potential for impacts to subsistence since the lower corridor and port site would be in areas traditionally used for subsistence by residents of

Tyonek while the other two alternatives are located in areas with no significant subsistence use. Also, the southern/Granite Point alternative would open access to the Chuitna River to impacts on subsistence fish species. Therefore, the southern/Granite Point alternative was judged to have a high relative total impact while the northern/Ladd and eastern/Ladd alternatives were judged to have low values.

Socioeconomics

No significant differences in socioeconomic impacts to Anchorage or the Kenai Peninsula were identified among the three alternatives. Potential socioeconomic impacts to Tyonek were evaluated primarily on the basis of effects upon: 1) local employment, 2) community population and infrastructure, and 3) social and cultural values.

No significant differences were identified among the three alternatives for local employment since Tyonek is connected to the southern/Granite Point alternative by the existing road system and a small vehicle bridge would be built across the lower Chuitna River to provide access to either of the two other alternatives. The social and cultural impacts to residents of Tyonek would be similar for any of the three alternatives. If the eastern/Ladd alternative were selected, however, it could give Tyonek a significantly greater degree of control over the project and would increase the applicant's accountability to the community. Tyonek would also receive revenue from the transportation corridor right-of-way lease. Therefore, the eastern/Ladd alternative was assigned a low relative total impact value while the southern/Granite Point and northern/Ladd alternatives were assigned moderate values.

Regional Use

Potential impacts to regional use were evaluated primarily on the basis of consolidation with existing facilities, potential for other regional uses, and component size, location, and adequacy for expansion.

The southern/Granite Point alternative would be closer than the other two alternatives to areas most likely to be developed in the future (e.g., the Placer U.S. Center Ridge coal deposit west of the Diamond Chuitna project area). This could have a positive effect upon the feasibility of some potential developments since a crossing of the Chuitna River would not be required to reach the port site as would be necessary with either the northern/Ladd or eastern/Ladd alternative.

The southern/Granite Point alternative would also consolidate with the existing road system and facilities in the Granite Point area while the other alternatives would not consolidate with existing facilities to the same extent. This, however, was not judged to be significant.

The southern/Granite Point alternative would be constructed entirely on public land and the port site would have ample room for expansion, thus likely making the corridor and port site available to other potential users. The northern and eastern corridors, however, would cross some private lands which may not be available to future users. Also, while the port site at Ladd is public land, the amount of public land is not as large as at Granite Point, possibly precluding expansion to accommodate other users and requiring development of another port.

In the final analysis, the southern/Granite Point alternative was judged to have a low relative total impact value while the northern/Ladd and eastern/Ladd alternatives were judged to have moderate values.

Technical Complexity

Potential technical complexity impacts were evaluated primarily on the basis of the availability of adequate technology and the relative complexity of design, construction, and operation. Adequate technology presently exists to design, construct, and operate all three alternatives. Both port sites have shoals offshore which would need to be considered in navigating ships during operations. This was not considered a significant cause for concern in either situation. Therefore, all three alternatives were assigned a low relative total impact value.

Cost

No comparative cost data for any of the three alternatives were made available by the applicant. Therefore, no relative total impact values have been assigned for this criterion.

3.2.5 Identification of Preferred Alternative

The comparison of alternatives process described above assigned relative total impact values to the three action alternatives for each of the ten evaluation criteria (Table 3-9). It should be remembered that when using relative total impact values, the lower the value the better, i.e., a lower value equates with a lower potential for adverse impact. Inspection of Table 3-9 shows that for the nine evaluation criteria for which data were available, seven showed significant differences among the three alternatives: water quality, fish, wildlife, set net fishery, subsistence, socioeconomics, and regional use.

The eastern/Ladd alternative clearly had the lowest overall relative total impact value. For five of the seven criteria showing a significant difference among the alternatives, it received a low rating. Only for the set net fishery criterion did it receive a high rating.

While impacts to set netters from a port site at Ladd could be significant, proper scheduling and operational management at the port site would likely substantially reduce or eliminate significant impacts to the fishery. Such impacts probably would not occur from coal loading operations at full production which would take place at the end of the trestle over 3 km (1.8 mi) from shore, but rather from the supply barge staging area on the beach adjacent to the trestle. Since the set net sites are used only during the fishing season, and then only on certain days of the week, proper scheduling of incoming supply barges to avoid fishing openings and to accommodate local fishermen's traditional uses could likely avoid serious impacts.

On the basis of its having the least overall relative total impact value and the capability of substantially reducing or eliminating significant impacts to the lone criterion (set net fishery) for which it received a high rating, the eastern/Ladd alternative was identified as the preferred alternative.

Whether the applicant could develop an eastern corridor, however, is not certain. The corridor would cross private land owned by TNC and to date, the applicant and TNC have been unable to negotiate a right-of-way agreement. Since there is no assurance that an eastern corridor could be developed even though identified as the preferred alternative, the southern/Granite Point and northern/Ladd alternatives were further analyzed to determine the secondary preferred alternative.

The southern/Granite Point and northern/Ladd alternatives showed significant differences in potential impacts for four criteria: wildlife, set net fishery, subsistence, and regional use (Table 3-9). The potential exists for significantly greater impacts to the set net fishery for the northern/Ladd alternative as discussed above for the eastern/Ladd alternative. Proper scheduling and operational management, however, would substantially reduce or eliminate such impacts.

The differences for the wildlife criterion were considered significant. The northern/Ladd alternative would have greater adverse quantitative and qualitative habitat impacts that could not be mitigated to eliminate those differences.

For the subsistence criterion, the southern/Granite Point alternative would have significantly greater adverse impacts that could not be mitigated to eliminate the differences. The northern/Ladd alternative would have very limited impact on subsistence values while the southern/Granite Point alternative would be built through a significant traditional use area.

From the regional use perspective, the low potential for adverse impacts for the southern/Granite Point alternative was considered a significant benefit. The size of the area available for the port site at Granite Point as well as its geographic location with respect to likely future developments and the southern corridor's location entirely on public land were considered to be significantly better than for the northern/Ladd alternative.

Thus the lower potential for adverse impacts from the southern/Granite Point alternative for the set net fishery, wildlife and regional use criteria were countered by the higher potential for impacts for the subsistence criterion. Therefore, on an overall basis the southern/Granite Point alternative was judged to have a lower potential for adverse impacts than did the northern/Ladd alternative. Although the preponderance of higher potential for adverse impacts to the evaluation criteria from this comparison were attributed to the northern/Ladd alternative, the potential effects upon local residents from the higher impacts to subsistence from the southern/Granite Point alternative were not lightly dismissed. Thus, while the overall potential for adverse impacts was judged higher for the northern/Ladd alternative, it was not a clear cut difference.

3.2.6 Comparison of Housing/Airstrip Options

The three alternatives compared above all used the Lone Creek site as the option for the housing and airstrip components. Two other options were identified for those components and are compared below to the Lone Creek site. These are the Congahbuna and Threemile sites. The purpose of this comparison was to determine whether either site provided a significant advantage over the Lone Creek site such that it could be substituted for the Lone Creek option in one or more of the alternatives.

The differences in impacts to the evaluation criteria among all three housing/airstrip sites are described below. For each criterion, the basis for the evaluations were the same as those used above in comparing the three alternatives (e.g., spill risk and sediment production for water quality, direct and indirect habitat loss for wildlife, etc.). The relative total impact values assigned to a criterion for each housing/airstrip option are shown in Table 3-10.

Water Quality

No significant differences in potential water quality impacts were identified for any of the three options. Therefore, each was assigned a low relative total impact value.

Table 3-10

EVALUATION CRITERIA MATRIX SHOWING RELATIVE TOTAL IMPACT VALUES ASSIGNED TO THE THREE HOUSING OPTIONS

	Evaluation Criteria	Lone Creek	Congahbuna	Threemile
1.	H_2O Quality	Low	Low	Low
2.	Fish	Moderate	Low	High
3.	Wildlife	Low	Moderate	Moderate
4.	Reclamation	Low	Low	Low
5.	Set Net	Low	Low	Low
6.	Subsistence	Moderate	High	Low
7.	Socioeconomic	Low	Low	Low
8.	Regional Use	Low	Low	Low
9.	Technical Complexity	Low	Low	Low
10.	Cost	No Data	No Data	No Data

Fish

The Congahbuna site would have a lower impact than Lone Creek since it is located at least 3.2 km (2 mi) from the Chuitna River, thus making it more difficult for workers to fish. The Threemile site would have a greater impact than Lone Creek as its location would permit access to several lakes or streams with fish. Thus, the Congahbuna site was judged to have a low relative total impact value while the Lone Creek and Threemile sites were judged to have values of moderate and high, respectively.

Wildlife

Both the Congahbuna and Threemile sites would have a greater impact upon waterfowl and swans than would the Lone Creek site as they would be located close to areas used by waterfowl and swans for breeding, resting, and some migration. Therefore, the Lone Creek site was assigned a low relative total impact value while the Congahbuna and Threemile sites were assigned moderate values.

Reclamation

Technology for successful reclamation of the housing and airstrip facilities at any of the three sites exists and has been demonstrated to be effective for other Alaska projects. Therefore, each of the sites was assigned a low relative total impact value.

Set Net Fishery

No significant differences in potential impacts to the set net fishery were identified for any of the sites. Therefore, each of the sites was assigned a low relative total impact value.

Subsistence

The Congahbuna site would have potential for significantly greater impacts to subsistence than the Lone Creek site as it would be located in an area of traditional subsistence use. The Threemile site would have somewhat lower potential for impact than the Lone Creek site since it would be well removed from areas of traditional subsistence use. Thus, the Congahbuna option was assigned a high relative total impact value while the Lone Creek and Threemile options were assigned moderate and low values, respectively.

Socioeconomics

Both the Congahbuna and Threemile options would have somewhat less potential impact than the Lone Creek option since there would be less fishing in the Chuitna River by workers and the local fishing guides would not have as much competition for fish. This, however, was not considered to be a significant difference. Therefore, all three options were assigned low relative total impact values.

Regional Use

Future developments (e.g., coal) would be most likely to take place to the northwest of the Diamond Chuitna project area. The Congahbuna housing and airstrip site would be closer to these potential development sites than would be either Lone Creek or Threemile. Closer inspection, however, shows that its distance from potential developments is great enough that the site would not likely be used by other developments in the region and thus any advantage over the Lone Creek site probably would be negligible. Thus, all three sites were judged to have a low relative total impact value.

Technical Complexity

Adequate technology presently exists to design, construct, and operate all three options. Therefore, all three options were assigned a low relative total impact value.

Cost

No comparative cost data for any of the three options were made available by the applicant. Therefore, no relative total impact values have been assigned for this criterion.

Identification of Preferred Housing/Airstrip Option

The results of the comparison of housing/airstrip options described above are shown in Table 3-10. There were few significant differences among the three options. For six of the nine criteria for which data were available, all three options showed uniformly low relative total impact values. For the three criteria for which significant differences existed (fish, wildlife, and subsistence), both the Congahbuna and Threemile options received alternately higher and lower values than the Lone Creek option such that neither emerged as having an overall significantly lower potential for adverse impacts than the Lone Creek option. For example, the Congahbuna option was judged to have values of low and high, respectively, for the fish and subsistence criteria while the Threemile option received values of high and low, respectively, for the same criteria. The Lone Creek option received moderate values for both criteria.

In final analysis, therefore, there was no basis for substituting either the Congahbuna or Threemile housing/airstrip options for the applicant's preferred option at Lone Creek in any of the three alternatives.

3.3 ALTERNATIVES AVAILABLE TO THE AGENCIES

There are three alternatives available to EPA, the Corps, DNR, and other state and local agencies through each agency's permitting responsibilities. They can: 1) issue permits as proposed with standard stipulations, 2) deny the permits, or 3) issue the permits with stipulations tailored to this project which address specific impacts. Generally, the third alternative is preferable because it allows the project to proceed while minimizing the unavoidable adverse impacts.

Although it is not the purpose of this EIS to decide what stipulations the agencies should impose, it is appropriate to review the relative advantages and effectiveness of the various mitigation options which agencies may require as permit stipulations. The major mitigation options available to the agencies are discussed in Chapter 6.0.

3.4 NO ACTION ALTERNATIVE

The No Action Alternative means that development of the Diamond Chuitna project would not occur. This alternative may be used as a baseline to which the action alternatives can be compared.

The No Action Alternative would result from denial of one or more federal or state permits necessary for project development or a decision by the applicant not to undertake the project.

Chapter 4.0

Affected Environment

4.0 AFFECTED ENVIRONMENT

4.1 INTRODUCTION

This chapter describes the environment as it currently exists without the proposed project, emphasizing those environmental aspects of the Diamond Chuitna project area that could be affected by the construction, operation, and reclamation of the proposed mining and support facilities. As required by federal (NEPA) regulations, these descriptions stress the elements of the natural and human environments that are most likely to be impacted or which have been identified as likely areas of concern through the scoping process.

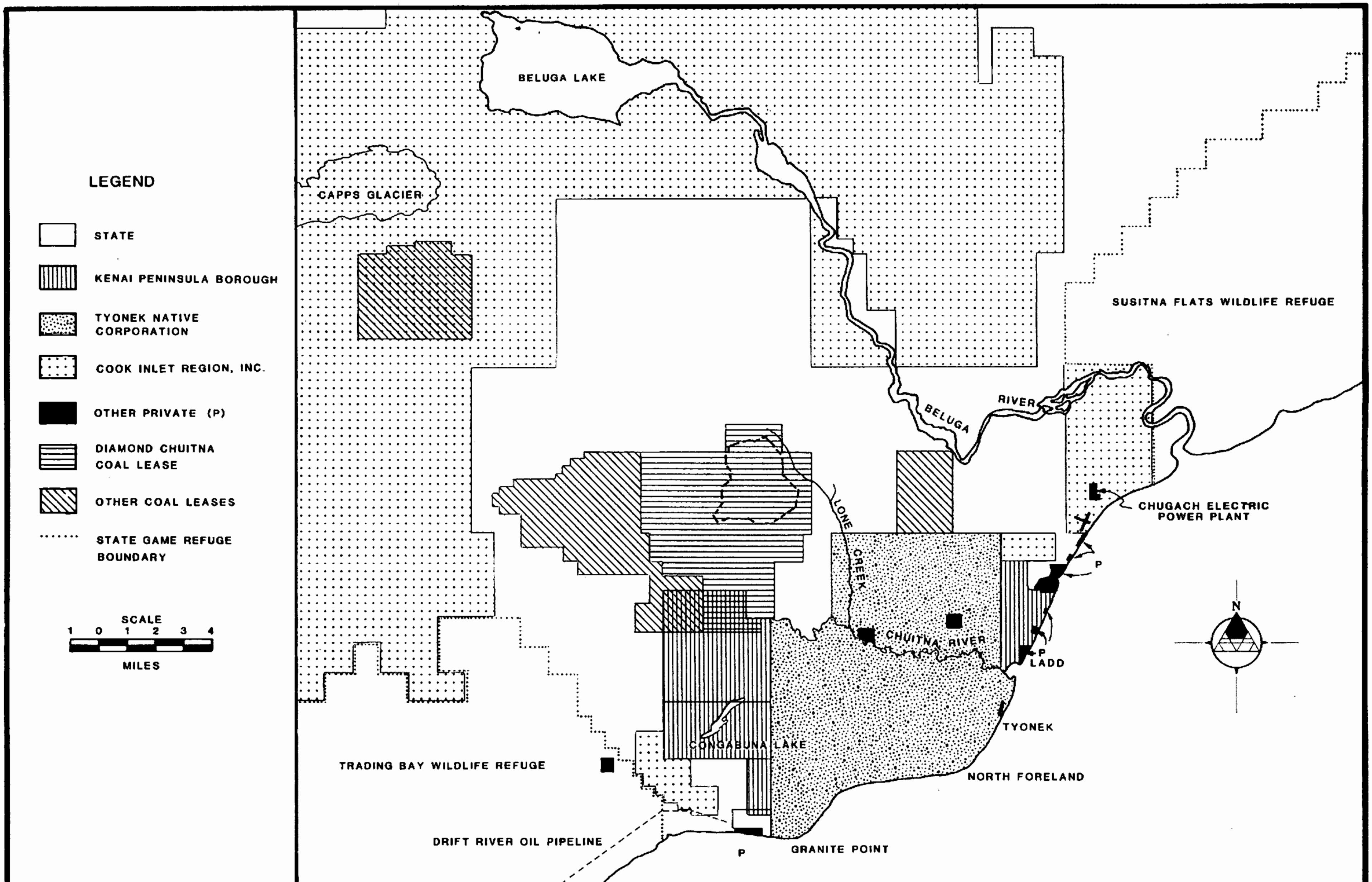
Much of the following information is derived from baseline environmental investigations that were initiated in 1982 and largely completed in 1984. Some additional work was done in 1986. The baseline study reports provide an important source of detailed information and are on file at the sites identified on page ii and in Section 7.7. The following reports are incorporated by reference into this EIS: ERT 1983, 1984a, 1984b, 1984c, 1984d, 1984e, 1984f, 1984g, 1985d, 1986; Gerlach and Lobdell 1984, 1986; Science Applications, Inc. 1984; and Riverside Technology, Inc. 1986.

4.2 REGIONAL HISTORY AND LAND STATUS

The Beluga region was first settled by Tanaina Indians who lived along the coast in the general vicinity of the present Native village of Tyonek. In 1934, the Moquawkie Indian Reservation was established for the benefit of the Natives living in the Tyonek area. In the early 1970s, reservation status ended and the Natives chose to participate as a village corporation under the Alaska Native Claims Settlement Act (ANCSA).

Exploration and development of natural resources have produced the primary impacts on the region. Major oil and gas exploration began in the early 1960s and included lands within the Moquawkie Indian Reservation. The first major permanent development in the region was the construction of Chugach Electric Association's natural gas power plant at Beluga which began operations in 1968 (Fig. 4-1).

The presence of coal outcrops in the region has been known since the early 1900s. Shortly after statehood, a major portion of the Beluga coal fields was selected by the State of Alaska under the federal government's mental health land grant entitlement. Coal exploration began in the 1960s with the first leases issued in the late 1960s. A number of coal leases exist in the region today (Fig. 4-1).



BELUGA REGION LAND (SURFACE) OWNERSHIP STATUS

Diamond Chuitna Environmental Impact Statement

FIGURE 4-1

In the mid-1970s, the State sold the salvage rights to a large amount of beetle-killed spruce timber west of the Tyonek Native Corporation lands. The ensuing logging operation established a road network in the area that ultimately stretched west through the Trading Bay Wildlife Refuge and across the Chakachatna River. The logs were trucked to a new facility constructed on Tyonek Native Corporation land at North Foreland where they were processed into wood chips and loaded onto ships from an elevated trestle.

There are four major landowners in the region today (Fig. 4-1). Most of the project area, including all the Diamond Chuitna lease area, the Granite Point port site, and about one-third of the southern transportation corridor, is state land as is the Trading Bay State Game Refuge to the south. In April 1985, a land use plan was adopted by DNR which designated development of coal resources as the primary management objective for their lands in the Beluga area. Most of the land east of the project area is owned or selected by the Tyonek Native Corporation, while Cook Inlet Region, Inc. (CIRI) owns the majority of the remainder of the land on the northeast, north, and west. The Kenai Peninsula Borough has either selected or received selection approval to approximately 6,249 ha (15,440 ac) around the southern portion of the southern transportation corridor just north of the Granite Point port site. In addition, the Borough owns approximately 1,416 ha (3,500 ac) along the coast between the Beluga airstrip and the Chuitna River including the Ladd port site. Title to the subsurface estate under all state and most borough lands lies with the State, while CIRI holds title to all subsurface estate under its lands, those of the Tyonek Native Corporation, and some borough lands. There are relatively few parcels of privately owned land in the region.

4.3 TERRESTRIAL ENVIRONMENT

4.3.1 Physiography, Geology, and Soils

4.3.1.1 Physiography

The Beluga region lies between the Beluga River and the Middle River and consists mainly of the broad Beluga Plateau which is of generally low to moderate relief (Schmoll et al. 1984). Streams have dissected the overburden and underlying sedimentary rock creating valleys ranging from a few tens of feet to several hundred feet in depth. Elevations range from about 49 m (160 ft) near the coast to about 427 m (1,400 ft) near the northwestern edge of the lease area. The study area has typical morainal* topography characterized by irregular ridges and depressions (ERT 1985d).

The project area is flanked on the northwest by higher portions of the plateau and adjoining foothills which rise westward toward the Alaska Range and, to the southwest, by estuarine* and alluvial* lowlands of the Chakachatna-McArthur embayment. South of the proposed mining area are lowlands covered by extensive bogs and marshes with numerous ponds and lakes. Areas near the larger streams are generally well-drained. The Beluga region is drained primarily by the Beluga and Chakachatna rivers, which are glacier-fed, and the Chuitna River which heads on the Beluga Plateau. In addition, several other streams, such as Tyonek Creek, Old Tyonek Creek, and Nikolai Creek, drain directly into Cook Inlet (ERT 1985d).

4.3.1.2 Geology

The primary regional geologic features in the area are plutonic* and volcanic* rocks and ash deposits, sedimentary rocks, and glacial deposits. Mount Spurr, an active volcano of the Alaska-Aleutian batholith*, lies about 48 km (30 mi) west of the site and has been active since at least Tertiary times. Extensive ash deposition occurred from about 3,000 to 6,000 years ago. South and west of the site, extrusive* and intrusive* igneous* rocks consisting primarily of andesites*, granodiorites*, and volcanic breccias* of Jurassic and Tertiary ages, and pyroclastics*, are exposed over extensive areas (ERT 1985d).

The central portion of the Beluga Plateau, including the project area, is characterized by a sedimentary plateau mantled by Quaternary glacial deposits. The sedimentary rocks consist of the Tertiary West Foreland Formation (noncoal-bearing) and the overlying Kenai Group. The Kenai Group consists of interbedded claystone, siltstone, sandstone, and conglomerate with numerous coal beds. Coal is also known to occur in the overlying Beluga Formation (ERT 1985d).

The coal-bearing sedimentary rocks in the lease area are part of the Tertiary Tyonek Formation of the Kenai Group. The Tyonek Formation is a sequence of fluvial* and deltaic* clays, silts, and sands with occasional gravel beds and coal seams. It is characterized by its extreme variability both laterally and vertically, with facies* and thickness changes over very short distances. Although at least 18 coal seams (including stringers*) are known to occur within the lease area, only four are thought to be of adequate areal extent and thickness to be significant for mining. The coals are of sub-bituminous* C rank, and are very low in sulfur content, ranging from 0.05 to 0.45 percent sulfur (ERT 1985d).

Five major Pleistocene glacial advances have been recognized in the Cook Inlet region; three of these have contributed to surface deposits within the Beluga region. All of the advances were characterized by dominant advances from the base of the Alaska Range at the northwest, toward lesser advances from the Kenai Peninsula on the southeast (ERT 1985d).

Thicker Quaternary deposits in the region include the embayment deposits* in the Chakachatna-McArthur River area and the Bootlegger Cove clay (ERT 1985d).

Composition of overburden, interburden, and coal seams have been extensively analyzed for plant growth suitability and water quality projections. Table 4-1 illustrates the average physiochemical characteristics of overburden and interburden material that would be encountered during mining. Sufficient quantities of selected parameters are present which accounts for the existing slightly elevated water quality concentrations discussed in the water quality section.

4.3.1.3 Seismology

Two major faults trend northeastward across the region: the Lake Clark fault to the north and the Bruin Bay fault to the south. They are believed to converge within 16 km (10 mi) northeast of the proposed mining site. There is a potential for seismic events ranging from the severe 8.5 Richter magnitude* earthquake of 1964 to short-duration, low-magnitude tremors that occur commonly throughout the Cook Inlet region (ERT 1985c).

During the 1964 earthquake, the Cook Inlet region experienced a variety of ground failures including slumping of surficial deposits toward steep unconfined slope faces, ground-water extrusion of sand and gravel, and landslides on gentle to moderate slopes resulting in tensional cracking and pressure ridges. These effects occurred near the Diamond Chuitna project area which was near the line of zero land level change (ERT 1986). According to the U.S. Army Corps of Engineers, the project area is located within Seismic Risk Zone* 4. This designation applies to areas that could be affected by earthquakes having a magnitude of 7 producing a peak acceleration of 0.4 gravity.

4.3.1.4 Soils

Surficial materials in the project area generally consist of alluvium, peat, and glacial deposits (non-homogeneous mixtures of clay, silt, sand, gravel, cobbles, and boulders) and minor amounts of loess* and volcanic ash. Alluvium is primarily found along stream drainages and consists of poorly-sorted cobbly sand to well-sorted sand and silt. Alluvial deposits are generally shallow, ranging from 3 to 9 m (10 to 30 ft). Peat deposits are found in depressions in the glacial deposits. They are characterized by accumulations of organic matter in various stages of decomposition, frequently interbedded with compacted sandy materials. Upland mineral soils are generally organic-rich

TABLE 4-1

STATISTICAL ANALYSIS OF PHYSIOCHEMICAL CHARACTERISTICS ACROSS NINETEEN DRILL HOLES IN THE DIAMOND CHUITNA MINE AREA

Statistic	pH	EC mmhos/ cm	SAR	ESP	H_2O Soluble Na (meq/L)	H_2O Soluble Ca (meq/L)	H_2O Soluble Mg (meq/L)	NH_4-OA_c Ext. Na (meq/100g)	CEC (meq/100g)	As (ppm)	Mo (ppm)	B (ppm)	Al	Neutralization Potential (T $CaCO_3$/1000 T Soil)	Acid Base Account (T $CaCO_3$/1000 T Soil)	Sulfur SO4	Sulfur Pyrite	Sulfur Residual
Mean	6.3	1.1	5.0	1.8	5.99	3.85	2.25	0.31	19.5	0.12	0.35	0.18	1.02	13.6	12.5	0.01	0.01	0.03
Minimum	4.1	0.1	0.3	0.5	0.18	0.05	0.02	0.18	0.9	0.005	0.01	0.01	0.02	2.0	1.0	0.005	0.005	0.005
Maximum	8.1	3.8	48.6	7.0	33.80	30.70	24.40	1.10	69.0	2.78	1.92	2.50	293.00	38.0	35.0	0.08	0.05	0.19
Observations	335	335	125	64	365	365	365	64	199	270	336	334	365	86	86	86	86	86

Statistic	Particle Size: Coarse Fragments	Particle Size: Total	Particle Size: Sand Coarse (%)	Particle Size: Sand Fine (%)	Particle Size: Silt	Particle Size: Clay	Saturation %	% Organic Matter	K Factor	K (meq/L)	Cl (meq/L)	CO_3 (meq/L)	HCO_3 (meq/L)	SO_4 (meq/L)	Ca (meq/100g)	Mg (meq/100g)	K (meq/100g)
Mean	13.2	51.3	44.4	11.0	33.9	15.0	37.3	2.3	0.40	0.36	0.41	0.18	3.80	2.74	10.02	2.79	2.30
Minimum	0.0	0.0	0.0	0.6	1.6	0.0	5.6	0.05	0.09	0.03	0.005	0.005	0.005	0.005	1.21	0.17	0.08
Maximum	64.3	98.2	89.0	51.6	84.9	54.4	89.1	14.3	0.70	5.92	2.50	2.93	23.4	15.80	25.00	12.40	11.80
Observations	219	347	135	134	352	352	333	144	137	229	199	199	199	191	64	64	64

Statistic	Se (ppm)	Hg (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Cd (ppm)	Pb (ppm)	Ni (ppm)	Cr (ppm)	Be (ppm)	P (ppm)	NH_4 + NO_3 (ppm)	Total N %
Mean	0.01	0.10	10.76	119.03	20.28	6.50	0.25	3.16	5.09	0.23	0.01	2.10	14.73	0.15
Minimum	0.01	0.01	0.07	0.10	0.84	0.22	0.22	0.05	0.12	0.05	0.00	0.30	4.30	0.01
Maximum	0.01	0.67	312.00	1760.00	101.00	21.50	2.47	10.70	83.00	1.50	0.03	12.50	60.30	0.91
Observations	196	197	229	229	229	229	229	229	229	229	229	191	63	62

Source: ERI 1985C

and are typically underlain by glacially-derived soils at depths of 76 to 114 cm (30 to 45 in) (ERT 1985d).

From the agronomic point of view, the soils of the project area are composed of numerous series* that represent both organic and mineral profiles (Soil Conservation Service 1980). The relationship between soils and vegetation for the project area is shown on Table 4-2. General profile characteristics of soil units are listed in Table 4-3.

Upland soils include the Talkeetna series which consists of several sandy loam variants. The soils are loessal and volcanic in origin and overlie glacial till. Other mineral soils are associated with alluvium along streams and primarily include the Killey-Moose River complex, although Cryaquents and Histosols were also mapped on alluvial floodplains and sandbars (Table 4-2) (ERT 1984d).

Poorly drained organic soils dominate much of the project area. Starichkof taxadjunct and Chichantna soils are associated with decomposed peat and muskeg (Table 4-3). Starichkof peats are similar to the Starichkof-Chichantna soils, comprised of peat with thin layers of volcanic ash, but occur primarily near the coast. Jacobsen mucky fine sand occurs on muskeg perimeters and poorly drained swales. Thus, this series is closely associated with the Starichkof organic soils prominent in bogs and the wetter areas of muskeg.

4.3.2 Vegetation

4.3.2.1 Plant Communities

The vegetation of the project area is broadly characterized as closed spruce-hardwood forest (Viereck and Little 1972) and as bottomland spruce-poplar forest, high brush, and wet tundra (Joint Federal State Land Use Planning Commission for Alaska 1973). A complex of forest, woodland, and shrub communities has been identified within these broader life-form types by an interagency vegetation inventory (U.S. Forest Service - U.S. Soil Conservation Service 1982) and by a baseline investigation specific to the proposed Diamond Chuitna mine lease and transportation corridor (ERT 1984g).

Table 4-2 lists the major vegetation units for the project area. Forests are formed by both open (25 to 75 percent tree cover) and closed (more than 75 percent tree cover) deciduous stands, or a mixture of deciduous and coniferous species. (Scientific names of dominant plant species as determined by mean foliar cover percentage are listed in Table 4-2.) Open broadleaf balsam poplar forests occur primarily on alluvium of stream channels. White spruce usually occurs as young trees or seedlings in the understory of this

Table 4-2

MAJOR VEGETATION UNITS AND COMMUNITY TYPES AND ASSOCIATED SOIL SERIES OF THE DIAMOND-CHUITNA PROJECT AREA

Major Vegetation Units[1]	Characteristic Community Type	Associated Soil Series
Forest		
Closed Paper Birch Broadleaf Forest	Betula papyrifera/Oplopanax horridus/Cystopteris spp. Paper birch/devil's club/bladder-fern	Mutnala (Typic Cryorthods)[2]
Open Balsam Poplar Broadleaf Forest	Populus balsamifera/Alnus tenuifolia-Viburnum edule/Calamagrostis canadensis-Polypodium sp. Balsam poplar/thinleaf alder-highbush cranberry/bluejoint reedgrass-polypody fern	Killey (Typic Cryaquents)
Open Mixed Birch-Spruce Forest	Betula papyrifera-Picea glauca/Menziesia ferruginea/Polypodium sp. Paper birch-white spruce/rusty menziesia/polypody fern	Mutnala (Typic Cryorthods)[2] Spenard (Sideric Cryaquads)[2] Jacobsen (Histic Cryaquepts)
Woodland		
Mixed Spruce-Birch Woodland	Betula papyrifera-Picea glauca/Alnus sinuata-Salix novae-angliae/Calamagrostis canadensis Paper birch-white spruce/Sitka alder-tall blueberry willow/bluejoint reedgrass	Mutnala (Typic Cryorthods)[2] Talkeetna (Humic Cryorthods) Spenard (Sideric Cryaquads)[2] Jacobsen (Histic Cryaquepts)
Needleleaf Black Spruce Woodland	Picea mariana/Vaccinium uliginosum-Empetrum nigrum/Rubus pedatus-Equisetum arvense Black spruce/bog blueberry-black crowberry/five-leaf bramble-field horsetail	Starichkof (Fluvaquentic Borochemists)
Shrubland		
Closed Tall Alder Shrub Scrub	Alnus tenuifolia-A. sinuata/Calamagrostis canadensis-Polypodium sp. Thinleaf alder-Sitka alder/bluejoint reedgrass-polypody fern	Kliskon (Typic Cryaquods)[2] Talkeetna (Humic Cryorthods)
Open Tall Willow Shrub Scrub	Salix nova-angliae-S. planifolia/Calamagrostis canadensis-Rubus arcticus Tall blueberry willow-diamondleaf willow/bluejoint reedgrass-nangoonberry	Kliskon (Typic Crgaquods) Talkeetna (Humic Gryorthods)
Open Low Sweetgale Shrub Scrub/Grass Fen	Myrica gale/Carex aquatilis-Eleocharis palustris Sweetgale/water sedge-spikerush	Starichkof (Fluvaquentic Borosaprists)
Herbaceous		
Mesic Graminoid Bluejoint Herbaceous	Calamagrostis canadensis-Epilobium angustifolium-Equisetum arvense Bluejoint reedgrass-willow weed-field horsetail	Mutnala (Typic Cryorthods)[2] Talkeetna (Humic Cryorthods) Killey & Moose River (Typic Cryaquents)

[1]Follows Viereck et al. (1982).

[2]These soil types were not mapped within the lease area.

Source: ERT 1984g.

TABLE 4-3

CHARACTERISTICS OF THE MAJOR SOIL UNITS OF THE DIAMOND CHUITNA PROJECT AREA

Soil Unit	Major Profile Characteristics	Drainage	pH
Talkeetna Variant	Deep (to 1.5 m [60 in]) sandy loams with volcanic ash overlying gravelly glacial till on morainic uplands	Well	4.2-4.6
Killey Series	Silt loam in alluvial sediments overlying gravelly substrata, 76-102 cm (30-40 in)	Poor	Acidic
Moose River Series	Stratified coarse alluvium over sandy - gravelly substrata (102 cm [40 in])	Poor	Acidic
Jacobsen Series	Deep (86 cm [34 in]) fine to coarse sand over glacial till mixed with volcanic ash; very acidic	Poor	3.8-4.7
Chichantna Series	Deep (66 cm [26 in]) peat w/ coarser peat volcanic ash inclusions, interbedded coarse sand at depth	Poor to very poor	5.3-4.7
Starichkof Taxadjunct	Moderately decomposed coarse and fine peat with interbedded volcanic ash	Very poor	5.1-3.9
Cryaquents-Histosols Complex	Cryaquents-stratified sand, sandy loams and silt loams overlying coarse sand and gravel alluvium	Poor to very poor	
	Histosols-deep peat, mucky peat and muck with some stratified mineral inclusions	Very poor	Acidic

community (ERT 1984g). A similarly stru[illegible]ured community is formed by paper birch on upland slopes and knolls. Again, white spruce is apparent in the understory. A more advanced stage in the paper birch to spruce succession is represented by a mixed white spruce-black spruce and paper birch woodland comm[illegible]ty. This type is associated with upland knolls and s[illegible]s and is abundant throughout the project area.

Woodlands (less than 25 percent tree cover) are found near black spruce on the perimeter of fens and sphagnum bogs on poorly drained soils. A mixture of white spruce and paper birch forms a second woodland community, but on uplands and slopes that have been disturbed (e.g., burned). This community is especially prominent north of the Chuitna River.

Alder thickets and willow stands are a conspicuous component of the vegetation in the project area. Thinleaf and Sitka alders form a dense tall shrub community on upland knolls and steep slopes, especially above 200 m (656 ft) e[illegible]ation. A second tall shrub community is formed by tall [illegible]berry willow and diamondleaf willow along the major [illegible]eam cours[illegible] of the area.

Low shrub-grass fen vegetation of sweetgale and sedges occurs as part of the muskeg-bog complex on poorly drained soils. This vegetation is scattered throughout the project area but is especially prominent south of the Chuitna River. A bluejoint grassland community is associated with openings in the white spruce-paper birch forest that has resulted from logging and beetle kill of trees (ERT 1984g). This community is considered early successional and is rich in herbaceous flora (Table 4-2). Logging activity has been especially prominent south of the Chuitna River, although recent harvesting has also occurred north of the river (ERT 1984g).

4.3.2.2 Threatened and Endangered Plant Species

No threatened or endangered plant species are known to occur in the vicinity of the Diamond-Chuitna project area (U.S. Fish and Wildlife Service 1984). Furthermore, no candidate threatened, endangered, or rare plant species is known to occur in this area (Murray 1980).

4.3.2.3 Wetlands

It has been nationally recognized that wetland habitats are a particul[illegible]y valuable ecological resource and an integral part c[illegible] [illegible]egional hydrological regimes. Because of these special [illegible]ues and vulnerability to development activity, wetlands were granted special regulatory status via Section 404 of the Clean Water Act of 1977. The U.S. Army Corps of Engineers has been delegated the responsibility of regulating the discharge of dredged or fill material into wetlands. Wetlands are treated as a separate section in this report in order to emphasize their special values. The regulatory definition of wetlands found in 33 CFR 323.2 Para. c is as follows:

> "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. Wetlands generally include swamps, marshes, bogs and similar areas."

Wetlands within the project area have been mapped as part of the National Wetland Inventory Program (USFWS 1984). More detailed maps of wetlands within the southern transportation corridor, Granite Point port site, and 10-year mine permit area are also available. ERT (1984g) identified nine wetland types within the above area (Table 4-4). The percentage of total surface area covered by wetland communities within the study area has not been precisely determined, but is probably in the range of 20 to 30 percent. Of the nine wetland types identified by ERT, open low shrub scrub/sweetgale grass fen was the most common, especially south of the Chuitna River, where it comprised nearly 50 percent of total wetlands. Open mixed forest wetland occupied 30 percent in this area, with seven other types comprising the remaining 20 percent. North of the Chuitna River, open mixed forest wetland appeared more common than open low shrub scrub/sweetgale fen, although both clearly were more dominant than any other wetland type.

Bogs composed of a complex of the above palustrine* wetland types are common within the study area. Typically, the wetter areas are characterized by various proportions of emergent grasses and sedges and woody shrubs which grade into forested wetland types at the edge of the muskeg areas. Often open water areas are present near the center of the wetland depressions. Estuarine salt marsh and mud flat wetland types are not present within the study area but do exist in the adjacent Trading Bay State Game Refuge.

Based on federal regulations (40 CFR 230) and scientific analysis, wetland values in the project area are viewed in four broad categories. The following is a discussion for each of the value categories in order to provide a basis for assessing the wetland impacts that could result from the proposed activities.

Food Chain Production

Some kinds of wetland communities are known to produce large quantities of plant matter compared to other biological systems (Darnell et al. 1976). However, the isolated

Table 4-4

WETLAND CHARACTERISTICS IN THE MINE LEASE AREA, SOUTHERN TRANSPORATION CORRIDOR, AND PORT AREA[3]

FWS Symbol[1]	System Class Subclass[2]	Dominant Vegetation[3]	Water Regime
PF04/1	Palustrine Forested Mixed needle-leaved evergreen/broad-leaved deciduous	Open Mixed Forest/Spruce Birch;Mixed Woodland/Spruce	saturated to semi-permanently flooded [illegible]
PF04	Palustrine Forested Needle-leaved evergreen	Needle-leaf Woodland/Black Spruce	saturated to semi-permanently flooded
[illegible]SS1	Palustrine Scrub/Shrub Broad-leaved deciduous	Open Tall Shrub Scrub/Willow; Closed Tall Shrub Scrub/Alder	saturated to semi-permanently flooded
PSS1/EMS	Palustrine Scrub/Shrub Broad-leaved deciduous Emergent Narrow-leaved Persistent	Open Low Shrub Scrub/Sweet-gale-Grass Fen	saturated to semi-permanently flooded
	Palustrine Emergent Narrow-leaved Persistent	Mesic Graminoid Herbaceous/ Bluejoint-Herb	saturated to semi-permanently flooded
R3OWH	Riverine Upper perennial Open water	--	permanent
L1OWH	Lacustrine Limnetic Open water	--	permanent
L2AB4H	Lacustrine Littoral Aquatic Bed Floating-leaved	Utricularia spp., Sphagnum spp., Nuphar spp., Nymphaea spp., Potamageton spp.	permanent
POWH	Palustrine Open water	Utricularia spp., Sphagnum spp., Nuphar spp., Nymphaea spp., Potamageton spp.	permanent

[1] [illegible] conform to those used in National Wetlands Inventory (U.S. Fish and Wildlife Service 1981)

[2] [illegible]in et al. 1979

[3] [illegible]uced from ERT 1984g

palustrine wetlands characteristic of the study area cannot be considered highly productive and probably have a lower net primary productivity* than the adjoining upland forests (Good et al. 1978). Nevertheless, these wetlands contribute substantially to the net production of organic matter that supports other ecosystem components. The plant matter produced enters the food web in a number of ways. Some animals such as insects and other invertebrates, bears, moose, and waterfowl feed directly on the vegetation. A portion of the vegetation, especially in the emergent sedge/grass communities, dies and becomes part of a decomposing mass which is consumed by bacteria and fungi which in turn is fed upon by invertebrates. Cones produced by the black spruce communities at the edges of the bogs provide a specific food source for red squirrels (Tamiasciurus hudsonicus) and some birds.

Habitat for Land and Aquatic Species

The wetland habitats within the study area provide openings and habitat diversity within the predominantly forested terrain and consequently enhance the value of the area to key species such as moose (Alces alces) and black bear (Ursus americanus). Ponds within the wetland depressions contribute some limited habitat for waterfowl. Sandhill cranes (Grus canadensis) as well as some shorebirds and songbirds utilize the muskeg areas for nesting and feeding.

Hydrology and Water Quality

Wetlands within the study area play an important role in the storage of water and the recharge of shallow ground-water aquifers (ERT 1984c). Water held in the deep organic material contributes to surface water flow in local streams. This storage capacity tends to buffer surface runoff and moderate stream flows. Enhanced winter stream flows due to ground-water input and moderate peak flows are important to successful fish production in the Chuitna River and other drainages.

Marsh and muskeg wetlands can contribute to flow of nutrients within freshwater and marine environments. Chemical reactions that occur during the process of decay within organic matter underlying wetlands cause nutrients such as nitrogen and phosphorous to be released into the water. Surface drainage distributes these nutrients to aquatic habitats. Wetlands also serve to purify waters of some trace elements and organic compounds by accumulation within the organic matter.

Recreational Use

Recreational use of wetlands within the Diamond Chuitna project area is low and incidental to a a-wide activities such as moose hunting. Coastal wetlar ,outh of the project area in Trading Bay State Game R receive some use by waterfowl hunters. The limited a....ss and subsistence orientation of local residents precludes heavy recreational use.

4.3.3 Wildlife

4.3.3.1 Birds

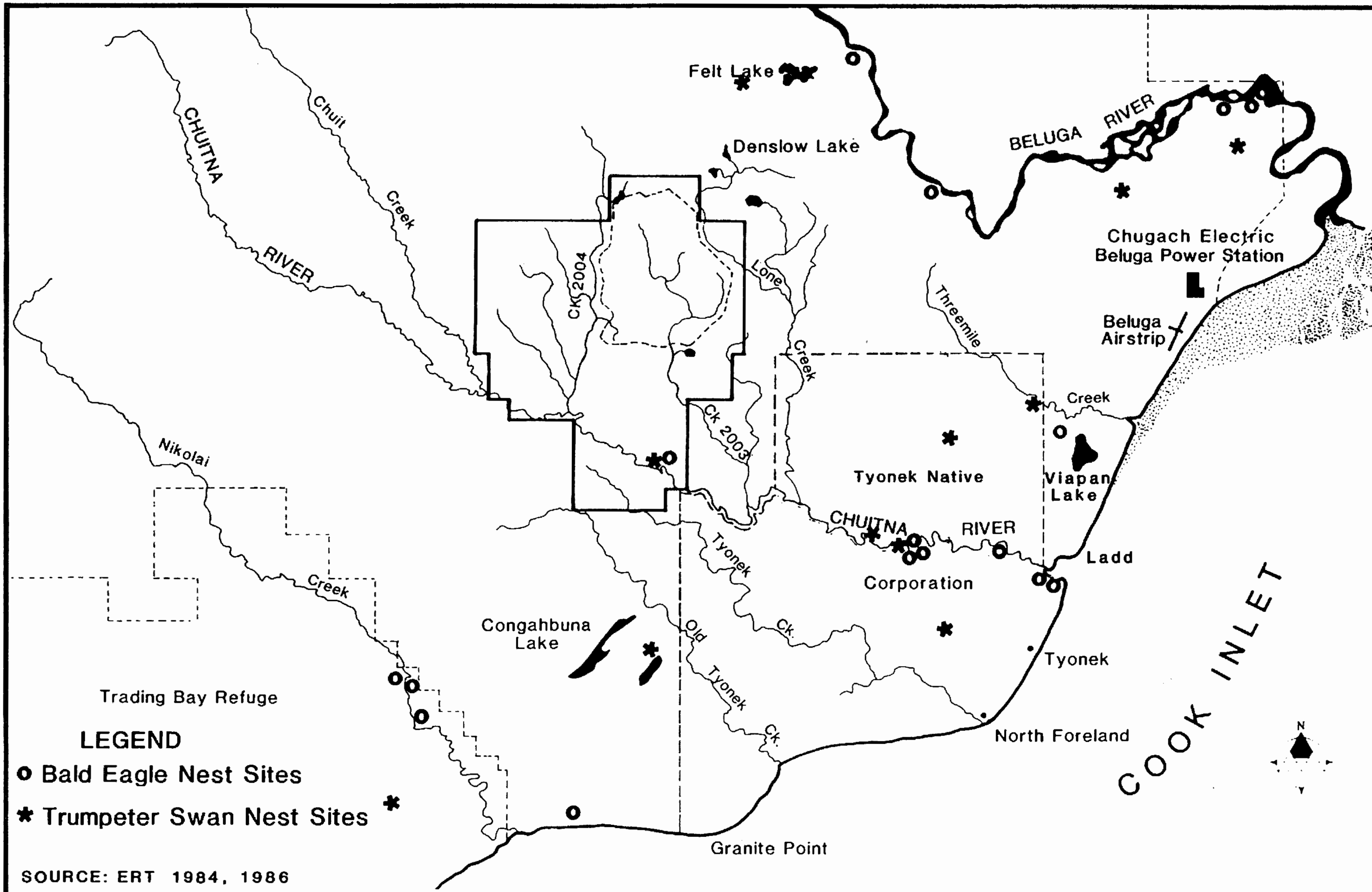
Three groups of birds are of particular interest in the project area: waterfowl, shorebirds, and raptors.

Waterfowl

Although it is flanked by important waterfowl breeding and migration areas on the south (Trading Bay State Game Refuge) and the east (Susitna Flats State Game Refuge), the project area itself contains relatively poor breeding and staging habitat for ducks and geese. Only a small area northeast of Congahbuna Lake and the bog area west of the Beluga Power Station provide significant habitat for breeding ducks (ERT 1983). During spring and fall migration, waterfowl (mainly mallards, greenwinged teal, and pintails) occur in fair numbers at the mouth of the Chuitna River and on mudflats east of the Beluga airstrip. However, neither area appears to be significant compared to other areas utilized by migrating waterfowl in Cook Inlet (ERT 1986).

The project area is of minor importance to migrating trumpeter swans (*Olor buccinator*), but it is bordered by important resting and feeding areas used during migration. The mine permit area and the upper portions of all transportation corridor options are seldom frequented by trumpeter swans, but one active nest site was found in 1983 adjacent to the Chuitna River crossing in the proposed southern transportation corridor (Fig. 4-4). The lower portion of the southern corridor falls within a broad band of swan nesting habitat that stretches from the Beluga River to Nikolai Creek, extending inland approximately 8 km (5 mi) from Cook Inlet (Fig. 4-2). This area includes 50 percent of the swan nesting sites within the Beluga Region (ERT 1984f). Surveys in 1986 revealed that better swan nesting habitat and greater swan use occurs north of the Chuitna River rather than along the river itself (ERT 1986).

With the exception of the portion of the southern transportation corridor option just north of Granite Point, the project area is not important for sandhill cranes (*Grus canadensis*). The area north of Granite Point may support



BALD EAGLE AND TRUMPETER SWAN NEST SITES

Diamond Chuitna Environmental Impact Statement

FIGURE 4- 2

two or three breeding pairs (ERT 1984f). There have been many sightings of cranes in Trading Bay State Game Refuge where a breeding pair was reported in 1981 (DOWL 1981).

Shorebirds

The project area itself is not important for migrating or breeding shorebirds or other waterbirds, but is bordered by important migration areas. The mudflats between Granite Point and Nikolai Creek, just west of the proposed Granite Point port area, are very important for migrating shorebirds (ERT 1984f). Migrating shorebirds are common at the mouth of the Chuitna River and on the mudflats east of the Beluga airstrip (ERT 1986).

Raptors

The most common raptor in the project area is the bald eagle (*Haliaeetus leucocephalus*). Eagles are found along the coast and the Chuitna River as far upstream as Chuit Creek during the spring, summer, and fall. They are less common along the major tributaries of the Chuitna in the mine permit area, but are regularly seen there feeding on dead salmon during the July through October spawning period (ERT 1984f).

Within the study area, 16 bald eagle nests have been located on or near three major waterways (Fig. 4-2). Seven nests are located on the Beluga River (only four of which are within the area depicted in Fig. 4-2), seven on the Chuitna River, four are on or near Nikolai Creek, and one is on the east side of Tukallah Lake. Only two nests, one on the north side of the Chuitna River near the proposed southern transportation corridor crossing and the second on the east side of Tukallah Lake, are located within the project area itself (Fig. 4-4)(ERT 1984f; Dalton 1987).

Passerines

Songbird habitat in the project area (including the transportation corridors and proposed port site) is typical of that found throughout southcentral Alaska. Common species include Swainson's thrush, alder flycatcher, ruby-crowned kinglet, orange crowned warbler, yellow-rumped warbler, blackpoll warbler, and dark-eyed junco. Most of these species nest in the area, particularly in spruce/birch forest and wet meadow habitats.

4.3.3.2 Mammals

Four species of mammals are of particular concern in the project area because of their economic, ecological, or cultural importance: moose (*Alces alces*), brown bear (*Ursus arctos*), black bear (*Ursus americanus*), and beaver (*Castor canadensis*).

Moose

Moose are common throughout the study area in spring, summer, and fall. Most calving takes place between the middle of May and the middle of June in the lowland bog and open, mixed spruce/hardwood communities below 152 m (500 ft). A majority of cows with calves remains in the area all summer because of the abundant vegetation. During that period, a sizable portion of the population, primarily bulls and cows without calves, follows the receding snowline to the open upland shrub/tundra communities above timberline (above 381 m [1,250 ft]). These animals remain there until forced down to lower elevations near the coast and along the main stem of the Chuitna River by deep snow in November and December (ERT 1984f).

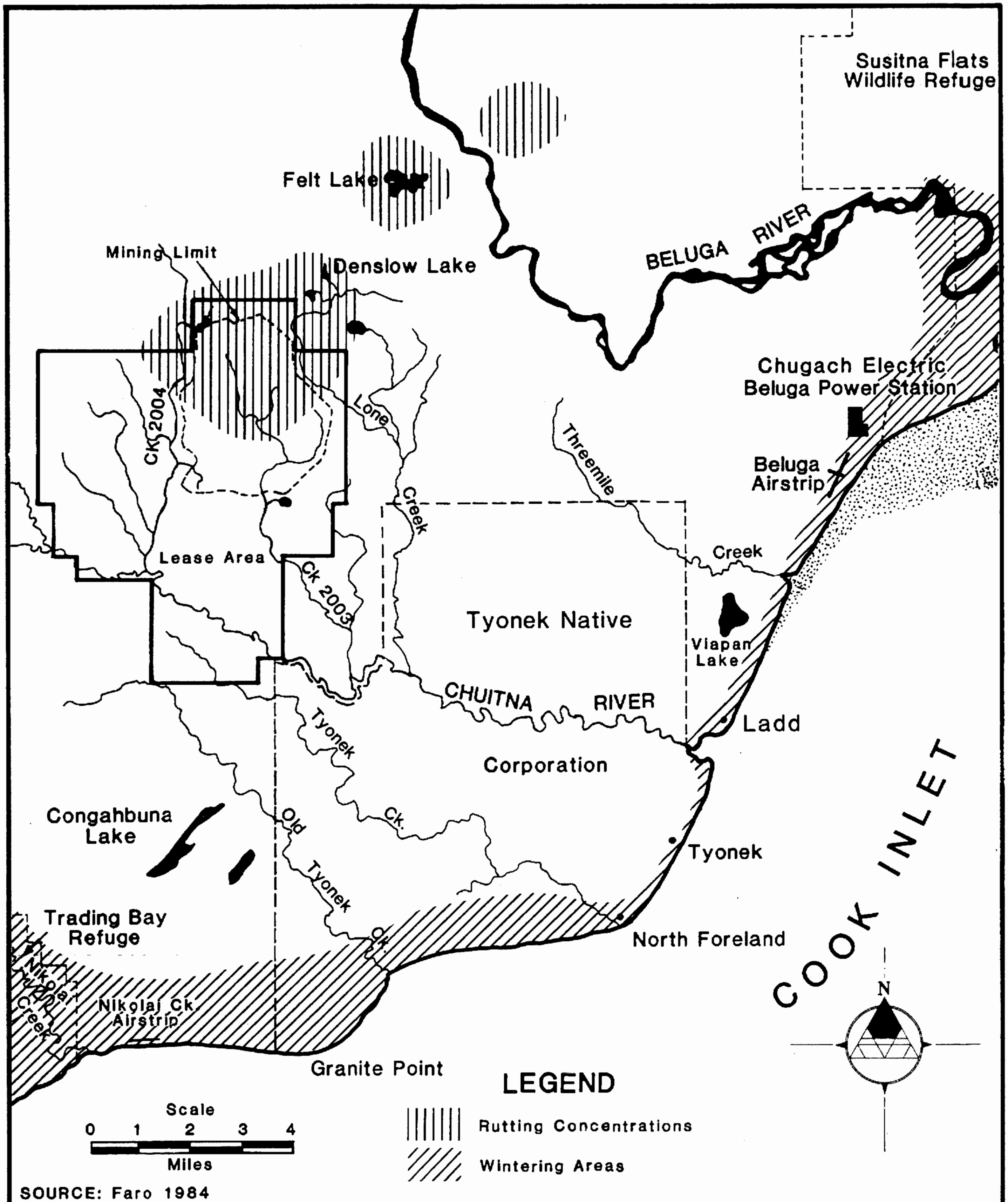
During the rut* (October/November), moose concentrate in small groups at higher elevations in the study area. One such rutting area is located south of Lone Ridge in the vicinity of Denslow Lake and the northern portion of the mine permit area (Fig. 4-3) (Faro 1985a).

In late winter, moose concentrate in the lowland flats on the south side of the Beluga River for a distance of approximately 16 km (10 mi) upriver from the mouth (Fig. 4-3). Moderate numbers of moose appear to inhabit a 3.2 to 6.4 km (2 to 4 mi) wide band stretching south from the mouth of the Beluga River along the coast of Cook Inlet to the vicinity of the Nikolai Creek escarpment and Congahbuña Lake. Small numbers of scattered moose range upstream to above the confluence of Chuit Creek in the riparian* willow habitats along the main stem of the Chuitna River. Small numbers are also found along most of Lone Creek and in the lower 3.2 to 4.8 km (2 to 3 mi) of Stream 2003. There appears to be little late winter use of the mine permit area by moose (ERT 1984f).

Moose wintering in the vicinity of Granite Point appear to spend a major portion of other seasons within the project area, including the mine permit area (Faro 1985a). A winter moose census within the study area in February 1984 estimated a population of 792 moose within the 1,343 km^2 (518.5 mi^2) area between the Beluga River and Nikolai Creek, or approximately 0.6 moose per km^2 (1.5 moose per mi^2) within the study area (Faro 1985a).

Brown Bear

Brown bears may be found throughout the study area during the spring, summer, and fall. They are likely to be found in any vegetative cover type, but generally prefer open habitats and are most common in the upland shrub and tundra communities. Brown bears are not as common in the lowlands adjacent to Cook Inlet as are black bears (ERT 1984f).



MOOSE RUTTING CONCENTRATIONS (OCT.'83) AND WINTERING AREAS (FEB.'84)

Diamond Chuitna Environmental Impact Statement | FIGURE 4-3

Food availability significantly influences brown bear distribution in the study area. Emerging grasses and herbaceous plants are critical to bears during the late spring period after leaving their dens and during early summer. From late July until as late as October, the availability of spawning salmon draws bears to the streams, often over long distances. The main stem of the Chuitna River within the project area is used very little by bears. The three major tributaries in or adjacent to the mine permit area (Lone Creek and streams 2003 and 2004), however, show substantial use by bears feeding upon salmon (ERT 1984f). In general, brown bears tend to predominate in the more open mid-level sections of these creeks while in the lower, more brushy and timbered portions, black bears appear to be more common. However, both species feed upon salmon in both areas. Seasonally, bears seem to be dispersed along the meandering, mid-elevation sections of the three creeks with no particular concentration areas identified (ERT 1984f).

In late July, berries become available and may constitute the bulk of the diet, particularly in years of heavy crops. Ripe berries can often attract bears away from accessible and abundant supplies of salmon (Erickson 1965).

Brown bears enter their dens in October or November depending upon the onset of winter. Dens are usually located at higher elevations and bears remain there until late April or May. No specific information is available on den site distribution nor does any accurate estimate exist for the size of the brown bear population in the study area. The brown bear population appears to be typical for relatively undisturbed coastal areas in southcentral Alaska.

Black Bear

Black bears may be found throughout the study area at any time of year, but they seem to prefer open, mixed hardwood/spruce forests at the lower elevations between Cook Inlet and timberline. They are commonly seen along streams and in and around bogs and clearings. Black bears do not appear to spend much time above timberline in the study area.

They generally eat the same spring and early summer herbaceous plant species as described above for brown bear, but they use a greater diversity of species. In early May, black bears feed on the emerging green vegetation found around water seeps at the base of the bluff on the north side of the canyon on the main stem of the Chuitna River (ERT 1984f). Also, black bears may be significant predators on moose calves in late spring (Miller and McAllister 1982).

Major factors affecting summer and fall black bear distribution are the abundance and distribution of berries and salmon. Since much of the salmon spawning takes place at lower elevations within their home ranges, black bears in the study area probably travel shorter distances to the streams than do brown bears (ERT 1984f). Black bears are found at lower elevations in the fall than are brown bears; denning probably also occurs at lower elevations in the mixed spruce/hardwood forests. No accurate estimate exists for the size of the black bear population in the study area, but it is probably relatively high.

Beaver

Beaver are widely distributed in the study area, from lowlands near Cook Inlet to the upland tundra/shrub communities at 503 m (1,650 ft) on top of Lone Ridge. They are most common along the major tributaries of the Chuitna River that have a low gradient (Lone Creek and streams 2003 and 2004) and in sloughs and backwater areas along the main stem of the Chuitna (Fig. 4-4). Beaver dams are a very important influence on the distribution of spawning and rearing salmon in the Chuitna River tributaries of the project area (ERT 1984f).

Beaver cache* counts show that Lone Creek has the highest number (0.70) of caches per km (1.13 per mi) of the tributary streams within the project area, followed by Stream 2004 with .49/km (.79/mi) and Stream 2003 with .26/km (.43/mi). The Lone Creek and Stream 2003 drainages also have several active lake colonies (ERT 1984f).

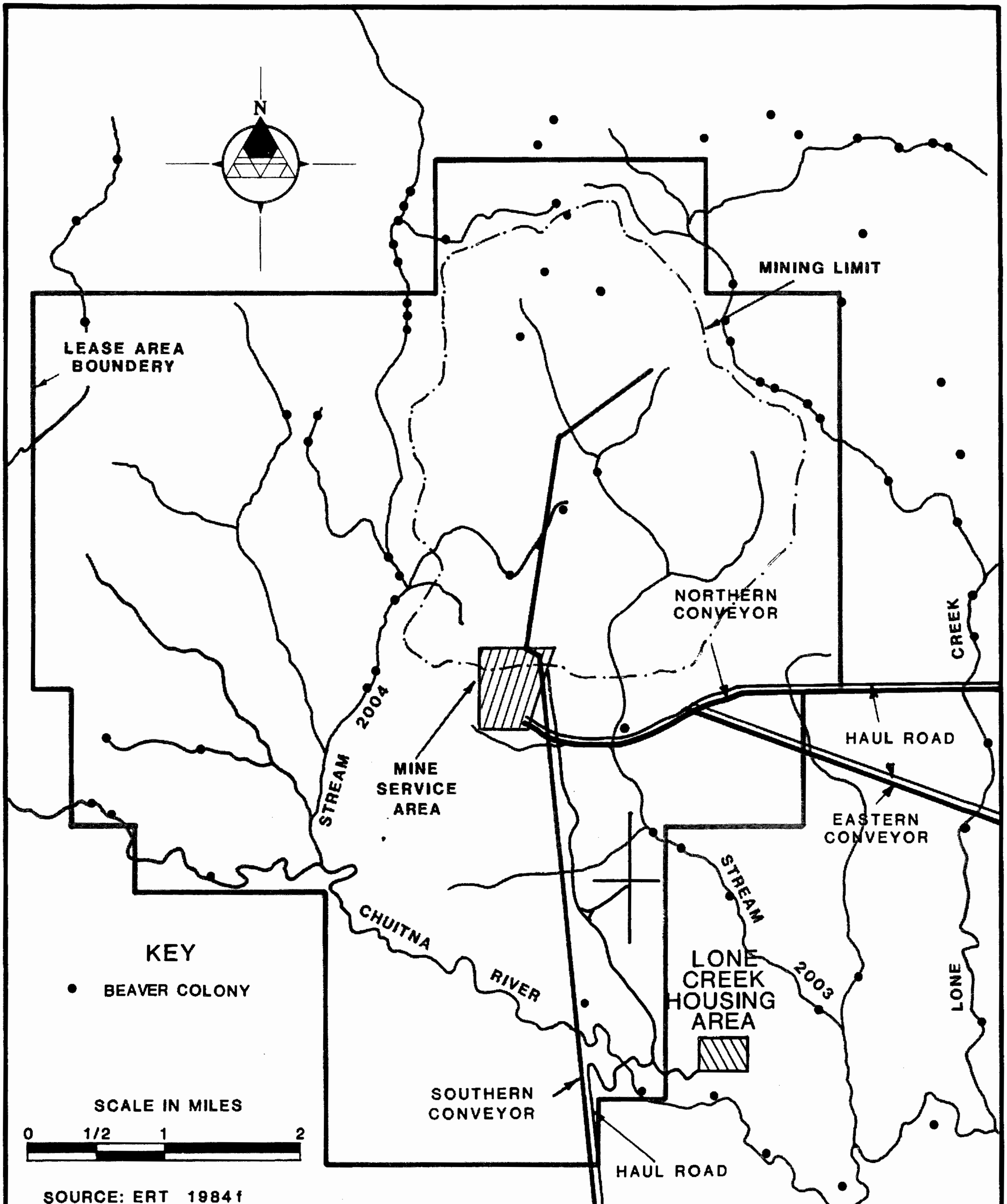
Two beaver colonies are located on Old Tyonek Creek within or immediately adjacent to the southern transportation corridor option and two more colonies exist on the large lake 1.6 km (1.0 mi) southeast of Congahbuna Lake. There are o known colonies on Tyonek Creek within the southern corridor nor in the Granite Point port area. Ten active beaver colonies occur just north of the Chuitna River ERT 1986).

4.3.3.3 Threatened and Endangered Species

Use of the study area by threatened or endangered wildlife has not been documented. The only endangered species which may be found in the area is a subspecies of the peregrine falcon (*Falco peregrinus anatum*). The project area is at the extreme southern end of the range of this species and no suitable habitat nor any individuals have been located by surveys (ERT 1984f).

4.3.4 Habitat Value and Sensitivity

A habitat mapping and evaluation study was conducted specifically for this EIS to provide a basis for comparing habitat impacts from project alternatives as well as comparing pre- and postproject habitat values. Specific evalu-



MINE AREA BEAVER COLONIES (OCTOBER 1983)

Diamond Chuitna Environmental Impact Statement	FIGURE 4-4

ation species were selected that have high public interest or serve as indicator species for habitats having significant ecological value. Evaluation species were moose, brown bear, black bear, trumpeter swan, and sandhill crane. Methods and results of the analysis are summarized below and presented in detail in Appendix A.

The habitat value categories used in the analysis (Appendix A, Table 1) roughly correspond with categories in the USFWS Mitigation Policy (FR Vol. 46 No. 15, 23 Jan. 1981). In general, none of the habitats in the project area would be considered to have "very high" value (unique and irreplaceable) relative to the key species. However, some habitats with values in the "high" range are present.

Mapping of moose spring/summer/fall range (Appendix A, Fig. 7) indicates that the mixed woodland/muskeg terrain that covers the area is predominately medium quality with scattered areas of high quality shrub habitat in some riparian and adjoining zones, especially in the vicinity of Old Tyonek Creek. Moose winter habitat (Appendix A, Fig. 9) is limited by snowfall to the southwest portion of the study area at elevations less than 152 m (500 ft). Within this lower elevation area, winter habitat value is primarily medium with some scattered high quality areas interspersed. It should be noted that the Appendix A habitat evaluation is based on habitat characteristics rather than actual animal distribution. Moose studies have indicated that winter concentrations occur along the coast (Fig. 4-3) within habitats rated from low to high value. Therefore, impact analyses should consider both animal distribution and modelled habitat value when assessing impact significance.

According to the models used in Appendix A, nearly all of the study area provides high quality habitat for both black and brown bears (Appendix A, Fig. 5). A few scattered areas of medium quality brown bear habitat are also present.

Sandhill cranes represent a somewhat different situation. Little information is available upon which to base habitat ratings. The study area was divided into suitable and unsuitable (not utilized) areas (Appendix A, Fig. 1). All suitable areas were considered to have high value for cranes. Suitable areas are scattered throughout the southwest portion of the study area within selected wetlands at elevations below 152 m (500 ft).

Trumpeter swan nesting habitat is limited to lakes. Lakes within the study area are rated as high, medium, or low value swan habitat (Appendix A, Fig. 3). High quality lakes are primarily north of the Chuitna River at lower elevations.

From the standpoint of sensitivity to impacts from development, high quality habitats that exist in limited quantity would generally be considered most vulnerable since disturbance of a relatively small area could affect a substantial percentage of the available habitat. On this basis, trumpeter swan nesting lakes and moose winter range would probably be considered the most sensitive habitat types relative to the evaluation species considered in Appendix A. Additionally, nesting swans are exceptionally sensitive to human disturbance and habitat value is readily lost if humans are present (Timm 1981).

4.4 FRESHWATER ENVIRONMENT

4.4.1 Ground-water Hydrology

Detailed information on the ground-water hydrology of the area can be found in the baseline study report (ERT 1984c). The following discussion summarizes the results of that study.

Ground water within the Diamond Chuitna project permit area can be categorized in seven hydrogeologic units. These units are distinct but interrelated. Ground water within the units is either confined* or unconfined. Starting with those closest to the surface the units are described as follows:

- Recent Alluvium - Consists of the sands and gravels within the present stream channels. The sands and gravels usually have high permeability and ground water is in an unconfined aquifer.

- Overburden - Consists of coal seams, clays, sandy silts, and silty sands of the Tyonek Formation and unconsolidated surface deposits predominantly of glacial origin. The Tyonek Formation is separated from the surface deposits by an erosional unconformity*. Ground water within the Tyonek Formation is confined while ground water in the surface deposits is generally unconfined. The overburden unit is generally unsaturated beneath the ridge areas of the site. The depth to the water table varies from 0 in low-lying areas to 91 m (300 ft) or more in the northwest portion (ERT 1984c).

- Blue Coal - Mineable coal seam which is discontinuous throughout the area due to erosion. Ground water in this unit is confined.

- Red 3 Seam - A mineable coal seam, also discontinuous throughout the permit area due to erosion. This layer is saturated with water and exists under confined conditions.

- Red 2 Seam - Mineable coal seam which underlies most of the site, except a few areas where removed by erosion. Ground water in the unit is confined.

- Red 1 Seam - A mineable coal seam which is continuous throughout the permit area. The layer is saturated and exists under confined conditions.

- Sub Red 1 Sand - A thick sandstone unit which is overlain by the Red 1 Underclay. The unit is continuous throughout the permit area and is saturated under confined conditions.

The layers between the coal seams and the Red 1 Underclay act as confining tiers between the hydrogeologic units. The confining properties of the layers are variable due to sandy zones within the units and to the ability of water to move between units due to the presence of erosion channels.

Transmissivity, i.e., the rate at which water flows through an aquifer, and the thickness of each hydrogeologic unit are listed in Table 4-5. The hydrogeologic units have variable transmissivities due to differences in the physical characteristics of the rocks or the amount of fracturing within the unit.

Ground-water flow is controlled by both the local topography and by the region's structural geology. The irregular topography provides for surface-water collection and for ground-water recharge* into the underlying alluvium or overburden unit. Ground-water discharge to the stream channels occurs where the channel has cut below the local ground-water piezometric* surfaces. Faulting within the Tyonek Formation (Chuit Fault in the northwest part of the permit area and the South-Pit Fault in the southern part of the permit area) act as barriers to ground-water flow; however, evidence suggests that leakage occurs across these barriers (ERT 1984c). Folding in the Tyonek Formation combined with the erosional unconformity at its surface has resulted in the formation of several discharge and recharge boundaries, e.g., folding or erosional breaks permit water exchange with the surface or the overburden unit (ERT 1984c).

Ground-water flow in the surficial overburden unit and recent alluvial units is predominantly from higher elevations to lower elevations in the stream valleys where ground water is discharged. Ground-water flow in the remaining hydrogeologic units is predominantly from west to east with the Blue Coal and Red 3 Seam discharging some flow to surfacewater channels. The remaining (deeper) hydrogeologic units do not currently contribute to surface water within the study area.

Table 4-5

AQUIFER CHARACTERISTICS

HYDROGEOLOGIC UNIT	TRANSMISSIVITY (gpd/ft)[3]	THICKNESS OF UNIT m(ft)
Recent Alluvium	3,000 to 50,000[1]	0- 12.2 (0- 40)
Overburden	155 to 250,000	0-152.5 (0-500)
Blue Coal	102 to 667	4.58(15)[2]
Red 3 Seam	96 to 624	4.58(15)[2]
Red 2 Seam	58 to 815	4.58(15)[2]
Red 1 Seam	29 to 300	4.58(15)[2]
Sub Red 1 Sand	86 to 1,850	9.15(30)

[1]Estimated.
[2]Average thickness.
[3]Reported in English units to correspond with hydrological convention.

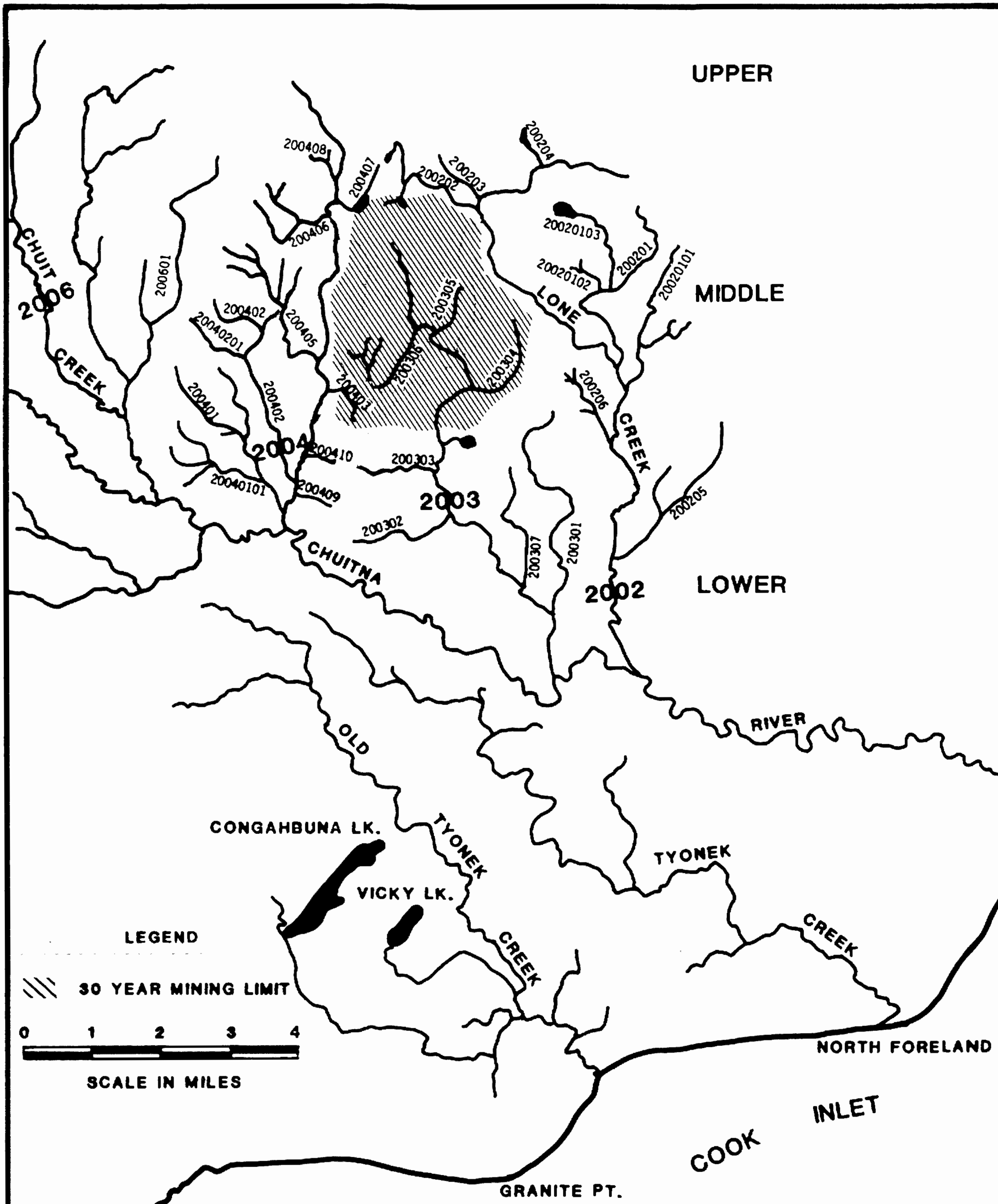
Source: ERT 1984c.

An understanding of the interrelationships between ground water and surface water is critical in providing a basis for impact assessment. Ground water contributes 34, 32, and 30 percent to the annual flows of Lone Creek, Stream 2003, and Stream 2004, respectively (ERT 1984c). At least 90 percent of this ground water is derived from the shallow overburden aquifers; the deeper aquifers contribute little to streamflow within the mine area. Muskegs are important to ground-water recharge and storage within the shallow aquifers. The stored water recharges rapidly causing flow of water in surface deposits that are ultimately drained by streams at the valley bottoms. These shallow systems on the terraced sideslopes of the project area drainages provide the majority of base flow to streams (ERT 1984c).

4.4.2 Surface Water Hydrology

The area of possible hydrologic impacts related to the project extends from the headwaters of the Chuitna River on the northwest to Cook Inlet on the southeast and to Threemile Creek on the northeast (Fig. 4-5). Upstream of the project boundary, the Chuitna River is joined by Chuit Creek, Wolverine Creek, and a number of smaller unnamed tributaries. These streams will not be affected by the proposed development.

The Chuitna River flows along the southwest side of the project area and drains a glacier-free area of about 388 km^2 (150 mi^2) over a total flow distance of about 27 km (17 mi)



WATERBODIES OF THE DIAMOND CHUITNA MINE STUDY AREA

Diamond Chuitna Environmental Impact Statement	FIGURE 4-5

from the northwest to southeast. Ground elevations in the basin range from sea level to approximately 549 m (1,800 ft). A short distance upstream of the project area, the streams are incised in a broad piedmont lowland that is covered with a thin mantle of poorly drained tundra vegetation.

North of the Chuitna River, the terrain is relatively flat with numerous ponds and small lakes. Larger lakes include Chuitbuna Lake, Viapan Lake and Tukallah Lake. The surface drainage in this area is poor; surface water runoff is generally to the east and south. Since the soils are nearly saturated, streams and ponds fill quickly during heavy rains (Riverside Technology, Inc. 1986).

The surface water bodies that could be affected by the proposed development include the Chuitna River and its tributaries in the vicinity of the mine area, Tyonek Creek and Old Tyonek Creek and their tributaries, and Threemile Creek. The drainage areas and estimated mean, minimum, and maximum flows of the potentially affected streams are shown in Table 4-6. Numerous lakes and ponds are also present in the study area including Congahbuna and Vicky lakes near the proposed southern corridor.

The average annual precipitation in the basin during the monitoring period 1982-83 has been estimated to be 122 cm (48 in) with evapotranspiration losses of 23 cm (9 in). Mean monthly temperatures range from a minimum of -17°C (1.5°F) in January to a maximum of 18°C (64°F) in July. In February 1983, the snow-course depth in the area varied from 58 cm (23 in) near Congahbuna Lake to 152 cm (60 in) on Chuitna Plateau, 162 cm (64 in) on Lone Ridge, and 229 cm (90 in) on Capps Plateau.

4.4.2.1 Seasonal Flow Characteristics of Affected Streams

During the winter months (November through March), below-freezing temperatures prevail in major portions of the watersheds of the streams likely to be affected by the project. Therefore, streamflows in these months are very low with lowest flows occurring in March. The period April through August is generally dry. During this time, streamflows are augmented by snowmelt and may vary from low in August to moderately high during the peak of snowmelt in late May and early June. The most significant rainfall in the area occurs in September and October. During this period, most of the streams experience high flows and flooding conditions following storm events.

4.4.2.2 Origin of Water in Surface Streams

The sources of surface runoff transported by the streams likely to be affected by the project include rain-

Table 4-6

AFFECTED STREAMS

Stream	Location	Drainage Area km^2 (mi^2)	Estimated Flows m/sec (cfs) Instantaneous Minimum	Mean Annual	Instantaneous Maximum
1. Chuitna River (Sta. C045)*	Southwest of mine area	183.81(70.97)	0.75(26.61)	5.70(203.68)	118.72(4240.16)
2. Chuitna River (Sta. C120)*	Near conveyor crossing	130.12(88.85)	0.84(29.93)	7.79(278.28)	156.80(5600.13)
3. Chuitna River (Sta. C230)*	Downstream of affected mine area	342.48(132.23)	1.77(63.36)	10.26(366.30)	189.82(6779.11)
4. Lone Creek (Sta. C220)*	Above confluence with Chuitna River	49.78(19.22)	0.13(4.73)	1.36(48.40)	25.46(908.80)
5. Unnamed Tributary 2003 (Sta. C180)	Above confluence with Chuitna River, 3.22 km (2 mi) east of conveyor and 4.83 km (3 mi) south of mine area	39.81(.15.37)	0.02(0.81)	0.71(25.37)	12.65(451.63)
6. Unnamed Tributary 2004 (Sta. C110)	Above confluence with Chuitna River, 2.4 km (1.5 mi) southwest of mine area	46.08(17.79)	0.09(3.33)	0.99(35.43)	36.76(1312.70)
7. Tyonek Creek	(a) At conveyor crossing	3.89(1.5)	--	0.08(3)**	--
	(b) At mouth of Cook Inlet	44.03(17.0)	--	0.95(34)**	--
8. Old Tyonek Creek	(a) At conveyor crossing	2.38(0.92)	--	0.05(1.8)**	--
	(b) At mouth of Cook Inlet	60.87(23.5)	--	1.32(47)**	--
9. Unnamed tributary of Old Tyonek Creek	(a) At conveyor crossing	5.44(2.1)	--	0.12(4.2)	--
	(b) At mouth	8.81(3.4)	--	0.19(6.8)**	--
10. Unnamed Creek south of Congahbuna Lake	(a) At conveyor crossing	10.10(3.9)	--	0.22(7.8)**	--
	(b) At mouth of Cook Inlet	12.95(5.0)	--	0.28(10)	--

* Based on observations from July, 1982 to August, 1983.
** Data not available. Estimated at 0.056 m^3/sec (2 cfs) per square mile.

Source: ERT 1984a

fall, snowmelt, and ground water. Using the continuous streamflow data for Station C045 and C230 on the Chuitna River for the period August 1982 to August 1983, rough estimates of the contributions of each source have been made. These estimates are based on the assumption that streamflows in September-October are contributed mainly by rainfall, those in November through March by base flows*, those in April-May by snowmelt, and those in June-July-August by snowmelt and rain. The resulting values are shown in Table 4-7.

In the absence of detailed information on the hydrology of Tyonek Creek, Old Tyonek Creek, Threemile Creek, and other streams in the area, it is assumed that contributions of rainfall, snowmelt, and ground water to the annual runoff of these streams will be of the same order of magnitude as shown in Table 4-7.

4.4.2.3 Runoff Characteristics of Affected Streams

In the Chuitna River drainage basin, surface soils have slow to very slow infiltration rates and, therefore, high runoff potential. The Soil Conservation Service Curve Number (CN) for these soils is estimated to be 61 for antecedent moisture condition* - II (AMC-II) and 78 for AMC-III. AMC-II represents the average soil moisture condition that precedes the annual flood; AMC-III represents saturated soil conditions caused by heavy rainfall or light rainfall and low temperatures during the 5 days previous to the given storm. The minimum infiltration rate for AMC-III conditions for these soils is estimated to be 0.2 cm/hr (0.08 in/hr). Estimated runoff factors for the Chuitna River basin at Station C230, downstream of the affected area, are shown in Table 4-8.

4.4.2.4 Flooding Characteristics

The maximum recorded flood on the Chuitna River near Tyonek occurred on September 20, 1976 and was estimated to be 124 m^3/sec (4,380 cfs) (USGS 1979). The drainage area of the river at this station is 339 km^2 (131 mi^2). No other data are available on the flooding characteristics of streams likely to be affected by the project. Therefore, the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year flood peaks of the streams in the project area have been estimated using synthetic methods. The peak flows and runoff volumes resulting from 24-hour storms of different recurrence intervals are shown in Table 4-9.

4.4.2.5 Channel Characteristics

Channel characteristics were observed for streams north of the Chuitna River near the existing Ladd Road. These are summarized on Table 4-10. Generally, the stream channels are 10 to 20 ft (3 to 6.1 m) wide with 2 to 3 ft (0.6 to

Table 4-7

SOURCES OF SURFACE WATER IN CHUITNA RIVER BASIN

Station	Source	Approximate percentage of annual runoff*
1. C045, Chuitna River southwest of mine area (Drainage area 183.81 km^2 [70.97 mi^2])	Rainfall	26 to 40
	Baseflow	5 to 26
	Snowmelt	22
	Snowmelt & rain	24 to 34
2. C230, Chuitna River downstream of affected area (Drainage area 342.48 km^2 [132.23 mi^2])	Rainfall	25 to 42
	Baseflow	5 to 26
	Snowmelt	20 to 34
	Snowmelt & rain	16 to 34

*Ranges are based on observed mean daily minimum flow and mean daily maximum flows.

Source: ERT 1984e

Table 4-8

ESTIMATED RUNOFF FACTORS FOR CHUITNA RIVER BASIN
(Drainage area 342 km^2 [132.23 mi^2])

Storm Designation			Estimated Runoff Factor
Return Period (years)	Duration (hours)	Depth (cm[in])	
2	24	7.59(2.99)	0.32
5	24	9.45(3.72)	0.40
10	24	12.04(4.74)	0.48
25	24	13.72(5.40)	0.52
50	24	14.38(5.66)	0.54
100	24	15.09(5.94)	0.55

Source: ERT 1984e

Table 4-9

ESTIMATED PEAK FLOWS AND RUNOFF VOLUMES FOR STORMS OF DIFFERENT RECURRENCE INTERVALS[1]

Station	Drianage Area (sq miles)	2-year 24-hour storm		5-year 24-hour storm		10-year 24-hour storm		25-year 24-hour storm		50-year 24-hour storm		100-year 24-hour storm	
		Peak Flow (cfs)	Runoff Volume (acre-ft)	Peak Flow (cfs)	Runoff Volume (acre-ft)	Peak Flow (cfs)	Runoff Volume (acre-ft)	Peak Flow (cfs)	Runoff Volume (acre-ft)	Peak Flow (cfs)	Runoff Volume (acre-ft)	Peak Flow (cfs)	Runoff Volume (acre-ft)
1. Chuitna River southwest of mine area C045	70.97	3,838	3,792	5,693	5,792	8,452	8,864	10,284	10,951	11,032	11,812	11,812	12,715
2. Chuitna River near conveyor crossing C120	88.85	3,966	4,711	5,918	7,175	8,859	10,977	10,854	13,584	11,642	14,624	12,525	15,795
3. Chuitna River downstream of affected area C230	132.23	4,209	6,825	6,398	10,471	9,704	16,050	11,952	19,879	12,852	21,419	13,830	23,095
4. Lone Creek above confluence with Chuitna River C220	19.22	985	1,097	1,456	1,660	2,162	2,525	2,633	3,111	2,828	3,355	3,030	3,610
5. Unnamed Tributary 1, 2 miles east of conveyor and 3 miles south of mine area C180	15.37	988	888	1,438	1,340	2,113	2,040	2,556	2,511	2,737	2,706	2,925	2,909
6. Unnamed Tributary 2, 1.5 miles southwest of mine area C110	14.79	1,126	855	1,619	1,290	2,347	1,964	2,822	2,417	3,016	2,604	3,215	2,800
7. Lone Creek east of mine area C200	7.15	562	429	808	647	1,167	981	1,403	1,207	1,498	1,298	1,599	1,396
8. Tributary of Chuit Creek west of mine area C020	2.37	218	142	308	214	440	325	526	400	561	430	597	463
9.. Tributary of Chuitna River just south of mine area, 0.7 miles east of conveyor C140	6.51	511	391	786	589	1,128	893	1,354	1,099	1,444	1,182	1,539	1,271
10. Tributary of Chuitna River south of mine area, 1.4 miles west of conveyor C080	9.42	780	566	1,115	852	1,603	1,292	1,925	1,590	2,053	1,710	2,190	1,839

[1] Reported in English units to correspond with hydrological convention.

Source: ERT 1984c

Table 4-10

STREAM CROSSING CHANNEL CHARAC[illegible]ISTICS (1)
LADD ROAD/NORTH ROAD AR[illegible]

ELECTRICAL TRANSMISSION ROW

Stream Crossing	Mean Width (feet)	Bank Full Width (feet)	Mean Depth (feet)	Maximum Depth (feet)	Valley Floor Width (feet)	Roughness [illegible]acteristics	Overbank Vegetation
2003	16	32	2.0	5.0	130	Coarse Gravel/Cobble	Mixed Woodland, Shrubs, & Grasses
200301	10	22	1.0	3.5	70	Silts/Cobble	Willows, Alders, & Grasses
Lone Creek (2002)	22	41	1.5	4.0	175	Silts/Cobble/Boulder	Willows, Alders, & Grasses
15	8	12	1.0	3.0	N/A	Silt/Fine Sands	Dense Riparian, Muskeg & Grasses

LADD ROAD

Stream Crossing	Mean Width (feet)	Bank Full Width (feet)	Mean Depth (feet)	Maximum Depth (feet)	Valley Floor Width (feet)	Roughness Characteristics	Overbank Vegetation
2003	16	32	2.0	5.0	60	Coarse Gravel/Cobble	Mixed Woodland, Shrubs, & Grasses
200301	10	22	1.0	3.5	70	Silts/Cobble	Willows, Alders, & Grasses
Lone Creek (2002)	22	41	1.5	4.0	180	Silts/Cobble/Boulder	Willows, Alders, & Grasses
15	7	10	0.6	3.5	N/A	Silt/Gravel	Dense Riparian, Muskeg & Grasses
10	5	8	0.5	2.5	N/A	Sand/Gravel	Dense Riparian, Muskeg & Grasses

(1) Values [illegible] composite of mulitple surveys conducted during [illegible] studies and are representative of the selected stream crossings.

0.9 m) vertical banks. They are well-developed, incised and V-shaped. Dense riparian vegetation and woodland comprise overbank vegetation. In the Chuitna River basin, channels appear to be dynamic and have potential for bank collapse and migration due to extreme runoff events. For flood events, less than bankfull, very little bank alteration would likely occur since they are held together by a heavy vegetative mat in most cases. Large streambed materials and low natural sediment content of the water minimize aggradation and degradation (Riverside Technology, Inc. 1986).

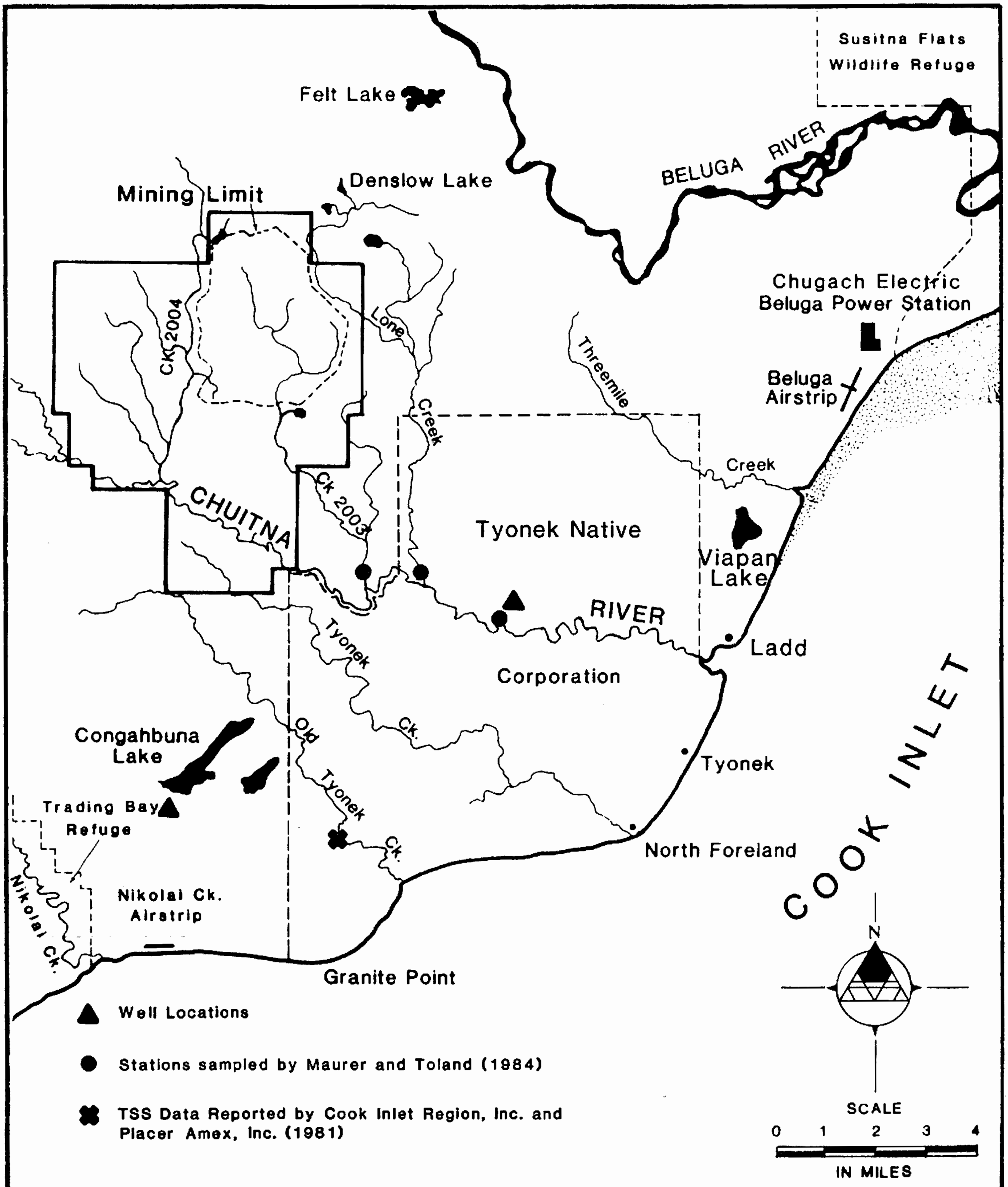
4.4.3 <u>Water Quality</u>

4.4.3.1 Ground-water Quality

Two wells drilled in the project area (Fig. 4-6) provide information about ground-water quality outside of the lease boundary. The well southwest of Congahbuna Lake had good quality soft water that was a mixture of calcium bicarbonate and sodium bicarbonate types (DOWL 1981). Water contained low mineralization, trace element concentrations were low, and the water easily met drinking water standards (ADEC 1982). Water in a well near the Chuitna River was calcium bicarbonate type (Scully et al. 1981). Other than iron, no physical constituents or properties were in excess of the EPA (1976) or ADEC (1982) drinking water standards.

Ground-water quality in the lease area, summarized in Table 4-11, was characterized by sampling numerous test wells. This water exhibits significant variation with depth or stratigraphic position of each hydrogeologic unit (ERT 1984a). The water quality of springs is similar to stream water quality and meets all of the primary drinking water standards. Mineralization (measured by total dissolved solids and conductivity), hardness, pH, and alkalinity tend to increase with the older and deeper units. Ground water from all units, except springs, exceeds the drinking water criteria for iron and manganese and the total dissolved solids criterion is exceeded in the Sub Red 1 Sand (ADEC 1982). Iron concentrations in all units, except springs, also exceed the level critical for the preservation of freshwater aquatic life, which is 1.0 mg/l (EPA 1976). Isolated ground-water samples also equalled or slightly exceeded aquatic life criteria for zinc and ammonia. Trace elements other than iron and manganese exhibit low concentrations, as do the EPA priority pollutants.

The water quality of the upper part of Lone Creek appears to be slightly affected by discharge of ground water originating from the deeper aquifers. Ground-water input to other streams is primarily from shallow aquifers with water quality similar to surface water and, therefore, water quality differences cannot be detected (ERT 1984c).



WATER QUALITY SAMPLE STATIONS

Diamond Chuitna Environmental Impact Statement | FIGURE 4-6

Table 4-11

GROUND-WATER QUALITY

Characteristic	Spring	Aluvium	Over-burden	Blue Coal	Red 3 Coal	Red 2 Coal	Red 1 Coal	Sub 1 Sa
Conductivity, micromhos/cm @ 25°C	44	180	250	280	400	590	580	910
Hardness, mg/L as $CaCO_3$	8.9	66	100	94	75	102	104	134
Dominant Cation	Ca/Na	Ca	Ca	Ca	Na	Na	Na	Na
Dominant Anion	HCO_3	HCO_3	HCO_3	HCO_3	HCO_3	HCO_3	HCO_3	CO_3
Sulfate, mg/L	1.9	5.0	5.8	21.2	2.5	38.9	39.7	5.9
Iron, mg/L	<0.02	3.5	5.1	2.1	2.1	12.1	39.7	3.7
Manganese, mg/L	<0.005	0.19	0.39	0.29	0.08	0.16	0.72	0.15
Zinc, mg/L	0.045	0.24	0.23	0.41	0.22	2.24	2.51	3.39
Trace Elements (other than Fe, Mn, & Zn)	Low	Low	Low	Low	Low	Low	Low	Low
Total Aromatic Hydrocarbons	Low	Low	Low	Low	Low	Low	Low	Low
Acid Extractables	Low	Low	Low	Low	Low	Low	Low	Low
Base/Neutral Extractables	Low	Low	Low	Low	Low	Low	Low	Low

Note: Values are averages for each unit.
Iron, manganese, and zinc concentrations are total recoverable levels.

Source: ERT 1984c.

4.4.3.2 Surface Water Quality

Data reported by Scully et al. (1981), ERT (1984e), and Maurer and Toland (1984) indicate that the water quality of streams in the Chuitna River basin (Fig. 4-5) is consistently high throughout the year, which is typical in pristine areas of Alaska. The stream flow is typically highly oxygenated with 90 to 100 percent saturation of dissolved oxygen and has little or no oxygen demand. The water displays neutral pH levels but low concentrations of alkalinity indicate the streams are poorly buffered. Mineralization is low as indicated by relatively low conductivity levels, ranging up to 120 micromhos per centimeter at 25°C (77°F). The dilute surface waters are a calcium bicarbonate type, have low concentrations of nutrients, and only a small amount of natural organic enrichment.

Breakup occurs in late April or early May. In May and June, water temperatures exhibit a moderate increase followed by a more rapid increase in late June and July. The annual maximum water temperature occurs in late July or early August and the maximum temperature recorded was 22.5°C (72.5°F) (Scully et al. 1981). Water temperatures decrease throughout September and usually reach near the freezing point by late October.

Total suspended solids concentrations have ranged up to 1570 mg/l in the Chuitna River (Scully et al. 1981). Total suspended solids concentrations and turbidity levels, however, are consistently low over a wide range in discharges on the smaller streams. In the Chuitna River, 86 percent of the suspended sediment is discharged during 10 percent of the time. Further, particle size analyses show that 30 to 70 percent of the suspended sediment consisted of sand particles and the rest was silt and clay (Scully et al. 1981).

Although iron and manganese concentrations exceed their respective drinking water criteria (EPA 1976; ADEC 1982) much of the time, concentrations of other trace elements are low. These constituents include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, selenium, silver, titanium, zinc, and uncomplexed cyanide. Background concentrations of boron, nickel, and zinc are low, but have been found to occasionally exceed standards for aquatic life. Organically derived ammonia nitrogen is also found to periodically exceed recognized standards. Recoverable iron has ranged up to 6.1 mg/l (Maurer and Toland 1984), with most of the measurements exceeding 1.0 mg/l--the level critical for the preservation of freshwater aquatic life (EPA 1976).

Radioactivity levels determined as gross alpha and gross beta on all samples were below the drinking water limits (EPA 1976).

Volatile organics, acid extractables, and base/neutral extractables were consistently less than their respective detection limits. This information indicates that there is no evidence of herbicides, pesticides, and other organic chemical contamination in these streams.

Limited water quality data exist for Threemile, Tyonek, and Old Tyonek Creeks. Four total suspended solids measurements in Old Tyonek Creek ranged from 2.1 to 19.0 mg/l (DOWL 1981), indicating a relatively low sediment load in this creek. U.S. Geologic Survey data (USGS 1981; USGS 1983; Still et al. 1984) indicate all three creeks display relatively low conductivity levels. Hence, mineralization is low. Water temperature ranges from 0 to at least 20°C (32° to 68°F), dissolved oxygen levels are moderately high to high, and pH values are typically neutral. Bicarbonate alkalinity concentrations are relatively low which means there is little buffering capacity in these creeks. Color levels in Tyonek and Old Tyonek Creeks are high.

4.4.4 Biology

4.4.4.1 Aquatic Ecology

There are four relatively distinct freshwater habitat types in the project area: the Chuitna River, the three tributaries to the Chuitna, Threemile Creek, and numerous ponds and small lakes (Fig. 4-5). Most of these habitats are relatively productive, supporting a diverse array of primary and secondary producers (algae and invertebrates). Where access has been available since the last ice age, resident fish have colonized many of these waters. Where access is currently possible, anadromous* fish dominate the aquatic communities.

For its lower 10 km (6 mi), the Chuitna River meanders over the relatively flat coastal plain that extends northward past the Susitna Flats. At a point about 1 km (0.6 mi) downstream of the mouth of Lone Creek, the river leaves a steep-walled valley and the sinuosity is somewhat reduced. Overall, the stream is characterized by long riffle sections interspersed with scattered deep pools. The entire mainstem through and above the project area is accessible to adult anadromous fish and is also utilized by juveniles for rearing (ERT 1984a). Substrate ranges from coarse sand to cobble and boulder with bedrock outcrops, often in the form of coal seams. Water is typically clear (non-glacial) and slightly stained with organics. Benthic productivity, as evidenced by standing crop, tended to be less than in the mine area tributaries. Mean annual flow has been estimated at 5.70 to 10.26 m^3/sec (203.68 to 366.30 cfs) with a recorded extreme range of flow of 2.41 to 112.00 m^3/sec (86 to 4,000 cfs)(ERT 1984e).

Three significant Chuitna River tributaries drain portions of the mine area. These tributaries, 2002 (Lone

Creek), 2003, and 2004, contribute 15, 7, and 10 percent, respectively, of Chuitna flow below the Lone Creek confluence (ERT 1985c). In addition, Tyonek and Old Tyonek creeks would be crossed by the southern corridor. The northern corrid crosses Lone Creek and crosses Threemile Creek twice. The eastern corridor crosses Lone Creek. In general, these streams can be characterized as clear-water streams with moderate to high organic staining, stable channels and flows, good benthic productivity, and good to excellent fish habitat. The benthic community is dominated by immature stages of chironomids (mosquitoes and midges), simuliids (black flies), mayflies, caddis flies, and stoneflies with species dominance shifting with time during the open water season (ERT 1984a).

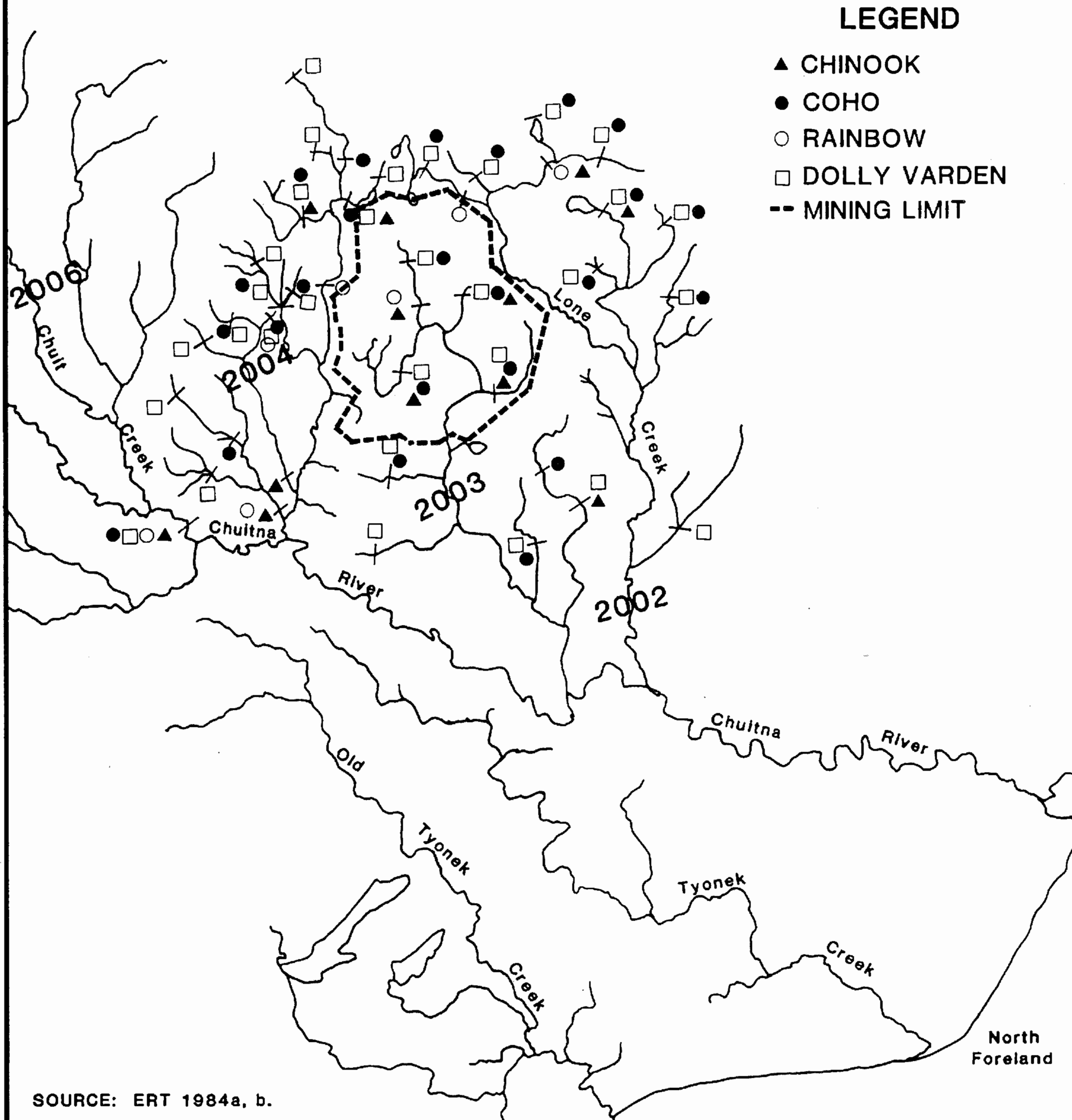
The mine area contains numerous small ponds and lakes in various stages of eutrophication. Most are being encroached upon by vegetative growth that will eventually turn them into boggy muskeg. Only a few of these lakes have been shown to support fish, primarily because of limited access or limited spawning or overwintering areas. Benthos and zooplankton densities and diversities measured in these lakes appeared low (ERT 1984a); however, sampling in July likely missed periods of peak abundance.

4.4.4.2 Fish

Freshwater habitats in the project area support abundant resident and anadromous fish populations that have significant subsistence, commercial, and sport value (see also Sections 4.5.3, 4.8, and 4.10.1). The distribution of fish and spawning and rearing habitat within the study area are shown in Figures 4-7 and 4-8.

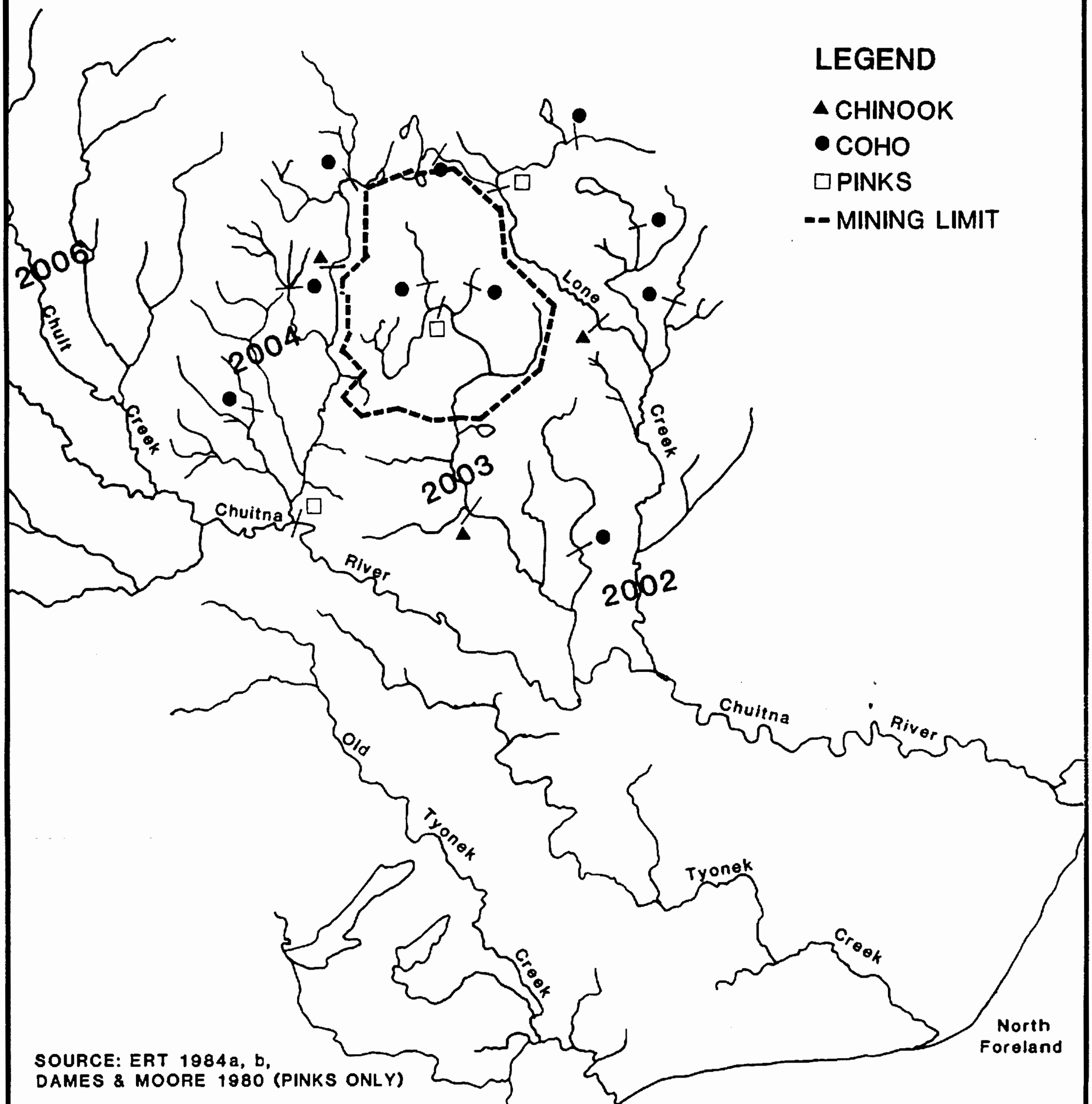
At present, resident species are not significantly exploited in project area streams. Limited numbers of both resident rainbow trout (Salmo gairdneri) and anadromous Dolly Varden char (Salvelinus malma) are taken as incidental catch in the salmon sport fishery in the lower Chuitna (ADF&G 1983, 1984). Possibly the most important resident species is the rainbow trout. The mainstem of the Chuitna River, particularly upstream of Stream 2004, contains a population of modest-sized (e.g., to 1 kg [2.2 lb]) rainbows that would be capable of supporting a limited, but high-quality, sport fishery (Dames & Moore 1980). Limited access and availability of other fishing opportunities have prevented development of such a fishery to date. Juvenile rainbow trout, and perhaps smaller adults, are widely scattered but not abundant in the tributary streams draining the mine area (ERT 1984a, 1985c).

Dolly Varden are the most widespread of the salmonids found in the study area, occurring in both resident and anadromous forms. In 1983, in excess of 3,000 anadromous Dolly Varden were counted entering the system (Table 4-11;



UPPERMOST EXTENT OF DOCUMENTED USE BY REARING JUVENILE SALMONIDS

Diamond Chuitna Environmental Impact Statement | FIGURE 4-7



SOURCE: ERT 1984a, b,
DAMES & MOORE 1980 (PINKS ONLY)

UPPERMOST EXTENT OF DOCUMENTED USE BY SPAWNING ANADROMOUS FISH

Diamond Chuitna Environmental Impact Statement	FIGURE 4-8

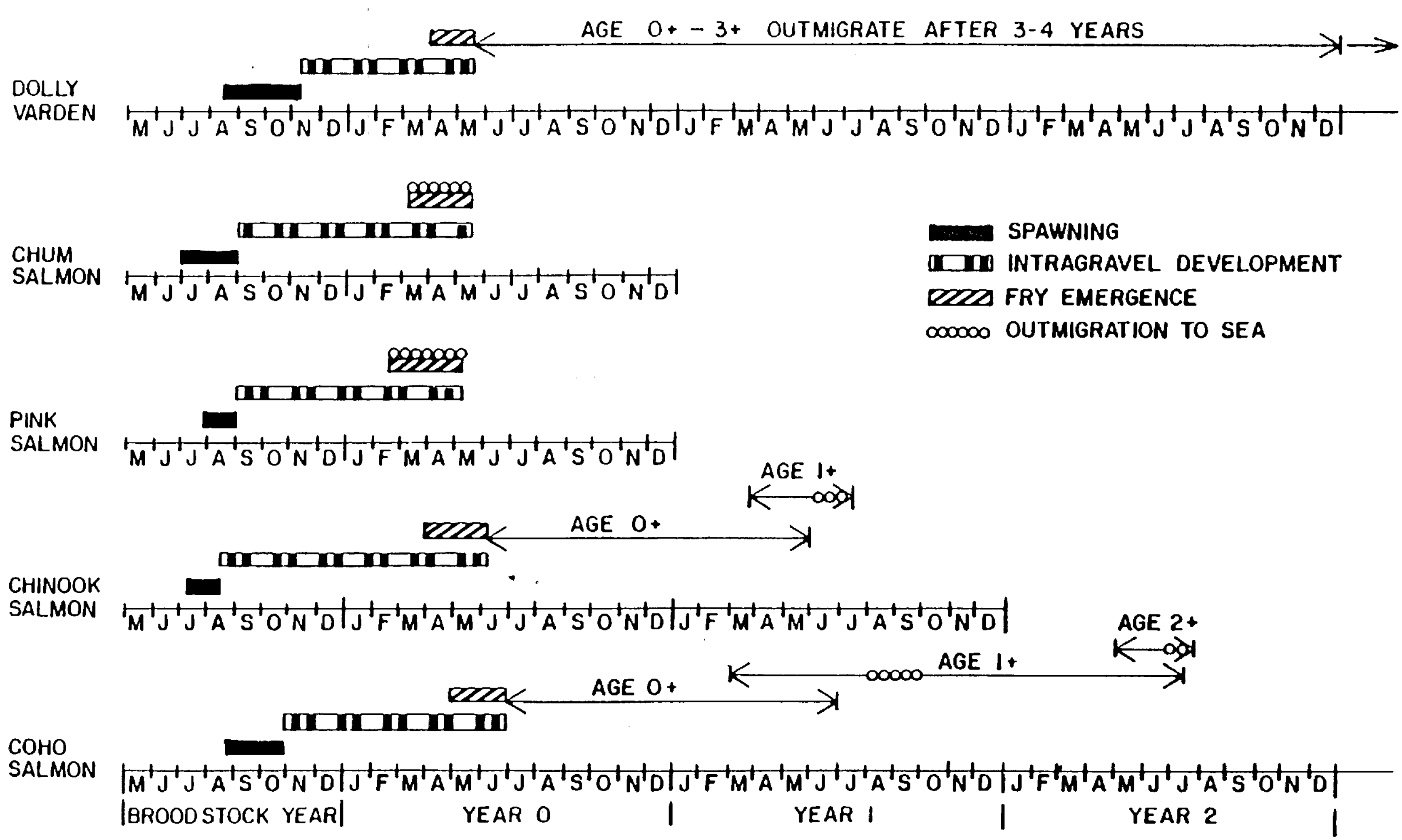
ERT 1984c). Juveniles were taken at virtually every stream location sampled that had any fish, including the uppermost reaches of tributaries to streams 2002, 2003, and 2004 (ERT 1984a, Dames & Moore 1980).

Other resident fish that have been taken in the Chuitna system include Pacific lamprey (Lampetra tridentatus), arctic lamprey (L. japonica), slimy sculpin (Cottus cognatus), coastrange sculpin (C. aleuticus), and threespine stickleback (Gasterosteus aculeatus, primarily a lake resident) (ERT 1984a).

By far the greatest fishery value of the Chuitna System is represented by the production of anadromous Pacific salmon, especially chinook (king) and coho (Oncorhynchus tshawytscha and O. kisutch). Pink salmon (O. gorbuscha) are also abundant in the system along with a few chum and red (sockeye) salmon (O. keta and O. nerka, respectively). Timing of key life history phases of important salmonids in the Chuitna System is presented in Figure 4-9. Documented spawning escapements* of chinook, coho, and pinks to the Chuitna system and to mine area tributaries are provided in Table 4-12. Chum escapements are not well documented, but are likely less than a hundred fish annually (ERT 1984a). Small numbers of red salmon are taken each year in the chinook fishery in the lower Chuitna (ADF&G 1983, 1984b).

Maturing adult chinook salmon enter the Chuitna River from mid-June through early July on their spawning migration. Estimated escapements in the three years of baseline data ranged from 3,537 to 6,000. Spawners were noted as far upstream as 6.5 km (4 mi) above the mouth of Wolverine Creek in the mainstem. Chinook spawners were documented as far upstream as 10, 5.6, and 7 km (6.2, 3.5, and 4.4 mi) above the mouths of streams 2002, 2003, and 2004, respectively, in at least one of the three baseline survey years (Table 4-12, Fig. 4-8). Maximum percentage of the documented chinook escapement for the Chuitna system spawning in each creek has been 7, 14, and 8 percent, respectively. Upstream extent of chinook spawning in these three streams has declined progressively from 1982 through 1984. Upstream migration distance, and very likely escapement numbers to each stream as well, is dependent in each year on the location of impassible beaver dams.

Chinook spawn in the study area from early July through mid-August (Fig. 4-9). Preferred spawning habitat is gravel and cobbles with a tendency toward use of coarser stream bed areas. Measured spawning area water velocities ranged from 0.27 to 0.46 m/s (0.9 to 1.5 ft/s) in depths of 25 to 35 cm (0.8 to 1.1 ft) (ERT 1985c). Emergence reportedly occurs throughout April and May (Fig. 4-9). Fry usually spend one year in the stream, residing primarily in the main Chuitna and the middle and lower sections of the tributaries and feeding on a mixture of terrestrial adult and immature



SOURCE: ERT, 1985

TIMING OF LIFE HISTORY PHASES FOR ANADROMOUS SALMONIDS IN THE CHUITNA RIVER DRAINAGE

Diamond Chuitna Environmental Impact Statement

FIGURE 4-9

Table 4-12

SALMON ESCAPEMENT TO THE CHUITNA RIVER AND PROJECT AREA TRIBUTARIES

	CHINOOK				COHO				PINK				DOLLY VARDEN			
STREAM	YEAR	UPSTREAM LIMIT	NUMBER	% OF SYSTEM	YEAR	UPSTREAM LIMIT	NUMBER	% OF SYSTEM	YEAR	UPSTREAM LIMIT	NUMBER	% OF SYSTEM	YEAR	UPSTREAM LIMIT	NUMBER	% OF SYSTEM
CHUITNA SYSTEM 20	1982	to mouth of 2011 (Wolverine Fork)	3537 to 4119	100	1982	not documented	1085 to 1500	100	1980	to 2 mi. below mouth of 2004	N.E.	N.E.	1982	not documented	N.E.	-
	1983	to 4 mi. above mouth of 2011	5750 to 6000	100	1983	to 4 mi. above mouth of 2011	1600 to 1800	100	1982	to mouth of 2004	20,410+	100	1983	above mouth of Wolverine Creek	3328+	100
	1984	to mouth of 2011 (Wolverine Fork)	3900	100	1984	not documented	1900 to 2500	100	1983	to mouth of 2004	7150	100	1984	not documented	N.E.	-
									1984	to mouth of 2004	9775 mainstem only	unknown				
LONE CREEK 2002	1982	to 0.5 mi. above 200201	200+	5 - 6	1982	to above 200204 (Denslow Lake)	130+	9 - 12	1980	to mouth of 200202	several thousand					
	1983	to 0.8 mi. above mouth	330+	7	1983	to 2 mi. above 200201	312	17 - 19	1982	to 0.5 mi. above 200205	N.E.	N.E.				
	1984	to 0.8 mi. above mouth	224	7	1984	to just below 200204; 0.5 mi. into 200202	446	18 - 23	1983	to 0.8 mi. above mouth	225	3				
									1984	to 0.8 mi. above mouth	324	3				
WATERSHED 2003	1982	to near mouth of 200302	508	12 - 14	1982	not documented	70+	5 - 6	1980	to just below mouth of 200306	5000?	N.E.				
	1983	to near mouth of 200302	325	6 - 7	1983	to just above 200306	141	8 - 9	1982	not documented	N.E.	N.E.				
	1984	to 1.0 mi. above of mouth	41	1	1984	to mouth of 200306; 0.4 mi. into 200305		5 - 7	1983	to 0.8 mi. above mouth	<50	4				
									1984	to 0.8 mi. above mouth	N.E.	N.E.				
WATERSHED 2004	1982	to 1.0 mi. above 200405	280	7 - 8	1982	documented only in 200405	100+	7 - 9	1980	none seen	0	0				
	1983	to just below 200403	81+	2	1983	to mouth of 200406	144	8 - 9	1982	none seen	N.E.	N.E.				
	1984	to 0.5 mi. above mouth	9	<1	1984	to mouth of 200406	86	3 - 5	1983	none seen	0	0				
									1984	none seen	0	0				

Source: ERT 1984a, 1984b; Dames & Moore 1980 aquatic insects (ERT 1984a). Outmigration probably occurs during the spring but may extend from March through July (ERT 1985c). Late fall migrations out of the smaller tributaries may occur but have not been well studied. Overwintering distributions are also not fully defined.

Maturing adult coho salmon enter the Chuitna River from late July into September on their spawning migration. Coho spawners have been noted as far upstream as 5.6 km (3.5 mi) above the mouth of Wolverine Creek in the mainstem and some 11 km (7 mi) up Chuit Creek (ERT 1984a). Coho spawners also were documented as far upstream as 17.6, 11.5, and 9.6 km (11, 7.2, and 6 mi) above the mouths of streams 2002, 2003, and 2004, respectively, in at least one of the three baseline survey years (Fig. 4-8). Maximum percentage of the documented coho escapement for the Chuitna system spawning in each creek has been 23, 9, and 9 percent respectively. Upstream migration distance and escapement to each stream do not seem to be as dependent on the location of beaver dams as for chinook and pink salmon.

Coho spawn in the study area from late August through October (Fig. 4-9). Preferred spawning habitat is a gravel or gravel/cobble stream bed in 27 to 30 cm (10.6 to 11.8 in) of water with a velocity of 0.34 to 0.43 m/s (1.1 to 1.4 ft/s) (ERT 1985c). Emergence reportedly occurs from late April through June. Fry spend one or two years in the stream residing mainly in pools and slower reaches of accessible tributaries. They feed on a mixture of terrestrial adult insects that fall into the water and immature aquatic insects (Scott and Crossman 1973, Dames & Moore 1976). Outmigration probably occurs primarily during the spring but may extend throughout much of the year (Fig. 4-9). As with chinook salmon, late fall migrations and overwintering distributions are not well understood.

Maturing adult pink salmon enter the Chuitna River from mid-July through early August on their spawning migration. Estimated escapements in the three years of baseline ranged from 7,150 to over 20,400, with greater numbers during even-numbered years. Spawners were noted only as far upstream as the mouth of Stream 2004 in the mainstem. Pink spawners were documented as far upstream as 4.7 and 1.3 km (2.9 and 0.8 mi) above the mouths of streams 2002 and 2003, respectively, in at least one of the three baseline survey years (Table 4-12). Maximum percentage of the documented pink escapement for the Chuitna system spawning in each creek has been 3, 4, and 0 percent, respectively. However, in an earlier survey, during the exceptionally good 1980 pink year, pink spawners were far more abundant (Table 4-11) in streams 2002 and 2003 than during the baseline study years (Dames & Moore 1980). Spawning activity was noted as far upstream as 11.4 km (7.2 mi) above the mouth of Stream 2003. In Lone Creek (2002), pinks were seen as high as 14.6 km (9.1 mi) above the mouth (at the confluence of 200202) in

1980 (Dames & Moore 1980). As with chinook, upstream migration distance, and very likely escapement numbers to each stream as well, is very dependent on the location of impassible beaver dams; a trend of increasing exclusion from upper reaches of mine area tributaries has occurred since 1980.

Pink salmon spawn in the study area from late July to early September (Fig. 4-9). Preferred spawning habitat is a gravel or gravel/cobble stream bed with depths of 12 to 46 cm (0.4 to 1.5 ft) and velocities from 0.30 to 0.60 m/s (1 to 1.9 ft/s) (ERT 1985c). Emergence reportedly occurs from mid-February into May (Fig. 4-9). Fry spend only a few days or weeks in their natal stream, moving rapidly out to the marine environment and feeding little in freshwater.

The fish resources of independent drainages that would be crossed by alternative transportation corridors have not been studied in great detail. However, ERT (1984b) reported spawning pink salmon in the lower mile of both Tyonek and Old Tyonek creeks in August 1984 and coho spawners in the upper reaches of each stream in October 1984. Threemile Creek has a run of several thousand red salmon and may also have some coho (Hepler 1985). Nikolai Creek has a run of perhaps several hundred chinook, as well as good runs of even-year pinks, a good resident rainbow population, and very likely some coho salmon (Hepler 1985).

4.4.4.3 Stream Habitat Evaluation

Physical and biological characteristics of the Chuitna River and its mine area tributaries have been described above in Sections 4.2, 4.3, 4.4.4.1, and 4.4.4.2. In addition to this information, a considerable body of data on specific characteristics of individual stream reaches that may be directly or indirectly impacted by the project was gathered in the baseline studies. These data (ERT 1984a, 1985c) are essential to the impact analyses described in Section 5.0 and provide necessary documentation for designing and measuring the success of stream reconstruction and rehabilitation. Parameters that are used in the impact analysis are summarized by stream reach in Table 4-13. Other physical and biological habitat data are available in the baseline studies reports (ERT 1984a,b) and the State Permit Application (ERT 1985c).

Maximum measured rearing densities and maximum spawner densities for each key species have been included (Table 4-13) for the various stream reaches that may be influenced by the project. Finally, each reach has been assigned a rating of habitat (resource) value based on a localized application of USFWS mitigation policy (FR Vol. 46, No. 15, 23 January, 1981). These assignments are based on perceived potential value of the various reaches (cf. entire drainage in standard USFWS applications), the physical and biological

Table 4-13

HABITAT AND BIOLOGICAL CHARACTERISTICS OF POTENTIALLY AFFECTED REACHES OF MINE AREA STREAMS (a)

DRAINAGE	20 CHUITNA R.	2002 LONE CR.	2002 LONE CR.	2002 LONE CR.	2003	2003	2003	2003	2003	2003	2004	2004	2004	2004
TRIBUTARY	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	200304	200305	200306	MAINSTEM	MAINSTEAM	MAINSTEM	200403
REACH	BELOW 2003	UPPER	MIDDLE	LOWER	UPPER	MIDDLE	LOWER	ENTIRE	ENTIRE	ENTIRE	UPPER	MIDDLE	LOWER	UPPER 360 m
REACH LENGTH (meters)	17910	3670	11340	6390	4610	8860	4020	2820	1450	2100	4630	4830	3020	360
MEAN WIDTH (meters)	22.6	2.4	3.7	6.7	1.8	4	4.6	1.2	1.2	2.4	2.4	3.3	3.9	1 (i)
REACH AREA (m2)	404766	8808	41958	42813	8298	35440	18492	3384	1740	5040	11112	15939	11778	360
POOL/RIFFLE (area ratio)	0.4-0.85	0.4-1.7	0.8-3.4	1.2-4.3	0.73-12.0	1.69-7.13	0.34-0.50	31.1	0.83-290	2.08-617	0.27-4.53	1.36-4.32	2.39	-
SLOPE (%)	0.5-3.0	1.0-3.0	1.0-1.5	1.0-1.5	0.5-3.0	0.5-2.5	1.5-3.5	3	1	1	2.0-5.0	0.5	2.5	-
SINUOSITY	HIGH	LOW	HIGH	MODERATE	LOW	HIGH	LOW	LOW	LOW	MODERATE	MODERATE-HIGH	HIGH	LOW	-
RIFFLE VEL. (major category, m/s, and percent)(b)	0.31-0.76 44	0.31-0.76 90	0.31-0.76 59	0.31-0.76 75	0.16-0.30 68	0.16-0.30 65	0.77-1.1 56	0.16-0.30 71	0.16-0.30 63	0.31-0.76 67	0.16-0.30 55	0.31-0.76 61	0.31-0.76 75	- -
BEAVER DAMS	NONE	FEW	MANY	FEW	NONE	MANY	FEW	FEW	NONE	MANY	FEW	FEW	MANY	-
DISCHARGE (annual range m3/s)	2.4-113+	0.01-2.9	0.08-17.2	0.23-19.4	<0.003-0.17	0.06-4.5	0.11-9.3	0.01-0.07	0.003-0.28	0.01-0.04	<0.006-0.25	0.08-13.1	0.11-24	-
MAXIMUM MEASRED SPAWNING DENSITY (no./km)														
- CHINOOK	85	-	(j)	200	-	85(l)	85	-	-	-	45 (l)	45	-	-
[illegible]	-	20	20-35	160	16-18	3-18	8	-	5	-	(j)	(j)	(j)	-
	1140	-	300(k)	190	150-250(k)	800-1000(k)	800-1000(k)	-	-	-	-	-	-	-
MAXIMUM MEASURED REARING DENSITY (no./m2)														
- CHINOOK	0.64 (d)	0.11	0.43	0.32	0	0	2.05	0	0	0.0 (e)	<0.04 (f)	<0.04 (f)	0.23 (f)	- (g)
- COHO	0.55 (d)	0.75	3.03	0.9	1.08	1.64	0.75	1.28	2.56	1.92 (e)	0.13 (h)	2.98 (h)	0.74 (h)	1.92 (e)
- RAINBOW/ DOLLY VARDEN	0.47 (d)	0.64	0.1	0.2	0.86	0.11	0.76	0.27	0.4	0.34 (e)	1.44 (h)	0.39 (h)	0.77(h)	0.34 (e)
ASSIGNED PROJECT AREA HABITAT VALUE														
- CHINOOK	VERY HIGH	MEDIUM	HIGH	VERY HIGH	LOW	HIGH	VERY HIGH	MEDIUM	MEDIUM	LOW	MEDIUM	HIGH	VERY HIGH	MEDIUM
- COHO	HIGH	HIGH	VERY HIGH	HIGH	HIGH	VERY HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	VERY HIGH	HIGH	HIGH
- PINK	HIGH	MEDIUM	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	LOW	LOW	LOW	LOW	LOW	LOW
- RAINBOW/ DOLLY VARDEN	HIGH	HIGH	MEDIUM	MEDIUM	HIGH	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	HIGH	MEDIUM	HIGH	MEDIUM

(a) Source: ERT (1984a, 1984b, 1985c) except as noted.
(b) Percent of total riffle area with velocities in major category.
(c) Actual density shown is highest documented in any baseline study year.
(d) Scaled from maximum density in lower 2003 and 2003 (averaged), based on ratios of 1982 minnow trap catch per unit of effort (CPUE); applicable to shorelines only.
(e) Based on average of 200304 and 200305 values.
(f) Scaled from lower 2003 density using ratios of 1982 minnow trap mean CPUE'S from applicable reaches.
(g) No basis for extrapolaton of density values.
(h) Scaled from highest 1983 or 1984 densities on 2002 and 2003 using 1982 minnow trap mean PCUE'S from comparable reaches.
(i) Estimated value.
(j) Species is present; no density estimate obtained.
(k) Source: Dames & Moore 1980.
(l) Lower portion only.

data available, and the assumption that access is unhindered to reaches currently blocked by beaver dams. This assumption is based on the trends observed between 1980 (Dames & Moore 1980) and 1984 (ERT 1985c) which indicate a progressive decline in numbers of chinook and pink spawners reaching upper stream areas. For example, the middle reach of the mainstem of Stream 2003 was rated as having high habitat value for chinook salmon despite the fact that none were taken in the 1983 or 1984 quantitative sampling in the reach. However, habitat present should be excellent for chinook juveniles if upstream access were not blocked by beaver dams and very likely would be used by adults for spawning as well.

Overall, the lower reaches of all three streams were rated as very high in habitat value for chinook while the middle reaches were rated very high for coho. Middle reaches were rated high for chinook based on their rearing potential but upper reaches and small tributaries tended to be rated low because low flow likely would limit access even in the absence of beaver dams. Most reaches in 2002 and 2003 were rated high for pinks based on the high densities of spawners seen in 1980 (Dames & Moore 1980), while 2004, where none have been seen, was rated low. All reaches were rated at least high for coho since only the uppermost reaches of the smaller tributaries lacked significant rearing by this species. Upper and lower reaches of the three streams were generally rated high for resident rainbow and Dolly Varden while middle reaches were of lesser value based on measured usage densities. The Chuitna River below 2003 was rated as very high in habitat value for chinook and high for all other species because of its combined function as a migratory pathway, spawning area, rearing area, and excellent sport fishing water.

4.5 MARINE ENVIRONMENT

4.5.1 Physical and Chemical Oceanography

Cook Inlet is a large tidal estuary with its axis trending NNE-SSW. It is divided into north and south sectors by the East and West Forelands. The Beluga region is in the north sector of Cook Inlet which has implications relative to circulation, water quality, and ice conditions.

4.5.1.1 Currents/Circulation

Tidal influences dominate currents and circulation patterns in Cook Inlet. Models of Cook Inlet tidal processes have been constructed (Carlson and Behlke 1972; Mungall and Matthews 1970) but do not offer sufficient resolution at the three possible port sites for impact assessment. Cook Inlet tides are mixed diurnal, exhibiting two unequal high and low tides in a period of about 25 hours; amplitudes range from 3 m (10 feet) at the mouth to 9 m (30 feet) at the head.

Tides were measured at the Granite Point port site for a few days during the feasibility investigations (Bechtel 1983; Nortec 1982) and these results indicate a tidal range on the order of 4 m (13 to 14 feet). Comparison of these data with predicted tides from other parts of Cook Inlet suggests some differences at the Diamond Alaska site relative to expected (adjusted predictions) tidal datum, levels and times. This affects site bathymetric survey data.

Currents, being tidally driven, reverse direction approximately every 6 hours. With the great tidal range, the velocities and turbulence of currents in Cook Inlet can be dramatic. The National Ocean Survey (NOS) conducted current monitoring in Cook Inlet during the mid-1970s. Their stations 55, 57, and 58 are in the Granite Point/North Foreland vicinity. Data from the NOS tidal current tables indicate higher flows approaching 5 knots. Because of the irregular seafloor and coastline, the ebb and flood current directions also vary from being exactly opposite in direction reversal; this is important in selecting dock location and orientation.

The highest currents measured at Granite Point during the brief feasibility investigation were on ebb, which peaked at 2.8 knots; flood tide reached 2.6 knots during this same short period. A statistical analysis (Nortec 1982) concluded that extreme tidal range at the site would be 5.8 m (17.8 feet) and extreme tidal current would be 6.2 knots. Net circulation direction across this site is probably to the southwest.

4.5.1.2 Bathymetry

Detailed bathymetric data are not available for the area between Trading Bay and the Beluga River except in the immediate vicinity of the proposed Granite Point and Ladd port sites (Nortec 1982). Navigation charts show that, in general, the sea bottom is gently sloping with a shallow shelf less than 18 m (60 ft) deep extending into Cook Inlet or a distance of 2100 m (7000 ft) to 3600 m (12,000 ft). The shelf narrows opposite the North Forelands where 18 m (60 ft) depths are found about 900 m (300 ft) from shore. The Granite Point bathymetric study indicated that many uncharted irregularities exist in the bottom topography. Shoals with water less than 18 m (60 ft) deep are present south of Granite Point and southeast of the mouth of Threemile Creek.

4.5.1.3 Wind and Wave Climate

Cook Inlet lies in a northwest-southeast storm track that is bounded on the northeast by the Canadian continental air mass and on the south and west by a maritime air mass. The location is susceptible to sudden intense storms. Prevailing winter winds are from the northeast and can reach intensities up to 66 knots. Because Cook Inlet is paralleled by mountain ranges, winds perpendicular to the channel seldom exceed 35 knots (Bechtel 1983).

There is little published data on waves in Cook Inlet. Carsola (1975) investigated waves in lower Cook Inlet and reported significant wave heights less than 0.6 m (2 feet) about 80 percent of the time. Maximum observed significant wave heights were reported at 2.4 m (8 feet) in that study. Most common wave periods are 3 to 4 seconds. The frequency of occurrence for deepwater waves greater than 2.6 m (8 ft) is about 12 percent, 5 percent for waves of 3.8 m (11.5 ft). Fishermen have reported observing waves in excess of 6.6 m (20 ft) during storms.

Tsunami waves are a possibility in Cook Inlet. Such waves were observed at Seldovia, and possibly at Homer, during the 1964 Alaska earthquake (Wilson and Torum 1968). The active volcanoes near Cook Inlet might also generate a tsunami wave. Mt. Augustine, an island in Cook Inlet south of the project area, erupted in 1976 and 1986.

4.5.1.4 Marine Water Quality

Cook Inlet water quality is incompletely understood and no studies have been done at this site. However, regional Cook Inlet studies and the dynamic mixing that is characteristic of Cook Inlet permit some generalizations for the site.

The water column is expected to be well-oxygenated. Suspended solids are very high in Cook Inlet, owing to the turbulent transport and the contribution of silt from glacier-fed runoff, which is especially high during spring/summer seasons (especially July, August, September). Rivers near the project area are important in this respect and include the Susitna, Beluga, and McArthur.

In upper Cook Inlet, the clay and silt particles are kept in suspension by the tidal currents. The circulation patterns in Cook Inlet result in much of this fine sediment being transported down the west side of the inlet, across the site (Gatto 1976). Surface suspended sediment near the site will be generally greater than 100 mg/l (Sharma et al. 1973).

Cook Inlet is a tidal estuary and its salinity may vary widely in areal distribution and by season. A mean salinity value at the site would be about 15 parts-per-thousand (Nortec 1982). During May through September, river discharges decrease the salinity of the upper inlet. Wintertime salinities rise due to greater dominance of the ocean water inputs from the south. The water on the west side of Cook Inlet tends to be fresher than on the east (Sharma et al. 1974; Burbank 1974).

Variations in surface salinities and temperatures are also a function of tide stage (Gatto 1976). The gradients will be stronger on the flood tide and less on the ebb, due to greater mixing.

The waters of western Cook Inlet are essentially unpolluted (except for natural sediment). Some local sources of pollution exist in the Anchorage and Kenai areas and in association with offshore drilling platforms. However, the flushing rate is so high that pollutants are quickly diluted.

4.5.1.5 Ice Conditions

Ice conditions are more extreme in the northern half of Cook Inlet than the southern. The ice derives from four sources: sea ice, beach ice, stamukhas*, and fresh water (river/esturary) ice. Ice floes commonly reach up to one mile across and 3-4 feet thick in Cook Inlet. Thicker ice also occurs from stamukhas and so tends to be softer. The greatest ice development is in December, January, and February. Ice floes tend to concentrate along the western shoreline during ebb tides, passing through the site vicinity.

Ice movement is primarily influenced by Cook Inlet circulation patterns, although this can be enhanced or retarded by winds. Cross-inlet ice movement due to wind forces is considered uncommon.

Local ice conditions may affect shipping and port design. There is some indication from satellite imagery that the Granite Point port site is somewhat protected from the dominant out-flowing ice due to the presence of Granite Point.

4.5.1.6 Other Marine Conditions

Corridors containing buried oil and gas pipelines extend eastward from Granite Point to offshore oil production platforms and across the inlet to Nikiski. Additional pipelines extend shoreward from oil platforms in Trading Bay. No anchoring is permitted near these corridors.

Cook Inlet is used year-round for shipping, with regular winter traffic to the Port of Anchorage. Offshore oil platforms are common in the site's operating vicinity.

Fishing vessels operate throughout Cook Inlet during the open-water seasons.

4.5.2 Biology

4.5.2.1 Lower Trophic Levels

The estuarine habitat of upper Cook Inlet is characterized by high turbidity and suspended sediment levels, extreme tides and currents, highly variable salinity, and seasonal ice formation (Section 4.5.1). This combination has discouraged biological research and has lead to the widely held conviction that, except for seasonal passage of anadromous fish such as Pacific salmon and eulachon (*Thaleichthys pacificus*), and the belukha whales (*Delphinapteras leucas*) which feed upon them, the upper Inlet is a very unproductive environment (Bakus et al. 1979). Bakus et al. (1979) looked at some portions of the biological community in the vicinity of the Anchorage airport and concluded that subtidal infauna was essentially nonexistent and that intertidal life was very poor. The diversity and abundance of plankton also was less than that observed at other locations. Macroscopic algae on the beaches in the Granite Point/Trading Bay area are reportedly limited to mats of the green alga *Vaucheria* sp., while three additional species have been reported elsewhere in the upper Inlet. In contrast, in an intensive study of Knik Arm, Dames & Moore (1983) found evidence of an active ecosystem despite these conditions and despite the apparent low primary productivity. They found that massive quantities of organic detritus are carried to the Inlet by its many tributary rivers and that an abundance of a limited number of species of large epibenthic invertebrates that are likely detritivores* (mysids, crangonid shrimp, amphipods) are found in the Inlet. Limited sampling in the vicinity of Granite Point indicate that a similar invertebrate assemblage is present at the locations of the two port site alternatives (ERT 1984a). Infauna* at the port site is very likely limited to a small bivalve (*Macoma balthica*) and unidentified polychaetes (DOWL 1981).

4.5.2.2 Fish

In addition to serving as a transport pathway bringing large quantities of organic detritus to the highly productive waters of lower Cook Inlet, the upper Inlet is also a migratory pathway for anadromous fish including all five eastern-Pacific species of salmon as well as eulachon, smelts (Osmeridae) and Bering cisco (*Coregonus laurettae*). A number of species of marine fish have been taken in upper Cook Inlet (Table 4-14) although their significance does not compare with that in the lower Inlet (Blackburn 1978). Limited late-summer beach seine sampling in the North Foreland area captured 10 species of fish, including pink, chum, and coho salmon as well as Dolly Varden (age unspecified, ERT 1984a). A more intensive spring sampling regime in Knik Arm (Dames & Moore 1983) collected 18 species including five not previously reported from the upper Inlet which must be

Table 4-14

FISH SPECIES KNOWN TO OCCUR IN UPPER COOK INLET

Scientific Name	~~on Name	Spa~~ning Period[1]	Time Spent in Marine Enviroment
Fish			
Salmonidae	Trout, salmon, white fish		
Oncorhynchus gorbuscha	Pink (humpback) salmon	mic ~~uly - early Sept.	1+ year
O. keta	Chum (dog) salmon	ear~~y Aug. - early Oct.	2 - 4 years
O. kisutch	Coho (silver) salmon	early Aug. - Feb.	1 -3 year
O. nerka	Sockeye (red) salmon	early Aug. - Nov.	1 - 4 years
O. tshawytscha	Chinook (king) salmon	mid- June - mid-Aug.	1 - 6 years
Salmo gairdneri	Steelhead (rainbow) trout[2]	fall - spring	2 mo. - 4 years
Salvelinus malma	D~~lly Varden	fall	several weeks to 6-7 months
Coregonus laurettae	Bering cisco	fall(?)	2 - 3 months per year
Osmeridae	Smelts		
Hypomesus pretiosus	Surf smelt	March to May	entire life cycle
Sperinchus thaleichthys	Longfin smelt	Oct. to Dec.	1 - 2 years
Thaleichthys pacificus	Eulachon	mid- to late May	entire life cycle except about 2 weeks
Clupeidae			
Clupea harengus pallasi	Pacific herring	spring	entire life cycle
Gadidae	Codfishes		
Gadus macrocephalus	Pacific cod	usually Jan. & Feb.	entire life cycle
Theragra chalcogramma	Walleye pollock	winter	entire life cycle
Elginus gracilis	Saffron cod		entire life cycle
Gasterosteidae	Sticklebacks		
Gasterosteus aculeatus	Threespine stickleback	June to July	variable, but anadromous forms spend up to 1 year in fresh water before moving to sea
Pungitius pungitius	Ninespine stickleback	May to July	variable, always spawn in fresh water
Liparidae	Snailfish		
Liparis rutteri	Ringtail snailfish		entire life cycle
Cottidae	Sculpins		
Leptocottus armatus	Pacific staghorn sculpin	Oct. to March	entire life cycle
Pleuronectidae	Flounders		
Platichthys stellatus	Starry flounder	March to April	entire life cycle
Hippoglossoides elessodon	Flathead sole	March to late April	entire life cycle
Hippoglossus stenolepis	Pacific halibut	winter	entire life cycle
Limanda aspera	Yellowfin sole		entire life cycle

Sources: ERT 1984a, Dames & Moore 1983, Scott and Crossman 1973.

[1] No anadromous rainbows are known from rivers north of east and west forelands; however, Dames & Moore (1983) captured a single sexually mature rainbow (195 mm [7.7 in]) in uper Cook Inlet in May 1983.

assumed to also occur seasonally in the study area (Table 4-14). More importantly, the Knik Arm study proved that fish do more than just migrate through the upper Inlet; many, including juvenile salmon, feed on the abundant epifauna in the area, while others, such as smelt and Pacific herring (Clupea harengus) may spawn on the beaches of the upper Inlet.

Use of the study area beaches and nearshore waters for these functions is unknown; however, given the considerable human activity in the area, significant beach spawning would not likely have gone unnoticed. Beaches in the study area do not appear unique in any way and the Knik Arm study did not detect any particlar preferences of fish for specific beach types. Certainly, there is considerable feeding by juvenile anadromous fish in the area, particularly on the broad flats and tidal channels of Trading Bay and around the mouth of the Chuitna River. Adult salmon returning along the shoreline to their natal streams probably do not feed extensively in the upper Inlet. For them, the study area shoreline likely is an extremely important migratory pathway providing access to the numerous rivers to the north. Commercial fisheries in the area are discussed in Section 4.5.3.

4.5.2.3 Birds and Mammals

Most beaches, mud flats, and nearshore waters of upper Cook Inlet are not heavily utilized by waterfowl and marine birds (Dames & Moore 1983). Small numbers of gulls (Laridae) and sea ducks rest on the water surface but foraging opportunities are limited by the high turbidity. Scarcity of infauna likewise may discourage use by shorebirds, except in small bays and at the mouth of creeks and rivers. An exception to this generally low use by birds occurs in the large saltmarsh and mud flat areas of Trading Bay to the south and the Susitna Flats to the north, as well as the much smaller flats around the mouth of the Chuitna River and between Granite Point and Nikolai Creek. These areas are very important spring and fall staging areas for a number of waterfowl and shorebird species and are important sport hunting areas as well (see Section 4.10.2). In addition, a small (estimated 30 nesting pairs) colony of glaucous-winged gulls is located about 0.8 km (0.5 mi) north of the proposed Ladd port site (ERT 1986).

Only two of the 21 species of marine mammals reported from lower Cook Inlet are common in the upper Inlet; these are belukha (beluga) whale (Delphinapterus leucas) and harbor seal (Phoca vitulina) (Calkins 1981). In the study area, both species are common primarily in the spring and summer when they feed on anadromous fish near the mouths of rivers. The area from Trading Bay to the Susitna River appears to be especially important for belukhas with numerous sightings near the mouth of the Beluga River during

July of 1982 and 1983 by baseline study team members (ERT 1984a). The area between the Beluga and Susitna rivers may also be a significant calving and/or nursery area for belukhas (Calkins 1981).

Information on the life history of harbor seals in upper Cook Inlet is incomplete; however, they are common at times in certain areas (ERT 1984a). Harbor seals are present from May to September. During the winter months, they most likely move to Lower Cook Inlet. Like the belukha, they appear to feed on anadromous fish, following them to, and into, the mouths of the Inlet's tributary rivers.

4.5.2.4 Threatened or Endangered Species

None of the marine biota known to frequent the study area are considered endangered or threatened.

4.5.3 Commercial Fisheries

The only significant commercial fishery in upper Cook Inlet is that for the five species of Pacific salmon. Above the East and West Forelands, all commercial fishing is by set net (fixed gill net). Tyonek residents held 26 set net permits in 1983. The area from Chuit flats to Threemile Creek is fished intensively; set net sites are nearly continuous. Commercial fishing is somewhat less intensive from Chuit Flats to Granite Point. Permits in this area are held almost exclusively by Tyonek residents. From Granite Point west to within 1.6 km (1 mi) of Nikolai Creek, there are some 14 permits held and fished by local residents or lease holders (individuals leasing fishing camp sites).

The combined total catch of all species of salmon in ADF&G statistical areas 247-10 (West Foreland to Granite Point) and 247-20 (Granite Point to Threemile Creek) have averaged 4 percent of the total upper Inlet catch over the last 19 years (Table 4-15). While numbers of fish taken in these two reporting subareas have increased in the last 5 years, the percentage contribution to the total upper Inlet fishery has declined to 2.9 percent (based on 1980-1984 averages; Table 4-15), probably due to increased effort in other portions of the upper Inlet. The two commercial fishery subareas on either side of Granite Point contribute the highest percentage of pink and coho salmon (6 and 7.3 percent, respectively, using 1980-1984 averages) and the lowest percentage of chum and sockeye (0.7 percent each using 1980-1984 averages). This harvest distribution coincides to a degree with the relative importance of these species in the Chuitna River, although what proportion of the catch is actually contributed by the Chuitna System has not been determined.

Table 4-15

UPPER COOK INLET SALMON CATCH SUMMARY 1966-1984

LOCATION[1]	CHINOOK 1966-84 AVE	%[2]	CHINOOK 1980-84 AVE	%	SOCKEYE 1966-84 AVE	%	SOCKEYE 1980-84 AVE	%	COHO 1966-84 AVE	%	COHO 1980-84 AVE	%	EVEN YEAR PINK 1966-84 AVE	%	EVEN YEAR PINK 1980-84 AVE	%
UPPER COOK INLET (No. of Anchor Pt.)	11956.9	100.0	15262.0	100.0	1569808.0	100.0	2658000.0	100.0	285337.0	100.0	501881.0.	100.0	1236872.0	100.0	1066529.0	100.0
NORTHERN DISTRICT (No. of Forelands)	1583.0	13.2	1250.0	8.2	105224.0	6.7	173707.0	6.5	61154.0	21.4	94799.0	18.9	234180.0	18.9	217245.0	20.4
GENERAL SUBDISTRICT (West side of Inlet)	1006.0	8.4	1001.0	6.6	61218.0	3.9	105884.0	4.0	50025.0	17.5	77890.0	15.5	209963.0	17.0	198198.0	18.6
AREA 247-10 (W. Foreland Granite Pt.)	425.0	3.6	317.0	2.1	11463.0	0.7	15874.0	0.6	14184.0	5.0	18231.0	3.6	56940.0	4.6	43375.0	4.1
AREA 247-20 (Granite Pt. to Threemile Creek)	222.0	1.9	183.0	1.2	13421.0	0.9	21785.0	0.8	12910.0	4.5	18753.0	3.7	46584.0	3.8	33032.0	3.1

LOCATION[1]	ODD YEAR PINK 1966-84 AVE	%	ODD YEAR PINK 1980-84 AVE	%	CHUM 1966-84 AVE	%	CHUM 1980-84 AVE	%	ALL SPECIES 1966-84 AVE	%	ALL SPECIES 1980-84 AVE	%
UPPER COOK INLET (No. of Anchor Pt.)	176448.0	100.0	98748.0	100.0	703945.0	100.0	891441.0	100.0	3305607.0	100.0	4773000.0	100.0
NORTHERN DISTRICT (No. of Forelands)	52283.0	29.6	37465.0	37.9	31522.0	4.5	42222.0	4.7	347500.0	10.5	457291.0	9.6
GENERAL SUBDISTRICT (West side of Inlet)	46671.0	26.5	33350.0	33.8	28853.0	4.1	36284.0	4.1	273717.0	8.3	353317.0	7.4
AREA 247-10 (W. Foreland Granite Pt.)	11458.0	6.5	4960.0	5.0	4323.0	0.6	4140.0	0.5	65791.0	2.0	66671.0	1.4
AREA 247-20 (Granite Pt. to Threemile Creek)	13818.0	7.8	11725.0	11.9	8533.0	1.2	8262.0	0.9	66150.0	2.0	73492.0	1.5

1 Data from K. Tarbox, ADF&G Commerical Fish Division, Soldotna; 1984 data are preliminary; Upper Inlet includes all gear types; other subareas are only fished by set net.

2 All percents are given as a percentage of the total upper Inlet harvest.

4.6 METEOROLOGY, AIR QUALITY, AND NOISE

4.6.1 Meteorology

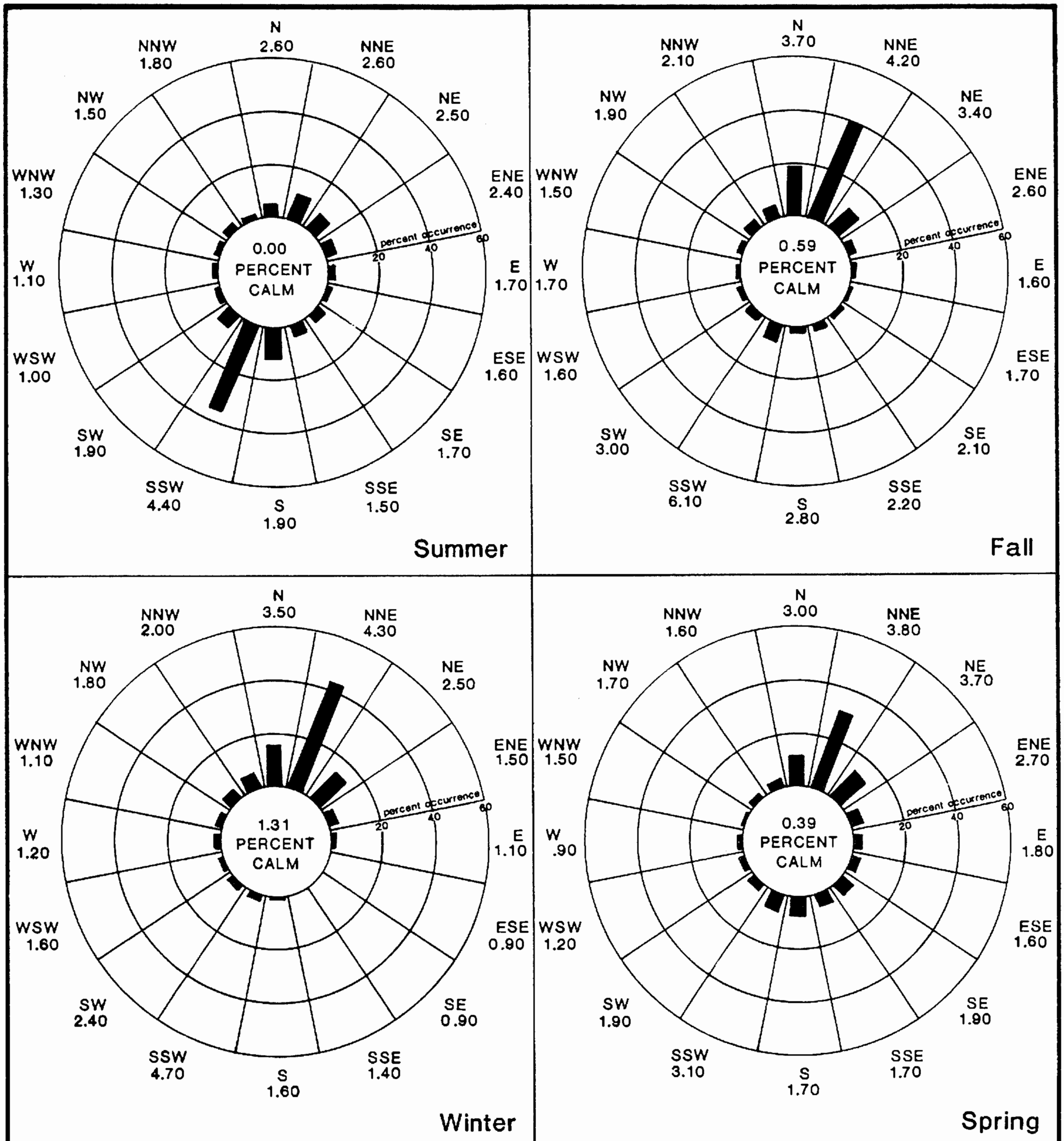
The regional climate near the project site is most noticeably influenced by regional topography and bodies of water. The Chugach Mountains to the south act as a barrier to warm, moist air from the Gulf of Alaska, decreasing local precipitation to less than 20 percent of that measured on the Gulf of Alaska side of the Chugach Range. The Alaska Range to the west and north acts as a barrier to very cold winter air masses which dominate the Alaska interior. Cook Inlet tends to moderate temperatures in the project area.

A one-year meteorological monitoring program was conducted at the project site from April 1983 through March 1984 (Science Applications, Inc. 1984). Two monitoring sites were installed: one near the proposed surface coal mine and a second near the proposed Granite Point port facilities. Wind speed, wind direction, and temperature were measured at 12 meters (39.4 ft) above ground level at both sites.

Seasonal wind roses for the two sites, given in Figures 4-10 and 4-11, show a predominant southerly flow during the summer months and a predominant northerly flow during the rest of the year. At Granite Point, north and northeast wind directions occur most frequently during the fall, winter, and spring seasons while the most frequent wind directions during the summer are south-southwest and south with a secondary maximum at north-northeast. At the coal mine site, the predominant wind directions measured were north-northwest and north during the fall and winter, north-northwest through north-northeast with a small secondary maximum at south-southeast during the spring, and south through southwest with a large secondary maximum about north during the summer. Wind speeds at both sites were relatively light, averaging 3.1 m/sec (6.9 mph) and 2.4 m/sec (5.4 mph) for the monitored year at the port and coal mine sites, respectively.

The climates of Anchorage and Kenai are similar to that of the project area due to the influence of the Chugach and Alaska mountain ranges and Cook Inlet. Seasonal wind roses for Anchorage (Figure 4-12) show a northerly flow during fall and winter and a southerly flow in spring and summer. North to northeast winds occur during the fall and winter months, while south to southeast winds dominate during the spring and summer months. Wind speeds at Anchorage are comparable to those of the project area, averaging 3.3 m/sec (7.3 mph).

Wind roses for Kenai (Figure 4-13) also show a strong northerly flow during fall and winter and a more subtle southerly flow in spring and summer. North to north-

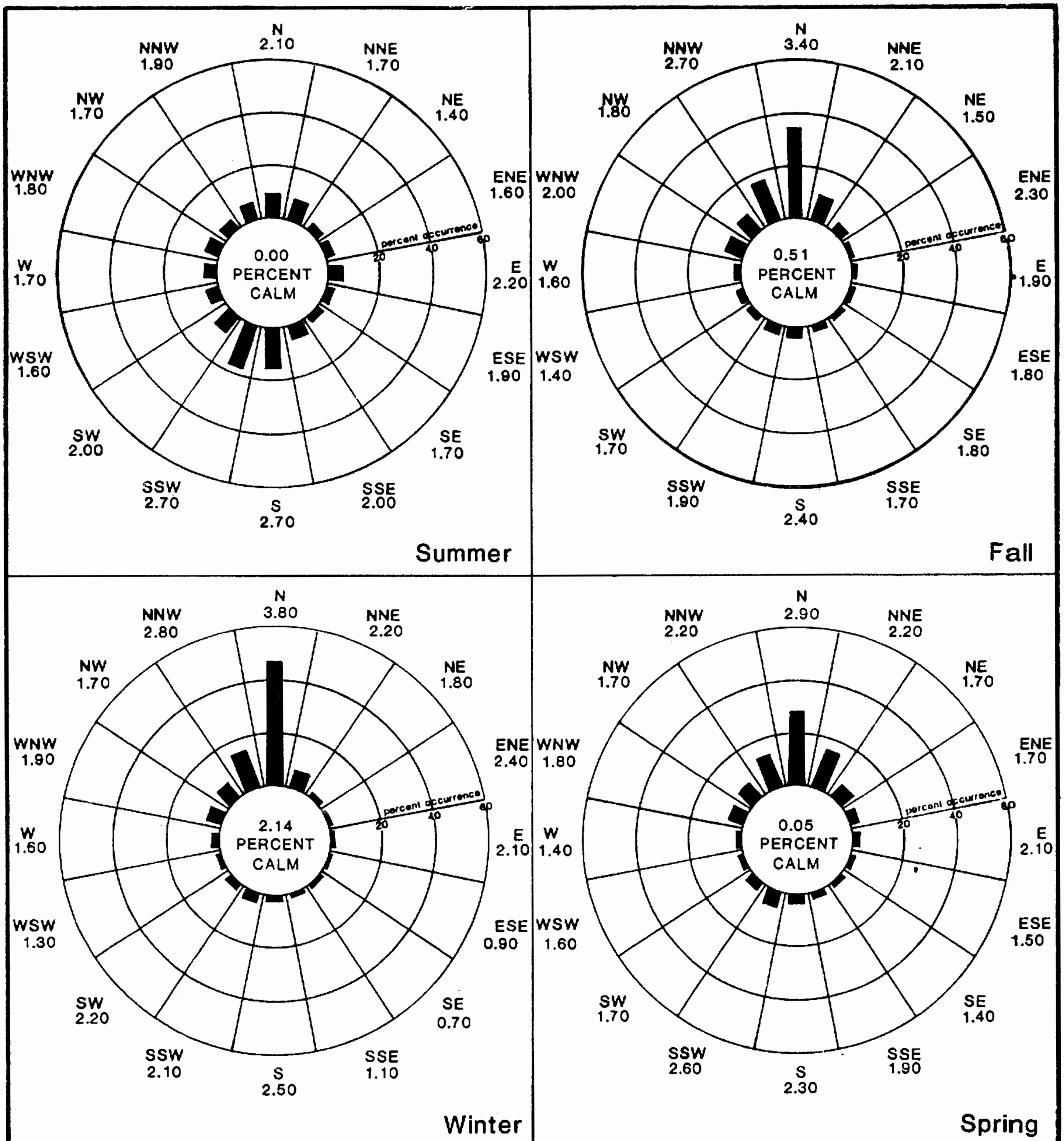


NUMBERS INDICATE SECTOR MEAN WIND SPEED (METERS/SEC.)

SOURCE: SCIENCE APPLICATIONS INC., 1984

WIND FREQUENCY DISTRIBUTION
GRANITE POINT PORT SITE

Diamond Chuitna Environmental Impact Statement	FIGURE 4-10

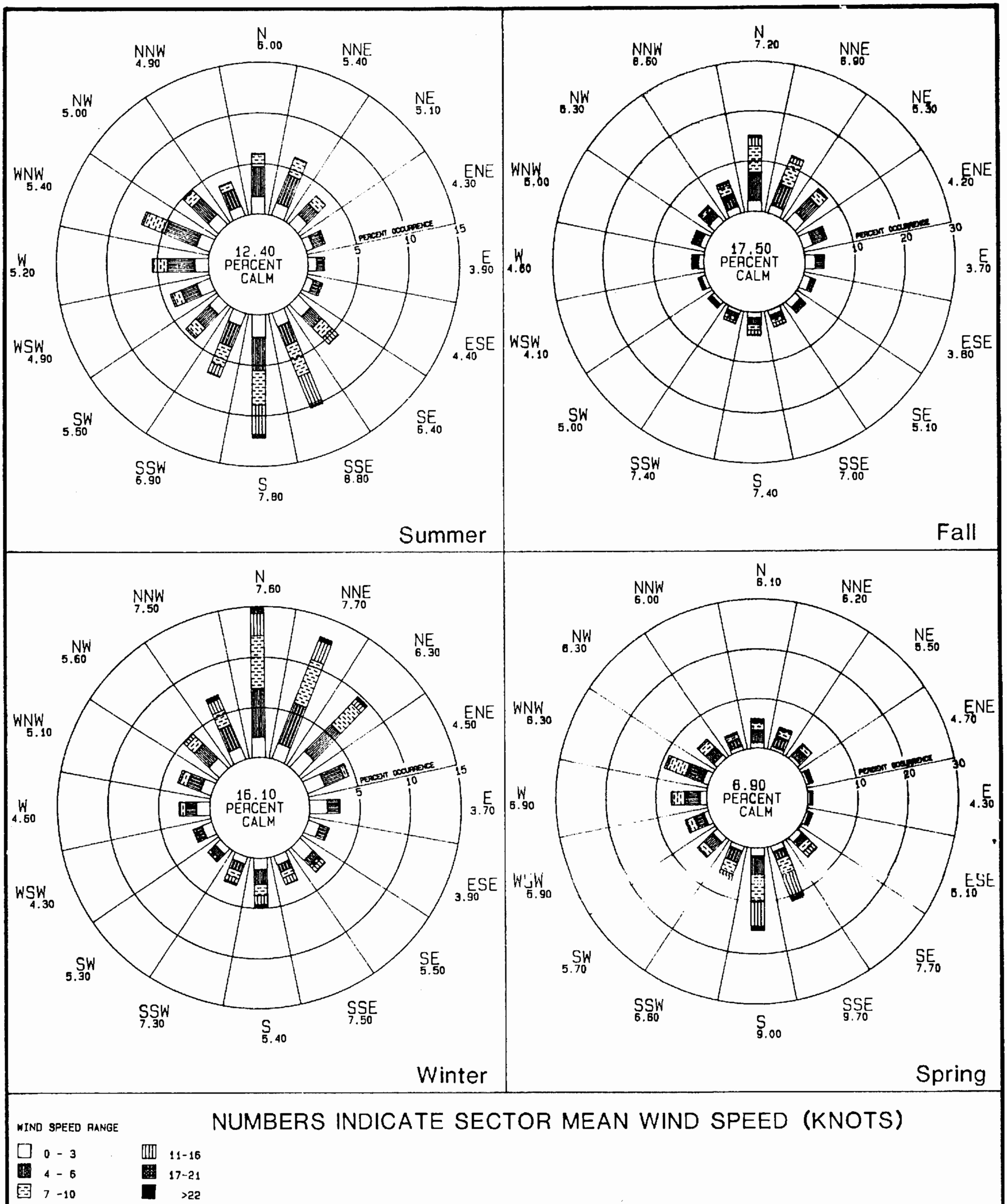


NUMBERS INDICATE SECTOR MEAN WIND SPEED (METERS/SEC.)

SOURCE: SCIENCE APPLICATIONS INC., 1984

WIND FREQUENCY DISTRIBUTION
MINE SITE

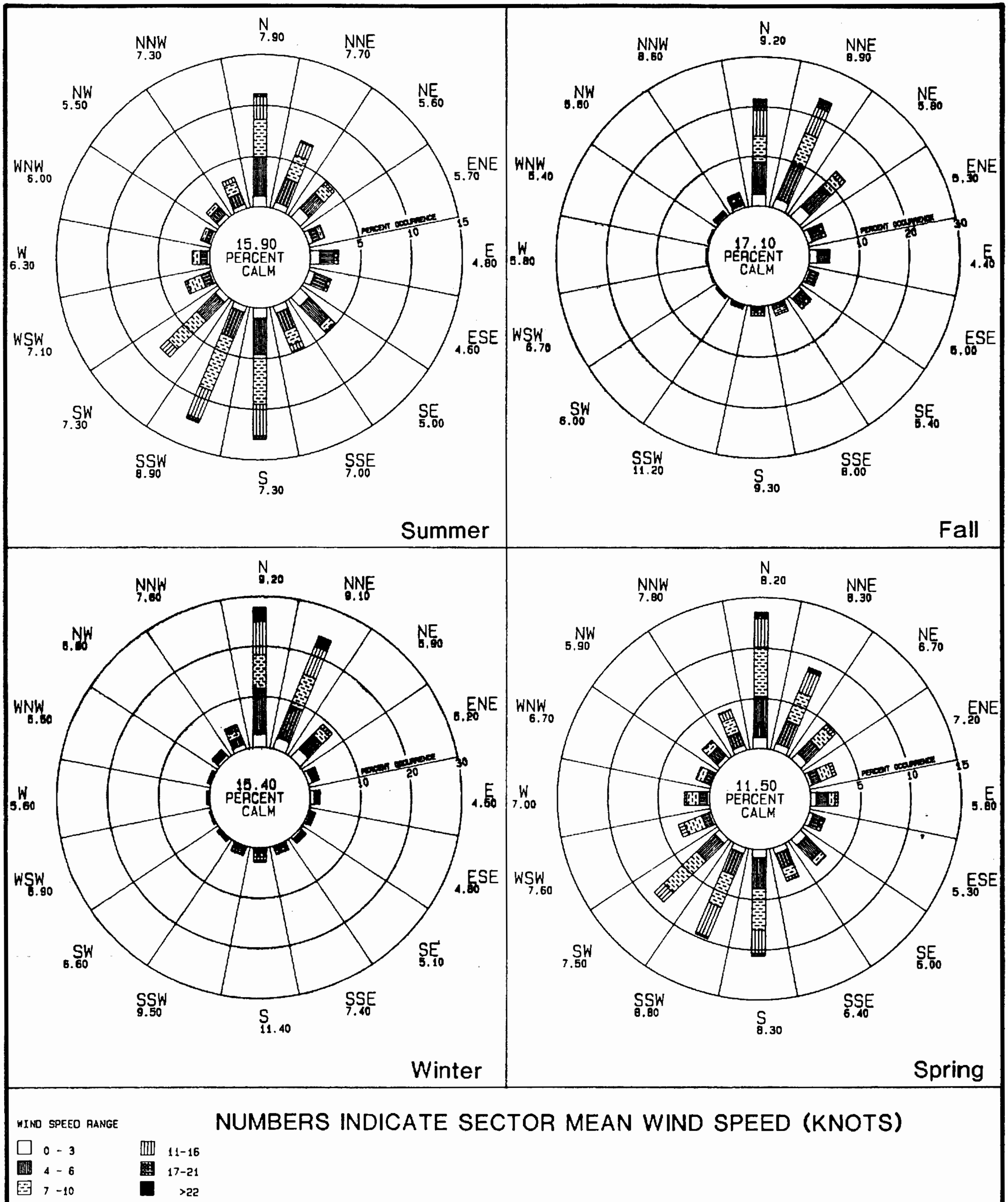
Diamond Chuitna Environmental Impact Statement	FIGURE 4-11



NUMBERS INDICATE SECTOR MEAN WIND SPEED (KNOTS)

WIND FREQUENCY DISTRIBUTION ANCHORAGE

Diamond Chuitna Environmental Impact Statement | FIGURE 4-12



WIND FREQUENCY DISTRIBUTION
KENAI

Diamond Chuitna Environmental Impact Statement	FIGURE 4-13

northeast winds are dominant during the fall and winter months, while south to southwest winds are frequent in spring and summer. Wind speeds at Kenai are similar to those at the project sites and Anchorage, averaging 3.4 m/sec (7.5 mph).

Monthly temperatures measured at the project monitoring sites are given in Table 4-16. Temperatures measured at the port site were slightly warmer than the mine site, particularly during the winter, with the mine site exhibiting slightly higher maximum daily temperatures in the summer. This pattern is typical for a shoreline environment and demonstrates the moderating effect of Cook Inlet on ambient temperatures. Maximum and minimum temperatures measured at either site were 22°C (71°F) and -22°C (-7°F), respectively. Temperature and precipitation summaries from a one-year monitoring program near Kenai (June 1981 through May 1982) are also given in Table 4-16. No site-specific precipitation data were measured at either project monitoring site. Average yearly precipitation in the Chuitna Basin is approximately 122 cm (48 inches), which is considerably greater than the 39 cm (15.4 inches) measured near Kenai. This difference is due to orographic* effects reflecting the higher elevations in the Chuitna Basin area. In 1983, snow depths in the area varied from 58 cm (23 in) near Congahbuna Lake to 229 cm (90 in) on Capps Plateau.

4.6.2 Air Quality

Air quality data for the project site area were available from the following programs:

- Monitoring site operated for Tesoro Petroleum near Kenai during June 1981 through May 1982 (All major criteria pollutants were measured except lead)

- ADEC Total Suspended Particulate monitor located on the Beluga Power station during April 1978 through May 1979

- ADEC SO_2 monitoring site located near Kenai at Wik Lake for November 1982 through May 1983.

Maximum measured concentrations from the Tesoro and Beluga monitoring sites are compared to ambient air quality standards in Table 4-17. These data indicate that measured ambient background levels of all major pollutants were significantly less than applicable standards. Sulphur dioxide (SO_2) data measured at the Wik Lake monitor during the available data period were nearly always 0 ppb (1-hour measurement) with an occasional 5 ppb reading which may have been due to instrument zero drift.

Since the project site is considerably more remote than the Tesoro monitoring site, air quality is expected to be better than that presented in Table 4-17.

Table 4-16

MONTHLY TEMPERATURE (°C) AND PRECIPITATION (cm)
SUMMARY FOR PROJECT REGION

Month	Monthly Average Temperature			Average Daily Max. Temperature		Average Daily Min. Temperature		Monthly[1] Precipitation
	Port	Mine	Kenai	Port	Mine	Port	Mine	Kenai
JAN	-4	-5	-12	-2	-3	-7	-8	0.
FEB	-5	-6	-8	-2	-3	-7	-8	2.
MAR	3	2	-3	5	4	1	0	2.
APR	3	2	0	5	4	1	0	0.
MAY	8	7	5	11	10	5	4	1.
JUN	12	12	10	15	15	9	8	2.
JUL	13	13	12	15	16	11	9	5.
AUG	13	12	11	15	15	10	9	4.
SEP	8	6	9	11	9	5	3	6.
OCT	3	0	3	5	3	0	-1	12.
NOV	1	0	-4	2	2	-1	-1	4.
DEC	-4	-4	-8	-1	-2	-6	-5	1.
YEAR	4	3	1	7	6	2	1	39.

[1] given as liquid water equivalent

Source: Science Applications, Inc. 1984; Radian Corp. 1982

Table 4-17

REGIONAL MEASURED AIR QUALITY DATA
(micrograms/cubic meter)

Site/Pollutant	Averaging Time				
	1-hour	3-hour	8-hour	24-hour	Annual
FEDERAL AND ALASKA AIR QUALITY STANDARDS					
NO_2	- [a]	-	-	-	100
SO_2	-	1300	-	365	80
CO	40000	-	10000	-	-
O_3	235	-	-	-	-
PM	-	-	-	150	60
TESORO PETROLEUM					
NO_2	-	-	-	-	6.3
SO_2	-	70	-	9	0.3
CO	2560	-	1660	-	-
O_3	96	-	-	-	-
PM	-	-	-	60	9
BELUGA					
PM	-	-	-	78	- [b]

[a] indicates that an air quality standard does not exist for this pollutant and averaging time; hence, no measured air quality data will be presented.

[b] No annual average PM concentration was calculated for Beluga due to the large amount of missing data.

Source: Chapple 1985; Radian Corp. 1982

4.6.3 Sound Climate

The project area in the vicinity of the proposed mine and transportation corridor is expected to experience sound levels typical of remote locations unaffected by human activities. Typical natural sound levels are approximately 45 db(A) with higher levels of natural sound of about 65 db(A) associated with storms and wildlife. Sources of natural noise include winds, rain, and wildlife vocalizations.

The project area in the vicinity of the Cook Inlet coast experiences higher background noise levels. Cook Inlet contributes higher noise levels because of breaking waves and winter ice movements. Human activities are also more frequent near the coast. Some examples of human-generated noise include vessels (such as diesel-powered boats on Cook Inlet), aircraft (a landing strip is located approximately 2 miles from the proposed Granite Point port site), and other mobile vehicles such as snowmobiles and all-terrain vehicles. Typical noise levels for vehicles and aircraft are 80 to 95 db(A) at a distance of 50 feet. Commercial and noncommercial aircraft on route from Anchorage to southwestern Alaska locations fly over the project area routinely at varying altitudes.

4.7 SOCIOECONOMIC ASPECTS

The project site is located about 75 air miles west of Anchorage in the Kenai Peninsula Borough and about ten miles west of the Native village of Tyonek. Socioeconomic impacts would likely derive from increased income and employment of residents of both Anchorage and the Kenai Peninsula Borough, particularly the City of Kenai and the Village of Tyonek. The City of Kenai is the Borough seat of government and its most populous city; Tyonek is the nearest community to the project site. The following description of the socioeconomic environment focuses on conditions in the Kenai Peninsula Borough, the Municipality of Anchorage, and the community of Tyonek.

4.7.1 Anchorage and Kenai Peninsula

4.7.1.1 Population

The population of Anchorage and the Kenai Peninsula Borough grew rapidly between 1970 and 1984, exceeding the substantial statewide growth of 77.8 percent. Anchorage grew from 126,385 persons in 1970 to 244,030 in 1984-an increase of 93.1 percent. The Kenai Peninsula Borough population increased by 134.6 percent from 16,586 in 1970 to 38,919 by 1982 (Alaska Department of Labor 1984). The City of Kenai grew by 42.8 percent over this period, from 4,324 to 6,176 persons. The Central Kenai Peninsula, which includes the area within primary commuting distance of the

City of Kenai, had a 1984 population of 24,643. Historical population trends are summarized in Table 4-18.

The State of Alaska currently has no official population projections for either the Kenai Peninsula Borough or Anchorage (Williams 1985). Population forecasts used here assume a slowdown of growth for the Kenai Peninsula Borough from 11.1 percent annually over the 1980-84 period to 5 percent per year through 1992. Thus, by 1992 the population of the Kenai Peninsula Borough is expected to be approximately 57,500. The 1992 populations of the City of Kenai and the Central Kenai Peninsula are projected to be 9,100 and 36,400 respectively, based on a 5 percent average annual increase. Preliminary draft population projections for Anchorage indicate a high projection of 314,800 by 1990, a low projection of 273,100, and a medium or most likely population of 292,300 (Breedlove 1985).

4.7.1.2 Economy

The following discussions of the economies of the Kenai Peninsula Borough and Anchorage focus on the cash economy. Subsistence activities, which provide food and sustenance for many residents of the Kenai Peninsula Borough, are not reflected in the statistical data presented. Therefore, comparisons of data for Anchorage, in which relatively little subsistence activity occurs, to data for the Kenai Peninsula Borough, where substantial subsistence activities are conducted, must be made carefully. A discussion of subsistence activities of the Tyoneks is presented in Section 4.9.

The economies of the Kenai Peninsula Borough and Anchorage are distinctly different. While employment in Anchorage is relatively concentrated in trade, service, and federal government, employment in the Kenai Peninsula Borough is based primarily on resource development industries and state and local government.

Over time, employment patterns in the Kenai Peninsula Borough indicate a proportional drop (but a small numerical increase) in mining employment (the standard industrial code of mining includes oil and gas extraction). The loss of federal government jobs since 1970 has been counteracted by increases in state and local government, employment, manufacturing (including petrochemical industry), and the service sector (trade, services, and finance, insurance, and real estate). The sectors that bring new income into the region (the "basic" or "export" sectors) are primarily federal government, mining, and manufacturing. Tourism is also an important basic sector, but existing data do not isolate tourist-serving employment and therefore the employment involved is not readily quantifiable.

The Anchorage economy has diversified since 1970 and has become more service-oriented. Dependence on federal

Table 4-18

POPULATION TRENDS IN ALASKA,
ANCHORAGE, AND THE KENAI PENINSULA BOROUGH

	Population			
Jurisdiction	1970[a]	1980[a]	1982	1984
Alaska Statewide	302,583	401,851	460,837[b]	538,000[c]
Anchorage	126,333	174,431	204,216[c]	244,030[c]
Kenai Pen. Borough	16,586	25,282	5,231[d]	6,176[d]
-Central Kenai Pen. Bor.	na	15,672[e]	19,886[f]	24,643[f]

(a) Source: U.S. Department of Commerce, Census counts for years indicated.

(b) Source: Alaska Department of Labor 1984.

(c) Source: Van Patten 1985.

(d) Source: Kenai Peninsula Borough 1984.

(e) Source: Unavailable from census in geographically-consistent form. Figure is cited from 1978 special census conducted by Kenai Peninsula Borough which resulted in total Borough population estimate very close to the 1980 census estimate, considered by local planners to be a substantial undercount (McIlhargy 1985).

(f) Source: McIlhargy 1985.

government employment has declined and the proportion of employment in all other economic sectors has increased.

Unemployment rates in the Kenai Peninsula Borough have historically been substantially higher than those in Anchorage, as well as more subject to seasonal swings. Over recent years, the average annual unemployment rate in the Kenai Peninsula Borough has ranged from a high of 15.9 percent in 1982 to a low of 10.1 percent in 1977. The monthly unemployment rate, however, has been nearly 22 percent during winter months. Unemployment in Anchorage has remained within a narrow 7 to 8 percent range and exhibits relatively modest seasonal changes.

Unemployed workers in the Kenai Division tend to have previous experience in the oil and gas and construction industries, compared to the statewide average. Of the 2,165 unemployment claims filed with the Kenai office of the Alaska Department of Employment Security in 1982, 16.6 percent, or about 360, listed oil and gas as the last industry of employment and 24.8 percent, or about 540, listed construction. The corresponding Anchorage local office figures indicate that 22 percent of the unemployment insurance applications listed construction as last industry of employment. Oil and gas was listed by 6.4 percent. In terms of skills, structural work was the occupation listed by most applicants in either office (40.9 percent for Kenai and 28.7 percent for Anchorage) (Alaska Department of Labor 1984). It should be noted that there are probably fewer individuals represented by the above data which was taken from the number of applications, since some applicants probably applied twice or more during the course of the year. However, since only the last industry of employment and occupation are listed on unemployment insurance applications, the figures above probably understate the actual experience of applicants over their careers.

The Borough-wide employment-to-population ratio was 36 percent in 1984. Since labor force participation rates will likely continue to increase, a projected employment-to-population ratio of 40 percent is used herein. The area included within the primary Kenai commuting area is the Central Kenai Peninsula (CKP), consisting of Sterling, Soldotna, Ridgeway, Kalifonski, Kenai, Salamatof, Nikiski, and Tustumena. This area had a population of 24,643 in 1984 and is projected to grow by 5 percent annually without the project, to 30,000 by 1988 and 36,400 by 1992. If 40 percent of the population is employed, the number of employed residents of the CKP would be about 12,000 in 1988 and 14,600 by 1992. If the assumed annual Borough-wide population growth rate of 5 percent (Section 4.7.1.1) applies to the City of Kenai's employment base, about 3,000 of its residents would be employed by 1988 and about 3,700 by 1992.

Per capita personal income in the Kenai-Cook Inlet Division was $13,394 in 1982. This was somewhat below the statewide average of $16,598 and the Anchorage Division figure of $18,429 (U.S. Department of Commerce 1984a). Cost-of-living differentials between these three areas, however, prevent accurate comparison in terms of real income.

4.7.1.3 Community Facilities and Services

As Alaska's primary urban area, Anchorage is in general well-served by all facilities and services necessary for urban life, making detailed discussion unnecessary. For a smaller community, the City of Kenai is also generally well-served by sewer, water, and road systems and public services such as fire and police protection and education.

Public Services and Facilities in Kenai

Kenai's water system services much of the city, with about 1,100 residential connections (compared to an estimated 2,446 housing units in 1984 [Kenai Peninsula Borough 1984]) serving 3,500 people and under 100 commercial connections. The City's water source is the aquifer at Beaver Creek, which is of excellent quality and requires only chlorination at the wellhead. The combined design capacity of the City's two water pump stations is about 2,000 gallons per minute, or about 2.9 million gallons per day (gpd). Daily water demand averages slightly less than 500,000 gpd, with a peak of about 1,200,000 gpd (Lashot 1985).

Kenai's sewer system also services much of the City, with about 1,100 of the City's homes currently connected. The total volume of effluent treated averages 800,000 gpd. With a design capacity of 1,300,000 gpd, the system is expected to be adequate to service the City's needs through the early 199[illegible] Solid waste is disposed of at a landfill operated by th[illegible] Kenai Peninsula Borough (Bambard 1985).

The City A[illegible]rport is serviced by three commuter airlines as well as sev[illegible]ral private charter services. The airport has a 7,575 ft (2,309 m) paved and lighted runway, VORTAC and ILS navigational aids, and is in general well equipped with amenities. The airport has been consistently upgraded, with current projects including an expanded parking area and flight service area. The City has also applied for federal funding to build a new float plane basin to service high demands by wilderness expedition companies and individuals.

The Kenai Police Department employs thirteen officers, for a relatively low population-to-officer ratio of 475:1 (Kenai Peninsula Borough 1984). Fire protection is also provided by the City, which has a fire department staffed by twelve full-time firefighters. The fire station is equipped with a 1,500-gallon crash truck, three pumpers, and a 5,000-gallon tanker. The Insurance Services Office fire service rating is five (on a one-to-ten scale), which is about average for a city of Kenai's size (Winston 1985).

Emergency medical care in Kenai is provided by the Fire Department. Patients are usually brought to the Central Peninsula General Hospital (CPGH) in Soldotna; more serious cases are treated at Anchorage hospitals (Winston 1985). CPGH, the primary health care center on the Kenai Peninsula, provides 24-hour emergency service, four-bed intensive care unit, and an obstetrics unit. The staff consists of 18 MD's, 20 RN's, and 13 LPN's. During summer 1985, the emergency room and obstetrics unit was expanded, another MD was hired, and a 16-bed chemical dependency unit was constructed.

CPGH's 45 beds have an average capacity utilization rate of 35 percent and peak use of 100 percent. Utilization has leveled off in the past year due to increased emphasis on outpatient rather than inpatient care. Demand for beds is somewhat below the national average of about 3 beds per 1000 population, due primarily to the young age of the population in the CPGH service area (Nichols 1985).

Education is provided by the Kenai Peninsula Borough School District, which operates a high school, junior high school, and two elementary schools in the City of Kenai. Total enrollment has increased from 1,252 students in October 1980 (Kenai Peninsula Borough 1984) to 1,878 in May 1985 (Overman 1985). The District employs 124 teachers at its Kenai schools, for a relatively low student-teacher ratio of 15:1 (Jewell 1985). Subject to bond issue approval by voters, a construction program would increase the capacity of Kenai's schools from 2,250 to 2,750, adequate to handle enrollment growth until about 1990, if 7 percent average annual enrollment growth occurs. In the Kenai-Nikiski-Soldotna-Sterling area, planned construction would increase total capacity to 9,475 (subject to voter approval). This increase would be sufficient to accommodate projected enrollment until the 1992-1993 school year.

4.7.1.4 Local and Regional Governance

The primary government jurisdiction in the region of the site is the Kenai Peninsula Borough. Under state law, boroughs can exercise a variety of powers, including provision of education, land use planning, platting and zoning, public safety, and other services, and may collect property, sales, and use taxes levied within their boundaries.

The Borough does not currently have a land use plan for the site area. A coastal zone management plan for the Beluga coal field area was formulated by the Borough in 1980 but was never implemented.

The State of Alaska is also an important government entity by virtue of its land holdings in the site area, permitting authority, and power to levy taxes on resource developments.

4.7.2 Tyonek

4.7.2.1 Demography

Tyonek's February 1984 population of 273 residents was approximately 95 percent Native (Fall et al. 1984). Village officials estimate the February 1985 population at 325 people. The rate of population growth in Tyonek has fluctuated throughout the past century (Table 4-19). The village population declined in the late 1800s and eventually crashed in 1918 as a result of a devastating influenza epidemic. Since 1920, the population has gradually increased with only a slight decline between the 1940 and 1950 censuses. In the 1960s, the town experienced a growth rate of about 2.4 percent annually. The population growth rate dropped during the 1970s, however, stagnating at about 0.3 percent annually. This decline in population growth was due to outmigration (McCord 1985) since both employment opportunities and subsistence resources were in short supply throughout the 1970s. The population has grown by approximately 3.5 percent annually between 1980 and 1984.

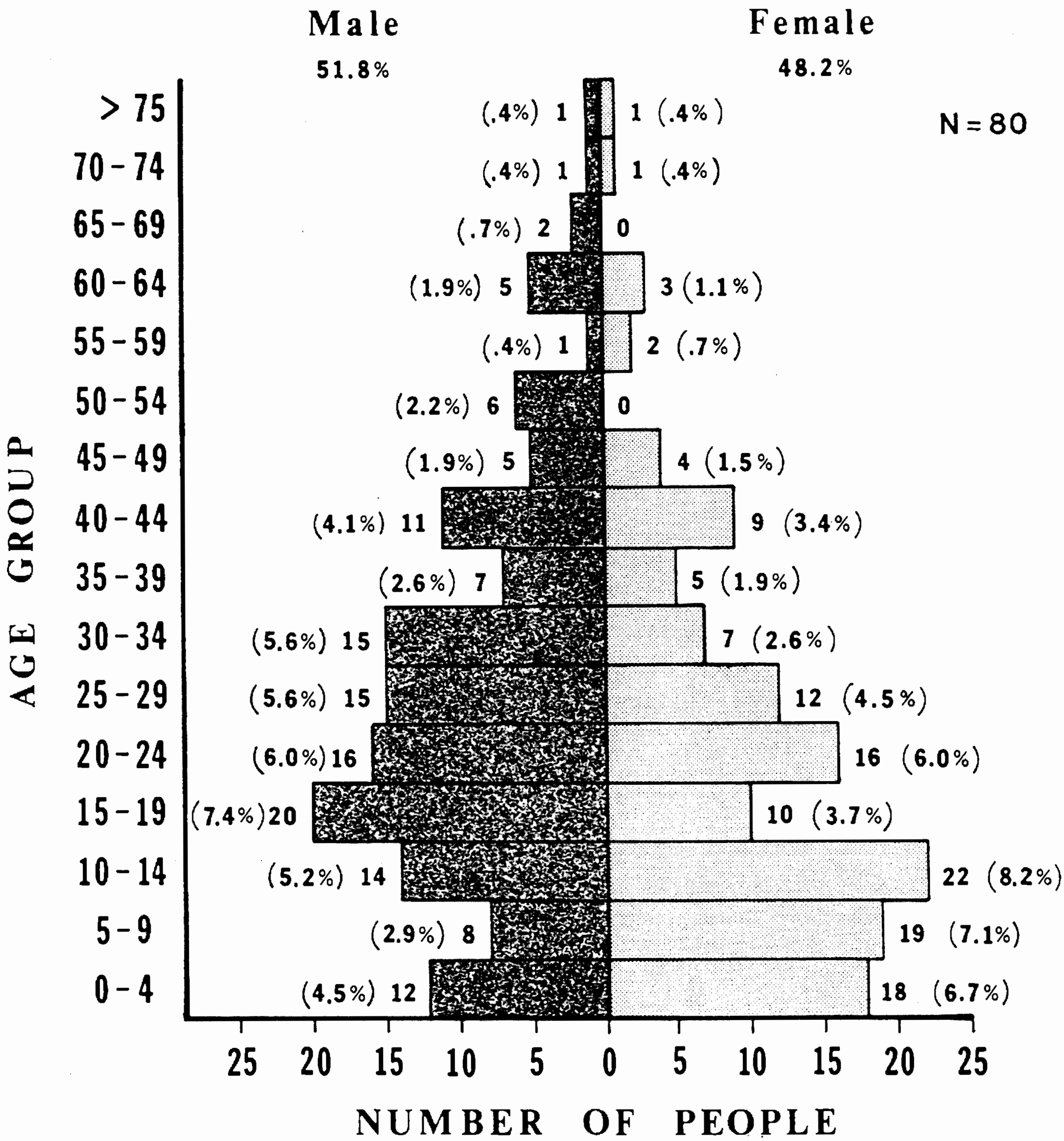
As presented in Figure 4-14, 78 percent of the population is under 35 years of age (Fall et al. 1984). Although this segment of the population was represented equally by males and females, the male/female ratio is disproportionate in certain age groups. There were 66 males and 45 females between the ages of 15 and 34. This may possibly be due to a higher outmigration of females. In contrast, there were 59 girls and 34 boys under 15 years of age.

Table 4-19

POPULATION OF TYONEK, ALASKA, 1880-1984

1880	117
1890	115
1900	107
1920	58
1930	78
1940	136
1950	132
1960	187
1970	232
1980	239
1984	273

Source: Fall et al. 1984; Darbyshire and Associates 1981a



SOURCE: FALL, FOSTER, STANEK. ADF&G, DIVISION OF SUBSISTENCE TECHNICAL REPORT #105. ANCHORAGE, ALASKA, 1984.

POPULATION PROFILE BY AGE AND SEX, TYONEK, FEBRUARY, 1984

Diamond Chuitna Environmental Impact Statement	FIGURE 4-14

4.7.2.2 Economy

Tyonek residents participate in a mixed economy that requires integration of elements of both subsistence and cash production into a unified economic strategy (Fall et al. 1984). For example, cash is required to purchase equipment necessary to harvest subsistence resources. Although the two production strategies are related, their integration is often difficult. A successful renewable resource harvester must be willing to wait for suitable weather and adapt to the seasonal availability and variable migration patterns of targeted resources. This flexibility is frequently incompatible with full-time employment. Hence, employers are often faced with absenteeism and villagers must choose between work and subsistence resource harvesting. Layoffs, seasonal job fluctuations, and chronic unemployment and underemployment are perennial problems in Tyonek. This general situation was illustrated by the construction of a logging and chip mill operation by Kodiak Lumber, Mills (KLM) in 1975. Despite high unemployment and KLM's apparent desire to hire local workers, problems similar to those described above were encountered and KLM eventually found it necessary to replace much of the Tyonek work force with non-locals. By 1979, only eight Tyonek villagers worked for KLM (Braund and Behnke 1980) compared with a maximum of approximately 30 Tyonek residents employed by KLM in 1976 (McCord 1985).

Tyonek villagers had an average 1983 household income of $12,853, with the median income about $11,000 (Darbyshire and Associates 1984a). In addition, Darbyshire and Associates found that, of a total local workforce of 145 villagers, 41 held full-time jobs in 1983 (Table 4-20). Darbyshire (1984a) estimated that an additional 63 part-time and seasonal jobs existed. Hence, 104 people were unemployed or underemployed in Tyonek in 1983, including those involved in commercial fishing and other part-time or seasonal opportunities. This high level of unemployment and underemployment is a serious impediment to the economic health of the community.

Positions with the Tyonek village council, Native Village of Tyonek (NVT) accounted for 19 (51 percent) of the 37 full-time jobs in Tyonek in 1983. These positions included: village president, equipment operators, secretaries, custodians, fire and patrol men, a nurse, health aide, and others. The Kenai Peninsula Borough employed five villagers full-time in 1983 in the school. In addition, six full-time positions were filled in private enterprises such as the local store. The remainder of the full-time positions were offered by a range of local industries including construction, transportation, utilities, and through state and federally funded programs. Changes in employment opportunities after 1983 include creation of approximately two positions in coal exploration, six carpentry positions for

Table 4-20

TOTAL VILLAGE INCOME AND EMPLOYMENT, BY INDUSTRY
VILLAGE OF TYONEK, ALASKA, 1983[1]

Industry	Full-time	Seasonal/ Part-time	Annual Income
Commercial Fishing	0	51	$ 142,500
Construction	1	1	15,000
Cottage Industry	0	2	1,500
Transportation	1	0	14,600
Communications/Utilities	2	0	30,600
Trade/Private Services	6	2	132,825
Real Estate	0	0	33,400
Village Government	19	1	282,325
Borough School	5	6	89,455
State & Federal Agencies/Services	3	0	82,000
Total Employment in Tyonek	37	63	$ 824,205
Outside Employment2	4	0	73,700
Transfer Payments			258,837
TOTAL VILLAGE EMPLOYMENT AND INCOME	41	63	$1,156,742

[1] Does not include Tyonek Native Corporation jobs filled by non-villagers.

[2] Residents who leave Tyonek periodically to work outside the community.

Source: Darbyshire and Associates (1984a) construction of the new tribal center, and two Chuitna River sportfish guiding businesses, one of which is based in Tyonek (McCord 1985).

The 63 possible part-time and/or seasonal employment opportunities were dominated by commercial fishing with seasonal positions available for approximately 51 people, including 26 limited entry salmon permit holders and their crew members. In 1983, 28 households derived a total income of $142,500 from commercial fishing for an average of $5,089 per household or $5,700 per permit (Darbyshire and Associates 1984a; Fall et al. 1984). In 1982, gross earnings from commercial fishing in Tyonek were slightly below 1983 fishing incomes at $4,753 per permit (Fall et al. 1984). Although data from only two years cannot be considered representative, commercial fishing earnings in Tyonek appear to be below those in other Cook Inlet fisheries. For example , gross earnings for Upper Cook Inlet set gill net permit holders averaged $9,672 per permit in 1979, $10,541 in 1980, $14,640 in 1981, $20,969 in 1982, and $16,283 in 1983 (Commercial Fisheries Entry Commission 1984).

In terms of relative contribution to Tyonek, Darbyshire and Associates (1984a) estimated private sector income including commercial fishing, village government, and transfer payments to be the most important sources of income (Table 4-21). The relationship between village government and the real estate sector of the economy requires elaboration. The Tyonek Management Corporation (TMC), a subsidiary of NVT, manages royalties from a 1965 sale of oil and gas drilling rights on the former Moquawkie Indian Reservation. TMC invested money both locally and outside the community. In 1983, rental properties in Tyonek generated $33,400, primarily through houses leased to teachers (Darbyshire and Associates 1984a). However, rental receipts from commercial properties located primarily in Anchorage essentially supported NVT and its activities. Thus, 30 percent of the economic base of the community was derived from TMC rent receipts (Table 4-21) . Private industries (including commercial fishing, construction and merchandise) accounted for 24 percent of the economic base and public sector funding represented 46 percent of Tyonek's economic base. Although the reliance on the public sector is substantial, especially in terms of direct transfer payments, Tyonek's dependence on state and federal programs is far less than most rural Alaskan villages (Darbyshire and Associates 1984a).

Table 4-21

TYONEK'S ECONOMIC BASE, 1983

Basic Industries	Percent
Private Activities	24
TMC Rent Receipts	30
Kenai Borough School Funding	10
State and Federal Services Funding	9
State and Federal Transfer Payments	27
	100

Source: Darbyshire and Associates (1984a)

4.7.2.3 Community Facilities and Services

Due in large part to oil and gas lease income in the 1960s, Tyonek has been able to continually develop and upgrade community facilities and services to meet the needs of the community. The oil and gas royalties supported construction of new village housing in the mid-1960s and contributed to construction of the school. Investment income from the royalties has allowed continued infrastructure development to meet the changing needs of the community.

Housing needs are filled by approximately 60 prefabricated homes that Tyonek built in 1965 and 27 houses that were built in 1978-79 with funds from Housing and Urban Development (HUD) and Cook Inlet Native Association (CINA) (Darbyshire and Associates 1981b). Public utilities available to Tyonek residents include water (treated with chlorine and flourine), telephone service, and electric service. In the late 1960s, Tyonek sold an electric generating unit to Chugach Electric Association in trade for an electricity allotment. In 1982, Tyonek's consumption was 4.7 million kilowatt-hours; by mid-1983, 11.9 million kilowatt-hours remained in Tyonek's allotment (Vecera 1985). Chugach Electric Association officials estimated that, at current rates of consumption, Tyonek would begin paying for electricity by 1986.

Sewage disposal (using septic tanks and leach fields) and solid waste disposal (at a landfill 6.4 km (4 mi) south of Tyonek) needs are filled on an individual basis. The E.L. "Bob" Bartlett School, constructed in 1967 by the Bureau of Indian Affairs and NVT and added to in 1976 by KPB, offers education for grades K-12. The school, which is operated by KPB, includes a library, full kitchen, gymnasium, and multipurpose room, as well as classrooms and offices.

A local health clinic accommodates health care needs, although residents commonly use hospitals in Anchorage for all but minor health needs. The village clinic is operated by a full-time CINA aide and a part-time CINA representative. In addition, personnel from the Public Health Service and the Alaska Native Service visit Tyonek periodically to provide health care (Darbyshire and Associates 1981b).

Other social services offered locally are administered by the NVT and supported by funds from CINA as well as various state and federal programs. These services include counseling, drug and alcohol abuse programs, day care, adult and child protection, and employment assistance (Darbyshire and Associates 1981b). In addition, CINA funds are used to support three local firemen. Public safety needs are further filled by a village public safety officer and two village security officers in Tyonek and a State Trooper in Beluga (Darbyshire and Associates 1984b; Fall et al. 1984).

Additional community facilities include a guest house/day care center, snack bar/recreation center, post office, heavy equipment shop, and community center that houses village offices (Darbyshire and Associates 1981b, 1984b). A new tribal center, funded by an HUD Community Development Block Grant, is nearing completion. It includes offices for the village government and various social service programs as well as a large public hall that will be used for village gatherings. Finally, other community service needs are filled by the private sector, including the village store and two Anchorage-based air taxi services that provide numerous daily flights between Tyonek and Anchorage.

4.7.2.4 Local Government

The Tyonek village council, under the name Native Village of Tyonek (NVT), is a federally chartered Indian Reorganization Act (IRA) council that is recognized as the local governing body for the village. The council has been active in the development of the community and its facilities for many years. Its responsibilities cover Tyonek's public affairs, public utilities, and management of village-owned lands and buildings. The Kenai Peninsula Borough administers the school and is responsible for operation of the landfill, though this function has been subcontracted to the village.

When the Alaska Native Claims Settlement Act (ANCSA) passed in 1971, Tyonek chose to participate in the Act rather than receive title to the former Moquawkie Indian Reservation. In doing so, surface title to the 10,893 ha (26,917 ac) reservation was transferred to Tyonek Native Corporation (TNC), a profit village corporation created by ANCSA, as part of its 46,621 ha (115,200 ac) entitlement. The subsurface estate of these lands was conveyed to Cook

Inlet Region, Incorporated (CIRI), one of 13 regional Native corporations created by ANCSA. Although the Native Village of Tyonek can retain ownership of up to 518 ha (1,280 ac) for municipal expansion (under Section 14(c)(3) of ANCSA), these lands have yet to be conveyed (McCord 1985). Thus, NVT lost control over both surface and subsurface uses on the former reservation lands to TNC and CIRI through ANCSA. Because both TNC and CIRI are motivated in part by profits from their land and investments, there are occasional conflicts of interest between these profit corporations and the people of Tyonek (Braund and Behnke 1980).

The State of Alaska and KPB are also major land owners in the area. Although the State does not take an active role in Tyonek's local government, state land policies nonetheless affect the nature and extent of development and land use near Tyonek (for example, through issuance of coal leases). Similarly, KPB controls surface uses in the Congahbuna and Viapan Lake areas. Both of these locations have been identified as possible settlement sites in the Susitna Area Plan (Alaska Department of Natural Resources 1984). Both the State and KPB must be considered key political players in the area.

4.7.2.5 Community Attitudes Toward the Diamond Chuitna Coal Project

Previous research efforts have produced conflicting reports on Tyonek residents' attitudes toward coal development in their area. Whereas Darbyshire and Associates (1981a) found that only 20 percent of Tyonek residents opposed development of the Beluga coal fields, other studies (Braund and Behnke 1980; Pacific Northwest Laboratory and Battelle Human Affairs Research Center 1979; DOWL 1981) indicated general disapproval for such development. As reported by these studies, Tyonek residents' concerns centered around increased outside influence on the community, disruption of their subsistence livelihood (through habitat disruption, increased competition for wildlife, or potential difficulty with access to hunting areas), and general village disruption. Field interviews conducted in January 1985 suggest that many of these concerns still prevail in Tyonek.

The January 1985 fieldwork conducted in Tyonek revealed that local attitudes toward specific aspects of the Diamond Chuitna project ranged from vehement opposition to enthusiastic support. Individuals strongly supportive of coal development invariably cited the expected increases in local employment opportunities as the major benefit to the community. Opposition to the project was based on the perceived sociocultural impacts, changes in local resource use patterns, and effects to the surrounding environment. Specifically, these concerns included:

- Effects of pollutants (especially coal dust, acidic runoff, and sewage) on fish, plants, and water quality

- Changes in fish and wildlife availability due to:

  - fish and game habitat disruption
  - stream blockage
  - increased activity that could drive fish and game away
  - overhunting by workers associated with the coal mine
  - increasingly restrictive hunting regulations should overhunting occur
  - disruption of moose migrations and traditional hunting patterns

- Disruption of the local sportfish guiding business due to increased competition for fish and reduced wilderness qualities

- Erosion of Tanaina culture and the rural way of life

- Increased outside influence in the community that could lead to:

  - loss of local control
  - increased traffic of drugs and alcohol into the community
  - increased competition for fish and game from non-locals
  - increased trespass onto Tyonek land
  - pressure for a road connection to Anchorage.

According to the interviews, the Tyonek residents who had reservations about development of the coal fields due to possible adverse social and environmental consequences realized that such development presents them with a dilemma. On one hand, they desire economic opportunities that will generate local jobs; on the other hand, they perceive the associated costs to their culture and lifestyle to be substantial. One Tyonek resident commented. "The problem is that everyone wants a job real bad, but I am kind of scared of what it will do to life here."

Some villagers voiced a need for a viable economic strategy, either based on continuation of subsistence activities (a strategy that many view as incompatible with coal development) or dominated by wage employment. These people see coal development as inevitable and want assurance that the transition into an economy dominated by coal mining is conducted in a way that allows Tyonek to participate in the development rather than be left behind and ignored. One Tyonek resident commented, "Our life is going to be changed. At least give us a chance to change with it."

Villagers who were interviewed considered the Diamond Chuitna Coal Project as one step in an on-going process of development on the west side of Cook Inlet that may eventually result in a dilution of Tyonek's culture. One Tyonek resident commented, "I'm most worried about the future and the kids and what they can expect. Before long, there will be 800 men in the Diamond camp and then Placer-Amex (sic) will come in. Pretty soon they will connect the road to Anchorage and this will be another Kenai." Another villager said, "The biggest fear is that we are going to be pushed out of this area altogether. We will be pushed into the Inlet and nobody will care."

Throughout the field interviews, parallels were frequently drawn between Diamond Chuitna Coal Company's proposal and the performance of the Kodiak Lumber Mill that operated at North Foreland in the late 1970s. According to the Tyonek interviews, agreements between KLM and Tyonek regarding worker conduct, preferential local hiring, and a no guns/no hunting policy were apparently violated, ignored, and subverted. For example, villagers indicated the no hunting policy worked until moose season opened; by 1979, few villagers worked for KLM; Tyonek Creek was blocked with sawdust and debris; the frequency of trespass increased; an ancestral cemetery was disturbed; and cables and trash were discarded on the beach and remain to this day. Tyonek residents use this recent experience as the standard for evaluating the merits of proposals to develop the coal deposits and the performance of developers in the area.

In summary, despite the advantage of enhanced local employment opportunities, many Tyonek res dents were skeptical about the Diamond Chuitna Coal Project and pessimistic that any agreements will be carried out in good faith. This skepticism is in part due to the performance of KLM, but is compounded by perceptions that Tyonek is being excluded from the planning process and is powerless to affect the outcome of major land and resource use decisions for the area. One resident said, "They have planned everything off of our boundaries. It seems like they are going all around us without working with us."

4.8 SUBSISTENCE

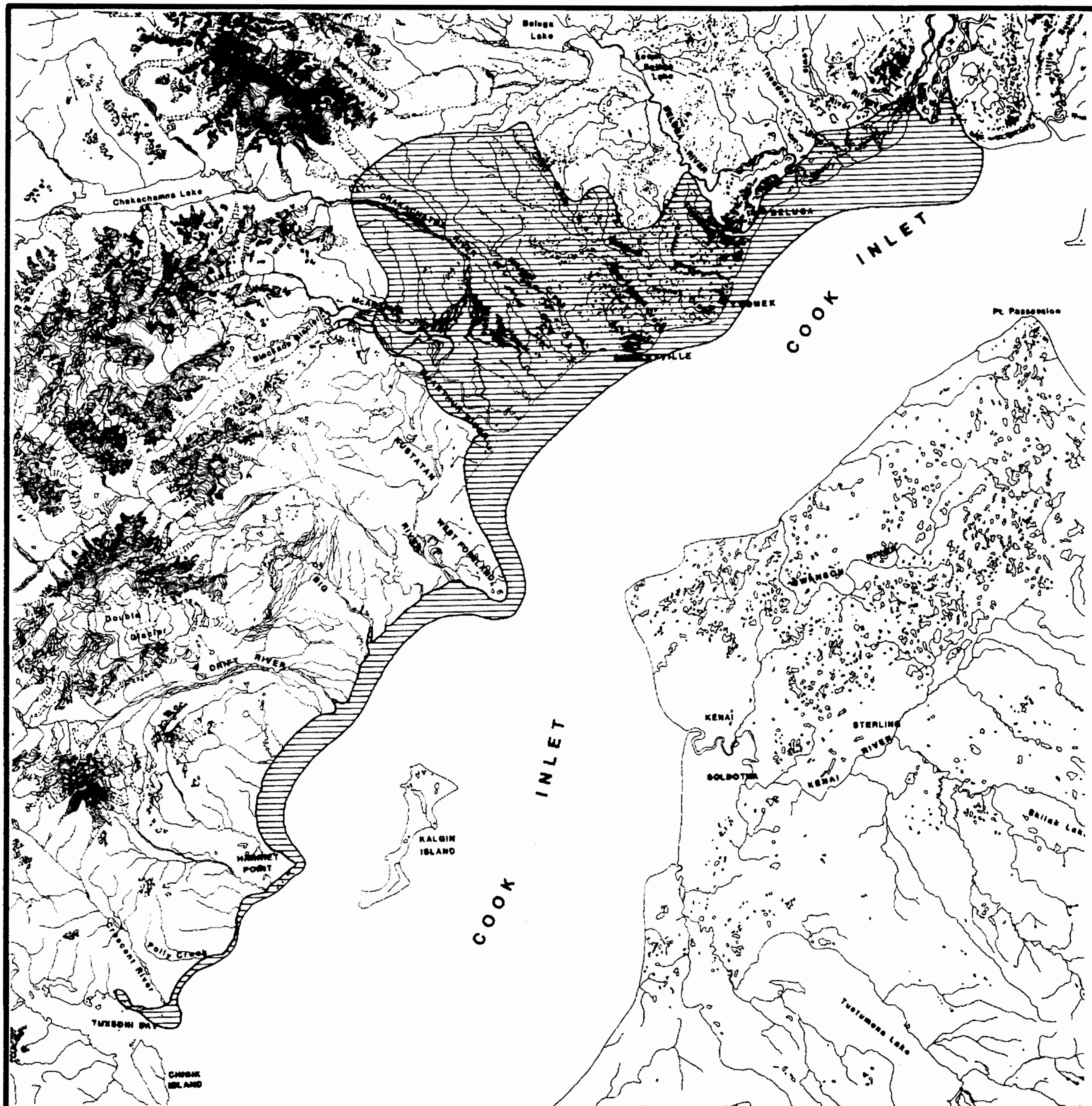
The harvest and use of subsistence resources are important to Tyonek residents for three reasons. First, locally available wild resources are less expensive than, and often nutritionally superior, to store-bought goods. Second, subsistence resources can be a supplement or partial replacement for income derived from wage employment. As such, time and money spent obtaining subsistence resources can be adjusted depending on need, opportunities for wage employment, and success of recent cash generating activities such as commercial fishing. Finally, the harvest, use, and distribution of these resources is integrally tied to Tyonek villagers' social and cultural value system (Fall et al. 1984). Therefore, subsistence resource harvests must be viewed in light of food value, as a component of an overall economic strategy, and as a central focus of the social and cultural value system.

Figure 4-15 shows the overall resource use area for Tyonek residents from 1978 to 1984 based on a study by the Alaska Department of Fish and Game (ADF&G) from 1980 to 1983 (Fall et al. 1984). Tyonek's subsistence harvesters use a 1942.5 km^2 (750 mi^2) area generally west and northwest of the village and 217.2 km (135 mi) of coastline along the western shore of Cook Inlet (Fall et al. 1984). Methods and ease of access play a major role in determing Tyonek's use areas. Dories are used to travel along the coast and into the McArthur River flats. The road network, developed to facilitate logging and oil and gas exploration, is heavily used to access upland areas.

Although Tyonek residents harvest a wide variety of subsistence resources, moose and salmon are the most important in terms of nutritional contribution to their diet (Fall et al. 1984). In 1983, of a mean subsistence harvest of 359.6 Kg (964 lb) per household, 71 percent of the edible weight was salmon, primarily king salmon taken during a May 15 to June 15 subsistence fishing season. Moose comprise 21 percent of the 1983 edible harvest weight. The remaining 8 percent of the harvest included a variety of resources including other salmon species, porcupines (Erethizon dorsatum), berries, razor clams (Siliqua sq.), waterfowl (especially mallards [Anas platyrhynchos], pintails [A. acuta], and green-winged teal [A. crecca]), smelt (eulachon), rainbow trout, Dolly Varden, belukha whale, harbor seal, beaver, spruce grouse (Canachites canadensis), and ptarmigan (Lagopus sp.). A variety of furbearers, including red fox (Vulpes vulpes), weasel (Mustela sp.) and beaver are trapped for furs, although trapping effort is currently lower than historical levels due to low fur prices. In addition, firewood, building timber, and coal were collected by Tyonek villagers.

The area of most intensive marine resource harvest includes marine and estuarine waters from the mouth of the Chuitna River south to Granite Point. Village fish camps and fishing sites used for both commercial and subsistence salmon harvest are located along this stretch of beach.

Intensively used aquatic and terrestrial resource harvest areas include the floodplains of the McArthur, Middle, and Chakachatna rivers; Nikolai Creek; and portions of



NOTE: This map was compiled during 1982 with a sample of 39 Tyonek households, and updated in 1983-84. It represents areas used during 1978-1984. This map may be a partial representation of use areas by the community. Use areas change through time and are not fixed entities.

SOURCE: Fall, Foster, Stanek. ADF&G, Division of Subsistence Technical Report # 105. Anchorage. Alaska, 1984.

LEGEND COMPOSITE MAP OF ALL RESOURCE USE AREAS

SCALE 0 5 10 miles

COMPOSITE MAP OF ALL RESOURCE USE AREAS, TYONEK, ALASKA, 1978-1984.

Diamond Chuitna Environmental Impact Statement | FIGURE 4-15

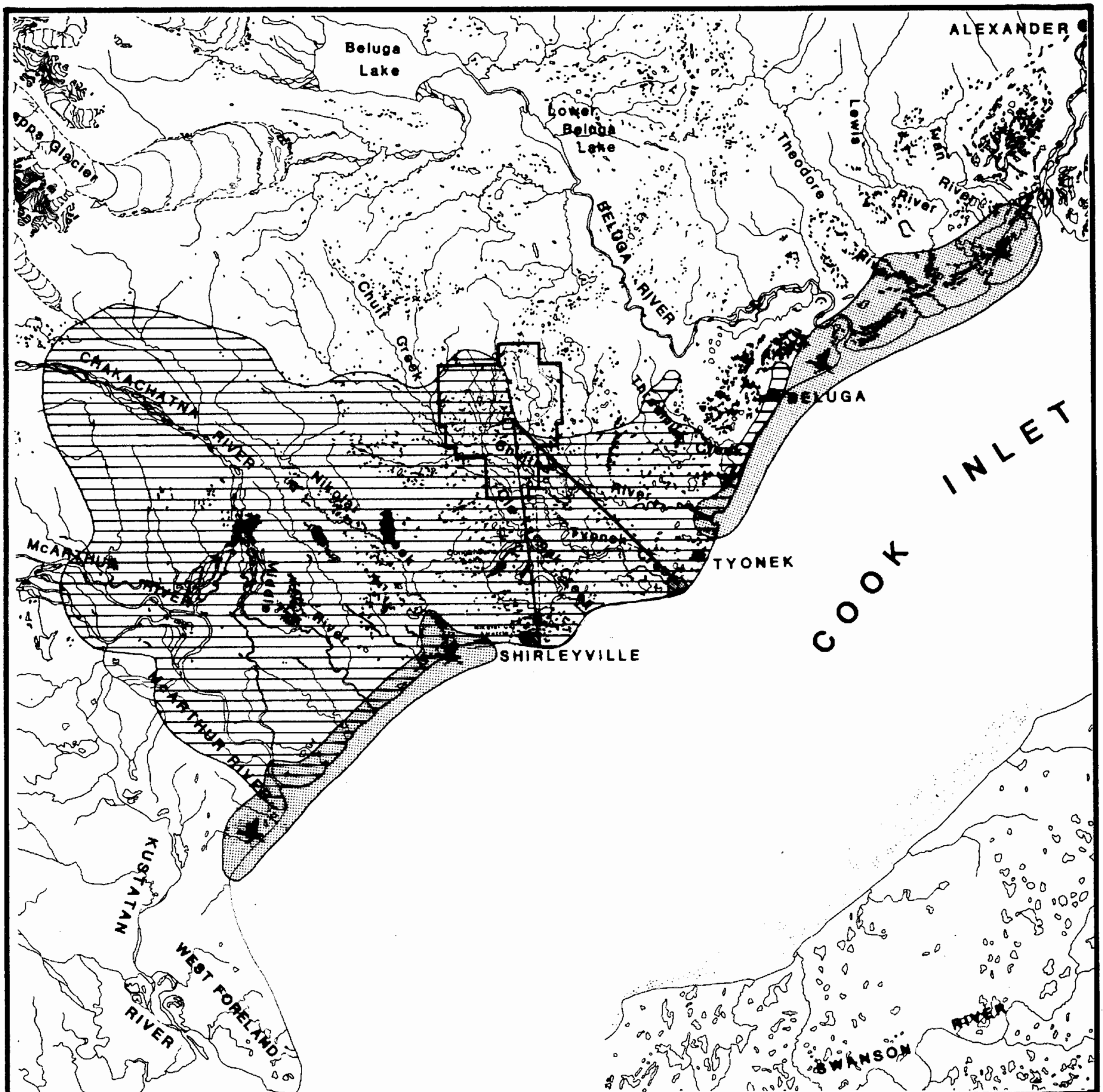
smaller creeks in the area such as Old Tyonek Creek, Tyonek Creek, and Threemile Creek. These areas receive more intensive use than surrounding habitat due to harvest efforts on instream salmon stocks, freshwater fish, waterfowl, and moose that winter in these river valleys.

Spring, early summer, and fall are generally the busiest seasons for subsistence resource harvests. May and June are dominated by the subsistence king salmon harvest and preservation. This subsistence fishery was reopened in 1980 following a 16-year closure and originally consisted of 10 fishing periods (12 hours each) between May 23 and June 15 with a household harvest limit of 50 king salmon or a total community harvest of 3,000 king salmon. Both the season length and harvest limits for subsistence fishing in Tyonek were relaxed in 1981 to allow three 16-hour openings each week between May 25 and June 15 and 12-hour openings on Saturdays from June 16 until October 15. Harvest limits were raised to 70 king salmon and 25 salmon of other species per permit holder or 4,200 kings for the community. Subsistence king harvests have ranged from a low of 1,565 in 1982 to a high of 2,750 in 1983 (Fall et al. 1984; Stanek and Foster 1980).

Other marine resources are also harvested in the early summer including smelt, razor clams, and, occasionally, marine mammals. As the season progresses, commercial salmon fishing opens in late June and continues until the runs diminish in August and September. Although these fish are taken with commercial gear under commercial fishing regulations, a proportion of the catch is usually removed and used for subsistence purposes. As the salmon runs decline, harvest efforts are transferred to moose, waterfowl, and a variety of other resources.

Moose hunting occurs during the general hunting seasons. Until 1976, ADF&G regulations allowed moose hunting during two seasons: August/September and November. The November season was eliminated in 1976 due to excessive hunting pressure. In 1983, moose populations had rebounded and a special November season was opened. Currently, ADF&G regulations allow openings for moose hunting in Game Management Unit 16B by local residents only between November 1 and January 31. According to ADF&G personnel, the winter moose season is opened when the snow is sufficiently deep to force the moose into more accessible lowland areas (Foster 1984). Tyonek residents stressed the importance of the winter moose season. During this time of year, moose are generally closer to the village, meat supplies from fall hunts have diminished, and competition is reduced because hunting is open only to area residents.

Figure 4-16 shows the area used for moose hunting between 1978 and 1984. Only portions of this area, however, are used in a given hunting season. Yearly variation in



NOTE: This map was compiled during 1982 with a sample of 39 Tyonek households, and updated in 1983-84. It represents areas used during 1978-84. This map may be a partial representation of use areas by the community. Use areas change through time and are not fixed entites.

SOURCE: FALL et al. (1984: FIGURE 41)

SCALE 0 5 10 miles

LEGEND

RESOURCE	SYMBOL
Small Game	
Moose	
Bear	
Waterfowl	

USE AREAS FOR MOOSE, SMALL GAME, BEAR, AND WATERFOWL, TYONEK, ALASKA

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FIGURE 4-16

moose hunting areas is determined by snow conditions, moose movements, and presence of other hunters in the area.

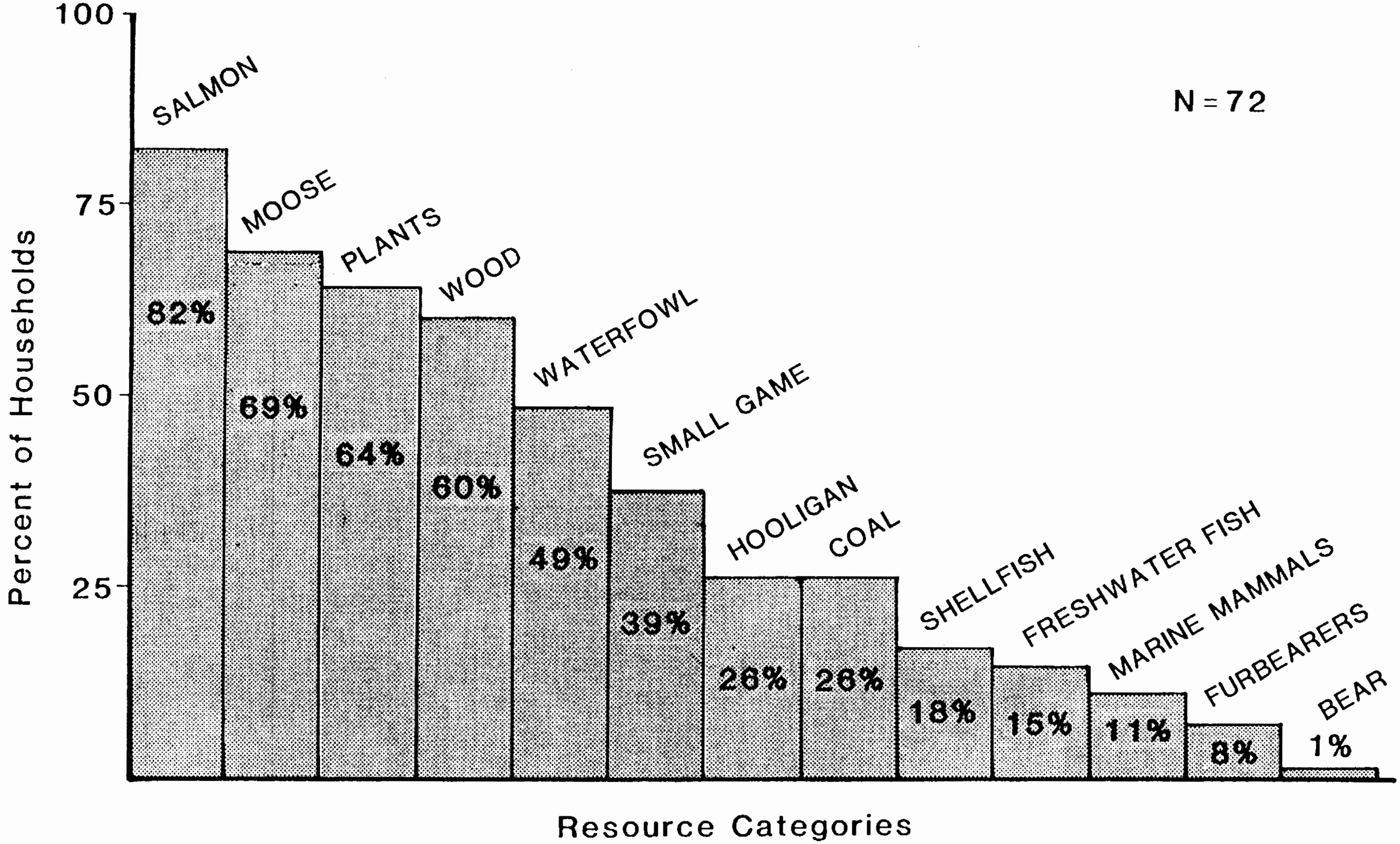
Fall moose hunting occurs primarily in the McArthur River Flats area and along the road network. Because dories are used to access the McArthur River, this area is not used during the winter. Winter harvest effort occurs primarily between the village and the Chakachatna River (Fig. 4-14). Trucks are used to travel throughout the road network; roadless areas are accessed by foot, snowmachine, or threewheeler. Although villagers indicated they once hunted moose frequently north of the Chuitna River as far as the Beluga River, this area is currently used less than previously due to increasing competition from permanent non-Native residents, especially in Beluga. Instead, winter hunting generally takes place to the southwest and northwest of Tyonek as far as the Chakachatna River.

Hunting for other species, including porcupines, grouse, and ptarmigan usually occurs incidentally while moose hunting. These species are also sought during the remainder of the year in combination with other subsistence pursuits such as ice fishing, trapping, and firewood cutting. Tyonek hunters indicated that the abundance of small game, especially porcupines, spruce grouse, and furbearers, decreased in the late 1970s and attributed this decline to logging activities of KLM.

Areas used for trapping by Tyonek residents currently include the Nikolai Creek drainage, areas along the road between the town and Granite Point including Old Tyonek Creek, and in the area north of the Chuitna River and east of Lone Creek. In addition, a trapper who does not reside in Tyonek traps throughout a broad area north of the Chuitna River from the western boundary of the Diamond Chuitna lease area, north to Beluga Lake and east to the Susitna River.

Eighty-two percent of the households in Tyonek harvested salmon in 1983 and 69 percent harvested or attempted to harvest moose in 1983 (Fig. 4-17) (Fall et al. 1984). Participation levels for other subsistence resources were lower than for salmon or moose. Although not all households in Tyonek participate in resource harvest activities, 90 to 95 percent of the households receive or exchange one or more subsistence resources in a given year (Foster 1981; Fall et al. 1984). Distribution of subsistence resources ensures that the benefits of subsistence harvests are dispersed throughout the community. Exchanges generally occur along kinship lines and are influenced by available surpluses, the number of dependents in a given household, and perceived need.

Cooperative harvest, use, and distribution of subsistence resources are important cohesive elements in Tyonek culture (Fall et al. 1984). The opportunity to hunt and



SOURCE: FALL, FOSTER, STANEK. ADF&G, DIVISION OF SUBSISTENCE TECHNICAL REPORT #105. ANCHORAGE, ALASKA, 1984.

PERCENTAGE OF TYONEK HOUSEHOLDS ATTEMPTING TO HARVEST RESOURCES BY RESOURCE CATEGORY, FEBRUARY 1983–JANUARY 1984	Diamond Chuitna Environmental Impact Statement
	FIGURE 4–17

fish is an affirmation of cultural values in an age when the dominant social, economic, and political influences tend to dilute the Tanaina culture. Continuation of traditional harvest activities, then, provides the focus of Tyonek's value system and kinship networks provide the social structure within which these traditional activities occur. Tyonek villagers want to retain these elements of their culture. It is for these reasons that Tyonek residents desire some degree of autonomy and control over the factors that influence the resources they rely on, their access to the resources, and the socioeconomic conditions that affect life in the village.

4.9 VISUAL RESOURCES

The project area is in the Coastal Trough physiographic province (U.S. Department of the Interior 1978a), which includes much of the land bordering Cook Inlet. This region is characterized by flat to rolling terrain and sparse to moderately dense vegetation. The project area is visually representative of this physiographic province, with elevations ranging from sea level at the proposed alternative port sites to about 275 m (900 feet) at the mine site and 415 m (1,360 feet) in the northwest portion of the Diamond Alaska lease area. Vegetation is generally of moderate density, consisting primarily of open mixed woods of birch and spruce in the uplands (9 to 12 m in height [30 to 40 feet]), and muskeg in the depressions and lowlands. Above 153 m (500 feet) in elevation are willow and alder shrub communities which may reach 6m (20 ft) in height. Numerous drainages and depressions exist on the site, which in combination with vegetation provide good, but not complete potential for screening of project facilities from view of the occasional visitors to the area.

The mine site and other proposed facility areas are rarely viewed due to their remoteness from inhabited areas and the low use level of nearby land and water. Lands near the proposed port sites can be viewed from nearby areas on Cook Inlet where occasional commercial, subsistence, and sport fishing occurs. Recreational use of the project area is described in Section 4.10.

Visual quality of the project site area was assessed using the U.S. Bureau of Land Management Visual Resource Management (VRM) System (U.S. Department of the Interior 1978b). The terrain unit (viewshed) used for the analysis consisted of a triangular area extending from Granite Point to North Forelands to the mine area. Because of the visual screening available from topography and vegetation, the viewshed included lands about 2 miles on either side of the proposed transportation corridor alternatives and 5 miles on either side of Granite Point and North Forelands.

As shown on Table 4-22, the scenic quality rating assigned to the area is 19 on a scale from 0 to 33. This rating is in Class A (of classes A, B, and C), which includes ratings between 19 and 33. According to the BLM criteria for categorization of an area as a potential area of critical environmental concern regarding scenic values, the scenic quality rating must be Class A and must have a scarcity rating of 5 or 6. Therefore, the project area would not qualify under these criteria. However, the Class A rating implies that some special management attention to maintaining the area's scenic quality may be merited.

Table 4-22

SCENIC QUALITY RATING FOR THE PROJECT AREA

Category		Score	Possible Range
Landform		3	1-5
Vegetation		3	1-5
Water		3	0-5
Color		3	1-5
Influence		3	0-5
Scarcity		2	1-6
Cultural Modification		2	-4-2
	Total	19	0-33

The area's remoteness from large communities or activity centers tends to lower the level of concern for visual intrusions. However, an important use of the area is for wilderness expeditions such as fly-in fishing and subsistence use, for which lack of man-made visual intrusions is an important attribute. Addition of this user attitude factor would tend to raise overall concern for visual changes to the area. The net effect of low use level and high user concern is assessed as neutral and the scenic quality rating of 19 is considered representative of the overall sensitivity of the project area to change.

It should be noted, however, that a common vantage point is not from the ground, but from the air, since most travellers who see the site area fly in. Thus, the viewshed is actually larger if aerial vantage points are included. If a larger area were considered to reflect aerial views, the visual sensitivity of the area would be somewhat lowered because "cultural modifications" such as logging roads, the Beluga power station, and power lines are more visible from the air. The presence of these man-made influences tends to lower scenic quality ratings according to the VRM methodology.

4.10 RECREATION

The primary recreational uses of the site and its environs are fly-in fishing expeditions, non-subsistence moose hunting, and some hiking, camping, and picnicking by Tyonek residents (see Section 4.8).

4.10.1 Sport Fishing

The project area, particularly the Chuitna River, provides excellent coho and king salmon fishing. The Chuitna is open for coho salmon fishing in its entirety and, since 1983, has been open for king salmon from Cook Inlet to the mouth of Lone Creek. These areas are accessible from Tyonek and nearby airstrips via abandoned logging roads and are fished during June-July for king salmon and July-August for coho. While there is good potential for a rainbow trout fishery on the upper Chuitna, lack of access probably limits use of upstream areas. Howeve:, good rainbow fishing is available on the lower Chuitna arly in the season. Kings and red salmon are also taken in this area.

At least two wilderness fishing operations regularly use the permit area. Clients are picked up at the Tyonek or Superior airstrip and driven to the Chuitna River or Lone Creek, then picked up at day's end. One operator has developed a trail network along the river banks and has built a lodge near the Chuitna River-Lone Creek confluence. Permit area waters are seldom fished. Although good fishing is available, fishing guides do not use either Nikolai or Threemile Creek, which are fished primarily by local residents for kings and red salmon.

In 1983, between 4,000 and 5,000 man-days of fishing effort are estimated to have been spent in Western Cook Inlet (including all streams north of the MacArthur system and south of the Lewis River). Most of this effort was on the Chuitna River. The king salmon fishery accounted for approximately 2,000 man-days of this total (the 1984 king salmon run attracted a similar level of use). The Chuitna River king salmon fishery is excellent, with harvest rates over 0.5 fish per man-day. The Chuitna River king salmon population is presently underharvested (Hepler 1985). The Chuitna River coho salmon fishery attracts somewhat lower fishing effort, but probably still accounts for most of the 4,000 to 5,000 man-days spent in Western Cook Inlet not represented by king salmon. No data are available on the level of effort for rainbow trout (Delaney 1985).

4.10.2 Hunting

Sport hunting in the project area is largely restricted to moose hunting. Waterfowl may be taken opportunistically on lakes in the area, but most waterfowl hunting takes place in the Trading Bay or Susitna Flats State Game Refuges.

Brown bear are not harvested except occasionally in "defense of life and property." In the vicinity of the Beluga River, approximately twenty hunters per year hunt black bear. There are no statistics available to indicate success. Ptarmigan are also occasionally hunted in the area.

Moose hunters number about 150 per year. Hunters usually arrive in Tyonek by air or boat and hunt from the road system. Tyonek residents provide some support facilities for hunters in their area. Hunts are held in the fall and in the winter. In 1984, ADF&G issued 48 permits for the winter moose hunt and in 1985, 67 permits were issued. Statistics indicate there is an approximate hunter success rate of 25 to 50 percent.

4.10.3 Other

Other possible recreational uses of the project area include recreational trapping and waterfowl hunting by non-Natives and picnicking, camping, and sight-seeing by the Tyonek villagers. Data on recreational trapping and waterfowl hunting by either Natives or non-Natives is unavailable, but some occasional use may occur.

4.11 CULTURAL RESOURCES

The Diamond Chuitna project area lies within a region of Alaska where relatively few archaeological sites have been discovered and even fewer scientifically excavated. Current understanding of the region's cultural history is sketchy due to the lack of data. It appears as if the earliest human use of the Cook Inlet area was sometime between 8,000 and 10,000 years ago. The lowest level of the Beluga Point site, on the north shore of Turnagain Arm, produced core and blade materials in an undated context; similar materials from sites elsewhere have been assigned to the American Paleoarctic Tradition of about 10,000 years ago (Reger 1977, 1981). The next known occupation of the region, also represented at the Beluga Point site, is characterized by material dating to about 3,000 years ago, which apparently does not have obvious relationships to cultural remains elsewhere in Alaska.

Two cultural manifestations at the Beluga Point site date between 3,000 and 1,500 years ago. The earliest probably is related to the Norton culture and thus may be connected with an intrusion of Eskimo peoples or cultural traits into the area. Other sites from the same time period and possessing similar collections of cultural material are known from the general area, particularly to the north. The later complex is not well represented but may be similar to a cultural manifestation known from Bristol Bay and dating to about 500 B.C. (Ross 1971).

The late period of prehistory is represented by several sites in the general project area, including Beluga Point where the uppermost level dates to around 600 years ago. Historic sites, occupied first by the Russians, later the Americans and, throughout the period, by the Tanaina Athapaskans (the Native people inhabiting the region at the time of contact) are common in the region, though few have been extensively excavated.

Only one archaeological site is known to be present in the Diamond Chuitna project area (Gerlach and Lobdell 1983). The site is located on the elevated bluff above Cook Inlet in the Granite Point area within the confines of the coal storage area proposed by Diamond Alaska at the port site. Shallow depressions, probably representing salmon storage pits, were reported at the site (TYO-064). Further testing might disclose evidence of habitation features or debris. Archaeological survey did not disclose any other materials attributable to past human use of the immediate project area. The remains of historic cabins are located adjacent to the Ladd port site (TYO-033). The cabins, which are greatly deteriorated, are frame and log structures. No archaeological investigations have been carried out in the Northern transportation corridor. However, the nature of the terrain and the extensive vegetative cover suggests the possibility that other archaeological sites may exist.

Chapter 5.0

Environmental Consequences

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 INTRODUCTION

The scientific and analytical bases for the comparison of alternatives summarized in Section 3.2.4 are presented in this chapter.

The No Action alternative is discussed first. Since for almost all disciplines, the impact of the No Action Alternative would be the status quo, impacts of this alternative are not discussed for each of the individual disciplines. Rather, the No Action alternative is discussed in a separate section (Section 5.2) which deals primarily with the socioeconomic impacts of no project implementation.

Section 5.3 discusses the impacts of components common to all action alternatives, i.e. impacts associated with the mine, overburden stockpile location, and mine service area. Impacts are considered for each discipline. Next, the chapter deals with the applicant's Proposed Project, which includes two port site/transportation corridor alternatives. Finally, several additional alternatives are discussed, including an eastern corridor/Ladd alternative and three housing area configurations.

The environmental consequences described for the action alternatives in this chapter assume that the level of mitigation would be as proposed by the applicant (Chapter 2.0). One of the alternatives available to the permitting agencies is to request additional mitigating measures as a condition of their respective permits. Possible mitigation measures beyond those proposed by the applicant and the environmental consequences of their implementation are discussed separately in Chapter 6.0.

Throughout the following impact discussion, various references are made to "local" impacts and "regional" impacts. For purposes of this EIS, "region" refers to the Beluga Region or the area roughly outlined in Figure 4-1. Local impacts refer to effects that occur at, or immediately adjacent to, proposed project facilities. Therefore, impacts that are "regionally significant" would normally be noticeable or measurable when considered from a regional perspective. "Locally significant" impacts would be noticeable or measurable in the vicinity of the impact but would not be noticeable on a regional basis. Regionally significant impacts could have significance on a broader scale (statewide or national) if the magnitude were large enough or the resources particularly sensitive.

5.2 THE NO ACTION ALTERNATIVE

The No Action alternative would result if at least one of the permits necessary for project development were denied or if the project sponsor chose not to undertake the project. No Action would mean that none of the activities described in Chapter 2.0 would occur. In addition, ongoing exploration activities would likely stop and Diamond Alaska would probably be required to rehabilitate existing disturbed areas. None of the impacts to the physical and biological environment described in the remaining sections of this chapter would occur and the area would essentially retain its relatively undeveloped character. Some development scars from past exploration would remain in the coal field vicinity for an indefinite time period, but they would become less conspicuous with the passage of time.

Not developing the Diamond Chuitna Coal Project could create a future need for coal mines at other locations. The extent of this need would depend on local and worldwide conditions of supply and demand. If substitute mines were developed, environmental impacts of unknown, but possibly significant, magnitude could occur at some other location(s). Whether or not the impacts would be greater or less than those that would occur at the Diamond Chuitna site cannot be determined.

If it is assumed that the No Action alternative would cause Diamond Alaska to cease exploration and predevelopment activities, then the small number of jobs that are currently supported by these activities would be lost and Diamond Alaska would turn its energies elsewhere. Failure to proceed with mine development would result in at least 848 permanent jobs not being realized over the 34-year life span of the mine. The various positive and negative socioeconomic impacts to the village of Tyonek and Kenai Peninsula communities described in subsequent sections of this chapter would not occur.

From a regional standpoint, not developing the Diamond Chuitna mine could significantly affect the course of future development in the area. Development of the project and its infrastructure would likely serve as a stimulus for development of other coal fields as well as providing the economic base for support industries (see Section 5.7). The No Action alternative would prevent or delay industrial development of the Beluga area and tend to maintain the present character of the area.

5.3 IMPACTS COMMON TO ALL ACTION ALTERNATIVES - MINE AND MINE FACILITIES

5.3.1 Impacts to Terrestrial Environment

5.3.1.1 Physiography and Geology

The major construction and operation impacts of the proposed project on physiography, geology, and soils are related to coal and gravel extraction and gravel placement for facilities and for roadway and drainage structures. Four sites (Fig. 2-16) have been selected as potential gravel mining sites. These sites would provide a maximum of 4.3 million m^3 (5.6 million yd^3) of material and riprap which would be required for facilities foundations, roadway and drainage embankments, drainage structure protection, and reclamation. Extraction of coal, gravel, and rock would deplete portions of valuable resources. The above figure includes approximately 3060 m^3 (4000 yd^3) riprap, 459,000 m^3 (600,000 yd^3) gravel or road surface material and 2.3 million m^3 to 3.8 million m^3 (3 to 5 million yd^3) unclassified fill. The impacts of specific components are discussed in the following paragraphs.

Mining operations would deplete approximately 299 million Mt (330 million short tons) of coal. A 16.8 million m^3 (22 million yd^3) overburden stockpile would be created from overburden and interburden from the initial box cut for the mine. Approximately 81 ha (200 ac) would be covered by the overburden stockpile. Consideration has been given to the stability of the overburden stockpile slopes and future slope failures on the waste pile would not be anticipated with the proposed configuration.

The earth-moving sequence proposed by Diamond Alaska would replace materials in approximately the same order as their removal. However, it is anticipated that significant mixing of overburden and interburden would still occur during their extraction and replacement in depleted portions of the mine pit. Therefore, the postmining stratigraphic sequence would be similar to, but not identical to, the premining condition.

The surface excavation required to remove the coal would substantially alter the topographic relief during mine operation. As described in Section 2.3.2, the pit face would be continually advancing as new overburden is removed. The trailing edge of the pit would also advance as overburden is dumped onto mined-out areas. In effect, a 182 ha (450 ac) hole in the ground would move across the landscape over a 30-year period. The reclaimed area behind the mine pit would be regraded to its approximate premining topography as the pit advances and, at completion of mining, the whole area would be restored. Postmining topography would be similar, but not identical, to the premining condition.

5.3.1.2 Soils

Clearing and grubbing operations for the mine and mine service facilities would directly disturb over the life of the mine about 2,050 ha (5,066 ac) of mainly organic soils, including 1,127 ha (2,785 ac) of Mutnala-Chichantna, 548 ha (1,354 ac) Mutnala, and 284 ha (7 ? ac) Starichkof soil types (see Tables 4-1 and 4-2 for characterizing features of the affected soils)(Bechtel 1982).

The 10-year mine area consists of 1,436 ha (3,546 ac) of which 1,047 ha (2,585 ac) or 73 percent consists of Strandline soils that have a sandy loam texture (ERT 1984d). Because of their mineral nature, these soils are valuable for revegetation. Peaty Starichkof - Chichantna soils occur on 366 ha (905 ac) of the 10-year mine area. The remaining 23 ha (56 ac) consists of Jacobsen sand and Killey - Moose River silt loams.

Because of the long period required for soil formation, soils in the Diamond Chuitna mine area are highly susceptible to irreversible, disruptive impacts from surface mining. A major long-term disturbance would result from the removal of soils ıd overburden to reach the coal seams.

The initial construction impact to soils would be eventually mitigated by implementation of the reclamation plan and successful revegetation. The revegetation medium would be provided by backfilled overburden with a minimum 6-inch layer of redistributed topsoil. The development of a favorable growth medium would be facilitated by addition of fertilizer and control of accelerated erosion. Development of a biologic (i.e., biologically mature) dynamic soil profile from overburden equivalent to that which currently exists would require a long time period (hundreds of years) in this subarctic climate (Douglas and Tedrow 1959; Heilman 1966; Brady 1974). The addition of a topsoil layer containing biologic components as currently planned would greatly accelerate the process of soil evolution. Thus, construction, operation, and reclamation impacts of the project on existing soils would be a long-term, but partially reversible commitment of the resource. It should be noted that a successful revegetation program, including ttainment of a diverse and productive community, is not cessarily dependent upon the development of a mature soil p file.

5.3.1.3 Vegetation

Community Composition

During construction and operation, clearing for the mine would directly disturb about 2,029 ha (5,014 ac) of existing vegetation, including 1,356 ha (3,351 ac) of mixed spruce-birch woodland, 364 ha (899 ac) of open low shrub scrub/sweetgale-grass fen, and 182 ha (450 ac) of closed alder/tall shrub scrub (ERT 1985e). An additional 22 ha (54 ac) of primarily mixed spruce-birch woodland vegetation would be disturbed by construction of the mine service facilities (Table 5-1).

Vegetation would also be disturbed by mining of gravel, the extent of which would depend on the number of sites used (Fig. 2-16). Site 5 would disturb about 106 ha (262 ac) of mainly mixed spruce-birch woodland vegetation. Sites 8 and 7 would disturb 134 ha (331 ac) of mixed spruce-birch woodland and mesic graminoid herbaceous/bluejoint herb vegetation and 119 ha (294 ac) of mainly mixed deciduous woodland vegetation, respectively.

Damage to vegetation could also occur from fuel and chemical spills. The degree of impact would depend on the amount of the spill, the time of the year, type of community, and type of action required for the cleanup (Brown and Berg 1980). Spills in communities with wet, organic soils during the growing season are considered to be more damaging than those occurring in mineral soils or those occurring in winter. Spill contingency plans would help to prevent or minimize damage.

Another possible indirect impact would be the increased risk of spruce beetle infestation of native trees resulting from the spread of beetles in piles or windrows of trees created during clearing operations. Delayed burning of dead trees would increase this risk.

As might be expected, the use of topsoil as a revegetation growth medium would facilitate the establishment of vegetation and would reduce the time and effort required to attain a self-sufficient plant community (McGinnies and Nicholas 1980). Revegetation studies by Diamond Alaska on test plots in the mine area have indicated that early successional species (e.g., grasses) will readily grow on typical overburden materials even in the absence of topsoil. Estimation of the time required to attain a plant community with a similar structure and diversity to premining conditions (or a successional stage leading to such) requires extrapolation of data from similar areas and project development circumstances. Because no data are directly transferable to the Diamond Chuitna Project, conservative estimates of time required for soils and vegetation regeneration have been obtained by a review of literature documenting natural and man-assisted succession.

The time period required for vegetation reestablishment varies with ecosystem (climatic regime) and site conditions. In the absence of reclamation, secondary succession to attain premining vegetation biomass on overburden would require an estimated 20 to 40 years. This estimate is based on regeneration data, including studies on secondary succession and revegetation after complete soil disturbance.

Table 5-1

AREA (ha [ac]) OF VEGETATION DISTURBED
BY VARIOUS MINE COMPONENTS

Project Component	Vegetation Unit[1] 1	2	3	4	5	6	7	8	9	Total Area (Ha[ac])
Mine and Mine Facilities										
Mine	-	-	-	20 (49)	1356 (3351)	-	182 (450)	364 (899)	101 (250)	2029 (5014)
Mine Service Area	-	-	-	-	14 (35)	-	-	8 (20)	-	22 (54)
Housing Facilities and Airstrip (Lone Creek)	-	-	-	-	(62) 25	-	(4.9) 2	(2.5) 1	(2.5) 1	(72) 29
TOTAL	-	-	6 (14.8)	20 (49)	1395 (3447)	-	184 (455)	373 (922)	102 (252)	2080 (5140)

[1]Vegetation Units (ERT 1985e) are as follows:

1 - Closed broadleaf forest/paper birch
2 - Open broadleaf forest/balsam poplar
3 - Open mixed forest/spruce-birch
4 - Needleleaf woodland/black spruce
5 - Mixed woodland/spruce-birch
6 - Open tall shrub scrub/willow
7 - Closed tall shrub scrub/alder
8 - Open low shrub scrub/sweetgale-grass fen
9 - Mesic graminoid herbaceous/bluejoint herb

Natural regeneration after logging to an early successional Canada bluejoint grass community occurs relatively quickly in the project area (ERT 1984g). However, vegetation regeneration on highly disturbed soil would be expected to require a somewhat longer period. Natural vegetation, including the establishment of willows and black cottonwood, occurred within 25 years on newly exposed glacial till and a nearly continuous cover of alder had established after 35-40 years in the moist environment of Glacier Bay (Crocker and Major 1955). Younkin and Martens (1985) indicate reinvasion of native species including trees and shrubs after four years on fertilized mine overburden in a boreal forest ecosystem in Canada (61 degrees latitude). Unassisted revegetation (20 percent cover) was attained in the same time frame in the Yukon Territory (64 degrees latitude) on pipeline overburden (Younkin and Martens 1985). Willow and alder with an herbaceous understory have established within 20 years after fire in central Alaska (Lutz 1956). However, the establishment of a diverse, relatively mature community from natural succession alone could take 50 to 100 years (Rowe and Scotter 1973; Hettinger and Janz 1974).

Implementation of reclamation procedures as currently planned would facilitate and accelerate the reestablishment of self-perpetuating plant communities on disturbed sites within the project area. Using results of previous work (Younkin and Marten 1985; Crocker and Major 1955; Lutz 1956; Vierick 1982), it is postulated that well-developed stands of herbaceous and shrub vegetation would be established 5 to 10 years after commencement of reclamation. Self-perpetuating vegetation with sufficient cover to prevent erosion could probably be established within 10 to 20 years after reclamation. The establishment of mature shrublands and young forests would require an estimated 20 to 30 years. Reestablishment of woody communities, species diversity, and wildlife values similar to existing communities, however, could require a longer period (20 to 40 years). The use of topsoil as a revegetation growth medium would tend to shorten the time needed to obtain a self-perpetuating plant community.

Long-term adverse impacts on vegetation would occur in areas that are cleared and used continuously during mining. Reclamation operations could not be implemented until the mine service area and other mine facilities were dismantled. Thus, reestablishment of vegetation would not occur until 10 to 15 years after project completion.

Threatened and Endangered Species

No threatened, endangered, or special status plant species are known to occur within the mine area.

5.3.1.4 Wetlands

Of the total area directly altered by clearing for and construction of the mine and mine facilities, 443 ha (1094 ac) or 22 percent is classified as wetlands according to the criteria presented in Section 4.3.2.3 (Table 5-2). In addition to direct adverse impacts, wetland structure and function would be altered adjacent to project facilities by blockage of natural drainage patterns and disturbance of wetland inhabitants.

Some wetland areas would probably become reestablished in low areas following reclamation of the mine area. However, because of unknowns regarding postreclamation soil permeability and water tables as well as the long period of evolution that is required to create natural peatlands with their inherent water holding capacity, it is likely that the extent of wetlands would be much smaller following reclamation than prior to mining. Most wetlands within the reclaimed mine area would lack the peat and organic material which characterize the existing wetlands. Mineral soil substrate with sparse sedges and grasses would initially predominate in wet areas. In the very long term (hundreds of years), organic matter would accumulate and some peat growth would probably occur, bringing the area closer to its initial condition. As a partial mitigation measure to offset this loss of peatlands, Diamond Alaska plans to include establishment of 2 to 5 acre peat-filled depressions as part of their reclamation plan. In addition, reclaimed sedimentation basins would be selectively revegetated to accelerate the buildup of organic components. These experimental measures would alleviate wetland impacts to some extent but would cover a small surface area compared to the area of existing wetlands.

Wetland-related impacts to vegetation and wildlife for each alternative are presented in subsequent sections. The following paragraphs address wetland impacts in relation to the special values presented in Section 4.3.3.

Most wetland-related plant and animal productivity would be lost during operations, for a substantial period thereafter, and possibly indefinitely depending on the success of wetland reclamation. The acidic, muskeg-type wetlands which are widely dispersed throughout the area are not especially productive and the net primary productivity of replacement communities would probably be as high or higher than the communities which now exist. Therefore, adverse impacts resulting from overall loss of primary productivity would probably not be significant on a regional scale. Food webs would be interrupted locally (in the immediate vicinity of the disturbed wetland), but such interruption would probably not be significant on a regional basis because of the isolated nature of most area wetlands and the presence of similar wetlands outside the project area.

Table 5-2

HECTARES (ACRES) OF WETLAND LOST AS A RESULT OF MINE DEVELOPMENT BY PROJECT COMPONENT

	Wetland Type[1]							
Components	PFO4/1	PSS1/FO4	PFO4	PSS1	PSS1/EM5	PEM5	POW	TOTAL
- Mine Components								
30 year mine limit[2]	2.4ha(6ac)	--	--	21.5ha(53ac)	329ha(813ac)	329ha(813ac)	23ha(57ac)	440ha(1086ac)
Mine Service Area	0.4ha(1ac)	--	--	2.8ha(7ac)	--	--	--	3.2ha(8ac)
- Tranportation Corridors								
Southern Corridor haul road & conveyor system	2.4ha(6ac)	--	--	0.4(1ac)	10.5ha(26ac)	0.4ha(1ac)	0.4ha(1ac)	14.2ha(35ac)
Material Sites								
(a) #5	--	--	--	--	1.2ha(3ac)	--	--	1.2ha(3ac)
(b) #7	--	--	--	--	--	--	--	--
(c) #8	--	--	--	0.8ha(2ac)	1.6ha(4ac)	0.4ha(1ac)	--	2.8ha(7ac)
Eastern Haul Road and conveyor system	--	--	0.8ha(2ac)	0.8ha(2ac)	11.3ha(28ac)	1.6ha(4ac)	0.4ha(1ac)	15.4ha(38ac)
Northern Haul Road and conveyor system	0.4ha(1ac)	--	0.4ha(1ac)	--	25.9ha(64ac)	1.2ha(3ac)	--	27.9ha(69ac)
Northern Haul Road conveyor system (phased production)	0.4ha(1ac)	--	0.4ha(1ac)	--	25.9ha(64ac)	1.2ha(3ac)	--	27.9ha(69ac)
- Housing & Airport Facilities								
Lone Creek Site	--	--	--	--	2.4ha(6ac)	--	--	2.4ha(6ac)
Congahbuna Lake Site	--	--	--	--	2.4ha(6ac)	--	--	2.4ha(6ac)
Threemile Site	--	--	--	--	--	--	--	--
- Port Facilities								
Granite Point	--	--	6.0ha(15ac)	--	63ha(155ac)	--	1.2ha(3ac)	70ha(173ac)
Ladd Port Site	2.0ha(5ac)	6.5ha(16ac)	--	--	--	--	2.8ha(7ac)	11.3ha(28ac)

NOTE: Wetland area figures may not correspond exactly with areas in the vegetation sections because the two mapping efforts differed.

1) PFO4/1 Palustrine - Forested mixed needle leaved/broad/leaved deciduous

PSS1/FO4 Palustrine - Scrub-shrub/Forested broad leaved deciduous

PFO4 Palustrine - Forested broad leaved deciduous

PSS1 Palustrine - Scrub-shrub broad leaved deciduous

PSS1/EM5 Palustrine - Scrub-shrub broad leaved deciduous/Emergent narrow leaved persistent

PEM5 Palustrine - Emergent narrow leaved persistent

POWH Palustrine - Open water permanent

2) Includes overburden stockpile

Wetland habitat available for wildlife use within the disturbed areas would be reduced. For the most part, the wetlands in the project area are not themselves high value habitat, but the habitat diversity and forest edge associated with the interspersed wetlands contributes significantly to the overall moderate to high value of the area to wildlife, especially moose and bears. Postreclamation habitat value for moose and black bear could be less than premining (Section 5.3.1.5 and Appendix A) partly because of loss of habitat diversity now contributed by wetlands.

Significant impacts to local hydrological regimes would occur as a result of eliminating, reducing, and altering wetlands in the mine area (Section 5.3.2.1). Wetland areas affect the hydrological characteristics of their watersheds in a variety of ways depending on wetland characteristics. Wetlands in the mine area store large quantities of water and play an important role in surface water - ground water interactions (ERT 1984c). The baseline investigations indicated that the deep organic layer underlying the muskeg areas on the sides of the stream valleys forms a shallow ground-water system that contributes the majority of base flow to the streams in and adjacent to the mine area. Removal of the vegetation and organic soils would destroy this shallow system and potentially prevent restoration of streams to premining conditions. Removal of wetlands would probably also increase flood peaks in the Chuitna drainage to some extent (Carter et al. 1978); however, saturated peatlands tend to respond quickly to precipitation events and the impact of removing the muskeg would probably not be dramatic (Verry and Boelter 1978). Recharge rates within the deeper ground-water systems could be increased after mining because deep organic deposits can inhibit percolation; evapotranspiration within wetland communities removes substantial water that would otherwise be available for recharge (Carter et al. 1978). Lone Creek and stream 2003 could be affected (Section 5.3.2.1), resulting in lower minimum flows and higher peak flows.

The removal of wetlands would cause long term alteration in the quality of surface-water runoff from the mine area. Wetlands tend to remove suspended sediment from inflowing waters (Carter et al. 1978); therefore, postreclamation runoff would likely contain more sediment than at present which could affect long-term stream water quality. Peatlands also tend to lower the pH (increase the acidity) of water flowing through them, consequently, postmining runoff would probably be less acid than at present (Carter et al. 1978). Additionally, nutrients that are available as a result of organic matter decay within wetland areas would be reduced. However, it is unlikely that altered nutrient flow would significantly affect ecosystem functions within the region.

Wetland-related recreation activity within the project area is minimal and no significant impact to recreation opportunity as a result of construction, operation, and reclamation would be anticipated.

5.3.1.5 Wildlife

This section primarily addresses four adverse impacts to major species or groups: 1) direct habitat loss, which is the actual physical destruction of habitat; 2) indirect habitat loss, which is the effective loss of habitat use because of noise, human contact, or other disturbance directly associated with project construction or operation; 3) effects on animal movements; and 4) construction impacts. Impacts were viewed from regional and local standpoints.

Direct habitat loss from construction and operation of the mine itself, the mine service area, overburden stockpile, and associated roads would be approximately 2,051 ha (5,068 ac) during the 34-year life of the project. In the long term, this loss would be largely mitigated or eliminated for most species by reclamation of the entire area to reestablish wildlife habitat at least as useful and productive as the premining environment. In the short term, i.e., up to 25 years, there would be adverse impacts.

Direct habitat loss as a result of construction and operation would be significant for song bird, shorebird, and small mammal species on a local basis only. Approximately eight existing beaver colonies (Fig. 4-4) would be eliminated during the life of the mine. This, and the adverse impacts on other furbearers, would be significant on a local basis only.

For bald eagles, the loss of salmon spawning habitat with its associated eagle feeding activities, could be significant on a local basis, but would not be significant on a regional basis. Direct habitat loss for trumpeter swans, sandhill cranes, and waterfowl would not be significant.

Direct habitat loss would be significant on a local basis, and possibly on a regional basis, for moose because of elimination of approximately half of one rutting concentration area within the northern portion of the mining limit (Fig. 4-3). The factors that encourage repeated use of a specific area for rutting are unknown. Lone Ridge is an important rutting area on a regional basis. Stress from disturbance or displacement could affect breeding success or chronology and could result in reduced natality* and survival. For brown and black bears, the direct habitat loss would be of local significance due to loss of terrestrial habitat and salmon spawning habitat associated with bear feeding activities.

Indirect habitat loss for song bird, shorebird, small mammal, and most smaller furbearer populations, including beaver, could be significant on a local basis. These species, however, would likely adapt (to varying degrees) to the presence of the facilities and associated activities (Univ. Maine 1983). Indirect habitat loss would be insignificant for waterfowl, shorebirds, swans, and cranes since appropriate habitat is lacking. For bald eagles, indirect habitat loss could be significant on a local basis, unless they adapt to mining activities over time.

For moose and black bears, indirect habitat loss initially could be locally significant, but these species would likely adapt to some extent with time to the presence of noise and activities, and the degree of initial disturbance would probably decrease. Brown bears and marten, however, would likely experience significant local indirect habitat loss because of their generally strong aversion to human activity. This loss would not be significant on a regional basis.

Movements of birds and most mammal species with small home ranges adjacent to the mine area would be largely unaffected in a direct way by project activities in the mine area. However, seasonal movements of moose, bears, and some larger furbearers could be delayed or prolonged as animals seek new routes around the mine pit and other facilities. Individuals may eventually find alternate routes, although populations of moose, especially, tend to continue to use historical movement routes despite man-made obstacles such as the Trans-Alaska pipeline system.

Brown bear movements in particular could be affected because of this species' aversion to human activity. While brown bears are most numerous at higher altitudes in the more open habitats west of the mine area, smaller numbers do inhabit the lower forested areas to the south and east. If normal movements through the mine area were to be hindered by behavioral or physical barriers, brown bear numbers might be substantially reduced in the areas south and east of the mine area. This would be a significant adverse local impact and might be regionally significant if regional movements were affected.

Since the mine area would not be fenced, some animals, e.g., moose or bears, would occasionally wander into the area. These animals would usually not be harmed, but would probably need to be herded out by project personnel. In unusual cases, they may be killed (Section 6.3.1.3).

Construction activities within the mine area would likely have smaller adverse impacts upon all species than would actual mine operations because of the significantly greater noise and activity levels associated with mining operations.

Habitat Evaluation

The results of the terrestrial habitat evaluation study performed for this EIS are summarized in Table 5-3 for the mine and mine service area and presented in detail in Appendix A. Mining activities would disturb significant areas of high quality black bear and brown bear habitat as well as high and medium quality moose spring/summer/fall habitat. No trumpeter swan habitat or suitable sandhill crane habitat would be directly impacted by the mine or mine service area.

The habitat evaluation study also compared the premining and postreclamation habitat values within the 10-year mine permit area based on the detailed revegetation plan presented in the Surface Mine Permit Application. As indicated in Table 5-4, the postreclamation habitat value would be significantly less for black bear and moose (summer/fall/spring). The reduced value to black bear would be primarily due to lack of berry-producing shrubs (such as elderberry, high bush cranberry, and blueberry) and succulent herbs (such as fireweed and vetch) as compared to the existing plant communities. Postreclamation summer/fall/spring habitat value for moose would be lower than existing value because some kinds of selected edible broadleafed herbaceous plants (such as aquatic emergent species) would be absent. In addition, the overall diversity would be somewhat lower, edge habitat (where wooded and open habitats meet) would be decreased, and most of the existing ponded areas would be absent.

It should, however, be emphasized that plant communities are dynamic, especially on reclaimed lands, and the communities established during reclamation would undergo a long-term succession as natural plants invade the restored communities. Eventually a more or less stable equilibrium would probably be reached. The exact nature of the postmining plant community and its wildlife habitat value several hundred years after restoration cannot be predicted with accuracy, but it is likely that it would approach the premining condition.

5.3.2 Impacts to Freshwater Environments

5.3.2.1 Ground-water Hydrology and Water Quality

Impacts to the ground-water regime as a result of mining operations would be substantial and would affect recharge and discharge relationships; quantity, quality, and direction of ground-water flows; and quantity and quality of surface water. These impacts are unavoidable; however, with proper planning, the impacts can be minimized.

The overburden materials and coal units that would be removed during mining operations contain large volumes of

Table 5-3

DIRECT LOSS OF WILDLIFE HABITAT AND SUITABILITY OF HABITATS IN HECTARES (ACRES)
FROM MINE DEVELOPMENT BY PROJECT COMPONENT

Species		Mine Service Area	10 Year Mine Limit: Pit Area	10 Year Mine Limit: Stockpile Areas	10 Year Mine Limit: Roads and Settling Ponds	30 Year Mine Limit: Pit Area
Sandhill Crane	Suitable	0	0	0	0	0
	X	---	0	0	---	0
	X	---	0	0	---	0
	Unsuitable	22(55)	564(1411)	80(200)	68(169)	2029(5012)
Trumpeter Swan	High	0	0	---	---	0
	Med	0	0	---	---	0
	Low	0	0	---	---	0
	NU[2]	22(55)	575(1438)	80(200)	68(169)	2029(5012)
Black Bear	High	22(55)	564(1411)	80(200)	64(158)	1982(4955)
	Med	0	0	0	0	0
	Low	0	0	0	0	0
	NU	0	11(27)	0	4(10)	23(57)
Brown Bear	High	22(55)	564(1411)	79(198)	64(158)	1982(4955)
	Med	0	0	0	---	0
	Low	0	0	0	---	0
	NU	0	11(27)	1(2ac)	4(10)	23(57)
Moose Spring/Summer/Fall	High	14(35)	380(950)	47(117)	47(117)	1356(3349)
	Med	8(20)	85(212)	33(83)	21(52)	653(1612)
	Low	0	180(449)	0	0	20(49)
	NU	0	0	0	0	0
Moose Winter	High	0	0	0	0	0
	Med	0	0	0	0	0
	Low	0	0	0	0	0
	NU	22(55)	575(1438)	80(200)	68(169)	2029(5012)
Total		22(55)	575(1438)	80(200)	68(169)	2029(5012)

1 Exact sighting not finalized.

2 Not utilized.

Table 5-4

COMPARISON OF PREMINING AND POSTMINING HABITAT VALUES FOR EVALUATION SPECIES (10 YR MINING AREA ONLY)

Evaluation Species	Habitat Value	Premining Habitat (Hectares [acres])	Postmining* Habitat (Hectares [acres])
Black Bear	High	660 (1639)	0
	Medium	0	660 (1639)
	Low	0	0
Brown Bear	High	660 (1639)	660 (1639)
	Medium	0	0
	Low	0	0
Moose Summer/Fall	High	398 (984)	71 (178)
	Medium	257 (637)	485 (1202)
	Low	0	104 (259)

*Postmining refers to the period after revegetation has been completed and allowed to stabilize but before reinvasion of native species has reached an equilibrium - estimated as 10-100 years after pit closure.

ground water and can be considered important aquifers in the local hydrological regime (Figure 5-1). The mining operations would disrupt the natural ground-water flow regime within each of the units as they are mined. The intercepted ground-water flow would become inflow to the mine pit area where it would be collected in sumps, pumped to down-gradient offsite sediment treatment ponds, and discharged to streams.

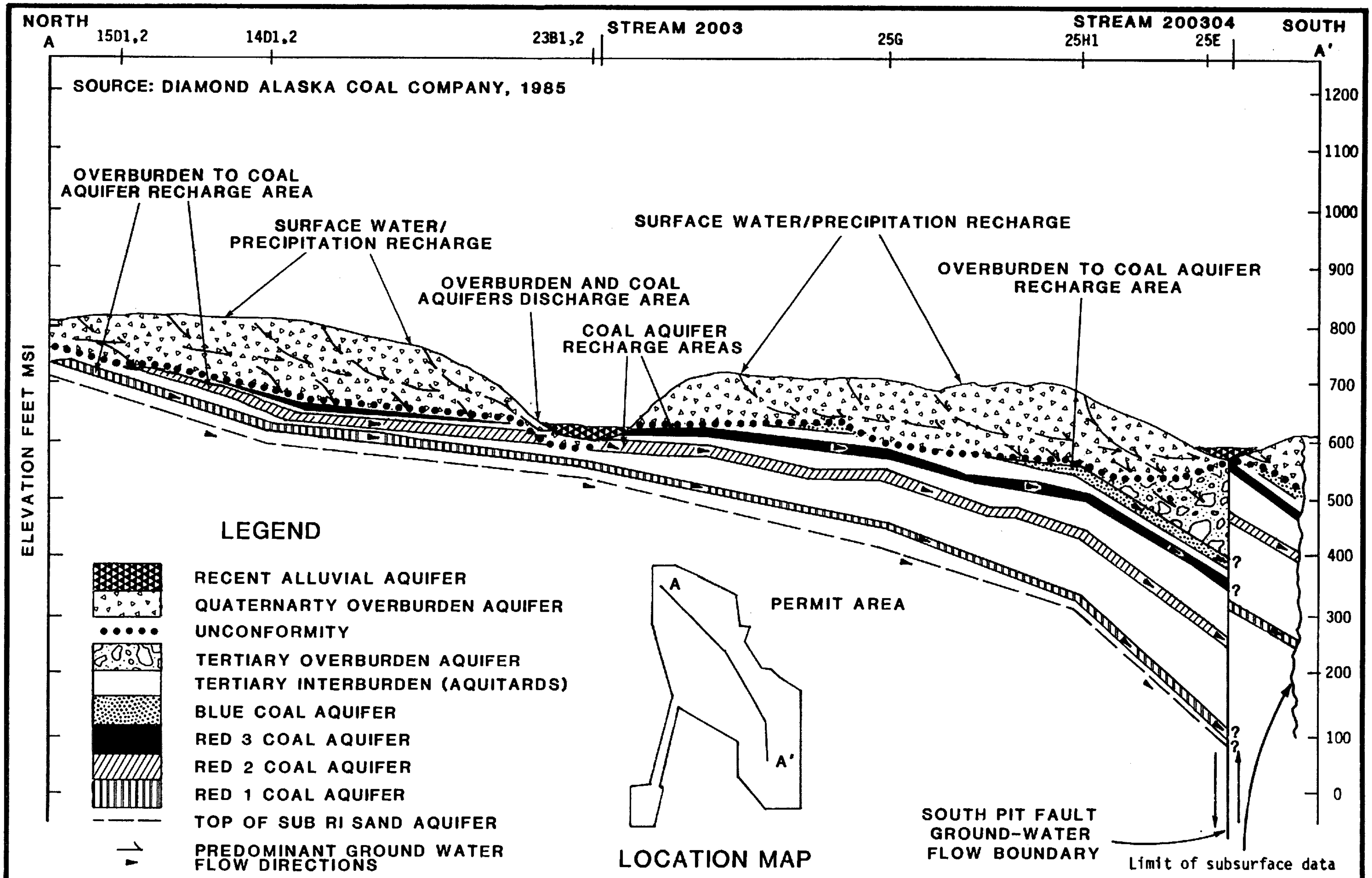
The predicted quantities of ground-water inflow to the pits as mining progresses are summarized on Table 5-5. The intercepted inflow to the pits would, in time, dewater each of the intercepted aquifers. The predicted drawdown values in the active pit after 10 years of operation are 13.7 m (45 ft) and 24.4 m (80 ft) for the overburden and coal zone, respectively. The cone of depression for the overburden aquifer is predicted to extend some 732 m (800 yd) to the northwest beyond the mine permit area, while the coal zone cone of depression is expected to extend to the mine permit boundary (Diamond Alaska Coal Company 1985).

Predicted impacts to the mine permit area as a result of the mining operations include:

- A reduction of flow in springs and streams: With time and continued mining, this impact would increase in magnitude. Impacts of interrupted base flow (ground-water input) to surface drainages would be complex. These significant impacts are discussed for each affected stream in Section 5.3.2.2.

  It is anticipated that mining operations (dewatering and lowering of the water table) would affect the ground-water regime throughout the mine permit area. However, these impacts would probably be limited to that area due to the structural faulting which borders the northwest and south sides of the permit area and due to the presence of Lone Creek to the northeast and east. Lone Creek would provide a constant source of recharge and, thus, would minimize the impact of mine dewatering to the east of Lone Creek.

- Disruption of the natural recharge due to mining operations: Natural recharge to the aquifers is predominantly the result of surface-water infiltration from both incident precipitation and snowmelt. Surface disturbance during mining and construction of support facilities and access roads would affect the potential for natural recharge. Surface-water diversions which channel flow to nearby streams would limit the opportunity for, and quantity of, water available for recharge in the mine area.



HYDROLOGIC CROSS SECTION A-A'

Diamond Chuitna Environmental Impact Statement

FIGURE 5-1

Table 5-5

ESTIMATED PIT INFLOW RATES[1]

Year of Operation	No Pit Backfill							
	3	4	5	6	7	8	9	10
Inflow to Pits from Overburden Aquifer (l/min[gpm])	484(128)	1,673(442)	1,926(509)	3,531(933)	3,852(1,018)	4,203(1,110)	4,508(1,190)	4,948(1,307)
Inflow to Pits from Coal Aquifer and Sub Red 1 Sand (l/min[gpm])	--	--	195(51)	310(82)	424(112)	516(136)	589(156)	661(175)
Total Inflow (l/min[gpm])	484(128)	1,673(442)	2,123(561)	3,841(1,015)	4,276(1,130)	4,719(1,247)	5,097(1,346)	5,609(1,484)
Total Inflow (l/day[gpd])	698,851 (184,637)	2,410,602 (636,883)	3,052,819 (807,624)	5,523,325 (1,451,197)	6,149,618 (1,626,883)	6,785,712 (1,795,162)	7,329,594 (1,939,046)	8,066,331 (2,133,950)

Year of Operation	With Pit Backfill							
	3	4	5	6	7	8	9	10
Inflow to Pits from Overburden Aquifer (l/min[gpm])	484(128)	1,673(442)	1,926(509)	3,198(845)	2,017(533)	2,540(671)	2,725(720)	1,987(585)
Inflow to Pits from Coal Aquifer and Sub Red 1 Sand (l/min[gpm])	--	--	195(51)	155(41)	159(42)	151(40)	140(37)	136(36)
Total Inflow (l/min[gpm])	484(128)	1,673(442)	2,123(561)	3,354(886)	2,176(575)	2,691(711)	2,865(757)	2,120(560)
Total Inflow (l/day[gpd])	698,851 (184,637)	2,410,602 (636,883)	3,052,819 (807,624)	4,828,835 (1,275,782)	3,130,437 (828,158)	3,870,225 (1,023,869)	4,120,393 (1,090,051)	3,050,150 (806,918)

[1] ERT 1985b

- Diversion of pit inflow and surface water in the mine area to nearby sediment treatment ponds: Since the treatment ponds are constructed on glacial deposits, some water would infiltrate, but most would be released as surface flow downstream of the mine area. Increased surface flows, with increased bank storage, could result in increased erosion and channelization; however, the storage capacity of treatment ponds would tend to counteract this effect by moderating extreme flows.

- High risk of ground-water degradation from fuel or chemical spills within the mine areas: Proper spill control and prevention plans, and immediate response to spills would limit the magnitude of the impact.

- Degradation of ground-water quality from leakage emanating from sewer lines and sewage treatment areas: These impacts would be insignificant in the overall context of the mining operation.

Reclamation of the mine area would at least partly reverse the ground-water impacts from mining. After removal of the surface-water diversion systems, surface water together with incident precipitation would recharge the underlying spoil materials and with time result in the reestablishment of a ground-water regime similar but not identical to the premining condition. It is anticipated that the water quality might be somewhat poorer than the premining quality due to the nature of the spoil material, i.e., intermixed clay, sand, and gravel. Postmining aquifer properties would also vary from premining conditions; however, this impact would not be expected to adversely affect the regeneration of the postmining hydrogeologic regime since the subsurface materials would probably be permeable and have some capacity for storage and transmission of ground water. The reestablishment of the ground-water regime and, in turn, reestablishment of the surface streams would likely require decades. This is governed by the necessary condition of establishing a quasi-equilibrium between the ground-water and surface-water regimes. If an equilibrium condition similar to the existing condition cannot be established, then maintenance of the baseflow contribution to streams during low flow periods might not be achievable. The elevation of the shallow aquifer water table relative to postreclamation ground surface elevations cannot be predicted with sufficient accuracy to assure base flow contribution to restored stream channels.

5.3.2.2 Surface Water Hydrology

The mine and mine facilities would occupy an area of approximately 2,051 ha (5,068 ac) including the mine pit, drainage and sediment control structures, structures for coal transportation and handling, buildings, and access roads. This area is comprised of portions of the watersheds of Lone Creek and unnamed tributaries of the Chuitna River (streams 2003 and 2004). The areal extents of the watersheds of these streams and the portions occupied by the mine and mine facilities are shown in Table 5-6.

During mine development, no surface runoff from the disturbed areas would enter any stream without passing through a sediment control structure. The stream course of Lone Creek is outside the mine limit and would not be disturbed. Surface runoff from disturbed areas along the western edge of the mine limit would be routed through sediment ponds, treated if necessary, and discharged to stream 2004. Surface runoff from the areas east of the mine pit would be routed through a system of ditches and sediment ponds and discharged to Stream 2003 and Lone Creek. The overall impacts on the downstream hydrology of these streams include moderation of flood peaks and reduction in the annual runoff contributed by the disturbed areas due to storage and evaporation in the sediment ponds.

Surface runoff from compacted gravel areas such as roads and staging areas within the mine limit would be increased to 3 or 4 times the premining conditions during the operation phase. However, these areas would be very small compared to the watersheds of the streams listed in Table 5-6. Water recovered by pit dewatering and surface runoff from the remaining areas within the mine limit would be passed through a system of sediment ponds and ditches before being discharged into streams 2003, 2004, or Lone Creek. Since precipitation (122 cm [48 in]) greatly exceeds evapotranspiration (23 cm [9 in]) in the project area, nearly all surface runoff held in the sediment ponds would eventually be discharged into the streams. Therefore, the net impact to the combined annual runoff of these streams from increased evaporation would be insignificant. The runoff peaks at the downstream boundary of the mine area would be somewhat moderated by the increased pond storage. This beneficial impact would, however, diminish as the mouth of the stream is approached and would eventually become insignificant. Impact on the Chuitna River from the above effects would not be significant.

One of the most significant physical impacts that would result from development of the Diamond Chuitna project would be alteration of the hydrology of the Chuitna River tributaries in the immediate mine vicinity (streams 2003, 2004, and Lone Creek). In general, the proposed mining plan calls for mining to progress from the northeastern corner of the property in the area of Lone Creek to the south and southwest. The mining will with time progress through a substantial portion of Stream 2003 and into several minor left bank tributaries to Stream 2004.

Table 5-6

WATERSHEDS OCCUPIED BY THE MINE AND MINE FACILITIES

Stream	Drainage Area: At Downstream Boundary of Mine Area	Drainage Area: At Mouth	Drainage Area within Mine Limit	Drainage Area within Mine Limit as a Percent of Watershed at Boundary of Mine Area	Drainage Area within Mine Limit as a Percent of Watershed at Mouth
1. Unnamed tributary of Chuitna River Stream 2003	16.86 km^2 (6.51 mi^2) (Station C140)	39.80 km^2 (15.37 mi^2) (Station C180)	14.89 km^2 (5.75 mi^2)	88.3%	37.4%
2. Unnamed tributary of Chuitna River Stream 2004	24.39 km^2 (9.42 mi^2) (Station C080)	46.98 km^2 (17.79 mi^2) (Station C110)	5.18 km^2 (2.0 mi^2)	21.2%	11.2%
3. Lone Creek (Stream 2002)	18.52 km^2 (7.15 mi^2) (Station C200)	49.78 km^2 (19.22 mi^2) (Station C220)	2.59 km^2 (1.0 mi^2)	14.0%	5.2%

Because of important implications to fish resources, the chronology of changes that would occur within each of these streams is described in the following paragraphs. Emphasis is on potential alteration of minimum flows because such flows are most often limiting to fish. Aspects of ground-water and surface-water hydrology are integrated to provide an overall view of impacts. In the absence of detailed information regarding the progression of the mine pit and pit backfilling, schedule of transferring treated pit water to the adjacent streams, and hydrologic characteristics of the backfill material, it is not possible to accurately estimate the net reductions in the flows of affected streams. Assuming the watershed areas intercepted by mine related activities after 30 years of mining to be those shown in Table 5-6, rough estimates of the reduced streamflows after 10 years and 30 years of mining have been made (Table 5-7). These estimates assume that there will be no transfer of treated pit water back into the streams and, consequently, represent a worst case situation. Minimum flows reflect primarily base flow contributions.

The methodology used to generate the figures in Table 5-7 is described below. The premining estimated monthly minimum streamflows shown in Table 5-7 are taken from ERT (1984e). The percentage reductions used to estimate minimum monthly flows after 10 years of mining are the same as those estimated by ERT for monthly average flows of streams at selected stations (Diamond Alaska Coal Company 1985). Generally, the reductions in monthly streamflows after 10 years have been evaluated by a nearly uniform distribution of the total estimated annual reduction in 12 monthly increments with minor adjustments made by judgment. The same heuristic* methodology has been used to estimate the reduced streamflows after 30 years of mining. The ratio of the reduction in annual streamflows to the total flows is assumed to be the same as the ratio of the drainage area occupied by mine-related facilities to the total drainage area of the stream at a particular station. The resulting annual reduction is divided nearly equally in 12 monthly increments.

Since the measured monthly minimum streamflows shown in Table 5-7 are not based on any mathematical ratio, the measured streamflow per square mile of drainage area for each stream is different. Therefore, the above method resulted in some anomaly in that the sum of the estimated reductions in streamflows for the tributaries of the Chuitna River are less than the estimated reduction in the streamflows of the Chuitna River itself. To avoid the unrealistic situation of 0 winter flow, it was assumed in the case of Stream 2004 that the reductions in the monthly flows, rather than the annual flows, are in the ratios of the drainage areas occupied by the mine to the total drainage areas of the streams. In view of the assumptions stated previously, the values given in Table 5-7 should be

Table 5-7

ESTIMATED MONTHLY MINIMUM STREAMFLOWS

Stream	Drainage Area km2 (mi 2)	Estimated Minimum Flow m3/sec (cfs) August	September	October	November	December	January	February	March	April	May	June	July
1) Lone Creek east of mine area, Station C200, Stream 2002	18.52 km2 (7.15 mi2)												
(a) Premining[1]		0.1 (3.48)	0.30 (10.64)	0.38 (13.43)	0.22 (7.85)	0.20 (7.31)	0.15 (5.18)	0.14 (5.16)	0.13 (4.62)	0.13 (4.68)	0.88 (31.60)	0.29 (10.47)	0.16 (5.56)
(b) After 10 years of mining[2]		0.09 (3.35)	0.29 (10.53)	0.37 (13.30)	0.22 (7.73)	0.20 (7.09)	0.14 (4.94)	0.14 (4.92)	0.12 (4.41)	0.13 (4.52)	0.88 (31.36)	0.29 (10.30)	0.15 (5.48)
(c) After 30 years of mining[2]		0.06 (2.20)	0.26 (9.36)	0.34 (12.15)	0.19 (6.57)	0.17 (6.03)	0.11 (3.90)	0.11 (3.88)	0.09 (3.34)	0.09 (3.40)	0.85 (30.32)	0.26 (9.19)	0.12 (4.28)
2) Lone Creek above confluence with Chuitna River, Station C220, Stream 2002	49.78 km2 (19.22 mi2)												
(a) Premining		0.26 (9.17)	0.69 (24.77)	0.71 (25.47)	0.48 (17.17)	0.46 (16.57)	0.38 (13.58)	0.32 (11.39)	0.26 (9.19)	0.27 (9.82)	1.60 (56.68)	0.40 (14.31)	0.22 (7.84)
(b) After 10 years of mining		0.25 (9.03)	0.69 (24.65)	0.70 (25.32)	0.48 (17.05)	0.46 (16.34)	0.37 (13.41)	0.31 (11.18)	0.25 (9.01)	0.27 (9.70)	1.60 (56.44)	0.39 (14.16)	0.22 (7.75)
(c) After 30 years of mining		0.23 (8.23)	0.67 (23.83)	0.69 (24.53)	0.46 (16.23)	0.44 (15.63)	0.36 (12.64)	0.30 (10.45)	0.23 (8.25)	0.25 (8.88)	1.58 (55.74)	0.38 (13.37)	0.20 (6.90)
3) Unnamed tributory of Chuitna River, Stream 2003, just downstream of mine area, Station C140	16.86 km2 (6.51 mi2)												
(a) Premining		0.05 (1.92)	0.22 (7.92)	0.22 (7.82)	0.11 (3.80)	0.06 (2.29)	0.08 (2.72)	0.06 (2.10)	0.05 (1.98)	0.07 (2.39)	0.34 (12.06)	0.08 (3.02)	0.04 (1.55)
(b) After 10 years of mining		0.05 (1.81)	0.21 (7.70)	0.21 (7.61)	0.10 (3.68)	0.05 (2.02)	0.07 (2.36)	0.05 (1.82)	0.05 (1.72)	0.06 (2.29)	0.33 (11.80)	0.08 (2.80)	0.04 (1.44)
(c) After 30 years of mining		0 (0)	0.12 (4.27)	0.12 (4.17)	0.004 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.24 (8.41)	0 (0)	0 (0)
4) Unnamed tributory of Chuitna River, Stream 2003 at mouth, Station C180	39.81 km2 (15.37 mi2)												
(a) Premining		0.13 (4.66)	0.49 (17.50)	0.52 (18.42)	0.28 (10.02)	0.23 (8.25)	0.17 (6.11)	0.14 (4.94)	0.13 (4.75)	0.14 (5.08)	0.66 (23.43)	0.19 (6.98)	0.12 (4.33)
(b) After 10 years of mining		0.12 (4.54)	0.48 (17.27)	0.51 (18.21)	0.27 (9.87)	0.22 (7.92)	0.16 (5.77)	0.13 (4.68)	0.12 (4.28)	0.14 (4.98)	0.65 (23.12)	0.19 (6.76)	0.12 (4.21)
(c) After 30 years of mining		0.03 (1.09)	0.39 (13.93)	0.42 (14.85)	0.18 (6.45)	0.13 (4.68)	0.07 (2.54)	0.04 (1.37)	0.03 (1.18)	0.04 (1.51)	0.56 (19.86)	0.10 (3.41)	0.02 (0.76)

Table 5-7

ESTIMATED MONTHLY MINIMUM STREAMFLOWS
(cont'd)

Stream	Drainage Area km2 (mi 2)	Estimated Minimum Flow m^3/sec (cfs)											
		August	September	October	November	December	January	February	March	April	May	June	July
5) Chuitna River downstream of affected area, Station C230	342.48 km2 (132.23 mi2)												
(a) Premining		1.68 (60.17)	5.98 (213.30)	6.82 (243.72)	3.51 (125.52)	3.08 (110.14)	2.80 (102.92)	2.22 (79.27)	1.66 (59.36)	1.88 (67.30)	15.64 (558.61)	4.87 (174.04)	1.56 (55.76)
(b) After 10 years of mining		1.68 (59.97)	5.96 (212.89)	6.81 (243.26)	3.51 (125.28)	3.07 (109.56)	2.86 (102.34)	2.21 (78.76)	1.65 (58.96)	1.87 (66.87)	15.62 (557.88)	4.87 (173.85)	1.56 (55.60)
(c) After 30 years of mining		1.41 (49.97)	5.74 (203.10)	6.61 (233.52)	3.26 (115.32)	2.83 (99.94)	2.62 (92.72)	1.95 (69.07)	1.39 (49.16)	1.62 (57.10)	15.52 (548.41)	4.64 (163.84)	1.29 (45.56)
6) Unnamed Tributary of Chuitna River, Stream 2004, Station C110, at Mouth	17.79												
(a) Premining		1.95 (68.9)	4.89 (172.8)	5.01 (177.0)	3.18 (112.4)	1.22 (43.1)	0.74 (26.1)	0.61 (21.6)	0.24 (8.5)	3.91 (138.2)	8.55 (302.1)	2.81 (99.3)	2.32 (82.0)
(b) After 10 years of mining		NO SIGNIFICANT IMPACT											
(c) After 30 years of mining		1.73 (61.1)	4.34 (153.4)	4.45 (157.2)	2.82 (99.6)	1.08 (38.2)	0.66 (23.3)	0.54 (19.1)	0.21 (7.4)	3.47 (122.6)	7.59 (268.2)	2.49 (88.0)	2.06 (72.8)
7) Unnamed Tributary of Chuitna River, Stream 2004, Station C080, About one mile upstream of mouth	9.42												
(a) Premining		1.03 (36.4)	2.59 (91.5)	2.65 (93.64)	1.68 (59.36)	0.65 (22.97)	0.39 (13.78)	0.32 (11.31)	0.13 (4.59)	2.07 (73.14)	4.53 (160.07)	1.49 (52.65)	1.23 (43.46)
(b) After 10 years of mining		NO SIGNIFICANT IMPACT											
(c) After 30 years of mining		0.81 (28.6)	2.04 (72.08)	2.09 (73.85)	1.32 (46.64)	0.51 (18.02)	0.31 (10.95)	0.25 (8.13)	0.10 (3.53)	1.63 (57.60)	3.57 (126.15)	1.17 (41.34)	0.97 (34.28)

Source: 1. ERT 1984e, 1985c
2. Dames & Moore calculations

treated as order-of-magnitude estimates to be used for qualitative assessment of potential mine-related impacts rather than quantitative indices based on measured or simulated data.

Lone Creek

The initial box cut will approximately parallel Lone Creek, but will not directly impact the stream course. Both surface runoff and the base flow contribution from that portion of the Lone Creek watershed within the affected mining area, however, will be directly impacted. The impacts to Lone Creek are expected to be greatest during low flow periods, particularly during late summer and winter, when the stream flow is comprised entirely of base flow (ground-water input). The resultant decrease in base flow contribution is estimated on the basis of maximum drainage area affected to be about 25 percent.

Another calculation method using a percent of the predicted pit inflow combined with a Glover depletion analysis (Diamond Alaska Coal Company 1985) estimated that base flow in Lone Creek would be reduced by 8.5 percent after year 10 at a stream station immediately below the mining activity. It is likely that actual maximum depletion would occur after year 10 and would be in the range of 8.5 to 25 percent. The maximum impact would be reached in the middle years of mining and would continue over the mine life. Some alleviation of impact could occur late in the mine life if ground-water recharge occurred in the backfill adjacent to Lone Creek and reached sufficient elevation so that it could begin to contribute again to base flow. However, the pit bottom, being the lowest point, would still be the principal point of collection for water within the mined out area and base flow contribution to Lone Creek from the mine area would not be fully restored until 5 to 10 years after backfilling is completed and recharge has occurred.

As indicated in Table 5-7, minimum flows could be reduced during low flow periods (late summer and late winter) by up to 25 percent within the portion of Lone Creek east of the mine. As flows increase downstream, impact would be proportionally less. The above calculations of flow reduction assume no transfer of pit drainage to Lone Creek. During the first 10 years of mining, Diamond Alaska plans to release much of its pit drainage into Lone Creek; therefore, net flow could actually increase at least temporarily. The up to 25 percent reduction would still occur in the event of pump failure or in the event that pit water freezes and cannot be pumped. Water allocation during later years of mining has not been planned but it is reasonable to assume that as the pit progesses westward, discharge from dewatering would be more likely to be released in the Stream 2003 or 2004 watersheds than into Lone Creek.

Stream 2003

Greatest impact would occur to Stream 2003 since a substantial portion of the stream and its watershed would be within the mine area. Mining would proceed in a southwesterly direction starting at the extreme headwaters of Stream 2003 and moving downstream. Thus, impact would be cumulative over the 30-year mine life with maximum impact occurring when the mine reached its maximum extent. At 30 years, about 14,200 m (46,570 ft) of stream channel would be removed along with 14.9 km^2 (5.75 mi^2) of watershed area.

As mining progressed to the southwest, the impact on Stream 2003 would continue to increase. The impact on base flow contribution to 2003 would be most pronounced during low flow periods (Table 5-7). The magnitude of the effect of base flow contribution to the stream would depend on its proximity to the active mining area. In this regard, the pit bottom, being the lowest point would be the principal point of collection for water within the mined-out areas. It would also be the "low point" with respect to existing terrain and, therefore, would induce drainage of surrounding areas. Plans provide for the accumulated surface and ground waters to be routed through a series of sedimentation/ treatment ponds prior to their discharge to existing streams. In the worst case (e.g., during cold winter weather), it is projected that during at least short periods of time, there would be no direct discharge from the mine to Stream 2003 downstream of the mining area. This implies, therefore, the total streamflow in Stream 2003 may be lost for at least some distance downstream of the mine limit. The downstream point at which ground-water discharge or base flow would be sufficient to sustain streamflow throughout the year is not known, but believed to be in the range of 0.8 to 2.4 km (0.5 to 1.5 m) downstream from the 30-year mine limit because of the confluence of tributaries 200303 and 200302, both of which would be relatively unaffected by mining. Minimum flow at the mouth of Stream 2003 could be reduced by as much as 80 percent during low flow period (Table 5-7).

After cessation of mining, the backfilled and reclaimed areas would begin to resaturate by infiltration and the ground-water levels in the vicinity would tend to recover to near premining conditions. Depending upon the hydraulic conductivity and porosity of the backfill material, it may take 5 to 10 years for the restoration of ground-water levels to the preminin conditions. Therefore, the impacts on streamflows shown i Table 5-7 would be expected to continue through this recovery period. As a consequence of pit excavation and mine dewatering, existing bogs and wetlands within the mine area would be eliminated. This would result in the loss of the shallow ground-water system within the organic layer that currently provides much of the input to Stream 2003. Thus, even after reclamation, the postmining monthly minimum streamflows of the affected streams would be expected to be somewhat lower than the premining values shown in Table 5-7.

The present course of Stream 2003 and its tributaries within the mine area would become extinct due to pit excavation. It is the applicant's intent to restore permanent stable channels along the approximate original courses of these streams after reclamation using established engineering techniques. However, the backfill material on which the restoration channels would be formed cannot be compacted to the same degree as the original bed material of these streams and would be susceptible to some erosion and degradation until geomorphologic equilibrium were attained. Remedial stabilization measures would probably be required during the early years of restoration. Furthermore, there would be no guarantee that the post-reclamation water table would coincide with the elevations of the recreated stream channels. Therefore, while it would be possible to reconstruct stream channels having physical characteristics similar to the existing stream channels, there is no way to predict whether the new channels would have sufficient base flow through the upper reaches to provide year-round flow similar to that which now exists.

Stream 2004

Toward the end of the 30-year mine period, several minor left bank tributaries of Stream 2004 would be mined out. The impacts of mining through these tributaries would be similar to those described for Lone Creek. These impacts would include a reduction in both surface flow and the base flow contribution to the stream. Based on drainage area considerations and the topographic relief to west of the stream course, the percentage reduction in flow is estimated to be about 21 percent of the normal flow at the time of maximum mine extent.

Possible alterations to minimum flows as a result of mining are presented in Table 5-7. Impacts to Stream 2004 would be of shorter duration than for the other mine area streams since the stream would not be affected until late in the mine life. After backfilling and ground-water recharge, base flows would be restored and long-term impact would probably be insignificant.

Chuitna River

As indicated in Table 5-7, minimum flow in the Chuitna River immediately below the mouth of Lone Creek could be reduced by up to 17 percent during low flow periods in the later years of mining. This reduction would represent an extreme worst case situation and would be unlikely during mining because of the addition of return water to the Chuitna drainage from the various mine area drainage systems. If the mine dewatering system should fail during low flow months (e.g., August, March) in the later years of mining, then a temporary flow reduction in the 10 to 20 percent range could occur. In the lower reaches of the Chuitna River where flow is greater, the impact of such a flow reduction would be proportionally reduced. Flow in the Chuitna River would also be reduced during the period following mine closure while ground-water recharge is occurring in the backfilled area. Initial reduction after mine closure could be in the 10 to 20 percent range and would gradually decrease to near 0 over a period of up to 10 years until recharge is completed. Hydrological characteristics of the Chuitna River after reclamation and recharge would not be significantly different from the existing condition.

5.3.2.3 Surface Water Quality

General Criteria

Surface water quality would be controlled by both EPA and state regulations. These regulations are based upon protection of existing and potential beneficial uses of the water as well as national water quality objectives. The most stringent requirements would be applicable. Domestic wastewater would, as a minimum, require secondary treatment. Most other water discharges from the project would be treated in upgraded sediment pond treatment systems prior to discharge. EPA criteria would require sediment pond discharge to meet the following minimum requirements (EPA 1982):

- pH in the range of 6 to 9
- During rainfall events (less than 10-year events occuring in 24 hours) that result in an increase in base streamflow or when snow or ice exist and ambient air temperature is above freezing (thaw conditions) settleable solids must be less than 0.5 ml/l
- During non-thaw or non-storm periods: 30-day average of 35 mg/l and 3.0 mg/l suspended solids and total iron respectively; maximum day value of 70 mg/l and 6 mg/l suspended solids and total iron respectively
- During 10-year, 24-hour or greater storm events, only the pH level requirement of 6 to 9 is applicable

In addition to the EPA pH, iron, and sediment standards, state standards would apply to protect the current and possible beneficial uses of the water. Generally, the ADEC receiving water standards would require (ADNR 1984):

- Turbidity

  - 5 NTU above natural background when background is below 50 NTU
  - 10% increase when background is above 50 NTU
  - 25 NTU maximum increase

- TSS/Suspended solids

  - No increase above background, can have a mixing zone

- Metals and other parameters

  - Drinking water criteria or aquatic life standards if a specific hazard to aquatic life has been identified.

The specific parameter limitations typically are modified to reflect background levels if a receiving water has normally elevated concentrations of specific parameters. The receiving water standards are based upon impacts to human and aquatic life and are therefore being used as standards for this impact analysis.

<u>Mine and Mine Area Facilities</u>

- Mine Site Runoff

Mine site runoff consists of surface water other than pit drainage that flows from the project area into area streams. During operation, the mining process would result in progressive disturbance and reclamation of a fixed size area. Before excavation begins in an area, surface drainages would be rerouted. Areas that had been mined would be reclaimed with interburden and overburden replaced in the same relative positions and in the same relative topographic configuration. Revegetation, routing drainage through ditches, and erosion control measures would be undertaken immediately upon redeposition of the material in the mined area (ERT 1985c).

Erosion control measures would consist of permanently developed site drainage courses, contour reclamation, mulching, temporary drainage control, revegetation, and construction of long-term sediment ponds. Eighteen sediment pond systems are planned for the mine and mine area facility. Drainage slopes and most side slopes would generally be limited to 5 percent to limit runoff velocities, although some areas would have slopes up to 12 percent. On steep slopes, alternative sediment control measures include filter dams, sediment filter fabric installations, gravel pads, chemical mulches, and matting as necessary (Diamond Alaska Coal Company 1985, Vol. XXI). Sediment ponds would be utilized until well after the entire reclaimed drainage is stabilized and runoff naturally meets background quality (ERT 1985c).

During sediment pond construction, temporary sediment control measures would be employed to limit impacts to streams. These measures could include filter fabric sediment fences, specific construction scheduling, immediate matting and revegetation or other approved techniques.

The erosion precautions noted would be designed to control major suspended solids discharges (ERT 1985c). However, test data illustrates that without further treatment, sediment discharges and corresponding turbidities would exceed proposed standards under various conditions (Diamond Alaska Coal Company 1985, Vol. XXI). Without flocculation treatment in the sediment pond systems, effluent turbidities could range from 30 to more than 14,000 NTU during major flow events (10-year/24-hour). The high range turbidity would be in excess of allowable discharge limitations. Therefore, additional treatment using polymer flocculation to increase settling effectiveness is necessary to provide compliance.

Recent laboratory bench scale and modeling tests h ve indicated that with a polymer flocculation-sedimentat on system, effluent turbidities may be reduced to between 5 nd 37 NTU* during major flow (10-year/24-hour) events (Dia nd Alaska Coal Company 1985, Vol. XXI). Based upon turbid y and suspended solids correlations, Diamond and the st te have estimated turbidities in receiving waters at various flood flows. Turbidity in receiving water is expected to range from 1,500 and 2,000 NTU for a 10-year, 24-hour flood event (Diamond Alaska Coal Company 1985, Vol. XXI). Therefore, all turbidity criteria would likely be met during major storm events. Compliance is further projected for 2-year, 24-hour storm conditions.

During winter baseflow conditions, stream turbidities are very low. Compliance of discharge at low baseflow conditions is not directly projected by the recent studies and modeling (Diamond Alaska Coal Company 1985, Vol. XXI). However, the conservative assumptions used, as well as limitations on discharge rates, proposed double stage flocculation for problem sediment pond systems, and possible use of controll discharge versus stream baseflow suggests that there is nough flexibility built into the system such that complianc can be achieved.

No specific testing has been conducted to determine what potential pollutants may leach from disturbed overburden material. However, laboratory leach tests on the coal have not indicated significant amounts of metals, organics, or other potential pollutants (Bookcliffs 1985). Table 5-8 combines information from available baseline measurements to estimate water quality that could be expected from normal

Table 5-8

ESTIMATED SEDMIENT POND EFFLUENT WATER QUALITY[1] (AFTER SEDIMENTATION AND FLOCCULATION TREATMENT)

Parameter	Projected Sediment Pond Effluent Water Quality (Range)[5]	Receiving Water Quality (Range)[2]	Anticipated Receiving Water Quality Standard[3]
Alkalinity as $CaCO_3$	5.5 - 43	5.5 - 43	20 or more
Aluminum, dissolved (mg/l)	<0.1 - 0.4 (total)	<0.1 - 0.4 (total)	---
Arsenic, dissolved (mg/l)	<.005	nd	0.05
Bicarbonate as $CaCO_3$ (mg/l)	<52	nd	---
Boron, dissolved (mg/l)	<.1 - 0.52	<.1 - 0.1	0.043*+
Cadmium, dissolved (mg/l)	<.005	nd	0.004
Calcium, dissolved (mg/l)	1.4 - 10	1.4 - 9.3	---
Carbonate as $CaCO_3$ (mg/l)	0	nd	---
Chloride (mg/l)	0.06 - 13	0.06 - 4.4	200
Chromium, dissolved (mg/l)	<.02	nd	0.05
Conductivity (umhos/cm @ 25°C)	11 - 300	11 - 121	---
Copper, dissolved (mg/l)	<0.02 - 0.12 (total)	<0.02 - 0.09 (total)	1.0
Fluoride (mg/l)	0.01 - 0.3	0.01 - 0.09	2.4
Hardness as $CaCO_3$ (mg/l)	<45	nd	---
Iron, dissolved (mg/l)	0.2 - 3.4 (total)	0.2 - 3.4 (total)	0.3*+
Lead, dissolved (mg/l)	<0.02 - 0.03	<0.02 - 0.03	0.03*
Magnesium, dissolved (mg/l)	0.1 - 4.4	0.1 - 2.5	---
Manganese, dissolved (mg/l)	<0.02 - 0.2	<0.02 - 0.2	0.05*
Mercury, dissolved (mg/l)	<0.001 - 0.001 (total)	<0.001 - 0.001 (total)	0.0002
Molybdenum, dissolved (mg/l)	<.02	nd	0.07
Nickel, dissolved (mg/l)	<0.02 - 0.05 (total)	<0.02 - 0.05 (total)	0.025*+
Nitrogen, ammonia (mg/l)	<0.01 - 1.5	<0.01 - 1.5	0.020*+
Nitrogen, nitrate/nitrite (mg/l)	<0.05 - 1.5	<0.05 - 1.5	10
Organic carbon, dissolved (mg/l)	<35	nd	---
pH (units)	5.9 - 7.8	5.9 - 7.8	6.5 - 9.0
Potassium, dissolved (mg/l)	0.25 - 3	0.25 - 2.0	---
Selenium, dissolved (mg/l)	nd	nd	0.010
Sodium, dissolved (mg/l)	0.4 - 35	0.4 - 6.0	250
Solids, dissolved (mg/l)	2 - 200	2 - 104	500
Sulfate (mg/l)	0.27 - 20	0.27 - 4.5	200
Suspended Solids (mg/l)	5 - 20[4]	<1 - 60	35 mg/l+
Zinc, dissolved mg/l)	<0.02 - .08	<0.02 - 0.04	0.030*+

nd = no data

*Parameters with potential to equal or exceed standards.

+The receiving water at times equals or exceeds some of these standards now under natural conditions.

NOTES:

[1] Water quality estimates are based upon an analysis of baseline data. No actual sediment pond related tests were performed. This estimate of quality is not statistically significant and represents possible ranges only.

[2] Range from an analysis of surface water quality. Does not include peak discharge quality measurements (ERT 1985a).

[3] Standard listed is the most stringent for the various protected uses in Alaska. Sources: EPA 1976; McNeely et al. 1979; Sittig 1981; ADEC 1982; ADEC 1984.

[4] From Diamond Alaska Coal Company 1985, Vol. XXI. Note - low flow conditions critical and require additional operational modifications for compliance with turbidity regulations.

[5] Range from an analysis of surface runoff quality (ERT 1985a) and leach data (Bookcliffs 1985).

sediment pond systems. Since the information for other than total suspended solids is for dissolved material, it is assumed for the worst case analysis that sediment pond settling would not reduce metals or similar contaminant levels significantly. A comparison with baseline data in existing site streams illustrates that normal sediment pond discharge may be expected to have slightly higher levels of the elevated parameters in the baseline stream water quality. Treatment to meet state and federal standards would limit increases in total loadings in the receiving water. No pollutants significantly in excess of background levels have been observed in runoff from disturbed site test areas (ERT 1984e). No significant water quality impact is anticipated from disturbed site leaching although some present surface water has slightly elevated levels of boron, iron, nickel, manganese, zinc, and ammonia nitrogen which may continue to be periodically above standards or slightly increase. The projection of a slight increase is based upon baseline data as well as a leaching test performed on coal samples. In addition, an analysis of overburden and coal constituents and corresponding ground-water quality supports a contention that leaching would not be excessive.

As proposed by the applicant, flocculation and sedimentation treatment for excessive suspended solids, turbidity, or metals would most likely involve the use of polymers for solids removal. If required, aluminum sulfate (alum), ferric chloride, or lime could be employed for metals precipitation. Polymers are listed as "relatively non-toxic" while lime addition would result in increased pH, higher dissolved solids, and increased calcium concentrations (Hawley 1977). Toxicity of lime would normally be pH dependent. The discharge could not be allowed to be elevated to pH levels causing aquatic impacts. Low levels of alum have not been found to be toxic (Hawley 1977).

Impacts from site runoff are not anticipated to be significant with proposed treatment. With present sediment pond design and planned polymer flocculation, tests have indicated that treated pit water discharges which would occur during dry periods when high runoff exemptions are not applicable may be the worst case condition but are not projected to exceed the limits for total suspended solids with special operational limits. Refer to Section 5.4.2.3 for an analysis of potential impacts to fish and other aquatic plants and animals.

Erosion control for overburden stockpiles would be accomplished as described for the mine area. Water quality impacts from these areas are not anticipated to be different from other disturbed sites.

- Pit Drainage

The actual mine workings or pit would accumulate water from surface runoff and from ground-water seepage into the pit. This water would not drain or infiltrate from the deep pit, but would be collected in the bottom sump of the pit where settling would substantially reduce sediment loads. Initial estimates by the applicant indicate up to 70 percent removal of solids in the pit settling areas. During periods of high rainfall, the pit drainage water would be high in suspended solids. During low rainfall, most of the pit drainage water would be from ground-water drainage and would reflect the quality of the aquifers intersected and erosion and sediment from excavations.

Table 5-9 illustrates the range of projected conditions for pit water quality. When runoff predominates, sediment levels after treatment may reach in excess of 20 mg/l TSS and parameters such as boron, iron, nickel, manganese, ammonia, nitrogen, and zinc may reach or exceed standards. When ground-water seepage predominates, projected suspended solids levels would be lower. It is significant that background water quality in the receiving waters would at times also likely equal or exceed the standards for boron, iron, nickel, manganese, ammonia, nitrogen, and zinc as shown by the baseline data. Table 5-9 also lists the applicable receiving water standards which discharge from the pit collection sumps must ultimately meet.

Water which would be pumped from the pit would be discharged into site drainage sediment pond systems. This would provide additional settling. Diamond Alaska has committed to a flocculant treatment system to comply with discharge requirements. Lime or a similar flocculant-coagulant would be used for metal removal, if necessary, while a polymer would be used to enhance sediment removal.

The potential for contamination from metals appears to be small according to laboratory leaching tests. Although the Beluga low sulfur coal is non-acid generating, some metals do leach from it in minor quantities (Bookcliffs 1985). If metals treatment or treatment for excessive sediment load became necessary, a precipitating flocculant could be introduced before the sediment ponds. The flocculant would reduce both metals and suspended solids (sediment). Initial operational testing would determine the need for such pretreatment since it is difficult to determine under laboratory conditions.

The impact of the pit drainage would be most significant during low winter stream flows. In the winter, surface runoff would be minimal, while ground-water seepage into the pit would continue at near normal rates. At certain times, most of the streamflow in Stream 2003 could be from treated pit drainages. At other times (depending upon the location

Table 5-9

PIT DRAINAGE EFFLUENT WATER QUALITY PROJECTION (AFTER SEDIMENTATION AND FLOCCULATION TREATMENT)

	Projected In-Pit Water Quality		
Parameter	Rainfall Predominated[1] (Range)	Seepage Predominated[2] (Range)	Anticipated Receiving Water Quality Standard[3]
Alkalinity as $CaCO_3$	5.5 - 43	98 - 270	20 or more
Aluminum, dissolved (mg/l)	<0.1 - 0.4 (total)	<.2	---
Arsenic, dissolved (mg/l)	nd	<0.01	0.05
Bicarbonate as $CaCO_3$ (mg/l)	nd	99 - 233	---
Boron, dissolved (mg/l)	<.1 - 0.1	<0.1 - .52	0.043*
Cadmium, dissolved (mg/l)	nd	<0.01	0.004
Calcium, dissolved (mg/l)	1.4 - 9.3	17 - 58	---
Carbonate as $CaCO_3$ (mg/l)	nd	0 - 24	---
Chloride (mg/l)	0.06 - 4.4	1.6 - 13	200
Chromium, dissolved (mg/l)	nd	<0.02	0.05
Conductivity (umhos/cm @ 25°C)	11 - 121	180 - 906	---
Copper, dissolved (mg/l)	<0.02 - 0.09 (total)	<0.02 - .1	1.0
Fluoride (mg/l)	0.01 - 0.09	<.24	2.4
Hardness as $CaCO_3$ (mg/l)	nd	65 - 134	---
Iron, dissolved (mg/l)	0.2 - 3.4 (total)	0.12 - 0.96	0.3*
Lead, dissolved (mg/l)	<0.02 - 0.03	<0.02	0.03
Magnesium, dissolved (mg/l)	0.1 - 2.5	<5	---
Manganese, dissolved (mg/l)	<0.02 - 0.2	.06 - .29	0.05*
Mercury, dissolved (mg/l)	<0.001 - 0.001 (total)	<.001	0.0002
Molybdenum, dissolved (mg/l)	nd	<.02	0.07
Nickel, dissolved (mg/l)	<0.02 - 0.05 (total)	<.02	0.025*
Nitrogen, ammonia (mg/l)	<0.01 - 1.5	0.5 - 4.1 (as N)	0.020*
Nitrogen, nitrate/nitrite (mg/l)	<0.05 - 1.5	<0.01 - 0.15 (as N)	10
Organic carbon, dissolved (mg/l)	nd	0.17 - 80	---
pH (units)	5.9 - 7.8	7.1 - 8.2	6.5 - 9.0
Potassium, dissolved (mg/l)	0.25 - 2.0	1.9 - 4.8	---
Selenium, dissolved mg/l)	nd	<0.01	0.010
Sodium, dissolved (mg/l)	0.4 - 6.0	9.1 - 57	250
Solids, dissolved (mg/l)	2 - 104	200±	500
Sulfate (mg/l)	0.27 - 4.5	2.5 - 40	200
Suspended Solids (mg/l)	5 - 20	<35 mg/l est.	35 mg/l
Zinc, dissolved mg/l)	<0.02 - 0.04	<0.02 - 0.36	0.030*

nd = no data

*Parameters with potential to equal or exceed standards.

NOTES:

1 Range of surface runoff quality. Does not include peak discharge quality measurments (ERT 1985a).

2 Ground water data (ERT 1984e) and leach data (Bookcliffs 1985).

3 Standard listed is the most stringent for the various protected uses in Alaska. Sources: EPA 1976; McNeely et al. 1979; Sittig 1981; ADEC 1982; ADEC 1984. The receiving water at times equals or exceeds some of these standards now under natural conditions.

4 From Diamond Alaska Coal Company 1985, Vol. XXI. Note - low flow conditions critical and require additiona operational modifications for compliance with turbidity regulations.

of mining activities) major portions of Lone Creek or Stream 2003 flows could be from treated pit drainage. Impacts to water quality would be greatest when nearby pit operations divert baseload ground water from the creeks, leaving the pit return flow as the primary water source. Since pit drainage would be a continuing winter flow, sediment ponds and other treatment processes would be operated to assure unobstructed water flow into and out of the sediment ponds.

Impacts of treated pit drainage to receiving waters would be especially critical since little dilution water would be available in winter. Therefore, in many instances, no real zone of mixing could be defined. During winter baseflow conditions, stream turbidities are very low. Compliance of discharge at low baseflow conditions is not directly projected by the recent studies and modeling (Diamond Alaska Coal Company 1985, Vol. XXI). However, the conservative assumptions used, as well as limitations on discharge rates, proposed double stage flocculation for problem sediment pond systems, and possible use of controlled discharge versus stream baseflow suggests that there is enough flexibility built into the system such that compliance can be achieved.

The specific impacts could be slight increases in normal sediment levels and turbidity and possibly in boron, nickel, iron, manganese, ammonia nitrogen, and zinc concentrations. The proposed treatment methods using flocculants are slightly reduced in efficiency during very cold conditions. Although other treatment methods are not feasible on the scale necessary, use of settling alone to remove suspended solids as well as precipitated metals would limit strict compliance with water quality standards without the proposed operational modifications. Treatment and removal of ammonia nitrogen would not be feasible on such a large scale nor at such low concentrations. The occurrence of metals and ammonia nitrogen in the projected pit drainage flow is based upon baseline data analyses and with present data is not statistically significant as a projection of actual pit drainage quality. In addition, estimated impacts would not be significant compared to baseline conditions.

- Mine Service Area

The mine service area would contain shops, coal transfer points, equipment ready yards, and a small coal storage area. Sources of waste water during operation include site runoff, runoff from coal storage and transfer areas, washdown water from equipment maintenance facilities, and domestic sewage.

Runoff from disturbed areas would be routed through stabilized drainage systems and sediment ponds before being discharged to tributaries of the Chuitna River. Water quality of the coal storage area and coal transfer point runoff could be similar to that of the pit drainage.

No adverse effect on water quality is expected from water use and the disposal of treated sanitary wastes from mine site facilities. Domestic waste will be treated by secondary treatment and discharged into the Chuitna River at the same location as the discharge from the housing complex. The effects of domestic waste discharges on the Chuitna River are discussed in detail in the Housing Facilities section using the total discharge from both treatment plants.

No significant impact would occur from the discharge of treated effluent. However, there may be risks from breaks in the 3.2 km (2 mi) pipeline due to freezing during the winter. This could result in discharge of treated secondary effluent to local drainages. The impact of such a spill would be limited in area and volume and the quality of the effluent would be high. Adverse impacts from such a spill would not be significant.

Wildfires and man-caused fires including slash burning can affect water quality by introducing into water bodies nutrients and suspended solids resulting from erosion in burned areas. Depending on the water body, this may be an adverse or beneficial effect. Fire fighting equipment and techniques also disturb watersheds, causing effects on water quality.

Petroleum product spills into water bodies would adversely affect water quality. A layer of petroleum on the surface of a water body would inhibit aeration of the water, reducing the dissolved oxygen content. Soluble fractions are usually toxic to plant and animal life. The probability of large spills, however, is low because all storage areas would be surrounded by dikes capable of retaining 110 percent of the volume of the petroleum product storage tanks. Additionally, an SPCC plan would be developed to minimize the potential for accidental discharge of refined products and to outline cleanup response if a spill occurred.

Solid wastes generated in the mine area would be landfilled in an approved solid waste disposal site. Permit restrictions would require design of a facility that would protect surface and ground-water quality. Wells would be installed to monitor any adverse effects early so that actions could be taken to correct any water quality impacts.

The solid waste disposal sites would require fencing and periodic covering of deposited wastes to control blowing debris and limit animal problems. Burnables would be incinerated prior to landfill. Sludges would be stabilized as required by state law using one or more of the approved methods prior to inclusion in the landfill.

Reclamation of landfill sites would include covering, contouring for proper drainage, and revegetation. Impacts would be limited to visual, noise, and site disturbances during use. Upon closure, the reclaimed site would be monitored for water quality impacts and reclamation success. A properly constructed, operated, and reclaimed site should limit significant long-term environmental impacts.

Sediment from the sediment ponds would be removed periodically to maintain pond capacity. The sediment would contain classified particles from erosion and pit dewatering activities. The material should represent the general composition of the existing overburden, interburden, and possibly coal site materials. Grain size of pond sediment would likely be smaller than the average site material. However, chemical composition should not be markedly different from a composite sample of the various site materials mixed at different proportions depending upon season and mining activity. The material may not be suitable for use in revegetation or for placement in the top soil zone due to higher than normal concentrations of parameters that could inhibit plant growth or the erosion potential of the smaller grain size distribution. Therefore, if pond sediment is found to be unsuitable, it would be buried under a layer (1.2 m [4 ft] minimum) of suitable erosion-resistant growth material.

The chemical composition of the sediment should be no more concentrated than individual geologic formations unless some natural flotation or gravity separation process is involved. However, the location and absence of weathering of sediments could result in greater reactivity of sediments. Therefore, monitoring will be necessary to fully assess short-term water quality impacts and suitability for use as plant growth media.

5.3.2.4 Biology

Mine Area

Construction, operation, and reclamation of the Diamond Chuitna Mine would result in a progression of changes over more than 30 years in the surface water quality and hydrology of mine area streams, primarily upper portions of Stream 2003. The nature and extent of these changes has been discussed above. Changes in the physical and chemical characteristics of the streams would cause changes in associated biota that would range from extreme and highly predictable (in cases of mining through existing drainages) to subtle and/or highly unpredictable (in adjacent streams such as Lone Creek and in downstream reaches of 2003). A major unknown is the time required to restore aquatic productivity to mined drainages. For the purpose of impact analysis, both the 10-year and 30-year impact scenarios have been considered (Tables 5-10 and 5-11).

At the 10-year point in mine development, 4.3 km (2.67 mi) of smaller tributaries to Stream 2003 would be mined

Table 5-10

AQUATIC HABITAT EVALUATION OF POTENTIALLY AFFECTED REACHES OF MINE AREA STREAMS (YEAR 10)(a)

DRAINAGE	20 CHUITNA R.	2002 LONE CR.	2002 LONE CR.	2002 LONE CR.	2003	2003	2003	2003	2003	2003	2003	2004	2004	2004	2004	TOTALS
TRIBUTARY	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	200304	200305	200306	MAINSTEM	MAINSTEM	MAINSTEM	200403	-
REACH	BELOW 2003	UPPER	MIDDLE	LOWER	UPPER	MIDDLE (upper)	MIDDLE (lower)	LOWER	ENTIRE	ENTIRE	ENTIRE	UPPER	MIDDLE	LOWER	UPPER 360 m	-
AFFECTED LENGTH (meters)	17910	3670	11340	6390	4610	3215	5645	4020	2820	1450	2100	4630	4830	3020	360	76010
MEAN WIDTH (meters)	22.6	2.4	3.7	6.7	1.8	4	4	4.6	1.2	1.2	2.4	2.4	3.3	3.9	1 (i)	
AFFECTED AREA (m2)	404766	8808	41958	42813	8298	12860	22580	18492	3384	1740	5040	11112	15939	11778	360	609928
HOW AFFECTED	WQ/FLOW	WQ/FLOW	WQ/FLOW	WQ/FLOW	WQ/FLOW	WQ/FLOW	WQ/FLOW	WQ/FLOW	MINED	MINED	AREA DISTURBANCE	NIL	NIL	NIL	NIL	-
MAX. % HABITAT REDUCTION (b)	2	20	10	5	25	20	15	10	25	100	50	0	0	0	0	-
MAX. PERCENTAGE OF DOCUMENTED SYSTEM ESCAPEMENT USING REACH (c)																
- CHINOOK	31	0	0	7	0	0	7.7	6.3	0	0	0	0	4.6	3.4	0	60
- COHO	50	1.4	7.2	7.4	1	2.3	2.3	2.4	0	1	0	2.6	3.7	2.7	0	84
- PINK	80	0	5	5	1	3	3	3	0	0	0	0	0	0	0	100
MAXIMUM DOCUM[illegible] [illegible]WNERS (no.) (d)																
- CHINOOK	37.2	0	0	21	0	0	69.3	37.8	0	0	0	0	0	0	0	165.3
- COHO	25	7	18	9.25	6.25	11.5	8.625	6	0	25	0	0	0	0	0	116.625
- PINK	328	0	102.5	51.25	51.25	123	92.25	61.5	0	0	0	0	0	0	0	809.75
POTENTIAL SPAWNING DENSITY (no./km)																
- CHINOOK	150	10	100	200	10	100	100	150	10	10	10	50	60	100	10	
- COHO	20	20	50	180	30	50	50	50	20	20	20	30	50	50	20	
- PINK	1500	200	600	400	200	600	600	600	100	100	100	0	0	0	0	
MAXIMUM LOSS OF POTENTIAL SPAWNERS (no.)																
- CHINOOK	53.73	7.34	113.4	63.9	11.52	64.3	84.67	60.3	21.15	14.5	10.5	0	0	0	0	505.32
- COHO	7.164	14.68	56.7	57.51	34.57	32.5	42.33	20.1	42.3	29	21	0	0	0	0	357.5165
- PINK	537.3	146.8	680	128	232	386	508	241	211.5	145	105	0	0	0	0	3320
POTENTIAL REARING DENSITY (no./m2)																
- CHINOOK	0.7	0.5	0.7	0.7	0.5	0.7	0.7	2.25	0.5	0.5	0.5	0.5	0.7	0.7	0.5	
- COHO	0.6	2	3.1	1.2	2	2	2	1	2	3	2	2	3	1.2	2	
- RAINBOW/ DOLLY VARDEN	0.5	0.9	0.15	0.3	1	0.15	0.15	1	0.4	0.5	0.4	1.7	0.5	1	0.5	
MAXIMUM LOSS OF POTENTIAL REARING SALMONIDS (no.)																
- CHINOOK	5666.724	880.8	2937.	1498.	1037.	1800.	2370.	4160.	1269	870	1260	0	0	0	0	23751.28
- COHO	4857.192	3523.	13006.	2568.	4149	5144	6774	1849.	5076	5220	5040	0	0	0	0	57208.35
- RAINBOW/ DOLLY VARDEN	4047.66	1585.	629.3	642.1	2074.	385.8	508.0	1849.	1015.	870	1008	0	0	0	0	14615.41

(a) SOURCE: ERT (1984a, 1984b, 1985) FOR STREAM CHARACTERISTICS; SEE TABLE 4-11; POTENTIAL FISH USEAGE IS ESTIMATED USING BASELINE MEASUREMENTS (TABLE 4-11) AND THE ASSUMPTION THAT ACCESS PROBLEMS CREATED BY BEAVER ACTIVITY ARE REMOVED.

(b) REDUCTION ASSUMED TO BE 100% FOR STREAMS TO BE MINED THROUGH. REDUCTION IN HABITAT FOR DOWNSTREAM REACHES WERE ASSIGNED BASED ON COMBINED EFFECTS OF WATER QUALITY AND FLOW CHANGES AT THE HEIGHT OF PROJECT DISTURBANCE FOR THAT REACH.

(c) SEE TABLE 4-10. CHUITNA PERCENTAGES BASED ON ERT 1985 (TABLE 3.8-9); OTHER PERCENTAGES PROPORTIONED ON THE BASIS OF RATIOS OF REACH AREA AFFECTED TO TOTAL AREA OF THE REACH FOR WHICH SPAWNING DATA IS AVAILABLE. PERCENTAGE FOR PINK SALMON IN 2002 AND 2003 ASSUMED TO BE 10 BASED ON LARGE NUMBERS PRESENT IN 1980.

(d) MAXIMUM PERCENTAGE USING THE REACH TIMES THE MAXIMUM PERCENT HABITAT REDUCTION TIMES MAXIMUM DOCUMENTED SYSTEM [illegible]NT FROM [illegible]-10.

(e) BASED ON MAXIMUM OBSERVED SPAWNER DENSITIES IN THE REACH IN QUESTION OR A COMPARABLE REACH IN AN ADJACENT SYSTEM; ASSUMES REMOVAL OF STREAM MIGRATION BARRIERS AND OPTIMUM OCEAN SURVIVAL.

(f) PRODUCT OF MAXIMUM % HABITAT REDUCTION TIMES POTENTIAL SPAWNING DENSITY TIMES REACH AREA (LENGTH).

(g) BASED ON MAXIMUM MEASURED REARING DENSITY (TABLE 4-11) IN THIS OR COMPARABLE REACH; ASSUMES REMOVAL OF ALL BARRIERS TO UPSTREAM MIGRATION.

(h) PRODUCT OF MAXIMUM % HABITAT REDUCTION TIMES POTENTIAL REARING DENSITY TIMES REACH AREA (m2).

<u>Table 5-11</u>

AQUATIC HABITAT EVALUATION OF POTENTIALLY AFFECTED REACHES OF MINE AREA STREAMS (YEAR 30)(a)

DRAINAGE	20 CHITINA R.	2002 LONE CR.	2002 LONE CR.	2002 LONE CR.	2003	2003	2003	2003	2003	2003	2003	2004	2004	2004	2004	TOTALS
TRIBUTARY	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	200304	200305	200306	MAINSTEM	MAINSTEM	MAINSTEM	200405	-
REACH	BELOW 2003	UPPER	MIDDLE	LOWER	UPPER	MIDDLE (upper)	MIDDLE (lower)	LOWER	ENTIRE	ENTIRE	ENTIRE	UPPER	MIDDLE	LOWER	UPPER 360 m	-
AFFECTED LENGTH (meters)	17910	3670	11340	6390	4610	3215	5645	4020	2820	1450	2100	4630	4830	3020	360	76010
MEAN WIDTH (meters)	22.6	2.4	3.7	6.7	1.8	4	4	4.6	1.2	1.2	2.4	2.4	3.3	3.9	1 (i)	
AFFECTED AREA (m2)	404766	8808	41958	42813	8298	12860	22580	18492	3384	1740	5040	11112	15939	11778	360	609928
HOW AFFECTED	WQ/FLOW	WQ/FLOW	WQ/FLOW	WQ/FLOW	MINED	MINED	WQ/FLOW	WQ/FLOW	MINED	MINED	MINED	WQ/FLOW	WQ/FLOW	WQ/FLOW	MINED	-
MAX. % HABITAT REDUCTION (b)	5	40	20	10	100	100	80	25	100	100	100	10	20	15	100	-
MAX. PERCENTAGE OF DOCUMENTED SYSTEM ESCAPEMENT USING REACH (c)																
- CHINOOK	31	0	0	7	0	0	7.7	6.3	0	0	0	0	4.6	3.4	0	60
- COHO	50	1.4	7.2	7.4	1	2.3	2.3	2.4	0	1	0	2.6	3.7	2.7	0	84
- PINK	80	0	5	5	1	3	3	3	0	0	0	0	0	0	0	100
MAXIMUM LOSS OF DOCUMENTED SPAWNERS (no.) (d)																
- CHINOOK	93	0	0	42	0	0	369.6	283.5	0	0	0	0	55.2	30.6	0	873.9
- COHO	62.5	14	36	18.5	25	57.5	46	45	0	25	0	6.5	18.5	10.12	0	364.625
- PINK	820	0	205	102.5	205	615	492	461.2	0	0	0	0	0	0	0	2900.75
POTENTIAL SPAWNING DENSITY (no./km)																
- CHINOOK	150	10	100	200	10	100	100	150	10	10	10	50	60	100	10	
- COHO	20	20	50	180	30	50	50	50	20	20	20	30	50	50	20	
- PINK	1500	200	600	400	200	600	600	600	100	100	100	0	0	0	0	
MAXIMUM LOSS OF POTENTIAL SPAWNERS (no.)																
- CHINOOK	134.325	14.68	226.8	127.8	46.1	321.5	451.6	452.2	28.2	14.5	21	23.15	57.96	45.3	3.6	1968.765
- COHO	17.91	29.36	113.4	115.0	138.3	160.7	225.8	150.7	56.4	29	42	13.89	48.3	22.65	7.2	1170.73
- PINK	1343.25	293.6	1361	256	927	1929	2710	1809	282	145	210	0	0	0	0	11265
POTENTIAL REARING DENSITY (no./m2)																
- CHINOOK	0.7	0.5	0.7	0.7	0.5	0.7	0.7	2.25	0.5	0.5	0.5	0.5	0.7	0.7	0.5	
- COHO	0.6	2	3.1	1.2	2	2	2	1	2	3	2	2	3	1.2	2	
- RAINBOW/ DOLLY VARDEN	0.5	0.9	0.15	0.3	1	0.15	0.15	1	0.4	0.5	0.4	1.7	0.5	1	0.5	
MAXIMUM LOSS OF POTENTIAL REARING SALMONIDS (no.)																
- CHINOOK	14166.81	1761.	5874.	2996.	4149	9002	12644	31205	1692	870	2520	555.6	2231.	1236.	180	91086.24
- COHO	12142.98	7046.	26013	5137.	16596	25720	36128	13869	6768	5220	10080	2222.	9563.	2120.	720	179347.7
- RAINBOW/ DOLLY VARDEN	10119.15	3170.	1258.	1284.	8298	1929	2709.	13869	1353.	870	2016	1889.	1593.	1766.	180	52308

(a) SOURCE: ERT (1984a, 1984b, 1985) FOR STREAM CHARACTERISTICS; SEE TABLE 4-11; POTENTIAL FISH USAGE IS ESTIMATED USING BASELINE MEASUREMENTS (TABLE 4-11) AND THE ASSUMPTION THAT ACCESS PROBLEMS CREATED BY BEAVER ACTIVITY ARE REMOVED.

(b) REDUCTION ASSUMED TO BE 100% FOR STREAMS TO BE MINED THROUGH. REDUCTION IN HABITAT FOR DOWNSTREAM REACHES WERE ASSIGNED BASED ON COMBINED EFFECTS OF WATER QUALITY AND FLOW CHANGES AT THE HEIGHT OF PROJECT DISTURBANCE FOR THAT REACH.

(c) SEE TABLE 4-10. CHITINA PERCENTAGES BASED ON ERT 1985 (TABLE 3.8-9); OTHER PERCENTAGES PROPORTIONED ON THE BASIS OF RATIOS OF REACH AREA AFFECTED TO TOTAL AREA OF THE REACH FOR WHICH SPAWNING DATA IS AVAILABLE. PERCENTAGE FOR PINK SALMON IN 2002 AND 2003 ASSUMED TO BE 10 BASED ON LARGE NUMBERS PRESENT IN 1980.

(d) MAXIMUM PERCENTAGE USING THE REACH TIMES THE MAXIMUM PERCENT HABITAT REDUCTION TIMES MAXIMUM DOCUMENTED SYSTEM ESCAPEMENT FROM TABLE 4-10.

(e) BASED ON MAXIMUM OBSERVED SPAWNER DENSITIES IN THE REACH IN QUESTION OR A COMPARABLE REACH IN AN ADJACENT SYSTEM; ASSUMES REMOVAL OF STREAM MIGRATION BARRIERS AND OPTIMUM OCEAN SURVIVAL.

(f) PRODUCT OF MAXIMUM % HABITAT REDUCTION TIMES POTENTIAL SPAWNING DENSITY TIMES REACH AREA (LENGTH).

(g) BASED ON MAXIMUM MEASURED REARING DENSITY (TABLE 4-11) IN THIS OR COMPARABLE REACH; ASSUMES REMOVAL OF ALL BARRIERS TO UPSTREAM MIGRATION.

(h) PRODUCT OF MAXIMUM % HABITAT REDUCTION TIMES POTENTIAL REARING DENSITY TIMES REACH AREA (m2).

through, in various stages of preparation for mining, or occupied by sediment ponds (Table 5-10). Full development of the 30-year mine pit would result in the direct destruction of some 14.6 km (9.1 miles) of stream habitat, mostly (98 percent) in system 2003 (Table 5-11). Measured or extrapolated levels of anadromous fish use (spawning and rearing) of these areas is generally high (Table 4-11).

Available information suggests that downstream impacts due to changes in water quality would be minimal except where sediment pond discharges comprise a major percentage of streamflow. The applicant intends to meet all applicable state and federal water quality standards. Nonetheless, extended periods of above-ambient levels of suspended sediments and turbidity would inevitably result from instream and in-drainage work in the mine area and from sediment retention pond discharges, especially during the winter.

Heavy siltation can smother aquatic invertebrates that comprise roughly one-half or more of the diet of trout and salmon in small streams (Dames & Moore 1976). Loss of interstices among larger gravel and cobbles removes areas of refuge for fry and may increase predation loss to birds or larger fish. Emergence pathways may also be blocked, resulting in delayed emergence or entombment of alevins (Phillips et al. 1975).

Siltation can also reduce fish production by reducing circulation of aerated water through the spawning gravel necessary for survival of eggs and alevins (Mason 1969). High turbidity (e.g., greater than 30 N.T.U.) greatly reduces feeding efficiency (Berg and Northcote 1985). Reduced light penetration of turbid water, if prolonged, may decrease growth of periphyton* on which some fish food organisms subsist. Healthy fish adapted to living in streams which traditionally flood at least once a year protect their gills by secretion of mucus to carry off the irritants. Prolonged exposure of fish to high concentrations of suspended particles with a hardness greater than one may cause damage to the gills and, in extreme cases, lead to death (EIFAC 1965; Cordone and Kelly 1961). The effect of natural siltation in local creeks is minimized by its association with periods of high runoff when stream velocities and turbulance are great enough to prevent significant deposition. Introduction of silt into streams during periods of low flow, when deposition is greatest, has a far more damaging impact on stream biota. Recent work by Berg and Northcote (1985) has shown that even short pulses of turbid water in the 30-60 NTU range reduces not only coho juvenile feeding efficiency but territorial behavior patterns as well.

The planned erosion and water quality control program for construction and operations should reduce sediment introduction during critical low flow periods. Erosion control measures also would reduce inputs during high runoff periods. However, some siltation would be inevitable as a result of work in and near streams, normal sediment retention pond discharges, or overloading of silt collection facilities during heavy rainfall. Some reduction in the abundance of benthic fauna and reduced growth rates of fish would likely result in stream areas near discharge points. Reduced survival of salmonid eggs and alevins in the stream bed gravels could occur downstream of discharge points (e.g., middle and lower 2003) when such sediments remain in spawning gravels during the winter intragravel development period for salmon. Discharges of water containing suspended materials under ice in the winter may be particularly harmful. If water quality standards are met during mine operation, sediment impacts would probably not be significant.

In addition to occasional introduction of above ambient suspended sediment loads, sediment pond discharges may intermittently contain levels of zinc approaching standards required for protection of aquatic life. Toxic effects of many trace metals, including zinc, on aquatic life are known to be highly dependent on water pH, hardness, and (less predictably) temperature (EPA 1972; Hodson and Sprague 1975). Acute toxicity generally increases with decreasing pH (below 7.0) as a result (in part at least) of the increased mobility and bioavailability of metals (EPA 1976). The pH values in surface waters of the study area are slightly basic, generally ranging between 7.5 to 8.5. Increasing hardness (commonly reported as equivalent concentration of calcium carbonate) reduces the toxic effects of divalent metal ions such as copper, lead, zinc, and cadmium (EPA 1976). Hardness in study area waters is typically low, ranging between 10 and 50 mg/l (as $CaCO_3$) with higher values during periods of lower flow and vice versa, thus little reduction in metal toxicity would be expected. Effects of temperature on metal toxicity are more variable with increased or decreased toxicity depending on species, acclimation temperature, exposure temperature, and metals concentration (whether above or below acutely lethal levels) (Hodson and Sprague 1975; Cairns et al. 1975).

Brown (1976) has suggested that fish can tolerate toxic metals up to a given concentration by actively secreting them back into the water (via gills or kidney) or by having them bound to a specific protein (metallothionein). However, once a threshold value is reached, only a slightly higher concentration causes mortality (the "spill-over hypotheses"). Roch et al. (1982), in studies of fish populations in contaminated reaches of the Campbell River system (British Columbia), concluded that metallothionein concentration was a useful measure of the degree of exposure to fish to heavy metals.

Levels of zinc projected for intermittent release from the ponds (0.04 mg/l) approach the EPA 24-hour average criterion for zinc (0.047 mg/l). These levels are all well below the maximum level of 0.534 mg/l shown by Holcombe et al. (1979) to have no effect on survival, growth, or reproduction in brook trout. They are also below the maximum level of 0.112 mg/l shown by Chapman (1978) to have no effect on adult to smolt survival, fertility, fecundity, growth, or saltwater adaptability of sockeye salmon. Exposure to 0.242 mg/l similarly had no effect over the embryo to smolt exposure period for sockeye. Thus, no measureable effects are expected on study area fish due to zinc exposures.

Another possible, but unpredictable, impact on salmon related to water quality concerns the fact that adult salmon identify their home stream by "smelling" the water. The addition of sediment or small concentrations of metallic pollutants would be unlikely to interfere with this ability. However, the transfer of water from one watershed to another, or, as is the case with Stream 2003, the elimination of headwaters could alter water chemistry to a sufficient degree to confuse homing ability. Such confusion could result in spawning occurring in marginal habitat or, at worst, elimination of a tributary as spawning habitat. Water allocation to various streams from the sediment pond and diversion systems would vary with the extent of mine development.

Changes in stream flow downstream of the mine pit on all three streams (Lone Creek, 2003, and 2004) during operation would result in changes in stream habitat for anadromous salmonids. Altered stream flow can have varied impacts on fish habitats depending on the direction and magnitude of the change, the time of year the change occurs, and the nature of fish populations present. ERT (1985c) performed an instream flow incremental methodology (IFIM) on Lone Creek and Stream 2003 for the first 10 years of mine life using the methodology developed by the U.S. Fish and Wildlife Service (Bovee 1982). Their results indicate that for "normal" water years, slightly decreased flows (0.028 m^3/sec [1 cfs] reduction at all stations and times was assumed) would have a variety of effects on fish habitat. During summer and fall, the reduced flows would generally result in reduced habitat for coho juvenile and spawning chinooks while increasing habitat for chinook juveniles. Flow reductions used in these analyses do not reflect the maximum projected over the 30-year project life and do not evaluate the potential impacts during winter, which may be the most critical time period for fish.

Based on available information on the cumulative effects of all of the physical and chemical alterations likely downstream of the mined area, a subjective estimate has been formulated of a likely resultant reduction in fish habitat in these reaches ("maximum percentage habitat reduction") for the 10 year and 30 year scenarios (Tables

5-10 and 5-11). This maximum percentage habitat reduction factor logically can range from 0 percent (no change in habitat) to 100 percent (complete destruction of the stream as it is mined through). Intermediate values are based largely on the maximum reduction in minimum stream flow that would occur when no return flow is provided to the streams from ground water entering the pit. During the summer months, the effects of this unlikely and short term occurrence (e.g., due to pump or power failure) could be readily modelled using the IFIM for selected species and life history stages (Diamond Alaska Coal Company 1985). Such an analysis would likely show changes in habitat for a given flow change that vary in magnitude and direction with species and life history stage. The most damaging summertime scenario would occur if a flow reduction caused drying of redds containing pink or chinook salmon eggs. However, IFIM is not appropriate for modeling changes in habitat that would occur due to the more likely scenario where cold weather causes the water entering the pit to freeze resulting in interception of ground water which normally would be pumped to the streams. Because limited data are available to address this condition and because of its likelihood of occurrence, the predicted winter flow reductions (Table 5-7) have been used as the primary basis for assigning the maximum percent habitat reduction values. These values are considered to be indicative of the relative magnitude of habitat reduction that might be experienced between stream reaches subjected to varying degrees of project-related impacts.

This estimated percentage reduction is used to weigh fish habitat loss estimates and to calculate resultant fish losses. It is assumed that there is a one to one relationship between habitat loss and fish loss. This would occur only if habitat is limiting to the species/life history stage in question, which is unlikely in portions of these streams to which beaver dams appear to limit access. In addition, it would only occur if the flow (i.e., habitat) reduction was prolonged; for example, a few days of lowered flows during the summer might reduce fish growth rates somewhat but would be unlikely to cause significant mortalities. This application is therefore conservative and represents a worst-case scenario.

Because access to many areas of the three mine area tributaries is severely limited by beaver dams (Dames & Moore 1980; Diamond Alaska Coal Company 1985), there is a high degree of variability in numbers of adults using the middle and upper reaches of these streams from year to year. Therefore, combined losses from both direct habitat loss in the pit area and indirect downstream effects have been calculated two ways (Tables 5-10 and 5-11): 1) using maximum documented spawner densities, and 2) using estimated potential maximum densities of both spawners and rearing fish. Calculations using potential maximum densities indicate that at year 10, habitat for 505 chinook, 360 coho, and 3,320 pink adults might be lost, assuming a maximum escapement for each species and assuming that fish encountering this habitat degradation do not successfully spawn elsewhere.

As discussed in the surface hydrology section, the period of maximum hydrological impact would occur in the later years of mining and in the early years of reclamation perhaps occupying years 20 through 30 of mine life. Worst case impacts would apply to this time period. As shown on Table 5-11, at the 30-year point in mine life, habitat for a calculated 1,970 chinook, 1,170 coho, and 11,300 pink salmon spawners might be lost under the worst case assumptions stated above.

Using the maximum documented (c.f. potential) spawning density in a similar calculation (Table 5-10) yields substantially lower adult loss figures: 165 chinook, 115 coho, and 810 pink spawners lost at the 10-year point due to habitat degradation (assuming that fish encountering this lost habitat do not successfully spawn elsewhere). These losses would constitute reductions of 2.8, 4.6 and 4.0 percent, respectively, of the maximum estimated system escapements for chinook, coho, and pink salmon (Table 4-12). At the 30-year point in mine life, a similar calculation gives an estimated habitat loss for 875 chinook, 365 coho, and 2,900 pink salmon spawners (14.6, 14.6 and 14.2 percent, respectively, of the maximum estimated system escapements).

In addition, habitat for 23,750 juvenile chinook, 57,200 juvenile coho, and 14,600 juvenile and adult rainbow and Dolly Varden also could be lost at year 10 (Table 5-10). These losses of juvenile habitat would result in a potential additional loss of some 238 and 571 returning adult chinook and coho salmon, respectively, assuming a 1 percent juvenile-to-adult survival. At the 30-year point in mine life (Table 5-11), habitat losses could affect 91,000 chinook, 179,300 coho, and 52,300 rainbow and Dolly Varden. These losses of juvenile habitat, if realized, could result in the loss of approximately 911 chinook and 1,793 coho adults - a very high percentage of the maximum documented total system escapement.

Obviously, these numbers are highly conservative in that they assume coincident loss of all stream habitats that would be affected by mine operation. They also assume maximum potential values of fish usage. Finally, these loss calculations have assumed the worst case flow reduction factors for each reach based on Table 5-7 which assumes interruption of the normal return flow to the streams from pit dewatering as discussed above. In actuality, there would be a loss of flow, hence productivity, in each creek for some years as the mine pit is progressively excavated and backfilled and the stream is rehabilitated. The degree of success with which streams can be rehabilitated is unknown and would depend on the level of effort expended, the degree to which the existing physical habitat can be reconstructed, and perhaps most importantly, the rate of ground-water recharge. Certainly there would be a long term (e.g., several decades or more) loss of habitat due to the difficulty of reconstructing habitat as good as naturally exists and due to loss of habitat area where highly sinuous stream reaches are replaced by straighter reaches.

Using the habitat value ratings assigned for the several stream reaches in the mine area, the wetted surface area of each reach, and the estimated maximum percent habitat loss (Tables 5-10 and 5-11), the area of habitat lost in each category for each species has been calculated for the 10-year and 30-year mine scenario (Tables 5-12 and 5-13). These calculations show a moderate potential loss after 10 years of 1.21 ha (2.99 ac) of very high quality chinook habitat in the lower reaches of the three tributaries and in the Chuitna River itself (4.02 ha [9.9 ac] after 30 years). Another 1.01 ha (2.5 ac) of high quality chinook habitat would be lost in the middle reaches of the three tributaries after 10 years (4.25 ha [10.50 ac] after 30 years). Very high quality coho habitat (1.02 ha [2.52 ac]) would be lost from the middle reaches of each tributary after 10 years (4.02 ha [9.9 ac] after 30 years) with additional loss of high quality coho habitat in all other area waters. High quality pink spawning habitat (2.43 ha [6.0 ac] and 8.60 ha [21.2 ac] after 10 and 30 years, respectively) would be lost from the mainstream of Lone Creek and 2003 where heavy spawning was noted in 1980.

5.3.3 Impacts to the Marine Environment

There would be no impacts to the marine environment associated with the mine and mine facilities.

5.3.4 Air Quality Impacts

Ambient air quality monitoring data are not available for the project site. Air quality monitoring done in the project region, however, demonstrates that ambient air quality levels are well below the National Ambient Air Quality Standards (NAAQS). Current ambient air quality levels at the project site are therefore expected to be in attainment with the NAAQS (see Section 4.6.2). Since air quality modeling was done for the whole project, the following discussion will cover the mine, mine service area, ports, transportation corridors, and housing sites.

5.3.4.1 Emissions

The project would generate emissions of several pollutants including nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), hydrocarbons (HC), particulate matter

Table 5-12

WEIGHTED MAXIMUM POTENTIAL HABITAT LOSS (HA) BY LOCALLY ASSIGNED CATEGORY, DRAINAGE AND SPECIES (YEAR 10)

Habitat Value	System	Chinook	Coho	Pink	Rainbow/Dolly Varden
		Evaluation Species			
Very High	- Chuitna	0.81	0	0	0
	- 2002	0.21	0.42	0	0
	- 2003	0.18	0.60	0	0
	- 2004	0	0	0	0
High	- Chuitna	0	0.81	0.81	0.81
	- 2002	0.42	0.39	0.63	0.18
	- 2003	0.60	1.07	1.00	0.39
	- 2004	0	0	0	0
Medium	- Chuitna	0	0	0	0
	- 2002	0.18	0	0.18	0.63
	- 2003	0.42	0	0	1.28
	- 2004	0	0	0	0
Low	- Chuitna	0	0	0	0
	- 2002	0	0	0	0
	- 2003	0.46	0	0.68	0
	- 2004	0	0	0	0
Total Potential Loss					
	- Very High	1.21	1.02	0	0
	- High	1.02	2.27	2.43	1.38
	- Medium	0.60	0	0.18	1.91
	- Low	0.46	0	0.68	0

[1]This area is the sum of the products of area and maximum habitat reduction (Table 5-11) for each reach with the habitat value in question.

Table 5-13

WEIGHTED MAXIMUM POTENTIAL HABITAT LOSS (HA) BY LOCALLY ASSIGNED CATEGORY, DRAINAGE AND SPECIES (YEAR 30)

			Evaluation Species		
Habitat Value	System	Chinook	Coho	Pink	Rainbow/Dolly Varden
Very High	- Chuitna	2.02	0	0	0
	- 2002	0.43	0.84	0	0
	- 2003	1.39	3.09	0	0
	- 2004	0.18	0.04	0	0
High	- Chuitna	0	2.02	2.02	2.02
	- 2002	0.84	0.78	1.27	0.35
	- 2003	3.09	3.23	5.31	2.22
	- 2004	0.32	0.32	0	0.39
Medium	- Chuitna	0	0	0	0
	- 2002	0.35	0	0.35	1.27
	- 2003	0.51	0	0	4.11
	- 2004	0.15	0	0	0.35
Low	- Chuitna	0	0	0	0
	- 2002	0	0	0	0
	- 2003	1.33	0	1.02	0
	- 2004	0	0	0.64	0
Total Potential Loss					
	- Very High	4.02	3.97	0	0
	- High	4.25	6.36	8.60	4.88
	- Medium	1.01	0	0.35	5.73
	- Low	1.33	0	1.66	0

[1]This area is the sum of the products of area and maximum habitat reduction (Table 5-12) for each reach with the habitat value in question.

(PM), and lead (Pb). Any project, before it can be permitted, must demonstrate the ability to comply with the NAAQS for these pollutants. All projects must also show compliance with the Prevention of Significant Air Quality Deterioration (PSD) increments for SO_2 and PM (stationary sources only).

Due to the large amount of particulates associated with mining projects, particulate emissions are of special concern. Air quality impact analyses have been performed to quantify the PM and SO_2 impacts associated with the project (TRC Environmental Consultants 1986, 1987a, 1987b). An analysis of air emissions (assuming that full production would be reached after 4 years) showed that the third and fourth years of coal production would have the largest emissions of particulate matter, the pollutant of greatest concern (TRC Environmental Consultants 1987b). Delayed phase-up to full production would mitigate air quality impacts somewhat because higher coal production levels would occur during later years of the project when the amounts of overburden to be removed would be less. However, this mitigating effect would not be expected to be substantial and largest emissions would still occur in the third and fourth years.

Production phase emissions sources would include those which produce particulate matter only and those which produce gaseous pollutants (NO_x, SO_2, CO, PM, and THC). Particulates sources would include coal and overburden handling activities and vehicle travel over unpaved roads. Gaseous pollutant sources would include bulldozer, ship, and other vehicle tailpipe emissions and slash burning. Annual emissions from all significant sources of particulate matter are shown in Table 5-14. The estimates are called intermediate production and full production, corresponding to the third and fourth years of production, and represent maximum emissions and impacts. Annual gaseous pollutant emissions are presented in Table 5-15. Short-term particulate emissions for full production and production year 3 are presented in Tables 5-16 and 5-17, respectively. Calculations of all emissions plus discussions of potential but insignificant air emissions sources are given in Appendix E. Where feasible, emissions were assigned to one of the four functional areas of the project: the mine area, the mine services area, the port facility, or the housing facility. Emissions which do not occur in one of the four functional areas, such as overland conveyor emissions or miscellaneous vehicle emissions, are classed under general project area emissions.

Slash burning emissions would require a separate permit. It was the applicant's initial plan to bury the slash material in the backfill areas of the pit. However, other

Table 5-14

PRODUCTION-PHASE ANNUAL PARTICULATE EMISSIONS

Source	Intermediate Production Emissions (ton/yr)	Full Production Emissions (ton/yr)
Mine Area:		
Land clearing/reclamation	55.5	55.5
Overburden removal - truck shovel	0.1	0.1
Overburden removal - dragline	165.0	221.4
Overburden hauling	225.6	62.9
Overburden dumping	0.1	0.1
Coal removal	6.3	12.6
Coal hauling	43.6	87.3
Coal dumping	0.0	0.0
Coal primary crushing	0.6	1.2
Wind erosion	38.0	35.9
Haul road maintenance/graders	15.6	15.6
Mine area combustion sources(a)	35.0	30.4
Mine Area Subtotal:	585.4	523.0
Mine Service Area:		
Secondary coal crushing	1.8	3.6
Coal screening	3.0	6.0
Coal handling	0.0	0.0
Coal stockpile	20.5	20.5
Wind erosion	10.0	10.0
Mine Service Area Subtotal:	35.3	40.1
Port Area:		
Coal handling	0.0	0.0
Coal stockpile	218.1	218.1
Wind erosion	11.9	11.9
Port area combustion sources	6.6	6.6
Port Area Subtotal:	236.6	236.6
Housing Area:		
Housing area combustion sources(a)	7.7	7.7
Housing Area Subtotal:	7.7	7.7
General Project Area:		
Overland conveyor	8.4	8.4
Miscellaneous vehicle traffic	9.1	9.1
General Project Area Subtotal:	17.5	17.5
TOTAL	882.5	824.9

Note: Emission rates listed as 0.0 are less than 0.05 tons per year.

(a)Further delineated in Table 5-15.

Table 5-15

GASEOUS AND PARTICULATE ANNUAL COMBUSTION EMISSIONS

Source	Annual Emissions (tons per year)				
	NO_x	SO_2	CO	VOC	PM
Mine Area					
Slash burning	4.8	0.0	167.9	28.9	20.4
Haul trucks	96.3(172.8)[b]	10.5(19.1)	27.0(48.1)	4.3(8.0)	5.9(10.5
Dozers	92.8	7.8	40.0	4.3	3.7
Graders	4.3	0.5	0.9	0.2	0.4
Fuel Storage	--	--	--	3.0	--
Mine Area Subtotal	198.2(274.7)	18.8(27.4)	235.8(256.9)	40.7(44.4)	30.4(35.0)
Port Area					
Ships	15.0	95.1	2.1	0.2	6.6
Fuel Storage	--	--	--	11.1	--
Housing Facility					
Incinerator	3.3	2.7	11.0	3.3	7.7
General Project Area					
Miscellaneous vehicles	0.1	0.0	0.7	0.1	0.0
Total	216.6 (293.3)	216.6 (225.2)	249.6 (270.7)	55.4 (59.1)	44.7 (49.3)

[a] Haul truck emissions include overburden and coal handling.

[b] Numbers in parentheses reflect emissions for production year 3 where these differ from full production emissions.

Table 5-16

FULL PRODUCTION SHORT-TERM PARTICULATE EMISSIONS

Source	Full Production Emissions (lb/hr)
Mine Area:	
Land clearing/reclamation	13.7(a)
Overburden removal - truck shovel	0.0
Overburden removal - dragline	50.6
Overburden hauling	14.4(b)
Overburden dumping	0.0
Coal removal	2.9
Coal hauling	19.9(b)
Coal dumping	0.0
Coal primary crushing	0.3
Wind erosion	8.2
Haul road maintenance/graders	5.1(c)
Mine area combustion sources	2.2(1.3)(d)
Mine Area Subtotal:	117.3(116.4)
Mine Service Area:	
Secondary coal crushing	0.4
Coal screening	0.7
Coal handling	0.0
Coal stockpile	4.7
Wind erosion	2.3
Mine Service Area Subtotal:	8.1
Port Area:	
Coal handling	0.0
Coal stockpile	49.8
Wind erosion	2.7
Port area combustion sources	3.5(d)
Port Area Subtotal:	56.0
Housing Area:	
Housing area combustion sources	3.5(d)
Housing Area Subtotal:	3.5
General Project Area:	
Overland conveyor	2.1
Miscellaneous vehicle traffic	2.1
General Project Area Subtotal:	4.2
TOTAL	189.1(188.2)e

Note: Emission rates listed as 0.0 are less than 0.05 tons per year.

(a) Based on 338 days per year versus 365 days per year.

(b) Based on an AP-42 average silt loading of 40.8 g/m^2 versus an erroneous ADEC factor of 10.6 g/m^2.

(c) Based on 50 percent control for watering instead of 85 percent control for chemical application.

(d) Only haul truck combustion source emissions were included in the modeling. Emissions are based on annual emissions as given in Table 5-15. Note that slash burning emissions were not included in the short-term emissions, as slash burning would not occur simultaneously with the majority of the mine area emissions.

(e) These were emissions used in particulate air dispersion modeling.

Table 5-17

PRODUCTION YEAR 3 SHORT-TERM PARTICULATE EMISSIONS

Source	Production Year 3 Emissions (lb/hr)
Mine Area:	
Land clearing/reclamation	13.7[(a)]
Overburden removal - truck shovel	0.0
Overburden removal - dragline	37.7
Overburden hauling	51.5[(b)]
Overburden dumping	0.0
Coal removal	1.4
Coal hauling	10.0[(b)]
Coal dumping	0.0
Coal primary crushing	0.1
Wind erosion	8.7
Haul road maintenance/graders	5.1[(c)]
Mine area combustion sources	3.3
Mine Area Subtotal:	131.5
Mine Service Area:	
Secondary coal crushing	0.4
Coal screening	0.7
Coal handling	0.0
Coal stockpile	4.7
Wind erosion	2.3
Mine Service Area Subtotal:	8.1
Port Area:	
Coal handling	0.0
Coal stockpile	49.8
Wind erosion	2.7
Port area combustion sources	3.5
Port Area Subtotal:	56.0
Housing Area:	
Housing area combustion sources	3.5
Housing Area Subtotal:	3.5
General Project Area:	
Overland conveyor	2.1
Miscellaneous vehicle traffic	2.1
General Project Area Subtotal:	4.2
TOTAL	203.3

Note: Emission rates listed as 0.0 are less than 0.05 tons per year.

(a) Based on 338 days per year versus 365 days per year.

(b) Based on an AP-42 average silt loading of 40.8 g/m^2 versus an erroneous ADEC factor of 10.6 g/m^2.

(c) Based on 50 percent control for watering instead of 85 percent control for chemical application.

Alaska State agencies have expressed concerns regarding bark beetle populations in the slash materials and have requested burning as a disposal method.

Production phase emissions given in Tables 5-14 and 5-15 are subject to both the NAAQS and PSD increments. In addition to the production phase emissions from the project, there would be construction and other temporary emissions. The construction emissions would consist of land clearing and slash burning emissions and would occur during the first three years of the project. The temporary emissions would consist of the emissions from overland truck coal haul during the first two years of coal production before the overland conveyor is constructed. These construction and temporary sources must comply with the NAAQS, but are exempt from the PSD increments. These construction and temporary sources would primarily emit particulates. Particulate emissions associated with these sources are given in Table 5-18.

The final category of emissions associated with the project are the secondary emissions from power generation. A nearby utility would provide generation capacity to accommodate the Diamond Chuitna project. Diamond Chuitna's needs for this project would be approximately 33 megawatts on an annual average basis, while peak demand would be up to 55 megawatts. Table 5-19 shows typical peak hourly and annual average air emissions associated with this demand. These emissions are calculated assuming one 30 MW turbine for average demand and two 30 MW turbines operating to meet peak demand.

The major air emission control measures currently proposed for the project include the application of water and dust control chemicals to the haul roads, installing baghouse devices on the crushers, hooding of the overland conveyor, application of water, as needed, to the stockpiles, and compaction of the unused portions of the stockpiles. Air emission controls for specific activities are given in more detail in Appendix E.

5.3.4.2 Air Dispersion Modeling Results

Air dispersion modeling (TRC Environmental Consultants 1986, 1987a, 1987b, 1988) was performed to determine the short-term and long-term impacts of production phase particulate emissions on ambient air quality. The Industrial Source Complex (ISC) model was used for this analysis. It is an EPA-approved air quality dispersion model. The emission sources were grouped according to location as follows:

Table 5-18

CONSTRUCTION AND TEMPORARY EMISSIONS

Source	Annual Emissions (tons per year) NO_x	SO_2	CO	VOC	PM
Construction					
Land Clearing					
-Fugitive Dust	--	--	--	--	61.6
-Tailpipe Exhaust	103.0	8.6	44.3	4.7	4.1
Slash Burning	4.8	0.0	167.6	28.8	20.4
Total Construction	107.8	8.6	211.9	33.5	86.1
Temporary					
Overland Truck Coal Haul					
-Fugitive Dust	--	--	--	--	343.0
-Tailpipe Exhaust	220.3	24.0	61.6	10.0	13.6
Total Temporary	220.3	24.0	61.6	10.0	356.6

Table 5-19

POTENTIAL TURBINE EMISSIONS ASSOCIATED WITH
POWER GENERATION FOR THE DIAMOND CHUITNA PROJECT

Pollutant	Gas Firing Peak Hourly (lb/hr)	Annual Average (tpy)
NO_x	165.1	723
SO_2	negligible	negligible
PM	5.7	25.0
VOC	1.7	7.6
CO	11.1	48.6

- pit sources: those located in the area where the mining and overburden removal operations are ongoing
- mine area haul roads: including the haul trucks, other vehicles, and graders
- mine facilities area: including crushers, conveyors, and the mine stockpile
- overland conveyor
- port area: including the port conveyor operations, the port stockpile, and the ships

Table 5-20 shows the modeled particulate matter impacts for the intermediate and full production years. Based on air dispersion modeling results, the project is in compliance with the previous TSP and new PM_{10} ambient standards, as well as the PSD increments for TSP and the project is in conformance with the Alaska State Implementation Plan.

The ISC model was also used to determine the impact of overland truck haul emissions on ambient air quality. Peak 24-hour average concentrations for these temporary construction emissions were approximately 57 micrograms per cubic meter. This concentration, even if added to a conservative background concentration of 50 micrograms per cubic meter, is still well below the previous 150 microgram per cubic meter TSP and the new PM_{10} ambient standards. As the overland truck haul emissions are a temporary source, PSD increments would not apply.

The only other pollutant of significant concern for this project is sulfur dioxide (SO_2) which is emitted from oil combustion in the ship boilers during "hoteling" operations in port. Table 5-21 shows the SO_2 impacts associated with coal ship operations at the port. Peak predicted concentrations for 3-hour and 24-hour averaging periods were 122 ug/m^3 and 21 ug/m^3, respectively. The values are well below the applicable 3-hour and 24-hour sulfur dioxide PSD increments of 512 ug/m^3 and 91 ug/m^3, respectively. Carbon monoxide and nitrogen oxides were not modeled to determine air quality impacts.

The impacts of the nearby power plant expansion would be addressed in a separate air permit application. It is not expected that there would be a significant cumulative air quality impact from these two projects.

5.3.4.3 Visibility

A level 1 visibility screening analysis (see Appendix E) showed that there will be no visibility impacts from the project on any Class I area.

Table 5-20

AIR QUALITY MODELING ANALYSIS
TOTAL SUSPENDED PARTICULATE (TSP) CONCENTRATIONS

Production Phase/Averaging Period	Modeled TSP Concentration (ug/m^3)	Background TSP Concentration (ug/m^3)	Total TSP Concentration (ug/m^3)	PM10(a) Ambient Standard (ug/m^3)	TSP(b) PSD Increment (ug/m^3)
Intermediate Production					
24-hour	34.5	50.0(c)	84.5	150	37
Annual	3.5(e)	9.0(d)	12.5	50	19
Full Production					
24-hour	36.8	50.0(c)	86.8	150	37
Annual	3.5(e)	9.0(d)	12.5	50	19

(a) The total concentration should be compared with the ambient standards for PM10, since PM10 concentrations will always be less than or equal to the TSP concentrations.

(b) The modeled TSP concentrations should be compared with the PSD increments.

(c) Second highest value observed at Tesoro Petroleum Corporation air monitoring station near Kenai, Alaska from June 1, 1981 to May 31, 1982 (Radian 1982).

(d) Average TSP concentration observed at Tesoro Petroleum Corporation air monitoring station near Kenai, Alaska from June 1, 1981 to May 31, 1982.

(e) Annual impacts based on air quality impact analysis prepared by TRC Environmental Consultants, December 11, 1986 and submitted to the Alaska Department of Environmental Conservation. These correspond to particulate matter emissions of 527.8 tons per year at the mine and mine services area and 87.3 tons per year at the port area.

Table 5-21

AIR QUALITY MODELING ANALYSIS
SULFUR DIOXIDE CONCENTRATIONS

Averaging Period	Peak Project Concentration (ug/m^3)	Background Concentration (ug/m^3)	Total Concentration (ug/m^3)	Ambient Standard (ug/m^3)
3-hour	122	35.0(b)	157.0	1300
24-hour	21	7.0(b)	28.0	365
Annual	NA(a)	0.3(b)	ND(d)	80

(a) Not available.

(b) Second highest value observed at Tesoro Petroleum Corporation air monitoring station near Kenai, Alaska from June 1, 1981, to May 31, 1982, (Radian 1982).

(c) Annual average geometric mean concentration recorded at the Tesoro Petroleum Corporation air monitoring station near Kenai, Alaska from June 1, 1981, to May 31, 1982, (Radian 1982).

(d) Not determined.

5.3.4.4 Summary

In summary, during project construction, operation and reclamation, maximum pr icted short- and long-term concentrations of particula matter and sulfur dioxide, when added to background leve_s or compared to PSD increments, would not exceed any state or federal ambient air quality standards in the Kenai, Anchorage, or Tyonek areas or within the undeveloped area outside of Diamond Chuitna Project lease areas. Based on the modeled emissions, it is not anticipated that any short- or long-term ozone, carbon monoxide, or nitrogen oxide ambient air quality standards would be exceeded as a result of this project.

It should be noted that this analysis has addressed major air quality issues and concerns. Particulate matter dispersion modeling and air emissions control technology aspects and concerns will be further addressed in an application for a permit to operate from the Alaska Department of Environmental Conservation.

5.3.5 Noise Impacts

The Diamond Chuitna Coal Project would be located in a relatively isolated area. Typical natural noise levels in areas similar to the Beluga region range from 15 to 45 dB(A), which is considered quiet. Natural noise levels up to 65 dB(A) may be associated with storms and wildlife activities. Coastal areas would have higher noise levels due to strong winds and wave and ice movements.

The mine site would be one of the two areas with the highest noise levels during project operations. Major noise sources in the mine area would include infrequent blasting, bulldozers, front-end loaders, draglines, haul trucks, and crushing equipment. Table 5-22 shows typical noise levels associated with mining equipment. Blasting sound pressure levels are normally thought of as relatively loud noises. However, blasting noise propagates in lower frequencies somewhat like a thunderclap. Low frequency sound of this type would usually be tolerable since it would occur infrequently. The other mine site sound sources would probably combine to a sound level of 100 dB(A) at 15 m (50 ft).

Human receptors in the project vicinity would include project workers and occasional recreational or subsistence hunters and fishermen. The village of Tyonek would be a minimum of 14.4 km (9 mi) from the mine site and it is unlikely that project-generated noise (except possibly occasional blasting) would be audible to Tyonek residents. Noise-related impacts to wildlife are discussed in Section 5.3.1.5.

Table 5-22

ESTIMATED SOUND LEVELS GENERATED BY
MINE AREA EQUIPMENT AND FACILITIES

Sound Source	Sound Pressure Level[1] dB(A)
Blasting	170 @ 91 m (300 ft)
Bulldozers	87 @ 15 m (50 ft)
Front-end Loaders	90 @ 15 m (50 ft)
Haul Trucks	90 @ 15 m (50 ft)
Primary/Secondary Crushers	95 @ 15 m (50 ft)
Utility Vehicles	80 @ 15 m (50 ft)
Aircraft Operations	95 @ 15 m (50 ft)
Conveyor	78 @ 10 m (33 ft)
For Comparison:	
OSHA Regulation (15 min. exposure)	115 (max. allowable)
Jackhammer	95 @ 15 m (50 ft)
OSHA Regulation (8 hr. exposure)	90 @ ear
Automobile (100 km/hr [62 mi/hr])	71 @ 15 m (50 ft)
Typical Outdoor Noise (wind, rain, birds)	40 @ 15 m (50 ft)
Soft Whisper	35 @ 2 m (6 ft)

1 The sound pressure level in decibels (Db) corresponding to a sound pressure (P) is compared to a reference level of 20 micropascals. Sound pressures for various frequencies of noise are weighted by factors (A weights) which account for the response of the human ear. The sound pressure level is dB(A) = 20 Log10 (P/20).

5.3.6 Socioeconomic Impacts

5.3.6.1 Anchorage and Central Kenai Peninsula

Socioeconomic impacts in Anchorage and the Central Kenai Peninsula would arise due to employment and income generated by the project. The project development schedule calls for a three-year construction period. Construction would begin in the spring with the workforce expected to peak at 1,300 workers by approximately October of the second year (Fig. 2-15). Once the peak of construction is past, employment at the site would decline for the remaining year of construction, then climb during mine operation over a four-year period from about 514 to 848 during the first year of full-scale operation. Air transportation to the site would be provided by the applicant from Anchorage and Kenai.

The primary skills required during construction would be equipment operators, laborers, and various structural construction trades. Mine operation would require primarily equipment operators, mechanics, electricians, plumbers, administrative personnel, and service workers for the worker housing facilities. These skills are in plentiful supply in the available labor force in Anchorage and the Kenai Peninsula Borough. The applicant plans to hire as much of the construction and operation labor force locally as possible, with the possible exception of several specialized equipment operators since persons with these skills are rare in Alaska.

At full production, all of the project alternatives would employ the same number of people. Therefore, socioeconomic impacts in Anchorage and the Central Kenai Peninsula, described below, apply to all action alternatives under the full production scenario.

A recent Kenai Peninsula Borough survey indicated that about 80 percent of the oil and gas employees working the Upper Cook Inlet fields live in the Kenai Peninsula Borough and the remainder live in Anchorage (McIlhargy 1985). However, company-sponsored transportation of these workers to Cook Inlet work sites, is provided only from Kenai. The applicant's local hire policy and probable provision of transportation from both Anchorage and Kenai would likely result in a higher proportion of worker residence in Anchorage. A 50-50 distribution of worker residence between Anchorage and the Kenai Peninsula Borough during both mine construction and operation is assumed for purposes of this analysis.

Impacts on Anchorage

Relative to Anchorage's 116,442 jobs in 1984, the estimated direct increase of approximately 650 jobs during the construction period and 424 jobs during full-scale mine operation would cause proportionally small but beneficial impacts to Anchorage's socioeconomy. Impacts on Anchorage's population would be correspondingly beneficial, but not noticeable given the level of baseline socioeconomic activity in Anchorage.

Impacts on the Central Kenai Peninsula

The effect of the 650 construction and 424 mine operation jobs would be more noticeable in the Central Kenai Peninsula (CKP) than in Anchorage. The most noticeable impacts would be those occurring due to mine operation. Operation-phase impacts are discussed below followed by a summary of construction impacts.

Mine Operation

Although the project's entire operation work force requirement would be directly filled by the locally-available labor supply, indirect impacts could occur. A common experience in Alaska, as in other areas where substantial new employment has been created, is an influx of persons seeking work. If this occurs, the impact of the project could be to substantially increase employment in the CKP, but not to noticeably change unemployment rates. To place a reasonable maximum limit on population growth due to the project, the following analysis assumes that immigration would occur in proportion to the employment increase. The actual impact of the project would probably be lower, particularly if state-wide efforts to discourage potential migrants without jobs from moving to the state are successful.

As the mine's employees spend their paychecks on local goods and services, employment in the service sectors of the CKP economy would increase. Thus, the ultimate increase in employment would be a multiple of the direct increase of 424 operation-phase jobs for local workers generated at the mine itself. Based on analysis of the Soldotna and Kenai Census Areas' place-of-work employment distribution by economic sector (Miller 1985), there are approximately 0.5 service-sector jobs for every job that brings income into the region. Therefore, the 424 jobs taken at the mine by CKP residents can be expected to produce a total increment of about 640 jobs. Most of the 216 service-sector jobs would be located in the City of Kenai, the area's main center of employment.

The spread of knowledge of substantial new employment in the Borough could attract job-seekers, some of whom may compete with Borough residents for jobs both at the mine and at other CKP businesses. If this occurs, a high-side population increase attributable to the project, including the effects of the employment multiplier, can be estimated as equiproportional to the increase in employment, or about 4 percent in the CKP and up to 17 percent in Kenai if all service-sector jobs and immigrants locate in the City (and bring families approximately equal in size to the area's existing families).

Because any inmigrating job-seekers could be expected to live in both Kenai and the surrounding area and some of the 215 new jobs would also be located outside of Kenai, a more reasonable estimated increase to the City's population would be approximately 10 percent by full mine operation. Thus, the maximum population increase to the City of Kenai is estimated at 900 persons. For the CKP, the corresponding population increase would be 1,600 (including the 900-person increase to the City of Kenai). The proportional increase would decline over time as the local socioeconomy grows due to other economic developments.

The population increases described above could have some impact on city planning but should not unduly strain public services and facilities available in the City of Kenai. The City has adequate excess capacity in its public facilities and services to accommodate a current increase in demand of 10 percent. Given the minimum of two years required after the start of construction before appreciable population increases are likely to be felt and the gradual increase in mine operations scale thereafter, there would be adequate time for the City to plan for any service improvement programs that may be required.

If a student-to-population ratio of one-third (the approximate 1985 local average) applies to the 900 persons expected to move to Kenai due to mine operation up to 300 students would be added to the Kenai schools. Several new schools are being completed in the Kenai area and it is expected that an increase in students due to the mine project could be accommodated.

The population increase attributable to the project (up to 1,600 persons) would also increase demand for health services. If a requirement of 5 beds per 1000 population (Nichols 1985) applies, 8 new beds would be required at Central Peninsula General Hospital in Soldotna.

The existing capacity of Kenai's water system is adequate to service demand well into the 1990s. If water demand growth is equal to annual projected without-project population growth of 5 percent, peak dail demand in 1992 will be 1.7 million gallons per day (mgd). If the current per capita peak daily demand of 343 gallons per day applies to the 900-person population impact of mine operation on Kenai, the peak water demand increase would be about 310,000 gallons per day. The total peak demand of 2.0 mgd would be well below the system's current pumping capacity of 2.9 mgd.

Kenai's sewage treatment system, however, will require capacity improvements by the early 1990s without the project. The population increase attributable to mine operation will require system improvement about two years earlier.

Kenai's police and fire protection services may also require improvement due to mine operation. At the 1985 population-to-officer ratio of 475:1, the population increase of 900 would require two new positions in the police department. Fire protection capacity may also require upgrading to serve the 20 percent project-related population increase. The type of capacity improvement would depend upon the location of the increased population and the type of housing and commercial facilities built in response to the increased population.

The maximum population increases to the remaining communities in the CKP would average under 3 percent by full production and would also be gradual over the operations phase-in period. The small population increase occurring over time would not be expected to strain public facilities and services in this larger area.

Mine Construction

Project construction would cause short-term increases similar to, but probably of much lower magnitude than, those described above for mine operation. Although the direct increase to the employed work force in the CKP would be higher (at about 650) than during operation, the short peak construction period would likely limit induced service-sector employment to a negligible level. Furthermore, the short peak period would probably lower the level of inmigration by persons who may move to the area to attempt to obtain construction jobs.

5.3.6.2 Tyonek

For purposes of analysis, the potential socioeconomic effects on the village of Tyonek are classified into three categories: 1) effects on local employment, 2) effects on community population and infrastructure including cumulative socioeconomic effects, and 3) social and cultural effects.

Effect on Local Employment

Unemployment and underemployment are chronic problems for residents of rural Alaskan villages and Tyonek is no exception. A lack of a basic year-round industry is the most pervasive reason for this economic problem. This absence of a solid economic foundation is often compounded by other problems when jobs do become available. For example, unskilled local labor, work schedules incompatible with subsistence and other traditional activities, lack of effective training programs, and cultural differences between Native workers and (usually) white employers contribute to the low levels of local employment in many Alaskan villages. Even in rural areas where industrial or natural resource development has occurred, employment of local residents frequently falls short of expectations. Low employment levels of Tyonek residents at the KLM timber harvesting operation and chip mill in the late 1970s provide an illustration of this problem. This case example is used to show that large-scale resource development projects are not necessarily a panacea to local unemployment problems and that the barriers preventing expanded employment opportunities for rural residents are substantial and must be approached with creative planning and implementation measures by all parties.

Table 2-3 presented projected employment levels associated with the Diamond Chuitna Coal Project. These employment figures refer to mining-phase employment only and do not include employment levels for project construction. Of the projected 848 permanent employees, approximately 218 would be heavy equipment operators, 125 would be light equipment and truck operators, 289 would be mechanics and skilled maintenance personnel, 110 would be involved in life support services (such as cooks), and 106 would be in administrative positions (Table 5-23). Table 5-23 also presents the skills present in Tyonek's current labor force. These skills match, to a considerable degree, the skills required by Diamond Alaska for operation of the coal mine. The potential will therefore exist for Diamond Alaska to use workers from Tyonek in a variety of capacities in both construction and operation of the mine and related facilities. Hence, the coal project has the potential to alleviate Tyonek's local unemployment problem.

In summary, the Diamond Alaska Coal Project would boost local employment opportunities but in the long term would not necessarily solve the unemployment problem in Tyonek. The success of the effort to maintain a high level of local employment would depend on the effectiveness of job training programs, the individual performance of Tyonek workers, Tyonek residents' adaptation to coal mining jobs, successful integration of mine employment with subsistence activities and agreements between Diamond Alaska and the village of Tyonek.

Effects on Community Population and Infrastructure

Because Diamond Alaska plans to house workers in a "single status" housing facility, short-term impacts on Tyonek's population level, infrastructure, and community services would be minimized. Worker needs, such as food, waste disposal, indoor recreation, and others would be provided by the applicant at the housing facility. Impacts on community population and infrastructure for other communities, such as Kenai and Anchorage, were discussed earlier.

Table 5-23

MINING PHASE EMPLOYMENT BY OCCUPATIONAL GROUP

Occupational Group	Mine Employees[1]	Number in Tyonek[2]
Heavy Equipment Operators	218	12
Light Equipment and Truck Operators	125	25
Mechanics and Skilled Maintenance	289	13
Life Support Personnel (e.g., cooks, house-keepers, etc.)	110	undetermined
Administrative	106	13
Total	848	

1 Diamond Alaska Coal Company

2 Based on a 1983 survey by Darbyshire and Associates (1984) that identified a total Tyonek work force of 145 people. These figures include the number of people indicating skill in each general occupational group.