KODIAK ISLAND BOROUGH COASTAL MANAGEMENT PROGRAM

Progress Report

June 1981

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1981

Woodward-Clyde Consultants

4791 Business Park Blvd., Suite 1
Anchorage, Alaska 99503

18713

KODIAK ISLAND BOROUGH

Telephones 486-5736 - 486-5737 — Box 1246
KODIAK, ALASKA 99615

July 2, 1981

Honorable Borough Mayor and Assembly:

The accompanying documents represent the Kodiak Island Borough Phase I Coastal Management Program Progress Report. The program has complied with all the contractual obligations contained in the Contract for Services of March 1980 (as amended) between the Division of Community Planning, Department of Community and Regional Affairs and the Kodiak Island Borough. The documents form the basis for the Kodiak Island Borough Coastal Management Plan.

The Phase I Progress Report consists of a text volume, a map volume, and two technical appendices. (Technical Appendix 1, Village Public Participation Program and Technical Appendix 2, OCS Technical Reviews and Comments, are available upon request.) In addition, "community profiles" for the six major villages in the Kodiak Island Borough have been completed through the program. The profiles for Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions will be available in August. The Phase II program, emphasizing implementation, finalizing draft portions of the Phase I program, and continuing public education and involvement, will complete the "Public Hearing Draft" of the Kodiak Island Borough's Coastal Management Plan. The Public Hearing Draft is scheduled for distribution in early November.

The Phase I Progress Report is the result of a number of people's work and cooperation. The Kodiak Island Borough had two major sub-contractors for the program. Wayne Marshall was the project manager for the Kodiak Area Native Association Village Public Participation subcontract. Dr. Richard Firth was the project manager for Woodward-Clyde Consultants who prepared the document and its contents, with the exception of the "Issues, Goals and Objectives" and "Public Involvement" sections. A great many others were involved to some degree in the preparation of this Phase I Progress Report, and they deserve thanks for the time they donated to the program.

The main purpose of the Phase I Progress Report is to provide substantive documentation for review and comment prior to the final preparation of the Kodiak Island Borough Public Hearing Draft Coastal Management Plan. We are requesting that all comments from individuals and groups be received by August 21, 1981. The comment period for Kodiak Island Borough residents and organizations is open until October 2, 1981. The additional comment period for Borough residents and organizations is an effort to allow people to review and comment on the Phase I Progress Report, after the major salmon fishing season is over.

This Phase I Progress Report constitutes the majority of the Kodiak Island Borough Coastal Management Plan. It should be reviewed seriously by all concerned.

Sincerely,

Linda L. Freed
CZM Coordinator

Alaska. Department of Community and Regional Affairs
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KODIAK ISLAND BOROUGH PUBLIC OFFICIALS

MAYOR
R. Danforth Ogg

ASSEMBLY
Phillip Anderson
Scott Arndt
David Herrnsteen
Dennis Murray
James Peotter
David Wakefield
Lorne White

ACTING MANAGER
Arnold T. Hansen

Alaska Coastal Management Program

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CZM TECHNICAL COMMITTEE

Robert Amesbury/Darwin Rennewanz
Leslie Anderson/Gary Haines
William Anderson
Tom Azumbrado
Forrest Blau
Tim Blott
Mike Brechan
Tim Hill
Wayne Marshall
Dave Nease/Laurel Peterson
Hank Pennington
James Peotter
Thomas Peterson
Gordon Ryan/Bill Bivin
Mary Jo Simmons
Richard Sims
Jeffrey Stephan
Gene Sundberg
Noreen Thompson/Bob Thomas
Nell Waage

KODIAK AREA NATIVE ASSOCIATION OEDP

Duke Delgado - Ouzinkie
David Eluska - Akhiok
Ron Lind - Karluk
Patricia Lukin - Port Lions
* Arthur Panamaroff - Larsen Bay
Dorothy Pestrikoff - Old Harbor

* - Active until February 1981.

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1.0 ISSUES, GOALS, AND OBJECTIVES

1.0
ISSUES, GOALS, AND OBJECTIVES

1.1 INTRODUCTION

The citizens of the Kodiak Island Borough (KIB) are both resource users and resource managers, and in these roles make many decisions about what types of land and water development are desirable, where the developments will take place, and what, in general terms, they will look like.

The Kodiak Island Borough Coastal Management Program set forth in the following pages establishes an agenda and provides the tools to direct development and to manage the resources of the coastal zone. The program emphasizes management tools that are explicit, yet flexible enough to provide guidance in a changing physical, economic, and regulatory environment.

1.2 ISSUES

The primary purpose of coastal management is to provide a framework for making decisions on uses of coastal resources, and on activities taking place within the coastal zone. In order to develop a coastal management program that best serves Kodiak Island Borough residents, issues concerning resource use and the needs of local residents should be addressed. Eight major issues have been identified: fisheries; land ownership status; energy resources and facilities; timber harvesting; recreation/tourism; transportation facilities and services; subsistence; and governmental coordination.

1.2.1 FISHERIES

The fisheries resources of the Kodiak Island Archipelago are the economic mainstay of most Borough residents, and comprise a large portion of the subsistence resources they harvest. Because the viability of fisheries resources is dependent on offshore and onshore habitats, development of other Borough resources has the potential for adverse impacts on fisheries if appropriate safeguards are not taken.

1.2.2 LAND OWNERSHIP STATUS

Uncertain Land Ownership Status

The status of land ownership by federal, state, Borough, and private entities is unclear at this time, and may not be settled for several years. However, the management of resources and activities in the Borough often transcends property lines, and requires a comprehensive management framework that can include different participants who have different needs and responsibilities. Uncertain land ownership only increases the need for such management.

Land Use Restriction

Much of the Kodiak Island Borough lies within the Kodiak National Wildlife Refuge. Use of lands and resources within the refuge, whether owned by Native corporations or other private entities, is subject to restrictions outlined by refuge management guidelines. In the past, these restrictions have hindered development of the Terror Lake hydroelectric project, and may limit future use of privately owned lands.

1.2.3 ENERGY RESOURCES AND FACILITIES

Oil and Gas Development Activities

Outer continental shelf (OCS) exploration and development activities have been a concern of Kodiak Island Borough residents since 1975. The impact of normal operations and oil spills on the fishing industry, and of onshore support facilities on lifestyle and community facilities, are of particular concern. The Borough formed the OCS Advisory Committee in 1976 to act in an advisory capacity to the Borough Assembly in matters related to OCS oil and gas development. With the passage in 1980 of the Alaska National Interest Lands Conservation Act, Section 1008 opens certain federal upland areas to the evaluation of oil and gas resources they may contain. These areas include the Kodiak National Wildlife Refuge, which could be opened for oil and gas exploration.

Hydroelectric Resource Development

The relative isolation of the Kodiak Island Borough and its communities has contributed to a dependence on fuel oil for power generation, which is an extremely costly source of energy. A major hydroelectric generation project has been proposed for Terror Lake, and Alaska District Corps of Engineers feasibility studies have identified potential hydroelectric generation sites at each of the Borough's communities. Hydroelectric power will provide a comparatively inexpensive and reliable long-term source of power for Borough residents. However, because many of these sites are located within the Kodiak National Wildlife Refuge, they are subject to Refuge management guidelines. These guidelines are oriented primarily toward protection of fish and wildlife habitat, and not toward other uses of the Refuge. Development of hydroelectric generation facilities currently faces lengthy licensing approval processes.

1.2.4 TIMBER HARVESTING

Timber has been harvested on Afognak Island over the last ten years, initiated under U.S. Forest Service supervision and currently managed by KONCOR. The timber resources on Afognak Island were the primary reasons for land selection there by Afognak (now Port Lions) and Ouzinkie Native Corporations, with the intent of continuing timber harvesting. Since taking over the management of the timber operations, KONCOR has been recognized as running one of the best timber harvesting operations in Alaska, generally surpassing the requirements of the State Forestry Management Guidelines.

There is concern among some Kodiak Island residents that timber harvesting activities on Afognak Island are damaging anadromous fish streams, and other fish and wildlife habitat, and are not compatible with the areas recreation and aesthetic values. These concerns were the focus of recent land ownership negotiations between the State of Alaska and Kodiak Island Borough.

1.2.5 RECREATION/TOURISM

Kodiak Island is a major state recreation and tourism attraction, offering excellent hunting, fishing, wildlife observation, and growing boating opportunities. Resident and nonresident use of these resources supports a local industry consisting of hotel operators, air taxi services, and guiding services. Increasing recreation activities have caused conflicts with other resource use, particularly in the vicinity of several Borough villages. At this time, conflicts include trespass on private lands, general disruption of community lifestyle, competition for subsistence fish and wildlife resources, and littering. The affected villages are currently evaluating solutions to the problem.

1.2.6 TRANSPORTATION FACILITIES AND SERVICES

Facilities

Because of the Island's mountainous topography, the availability of suitable space for locating transportation facilities is low and the cost of building such facilities is high. In the case of many existing facilities such as boat harbors and the Kodiak port, the capacity is inadequate to meet demands. At other facilities, such as village airstrips, operations can be severely constrained by weather conditions. Maintenance of existing facilities and developing material borrow sites for constructing new facilities are also significant problems. All of these factors contribute to high construction and maintenance costs for transportation facilities, and general Borough-wide demands for new facilities, increased capacities, and better maintenance.

Service

All Borough communities are dependent on air and marine transportation for commodity and passenger movement. While scheduled transportation services to the City of Kodiak are adequate to meet current needs, outlying communities generally depend on charter service, resulting in extremely high transportation costs. Many of these communities would like to see regular air and ferry service provided to reduce transportation costs and increase the ability to get into the City of Kodiak. However, state ferry service to the community of Port Lions has increased nonresident access for hunting and fishing purposes, and other communities are concerned that increased access could bring similar problems.

1.2.7 SUBSISTENCE

All Kodiak Island Borough residents use fish and wildlife resources for subsistence to a certain degree. In general, the villages have been more dependent on subsistence resources due to few local employment opportunities, high transportation costs, and social traditions.

In the Kodiak metropolitan area, subsistence use is limited by Alaska Department of Fish and Game regulations, increased competition between subsistence users, and competition with recreation and commercial users. Village subsistence faces increasing competition from recreation use of resources. In all cases, the possibility of resource allocation among subsistence, recreation, and commercial users is a growing concern.

1.2.8 GOVERNMENTAL COORDINATION

On federal and state government levels, various agencies make day-to-day decisions on the use of resources in the Kodiak Island Borough that are under their various management responsibilities. Those decisions can have great impact on Borough residents, yet Borough participation in decision making is often minimal or nonexistent. Prior to the Alaska Coastal Management Program, mechanisms for participation were advisory only.

Through Title 29 of the Alaska Statutes, the Kodiak Island Borough has planning powers for the area contained within Borough boundaries, including seven major communities. Past Borough planning efforts have incorporated varying degrees of individual community participation, often resulting in the feeling that Borough government was not responsive to local needs. Limited planning budgets and a wide range in individual community needs have contributed to this problem.

1.3 GOALS

The goals for the KIB District Plan reflect a wide spectrum of issues pertaining to coastal management and the well-being of the residents of the Kodiak Island Borough. Above all, as indicated below, the goals recognize that the most important resources in the KIB are fisheries resources.

1. To provide for the cultural/social strength, public safety, and economic welfare of Borough residents when siting future land use activities;

2. To recognize that residents of the Borough utilize local fish, game, and plant resources to meet dietary and traditional/cultural needs;

3. To protect coastal habitats and air and water quality in conjunction with development activities;

4. To preserve the scenic beauty and the cultural, ethnic, and historical values of the Kodiak Island Borough;

5. To strive for compatible use of coastal lands and waters among diverse development activities;

6. To encourage economic productivity and diversity in the Borough, while minimizing any conflict with fisheries resources and the fishing industry;

7. To encourage the provision of land for desired development activities; and

8. To simplify and expedite permit procedures and governmental agency review in the implementation of the KIB Coastal Management Plan.

Underlying these goals is the recognition that the Kodiak Island Borough strives to enjoy economic prosperity and development, and that the foundation of this prosperity is fisheries resources and the fishing industry. While coastal management cannot, by itself, ensure economic well-being, it can help to make economic events orderly and sensible

within the constraints of limited land, potential geological hazards, and sensitive habitats. These goals reflect concerns expressed by residents of the Kodiak Island Borough, and form the basis for objectives to be achieved through the program.

1.4 OBJECTIVES

1.4.1 PUBLIC SAFETY

It is an accepted fact that the Kodiak Archipelago, like other areas of Alaska, is subject to future earthquakes, marine landslides, flooding, avalanches, erosion, and wind damage.

To provide for public safety and to minimize uncertainty when developing coastal areas, the KIB Coastal Management Program will pursue the following objectives:

1. Evaluate seismic, avalance, erosion, flood, and wind hazards and specify development criteria to minimize these hazards;

2. Site industrial, commercial, residential, and recreational development in areas that minimize risk to life and property;

3. Require sound engineering practices to ensure the safe design and construction of public and private facilities;

4. Determine the best use of hazard-prone lands;

5. Identify further studies needed to determine the magnitude of potential geological hazards, mitigation measures, and utilization of hazardous lands;

6. Identify methods for providing proper water supplies and sewage and solid waste disposal for residents of the Borough;

7. Strive to ensure that the highest quality communication and navigational aids are available for marine safety and protection (through coordination with agencies and groups involved in marine safety and protection); and

8. Promote the development of all-weather harbors and docking facilities to minimize damage to the facilities and vessels.

Subsistence

The Kodiak Island Borough has recognized that subsistence use is a use of the resources of the Kodiak Archipelago. Subsistence should be considered a primary use of resources in the Borough, especially in village areas. This can be accomplished through the following means:

1. Encourage the maintenance of resource habitats; and

2. Encourage the management of resource harvests.

Resource Enhancement Protection

The Kodiak Island Borough will seek to ensure compatibility of future developments on a site-by-site basis and, at the same time, to enhance rather than destory the scenic beauty and valuable habitat characteristics of the Kodiak Archipelago.

1. Continue to promote the sustained-yield harvest of renewable resources in the Kodiak Island Borough;

2. Identify and protect coastal and upland habitats that are important for the development of renewable resources in the Kodiak Island Borough;

3. Protect resource values and air and water quality in the Kodiak Island Borough, through siting designs and construction techniques for development activities; and

4. Support the sustained-yield harvest of marine mammals that deplete fisheries resources.

Land and Water Uses

Land and water uses are irrevocably connected to public safety, resource protection, and economic development. However, given steep terrain and hazard areas, land suitable for development is limited and thus deserves special attention in the coastal management plan.

The coastal management plan will identify land for conservation, development with restrictions, and development without restrictions, and will strive for compatible multiple use of coastal lands and water. The Kodiak Island Borough recognizes that it cannot at this time identify the most appropriate use for all land and water within its jurisdiction. The Borough strives primarily to identify those areas that should be preserved and those areas that have development potential. The pursuit of the following objectives will help to implement this goal:

1. Determine future land and water use needs for development activities;

2. Reserve waterfront land for uses needing direct access to water;

3. Encourage innovative development to maximize the use of available land;

4. Maximize compatible multiple uses of land and water resources through siting and design criteria; and

5. Work closely with the State of Alaska and the political subdivisions in the KIB to coordinate the land disposal program and other state land management programs.

1.4.2 ECONOMIC PRODUCTIVITY/DIVERSIFICATION

Historically, the Kodiak Island Borough, because of its strategic location, has been one of the major fishing ports on the west coast of the United States. In addition, it has the potential for becoming a major transshipment point in the near future.

The Kodiak Island Borough is economically dependent on the fishing industry. Due to the nature of the fishing industry, dependence on seasonal employment has been an economic concern. Thus, Kodiak Island Borough would like to develop stable, year-round sources of income and employment to complement and supplement the fishing industry. Existing and potential development activities in the Borough hold promise for future economic diversification.

Fisheries

1. Encourage the maintenance of current biologically productive marine areas, and promote the enhancement of former biologically productive marine areas;

2. Examine the feasibility of locally controlled fish hatchery sties for commercial fish species;

3. Support the development and expansion of commercial and small boat harbors in the political subdivisions of the Kodiak Island Borough;

4. Promote programs to mitigate the conflicts between fisheries and other natural resource developments;

5. Encourage the development of viable sites throughout the Kodiak Archipelago as onshore support bases for the bottomfish industry;

6. Reserve areas for gear storage for the fishing industry; and

7. Promote the development of the University of Alaska's Fisheries Technology Center in the City of Kodiak.

Timber/Agriculture

1. Support the maintenance of fisheries habitat as a high priority in both timber and agricultural development;

2. Encourage the development of sustained-yield timber harvesting in identified commercially viable timber areas of the Kodiak Island Borough;

3. Identify transfer points for the movement of timber products from harvest areas to storage areas and shipping points that minimize the impact on other resources;

4. Explore the use of timber harvesting by-products for local utilization; and

5. Encourage the development of grazing on commercially viable grazing land in the Kodiak Island Borough.

Manufacturing

1. Promote the development of marine related manufacturing facilities throughout the Kodiak Island Borough, in order to maintain and support the fishing industry; and

2. Encourage the development of non-marine-related manufacturing - e.g., timber processing - in the Kodiak Island Borough.

Mining

1. Identify and encourage the development of commercially valuable mineral deposits in the Kodiak Island Borough, when fisheries and other resources can be protected.

Energy Development

1. Accommodate energy facility siting and onshore oil and gas exploration in a manner that will prevent adverse socioeconomic impacts in the Kodiak Island Borough and adverse environmental impacts on coastal resources that Kodiak Island Borough residents rely on for their livelihood.

2. Identify potential sites for petroleum-related facilities without preempting other developmental activities;

3. Support the development of the Terror Lake Hydroelectric Project, and the proposed transmission line to Port Lions;

4. Encourage development of microhydro projects, wind generation, and cogeneration as alternatives to traditional fossil fuels;

5. Explore the development of tidal power as an alternative to traditional fossil fuels, if there is minimal conflict with fisheries resources; and

6. Pursue the development of a Borough energy plan, as part of the Borough's overall planning effort.

Recreation/Tourism

1. Site industrial facilities and industrial parks to minimize damage to natural settings;

2. Improve public access to developed waterfront areas;

3. Identify potential sites for marine park facilities, that are located away from highly used subsistence areas;

4. Encourage recreational boating safety through improved navi-ation and communication aids, and search and rescue capability through coordination with agencies involved in marine safety and protection.

5. Encourage expanded ferry service to the City of Kodiak;

6. Support the development of facilities in local communities around the Kodiak Island Borough;

7. Initiate a Borough parks and recreation program that iden-tifies, in conjunction with local communities, areas of coastal recreation and tourist interest and provides access to these locations; and

8. Recognize and manage Shuyak Island for wilderness recreation and remote residential land use.

Transportation

1. Maximize the use of waterfront land set aside for development activities dependent on water-based transportation;

2. Upgrade transportation between the City of Kodiak, Kodiak Island villages, and the rest of Alaska;

3. Support regular air and freight/barge service between the City of Kodiak and the villages in the Kodiak Island Borough;

4. Identify future land requirements for docking facilities, ports, landing strips, and airport expansion, and reserve appropriate land;

5. Maintain coordination with the U.S. Coast Guard and Alaska District Corps of Engineers to ensure navigational safety in and around the Kodiak Archipelago;

6. Promote the extension of the Anton Larson Road to ice-free water;

7. Discourage the development of roads between the villages and the City of Valdez;

8. Promote the expansion of a deep water port in the City of Kodiak; and

9. Extend the Monashka Bay Road only to the end of the bay.

General Development

1. Determine the nature and siting requirements of general industrial expansion that will accompany growth in the transportation, fisheries, tourism/recreation, timber, manufacturing, mining, and petroleum industries;

2. Identify and reserve land for future industrial and commercial expansion;

3. Encourage the multiple use of federal and state-owned lands; and

4. Promote improved communication facilities among the political subdivisions of the Kodiak Island Borough.

1.4.3 REGIONAL INTERESTS

Historically, as well as today, the Kodiak Island Borough is linked economically with other areas of Alaska.

The Kodiak Island Borough is keenly interested in how state resource use, land management decisions, and developmental projects will affect its own economy and growth. Land conveyances, increased vessel traffic, implementation of fisheries management plans, and establishment of state parks are, in fact, Borough issues and therefore the Coastal Management Program has incorporated wider regional interests into its program objectives:

1. Coordinate future land use decisions with other concerned public and private agencies outside the Borough;

2. Promote the interests of Kodiak Island Borough residents in fisheries resources outside the jurisdiction of the Borough.

1.4.4 PERMITS AND GOVERNMENT CONTROL

Increasingly, all levels of government are participating in decisions to alter the natural and man-made environment. Through the consistency provision of the Coastal Management Act, the Kodiak Island Borough

intends to simplify and expedite permit procedures and to make certain that state and federal actions are consistent with the District Plan.

The matter of consistency is important to the Kodiak Island Borough, as a large portion of the land in the Borough is federally owned. Once approved the actions of state and federal agencies required are to be consistent with the KIB Coastal Management Plan, and thus it is important that the District Plan adopt policies and an implementation scheme that streamlines decision making and consistency review. In the course of program development, the Kodiak Island Borough will:

1. Ensure that state and federal activities are consistent with the local District Plan;

2. Consider mechanisms to coordinate local permitting and consistency review; and

3. Use existing ordinances and regulations to the maximum extent for implementation of the KIB Coastal Management Plan.

2.0 DISTRICT BOUNDARIES

2.0
DISTRICT BOUNDARIES

The boundaries of the Kodiak Island Borough Coastal Management District are the boundaries of the Kodiak Island Borough. (See Map 1, Coastal Management District Boundaries.)* These boundaries have been chosen based on:

- District Coastal Management Program Guidelines

  6AAC 85.040 states that "final boundaries of the coastal area subject to the district program may diverge from the initial boundaries if the final boundaries include all transitional and intertidal areas, saltmarshes, saltwater wetlands, islands, and beaches."

- Topography

  The relatively steep topography of the Kodiak Archipelago makes it possible for activities taking place at any elevation to interact with or influence coastal resources.

- Implementation

  By making the district coastal management boundaries the same as Kodiak Island Borough boundaries, the coastal management program

* All resource maps are contained in the companion volume to this Progress Report.

can be more easily implemented as an addition to existing Borough land use controls, such as the comprehensive plan and zoning ordinance.

- Consistency

One of the primary benefits of coastal management is that, once approved and adopted, state and federal activities must be consistent with the Kodiak Island Borough Coastal Management Program. In the past, the Borough has had little influence in activities or resource use on the Kodiak National Wildlife Refuge and other federal and state lands. Inclusion of the entire Borough within the coastal management district will provide the borough with some influence over existing federal and state resource use and in future activities, such as those associated with oil and gas exploration and development.

3.0 RESOURCE INVENTORY

3.1 NATURAL RESOURCE INVENTORY

All eight habitats identified in the Alaska Coastal Management Program are represented within the coastal management boundary of Kodiak Island Borough. These habitats are: offshore areas; estuaries; barrier islands and lagoons; wetlands and tideflats; rocky islands and seacliffs; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat [Alaska Coastal Management Act, 6 AAC 80.130 (a)].

Following a general description of the Kodiak Archipelago, each habitat type will be examined within the context of the natural resources of Kodiak Island Borough. Included will be a definition of the habitat derived from the Alaska Coastal Program Management and any variations in the definition to adapt it to the situations present in the Borough; a general description of the habitat; and the natural resources found within each habitat type.

3.1.1 GENERAL DESCRIPTION

The Kodiak Archipelago is approximately 100 miles wide and 200 miles long. It includes about 5,000 square miles of land, no point of which is more than 15 miles from the sea [Alaska Department of Natural Resources (ADNRa) 1980; Alaska Environmental Information and Data Center (AEIDC) 1979]. Kodiak Island consists primarily of mountainous terrain, with the ridge of the mountains running northeast-southwest. Although

several peaks are greater than 4,000 feet, most range between 3,000 and 4,000 feet. About 40 small cirque glaciers (none greater than 2 miles) are evident along the main divide (AEIDC 1979). Numerous hanging valleys feed into the main canyons radiating from the central divide. The uplands are drained by relatively short, swift, clear mountain streams.

From Shuyak Island to Kodiak Island uplands are dominated by stands of Sitka spruce. These stands extend south to a general northwest-southeast dividing line running from Kupreanof Peninsula to Cape Chiniak (AEIDC 1979). The Barren Islands to the north of Shuyak Island are primarily rocky scapes. Southwest Kodiak Island and Tugidak Island are relatively flat, and support extensive areas of wet and moist tundra.

Along a rugged 2500-mile coastline, exposed bedrock and shallow soils prevail (Sears and Zimmerman 1977). Northwest Kodiak shows effects of glaciation, with long, narrow fjords and U-shaped valleys. These lie perpendicular to the mountains and the geologic fault lines. Typically rivers enter at the heads of the fjords and are backed by extensive flat lands. The east and southeast coasts of the Archipelago are characterized by shorter, wider estuarine embayments. Southwest Kodiak Island and the Trinity Islands tend toward long, continuous shores with a few crenulate bays. Most of the sandy beaches occur on the west coast of Kodiak Island and the Trinity Islands (Hayes and Ruby 1979).

Fish and wildlife resources are of extreme importance to the economy of the Borough. Offshore areas are highly productive. They contain an abundance of intertidal and benthic and pelagic subtidal plant and animal life which supports extensive populations of shellfish, finfish, and marine mammals. An extensive array of shorebirds and waterfowl utilize the resources of the islands, either as permanent residents or for nesting, wintering, or stopping-off sites along their migratory paths. Upland habitats support populations of Kodiak brown bear, elk, deer, mountain goats, and numerous smaller mammalians.

3.1.2 OFFSHORE AREAS

Definition

Offshore areas include submerged lands and waters beyond mean lower low water (MLLW) to the offshore limits of Kodiak Island Borough. Because of the extensive estuarine system of the islands, offshore areas are those outside an imaginary line extending across the headlands of the estuaries.

General Description

Circulation in the Gulf of Alaska is counterclockwise [North Pacific Fisheries Management Council (NPFMC) 1979]. More locally, seawater circulation can vary considerably, both on a seasonal and a daily basis. For example, weak and inconsistent circulation patterns on shelf areas northeast and south of Kodiak Island promote eddies and frequent flow reversals. In these areas, where water can recirculate for one to two months, there is a high probability of localized high productivity and larval settlement. Alternatively, in some parts of Shelikof Strait there can be a threefold increase in rate of flow during October and November, which can promote the dispersal of larvae. See Map 10, Coastal Energy, Current Patterns and Coastal Hazards (BLM 1980, 1981).

Inshore and surface circulation patterns are dominated by tidal currents (BLM 1980, 1981; AEIDC 1979). Tides are semidiurnal, with a marked diurnal inequality. The range of tides varies; typically they increase from southwest Kodiak Island to northeast Afognak Island. Tides are also greater on the west side of the Archipelago. For example, the diurnal range [difference between mean higher high water (MHHW) and MLLW] is 7.5 feet in Sitkinak Lagoon, 14.6 feet in Uganik Passage, 8.5 feet in Kodiak Harbor, and 13.7 feet in Red Fox Bay in northeast Afognak Island (AEIDC 1974; Hayes and Ruby 1979).

Living resources are abundant in Kodiak's offshore area. Dominant fauna include shellfish, finfish, marine mammals, and marine birds. A conspicuous biological feature of the coast is extensive kelp beds located in both estuarine and offshore habitats. Kelp beds can exhibit rapid growth and regression depending upon local weather conditions. Areas with extensive kelp beds identified during 1976 included areas around Ugak Island, Kiliuda Bay, the northern tip of Sitkalidak Island east to Cape Barnabas, Sitkinak Strait, Alitak Bay, and Gurney Bay. North of Tonki Bay, the eastern coast of Sitkalidak Island, and Deadman Bay had moderate kelp coverage [Science Applications, Inc. (SAI) 1980]. Kelp and other macroalgal beds provide habitat for sea otters, spawning herring, and juvenile fish. They are important feeding areas for waterfowl and marine birds, and provide valuable primary production exported as algal drift, which is assimilated elsewhere in the marine ecosystem.

The living marine resources of the Kodiak area are of extraordinary economic importance to the populace of the Borough, the state, and the nation, and have been the subject of intensive investigation. In recent years, numerous studies have been conducted under the auspices of the National Oceanic and Atmospheric Administration (NOAA) Outer Continental Shelf Environmental Assessment Program (OCSEAP). Much of the following information is drawn from the most recent Kodiak Interim Synthesis Report produced under OCSEAP (SAI 1980).

Fisheries Resources

The marine fisheries resources of the Kodiak area include not only those species that support major fisheries, but also species or species groups that could potentially support a fishery, and species that are of ecological importance in the food chain that supports species of importance to commercial, subsistence, and recreational fisheries stocks. Consequently, a large number of shellfish and finfish species are of present or future importance to the Borough (Table 3.1). Not all of these

Table 3.1. Marine fish classified by habitat.

Epipelagic	
Pacific herring	Capelin
Salmon (maturing)	Pacific sandfish
Mainly: Pink	Pacific sand lance (juvenile)
Chum	Atka mackerel*
Sockeye	
Littoral/Pelagic	
Pacific herring (seasonal)	Dolly Varden
Salmon (juvenile)	Capeline (juvenile, seasonal)
Mainly: Pink	Pacific sand lance (adult)
Chum	Larvae: many species
Sockeye	
Littoral-Sublittoral/Demersal	
Snake prickleback	Crescent gunnel
Pacific sandfish (juvenile)	Snailfish
Greenlings (adult and juvenile)	Juveniles:
Kelp greenling	Flounders
Rock greenling	Rockfish
Musked greenling	Sculpins
Whitespotted greenling	Codfishes
Coastal/Demersal	
Pacific sand lance (juvenile)	Red Irish lord
Pacific cod (juvenile)	Other sculpin
Pacific halibut (juvenile)	Poaches
Yellowfin sole	Rock greenling
Rock sole*	Kelp greenling
Dover sole	Whitespotted greenling
Great sculpin	Masked greenling
Yellow Irish lord	
Offshore/Demersal	
Walleye pollock*	Sablefish*
Pacific cod*	Pacific halibut*
Pacific sand lance (adult)	Arrowtooth flounder*
Eelpouts	Rex sole
Searchers (ronquils)	Flathead sole*
Shortspine thornyhead	Ocean Perch*

Source: SAI 1980; MPFMC, 1979.

* Species recognized by NPFMP as primary groundfish species in Gulf of Alaska.

species will be considered here, but lack of a discussion of a given species should not be construed to indicate unimportance. Emphasis is placed on species of immediate and present importance to a fishery.

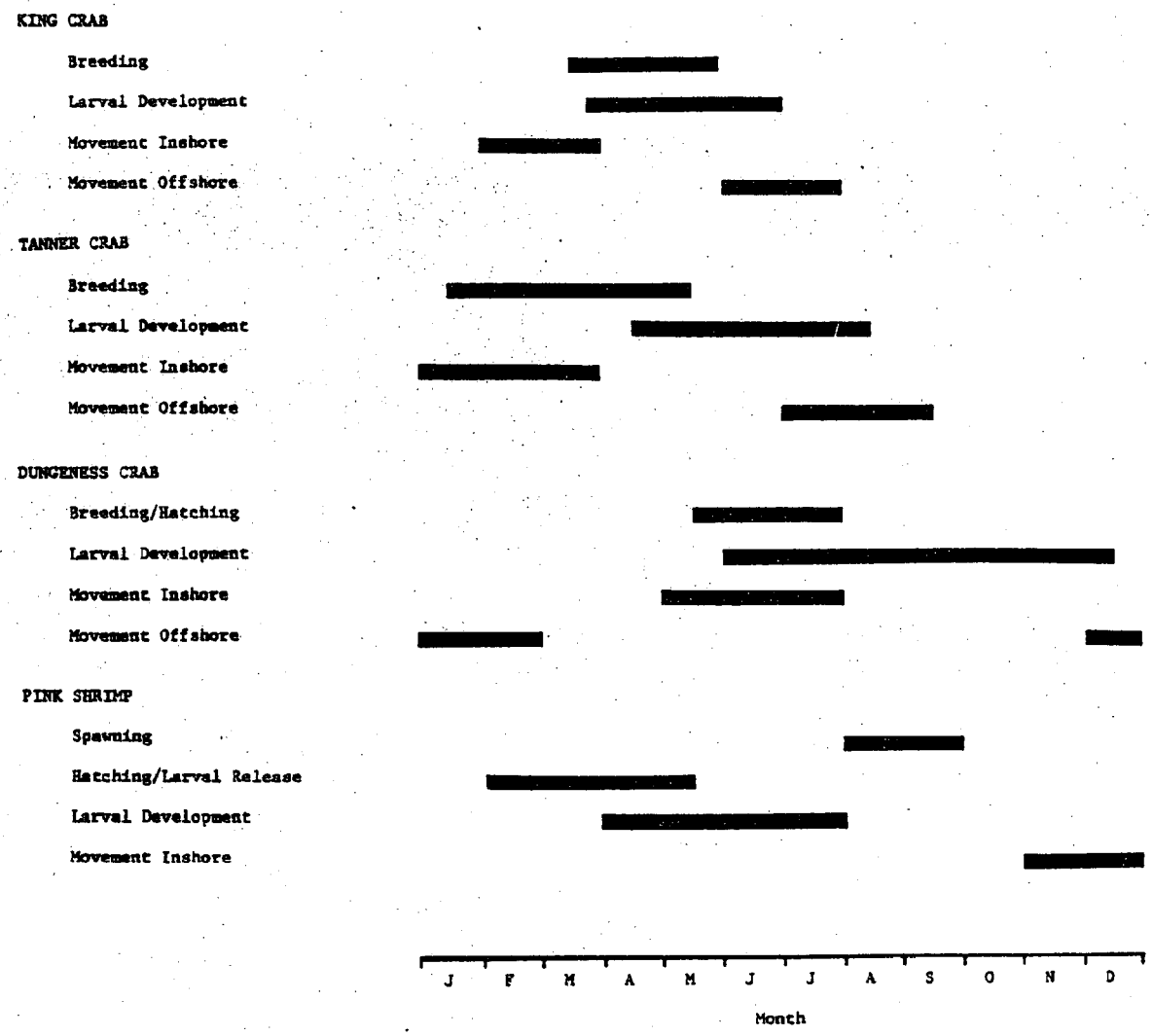
Shellfish. Kodiak waters contain major fishing grounds for king crab, Tanner crab, Dungeness crab, and pink shrimp; small amounts of scallop are also harvested in offshore areas.

Preferred habitat for most species of shellfish varies at different times in their life stages. Inshore movement generally occurs immediately preceding and during spawning. Offshore movements follow spawning for adults and larval development for juveniles (Figure 3.1). King, Tanner, and Dungeness crab, pink shrimp, and Pacific scallop are important offshore shellfish resources. As is evident from inshore movements during spawning and rearing, these resources also utilize other habitats. The primary discussion of these species, however, is contained in this section on offshore areas.

Throughout the following discussion, a distinction is frequently drawn between vital habitat and important habitat. No consistent definitions were used to differentiate these areas (Bill Donaldson, ADF&G, personal communication, 1981). The distinctions are retained in this section as a general statement of degree of habitat utilization, and not as an absolute ranking.

King crab are abundant to depths of 275 to 300 meters. Juvenile crab, however, occur in shallower water. Adults moving into the shallow water to breed are restricted in their movements to only those bays and inlets within specific geographic limits reflecting their native stock (Map 5, Crab Reproduction Areas). Within these broad areas, however, it is speculated that king crab can adjust their location to take advantage of currently abundant food supplies (SAI 1980). Vital habitats for king crab reproduction are inshore and nearshore areas. Those vital areas identified by the Alaska Department of Fish and Game (ADF&G) include all

Figure 3.1. Generalized life history tables for commercially important crabs and shrimp in Kodiak area.



Source: Science Applications, Inc. 1980.

the coastal waters of Shuyak Island, Afognak Island, Raspberry Island, north and east sides of Kodiak Island, Sitkalidak Island, and the Trinity Islands (ADF&G 1978). The shallow area surrounding Chirikof Island north to the Trinity Islands is particularly vital to king crab for both spawning and rearing (ADF&G 1978). The west coast of Kodiak Island south to Gurney Bay, Marmot Island, waters between the Barren Islands, and Shuyak Island, and offshore of the west coast of Afognak Island are considered important, rather than vital, for king crab reproduction (ADF&G 1978). Only the area on Kodiak Island between Gurney Bay and Low Cape (north of Sukhoi Lagoon) is not classified as a reproduction area for king crab.

Tanner crab habitat and movement are not well documented (ADF&G 1978, Bill Donaldson, personal communication). Tanner crab are considered the most widely distributed invertebrate of commercial importance in the Gulf of Alaska; their range extends from the shallow littoral zone to depths of 475 meters. Greatest concentrations are found in water deeper than 100 meters, and they show a preference for mud substrate (ADF&G 1978). During spawning, their distribution shifts to shallower water. Areas tentatively identified by ADF&G as important for rearing and mating include: the southwest coast of Kodiak Island from Karluk Anchorage to Cape Alitok, Kupreanof Strait west of Whale Island, and the north shore of Tugidak Island (ADF&G 1978). Tanner crab are present in limited numbers along the west shores north of Raspberry Island (Owen and Blackburn 1981).

Dungeness crab distribution extends from Baja California to Anchitka Island (SAI 1980). Dungeness inhabit all offshore areas less than 900 meters deep and show a distinct preference for sandy or sand-mud substrate. Vital areas for reproduction identified by ADF&G in the Borough include: the coast of Afognak Island south of Shuyak Island, Raspberry Island, offshore of the east coast of Kodiak Island, Hidden Basin and Saltery Cove within Ugak Bay, off the southeast coast of Tugidak Island, the west coast of Kodiak Island from Cape Alitak to Karluk Anchorage, offshore areas of Uyak and Uganik bays, and Zachar Bay within Uyak

Bay (ADF&G 1978). Other areas identified as important include: Chiniak Bay, most of Ugak Bay, Kiliuda Bay, Sitkinak Island, south of Sitkalidak Island around the base of Kodiak Island, and the area north of Karluk Anchorage to Viekoda Bay with the exception of vital habitat noted above (ADF&G 1978). Offshore areas west of Afognak Island have virtually no Dungeness crab (Owen and Blackburn 1981).

Numerous species of pandalid shrimp contribute to the fishery in Kodiak waters, but pink shrimp comprise more than 95 percent of the commercial catch (SAI 1980). Pink shrimp occur primarily in depths of 75 to 180 meters and generally within about 40 miles of the coast, over green muddy bottoms in submarine ravines. Pink shrimp primarily occur in water between the 3.5° and 4.2°C isotherms and avoid water warmer than 8°C. Vital areas for shrimp reproduction and rearing occur in the estuarine areas (ADF&G 1978). The general distribution of shrimp abundance is shown in Map 6.

Finfish

The continental shelf and slope waters of the Kodiak Archipelago are highly productive and support large populations of salmon, herring, smelt, halibut, pollock, and other groundfish (SAI 1980). Predominant species are listed in Table 3.1 according to their primary habitats, defined as follows:

- Epipelagic - offshore water column, surface to 100 meter depth.
- Offshore/demersal - more than 30 miles from shore and often deeper than 60 meters.
- Coastal/demersal - less than 30 miles from shore including embayments, and deeper than 25 meters.
- Littoral-sublittoral/demersal - tidally influenced nearshore area shallower than 25 meters.

- o Littoral-sublittoral/pelagic - nearshore water column in less than 25 meters of water (SAI 1980, NPFMC 1979).

Primary habitat varies with life history stages for most species. For example, summer depths are usually more shallow than winter depths. Egg and larval stages are planktonic and are borne along with the currents. Anadromous fish and herring utilize other habitat types in addition to the offshore areas. The following discussion provides an overview of offshore habitat utilization by important groundfishes, anadromous fishes, and herring.

Pacific herring frequently forage in the water column of offshore areas. Juvenile herring move from nearshore habitat into offshore waters by late fall, where they grow to maturity in about two and a half years. At maturity, herring migrate during fall into nearshore and estuarine areas, where they overwinter. Spawning occurs the following spring from mid-May through June (ADF&G 1978). After spawning, the adults return to offshore waters.

The important groundfishes in the offshore area include pollock, cod, sablefish, ocean perch, halibut, turbot, flathead sole, rock sole, and Atka mackerel (NPFMC 1979). The life history characteristics of these species are summarized in Table 3.2. In general, results of the most recent National Marine Fisheries Service (NMFS) groundfish surveys (1973 and 1975) indicate that the major concentrations are southeast and southwest of Kodiak Island (SAI 1980). Flatfish stocks appear to be more abundant to the southwest, while roundfish stocks are apparently more uniformly distributed over these two areas.

Pacific halibut are relatively abundant around the Kodiak Archipelago, where they commonly occur in depths of 10 to 250 fathoms. During summer, halibut are most abundant at 10 to 100 fathoms. In winter, the center of abundance is in deeper water (50 to 225 fathoms) (Table 3.3).

Table 3.2. Life history characteristics of principal groundfish species in the Gulf of Alaska.[1]

Life history characteristics	SPECIES								
	Pollock	Cod	Sablefish	Ocean Perch	Halibut	Turbot	Flathead Sole	Rock Sole	Atka Mackerel
Bottom depths of common occurrence (fathoms)	30-200	10-150	50-450	50-250	10-250	30-300	30-200	10-100	Coastal and open sea
Depths of high availability by season (fathoms)	100-200 (winter) 100[3] 50-150 (summer)	50-150 (winter) 71-110[3] 100 (summer)	? (winter) 90-110[3] 150-450 (summer)	150-250 (winter) 85-95[3] 80-150 (summer)	50-225 (winter) 110[3] 10-100 (summer)	200 + (winter) 71-110[3] 50-200 (summer)	100-200 (winter) 85-125[3] 50-150 (summer)	20-100 (winter) 45-55[3] 20-50 (summer)	offshore (winter) 95-115[3] inshore (summer)
Spawning period	March to June	Jan. to March	Dec. to April	March to June	Nov. to March	Dec. to Feb.	March to June	March to June	June to Sept.
Maximum age	17 years	12 years?	20 years?	30 years	42 years	22 years	21 years	16 years	?
Average age at maturity (female)	3 years	3 years	7 years	8 years	12 years	8 years	6 years	4-5 years	3-4 years
Average size at maturity (female)	30 cm	55 cm	71 cm	28 cm	125 cm	51 cm	29 cm	32 cm	33-35 cm
Instantaneous natural mortality rate	0.43	0.6	0.22	0.19	0.17	?	?	0.26	?
Growth completion rate (female)	0.27	0.67	0.14[2]	0.11	0.27	?	0.11	0.15	?
Fecundity at average size at maturity	100,000	800,000	400,00	10,000	600,000	?	50,000	200,000	9,000

Sources: NPFMC 1979; Owen and Blackburn 1981.

[1]Values and time periods given in this table are approximations.

[2]Sexes combined.

[3]Depth at which catch was most abundant during 1980 trawls in the northern Shelikof Strait.

Table 3.3. Abundance and habitat of commercially important groundfish in northern Shelikof Strait.

Fish	Percent of Total Catch	Rank in Study	Area of Greatest Concentration	Depth of Largest Concentration (fathoms)
Pacific Halibut	6	5	Shuyak Island	110
Arrowtooth Flounder (Turbot)	11	4	West of Afognak Island	71-110
Walleye Pollock	17	2	Throughout Shelikof Strait	<100
Pacific Cod	13	3	Throughout Shelikof Strait	71-110
Sablefish	3	7	Raspberry Island	91-110
Ocean Perch	<1	42	Not identified	85-95
Flathead Sole	23	1	Along Shuyak and Afognak Islands	85-125
Rock Sole	<1	29	Middle of Shelikof Strait	45-55
Atka Mackerel	<1	47	No major concentration	95-115

Source: Owen and Blackburn 1981.

Spawning occurs from November to March, and major spawning grounds include the Portlock Bank and Chirikof Island areas (BLM 1981). Important nursery grounds within the coastal zone include Alitak Bay, the shallow shelf regions of the Trinity Islands, and Cape Chiniok (SAI 1980). Halibut stocks have been negatively affected by the growing groundfish fishery.

Arrowtooth flounder (turbot) are one of the most common flatfish in the Gulf of Alaska, but are less common around Kodiak and Afognak Island. Little is known about the life history of turbot in Kodiak waters (SAI 1980). Consequently, its general life history features are extrapolated from information on stock elsewhere in the Gulf of Alaska. Its general bathymetric range is from 30 to 300 fathoms. During summer, turbot are most abundant from 50 to 200 fathoms, while in winter they occur most commonly in deeper waters. Spawning occurs from December to February. Juveniles probably inhabit shallower water than adults (SAI 1980).

Flathead sole are possibly the most abundant flatfish in the Kodiak area, where they have been taken in large numbers in 71 to 110 fathoms of water (Owen and Blackburn 1981). Areas that were characterized by high abundance were west of Afognak Island, south of Sitkalidak Island, off southwest Kodiak Island, and in other smaller areas off the south and east coasts of Kodiak Island (Ronholt et al. 1978, Owen and Blackburn 1981). Flathead sole generally occur in shallower water (50-150 fathoms) in summer than during winter (100-200 fathoms). Spawning occurs from March to June.

Rock sole are locally abundant in the Kodiak area. Rock sole are relatively shallow-water species generally occurring in 10 to 100 fathoms. In summer, higher concentrations occur in 20 to 50 fathoms. Concentrations occur in the offshore waters of Chiniak Bay and off Cape Chiniak (Ronholt et al. 1978). There are no known major areas of concentrations west of Kodiak Island (Ronholt et al. 1978, Owen and Blackburn 1981).

Walleye pollock may be the most ecologically and commercially important roundfish in the Gulf of Alaska (SAI 1980). Pollock primarily occur on the continental shelf and in the trough regions around Kodiak Island (SAI 1980). Its general depth range is from 30 to 200 fathoms. In summer pollock are most common from 50 to 150 fathoms, moving into deeper water (100-200 fathoms) in winter. Spawning occurs from March to June; but spawning in the Kodiak region probably occurs during April and May (SAI 1980). High concentrations of planktonic eggs and larvae suggest that a major pollock spawning area is in the Kiluida Trough and along the shelf break in the Chirikof-Shelikof Trough. Juvenile pollock occur in shallower water than adults, and have been routinely taken in bays and fiords of the Kodiak Archipelago (SAI 1980).

Pacific cod are the second most abundant roundfish in Kodiak waters and in the Gulf of Alaksa as a whole (SAI 1980). Relative incidental catch rates of cod in crab pots provide information on concentrations in the coastal aras (Watson and Blackburn 1980). Large incidental catches occurred off the southeast coast of Kodiak in 1972 through 1978. Chiniak Gully consistently produced moderate catches. Inner Marmot Bay generally produced low catches; catches in outer Marmot Bay were variable. Cod concentrations also occurred between Aliktak Bay and the Trinity Islands, and off the west coasts of Kodiak and Afognak Islands, especially between Uyak Bay and Raspberry Strait. On the southeast coast most concentrations occurred in 70 to 80 fathoms, while on the west coast cod concentrations increased to 120 fathoms. Juvenile fish predominated inshore, while larger fish occurred in deeper water. Other aspects of life history information on cod in the Kodiak area are limited. Spawning in the Gulf of Alaska generally occurs in January to March.

Sablefish (black cod) are a commercially important roundfish that commonly occur along the continental slope from the Queen Charlott Islands to the Shumagin Islands (SAI 1980). Sablefish are generally abundant below depths of 110 fathoms. Predominantly juvenile fish have been taken in 91 to 110 fathoms in Shelikof Straits; this is consistent

with the normal distribution of young fish in shallower water. Spawning generally occurs from December to April. Eggs are buoyant and a high percentage drift in surface waters over the Kodiak shelf where the larvae hatch and grow (SAI 1980).

Pacific ocean perch is the primary rockfish of commercial importance in the Kodiak area. It occurs along the edge of the continental shelf from the Aleutian Chain through the Gulf of Alaska to southern California; it also occurs along the shelf break in the Bering Sea. In the Kodiak area, Pacific ocean perch generally occur along the continental slope at depths in excess of 100 meters. The major foraging and spawning areas off Kodiak are the Portlock and Kodiak grounds (SAI 1980). From May to September males and females forage on pelagic crustaceans in about 100 to 150 meters of water. Mating is thought to occur in September, after which the females migrate into the northeastern Gulf of Alaska and disperse. Males do not migrate, and form small schools in about 250 to 450 meters of water from November to March. This species is viviparous, and young are born in spring, after which the females return to the foraging grounds, where sexually mixed schools reform.

The Atka mackerel is an epipelagic species that is widely distributed in the northern Pacific Ocean and Bering Sea. In the Kodiak area mackerel occur primarily along the continental shelf break. Adults migrate shoreward to spawn in nearshore areas where swift currents occur (i.e., as in straits between islands). Specific spawning sites in the Kodiak area have not been identified (SAI 1980). Spawning areas are typically characterized by rocky substrates in depths of 107 meters and water temperatures of 5° to 8°C. Spawning may occur from June to September.

Anadromous Fish. Anadromous fish spawn in fresh water. Fry spend a variable period of time in fresh water and then migrate to the sea, where they grow to maturity. After one or more years at sea, mature fish migrate to their natal stream to spawn. Seven species of anadromous

fishes occur in the Kodiak area: Dolly Varden trout, steelhead trout, and pink, sockeye, chum, silver, and king salmon. These species spend a portion of their adult lives in the offshore area, where they feed and grow rapidly. Key aspects of the life history of these species are summarized in Table 3.4 and Figure 3.2. Further discussion of the life history of thse species is presented in sections 3.1.3 and 3.1.8 dealing with resource use of the estuarine and river, stream, and lake habitats.

Marine Mammals

The coast and shelf of the Kodiak Archipelago support the largest concentration of marine mammals in the Gulf of Alaska [Retherford Associates and International Engineering Company (RRA/IEC) 1978]. Eight marine mammals are considered permanent residents in the Kodiak area (Table 3.5): sea lions, harbor seals, sea otters, Dall porpoises, harbor porpoises, Beluga whales, Minke whales and killer whales. In addition to the permanent whale populations, seasonal entrants include the following endangered species: gray whale, fin whale, sei whale, and humpback whale.

Sightings of these and other whale species are facilitated in the Kodiak region by the presence of two secondary whale migratory routes within the Borough's boundaries. One is between Raspberry Island and Kodiak Island, and a second between Ugak Bay and Ugak Island (BLM 1980). Whales are present around most of the Archipelago. The only exception appears to be the southwest portion of Kodiak Island, south of Uyak Bay (ADF&G 1973, Map 4).

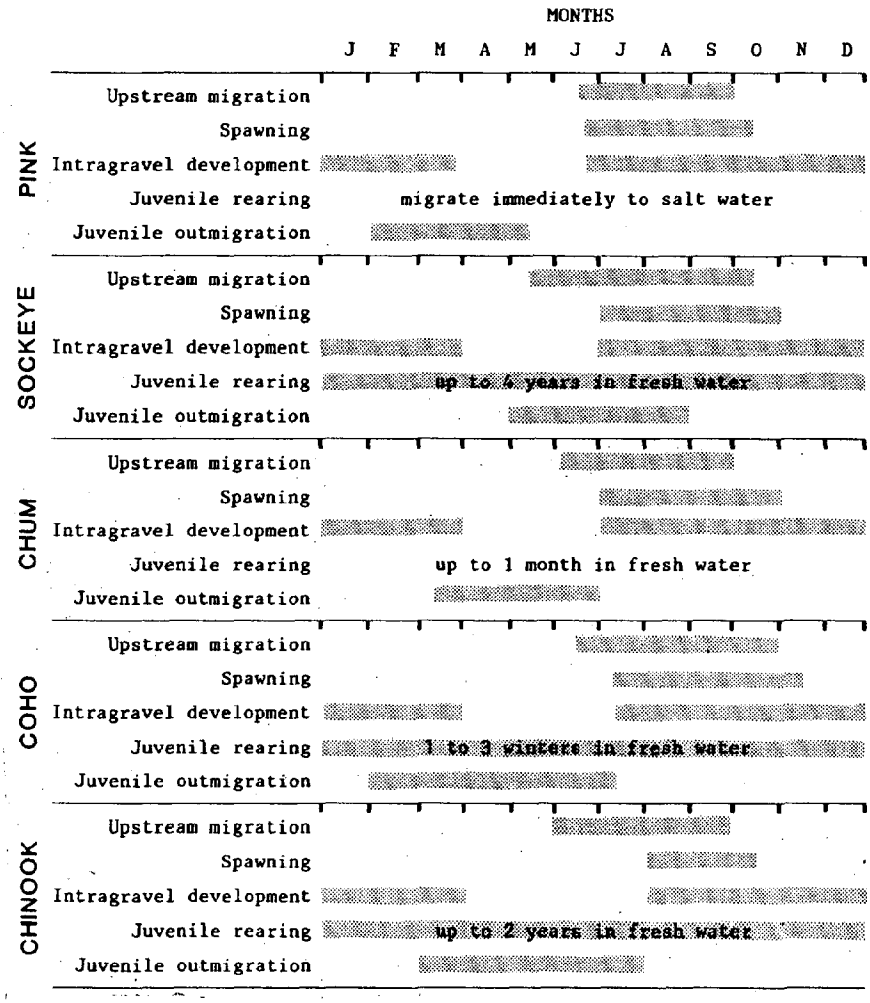
Sightings of Dall porpoise and northern fur seals occur throughout the offshore area. They are most frequently observed well outside the coastal boundaries of the Borough. Although the harbor seal is considered a permanent resident, its distribution throughout the Kodiak offshore region is not completely known (SAI 1980).

Table 3.4. Life history data for five species of Pacific salmon.

Characteristics	Species				
	Pink	Sockeye	Chum	Silver	King
Freshwater habitat	Short streams	Short streams and lakes	Short and long streams	Short streams and lakes	Large rivers
Length of time young stay in fresh water	one day or less	1 to 4 years	Less than 1 month	1 to 2 years	3 to 12 months
Length of ocean life	1-1/3 years	½ to 4 years	½ to 4 years	1 to 2 years	1 to 5 years
Year of life at maturity (years)	2	3 to 7	2 to 5	2 to 4	2 to 8
Average length at maturity (cm)	50.8	63.5	63.5	61	91.4
Average weight at maturity (kg)	1.8	2.7	4.1	4.5	10
Range of weight at maturity (kg)	0.9 to 4.1	0.7 to 4.5	1.7 to 20.4	1.7 to 13.6	1.1 to 56.8
Principal spawning months	Jul-Sep	Jun-Sep	Sep-Oct	Sep-Dec	Aug-Sep
Fecundity (number of eggs)	2,000	4,000	3,000	3,500	5,000

Source: AEIDC 1979.

Figure 3.2. Timetable of Pacific salmon life histories.



Source: AEIDC 1979.

Table 3.5. Marine Mammals of the Western Gulf of Alaska.

Species	Presence	Occurrence Coastal	Offshore	Pop. Est.	Feeding Behavior
Sea Otter	PR	X		5,000	Benthos Dem. fish
Steller Sea Lion	PR	X	X	8,500	Fish Crustaceans Squid
Northern Fur Seal	SE		X	20,000	Fish Squid
Harbor Seal	PR	X		15,000 - 25,000	Fish Crustaceans Squid
Gray Whale*	SE	X	X	1,100	B
Fin Whale*	SE		X	1,000	Ma
Sei Whale*	SE	X	X	300	Ma/Mi
Minke Whale	PR	X	X	200	Ma/I
Blue Whale	SE		X	120	Ma
Black Right Whale	SE		X	20	Mi
Humpback Whale*	SE	X	X	20	Ma
Sperm Whale	SE		X	600	T
Beluga Whale	PR	X	X	350	Bi/Ti
Killer Whale	PR	X	X	100	S/I/T
Bering Sea Beaked Whale	SE		X	R	Bi/Ti
Goosebeaked Whale	SE		X	R	Bi/Ti
Giant Bottlenose Whale	SE		X	R	Bi/Ti
Pilot Whale	SE	X	X	R	Ti
Dall Porpoise	PR	X	X	2,000	Bi/Ti
Harbor Porpoise	PR	X		1,000	Bi
North Pacific White-sided Dolphin	SE		X	R	Bi
Northern Right-Whale Dolphin	SE		X	R	I

Source: SAI 1980.

PR - Permanent resident
SE - Seasonal entrant
R - Rare
I - Ichthyophages
Bi - Benthoichthyophages
B - Benthophages
Ti - Teuthoichthyophages
T - Teuthophages
S - Sarcophages
Mi - Microplanktophages
Ma - Macroplanktophages

* Endangered Species.

Twenty-two sites, rather evenly distributed around the Archipelago, are identified as areas of sea lion concentration (ADF&G 1973). These extend from the Barren Islands to Chirikof Island. Among them are the most important sea lion rookeries in the Gulf of Alaska-Sugarloaf Island, Marmot Island, and Chirikof Island. After breeding, sea lions usually move away from these rookeries (Figure 3.3).

Harbor seals are the predominant nearshore seal. These seals feed within the 55-meter contour, and are present off all coasts of the Archipelago. Despite the fact that harbor seals are not believed to congregate in dense colonies, more than 125 sites that contain high-density seal populations have been identified around the islands (ADF&G 1973). Outstanding among these sites is Tugidak Island. There, approximately 13,000 seals congregate during the pupping season - the largest concentration of harbor seals in the world (SAI 1980).

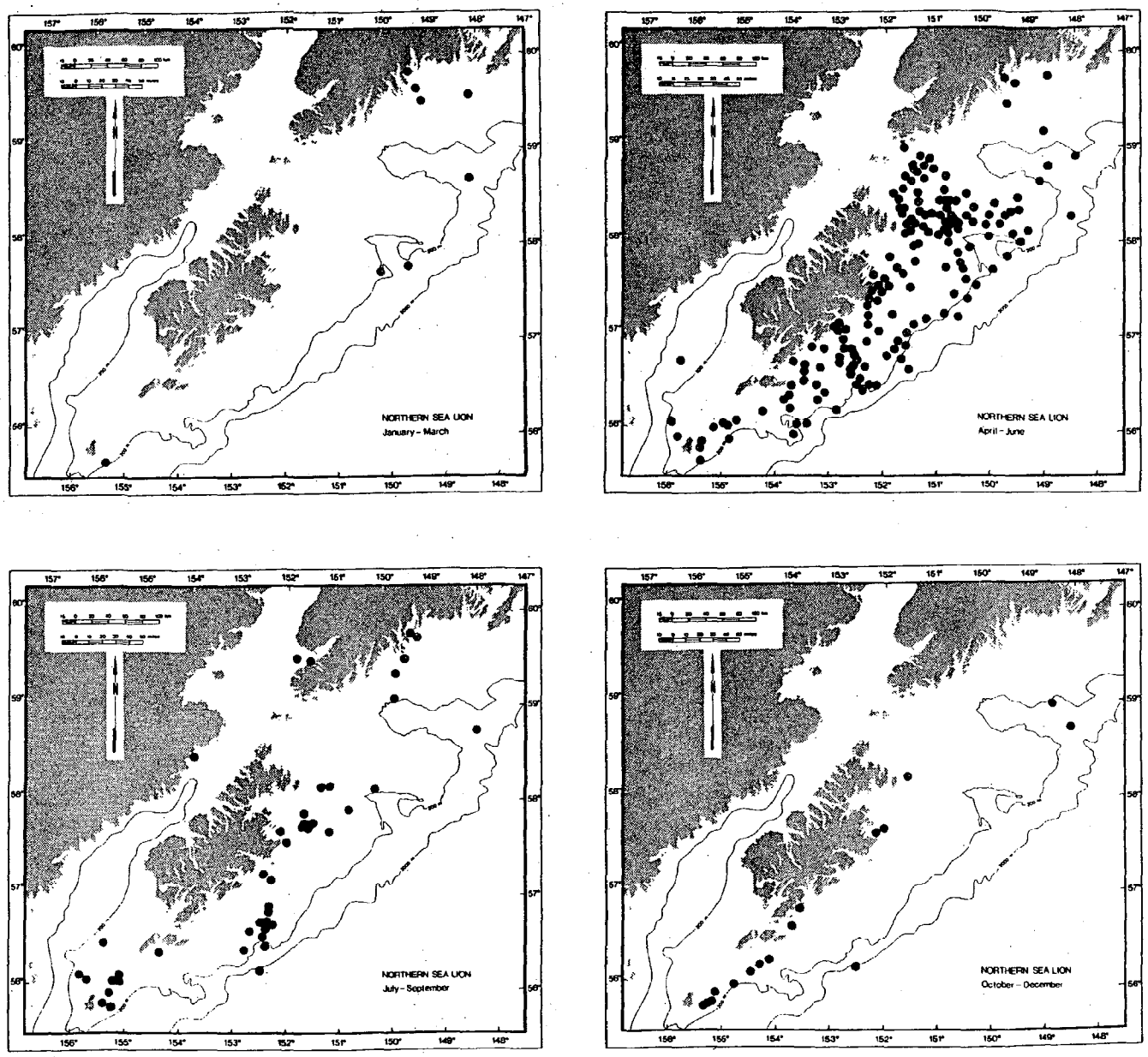
Sea otters live exclusively in marine waters, particularly those inshore areas along rocky coasts that have a rich benthic community. Primary concentrations, which extend from the Barren Islands to the northeast corner of Afognak Island, are all found along rocky or high-energy coastlines (ADF&G 1973). The population is evidently expanding its range toward the south; recent literature indicates well-established populations of sea otters around the west coast of Afognak Island, the Trinity Islands, and Chirikof Island (BLM 1980). Sea otters are also beginning to recolonize sites around Kodiak Island, expanding into Marmot, Chiniak, and Kizhuyak bays and the outer portions of Viekoda, Uganik, Spiridon, and Uyak bays (BLM 1981).

3.1.3 ESTUARIES

Definition

Estuaries are semi-enclosed bodies of water that have a free connection to the sea and in which sea water and fresh water mix. Fresh water is supplied by runoff from rivers and streams.

Figure 3.3. Marine sightings of northern (Steller) sea lion by season.



Source: Mercer et al. In SAI 1980.

Estuarine systems in the Kodiak Archipelago may involve large bodies of water, such as major bays, inlets, and fiords, or may be more limited systems at the mouths of rivers, extending upstream to the limit of saltwater intrusion.

General Description

In Kodiak, most nearshore marine waters are designated as estuarine because of their extensive dilution by fresh water (AEIDC 1979). Estuarine areas were considered to extend from headland to headland of bays, inlets, and fiords. Well-developed delta systems, apparently dominated by tidal action, lie at the head of most Kodiak fiords.

Kodiak estuarine areas are highly productive. Complexity of the submarine topography and sediments and good algal growth, including extensive kelp beds, provide basic nutrients and diverse habitat to support herbivore and carnivore populations. Some of these populations are not of commercial value, but are essential for maintaining the diversity and productivity of the estuary. In addition, many marine finfish and shellfish utilize the estuarine areas during larval and juvenile stages of development. For example, during extensive sampling of Izhut, Kalsin-Chiniak, Kiliuda, and Kaiugnak bays, planktonic fish eggs and larvae were present during all cruises in both surface and subsurface samples (Rogers et al. 1979).

Fisheries Resource

Shellfish. Shellfish rely upon the estuarine environment. In a series of samples taken in Alitak, Ugak, Kiliuda, and Izhut bays, the major portion of arthropods taken in the first three estuaries were king crab, Tanner crab, and pink shrimp (Tables 3.6 and 3.7). In Izhut Bay, Tanner crab were taken in quantity throughout the year; pink shrimp were predominant in August and May (Table 3.6).

Table 3.6. Percent biomass composition of epibenthic organisms trawled in Izhut and Kiliuda bays, 1978.

Phylum	Apr	May	Jun	Jul	Aug	Nov
Izhut Bay						
Porifera	21.9	0	0	0.3	0	t
Cnidaria	7.5	2.3	0.3	2.8	t	2.2
Mollusca	2.1	2.9	0.1	4.6	2.1	0.2
Arthropoda	5.8	44.0	83.4	58.7	64.7	56.9
Echinodermata	61.7	50.8	15.6	33.3	33.0	40.3
Other	1.0	0	0.6	0.3	0.2	0.4
Kiliuda Bay						
Porifera	0.1	–	0	t	0	t
Cnidaria	0	–	0	13.9	t	0.9
Mollusca	6.9	–	0	3.6	2.4	2.8
Arthropoda	90.4	–	100.0	81.9	97.0	96.1
Echinodermata	2.4	–	0	t	0	0
Other	0.2	–	0	0.6	0.6	0.2

Source: Feder et al. 1979. In SAI 1980.

Table 3.7. Number, weight, and density of major epifaunal invertebrate phyla of Alitak and Ugak bays: June, July, and August 1976 and March 1977.

	Number of organisms		Weight (kg)		Percent of total weight*		Biomass density (g/m^2)	
	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak
Porifera	649	1037	44	89	0.38	1.25	0.02	0.04
Cnidaria	71	275	12	45	0.10	0.63	0.01	0.02
Mollusca	276	570	17	6	0.14	0.09	0.01	**
Arthropoda	294,718	162,337	115,87	6,820	99.10	95.85	5.94	3.39
Echinodermata	77	577	23	137	0.19	1.93	0.01	0.07
TOTAL	295,791	164,796	11,683	7,097	99.91	99.75	5.99	3.52

Source: Feder and Jewett 1979b. In SAI 1980.

* Totals do not equal 100 percent due to rounding.
** Average biomass $0.01 g/m^2$.

Preferred habitat for king crab spawning is kelp-covered reefs or rocky areas (AEIDC 1975). Extensive areas throughout Kodiak waters have been identified by ADF&G as vital for king crab rearing (ADF&G 1978, Map 5). These areas include all estuaries on Sitkinak, Shuyak, and Afognak islands, and the east coast of Kodiak Island around Aliulik Peninsula and into Alitak Bay. Estuarine areas of Tugidak Island and the west coast of Kodiak Island were designated as important for king crab rearing.

Tanner crab life cycles and habitat in the Kodiak area are poorly documented (Bill Donaldson, personal communication). As a result, data concerning areas vital for their reproduction are incomplete. Olga Bay has been identified as an estuarine area of vital importance to Tanner crab (ADF&G 1978, Map 5). Other studies include Marmot Bay, Chiniak Bay, Ugak Bay, Kiliuda Bay, Kaiugnak Bay, and Alitak Bay as major estuarine areas used by Tanner crab for rearing and mating (SAI 1980).

Dungeness crab utilize all the estuarine areas of the Archipelago. Other important estuarine invertebrates include clams and shrimp. Major razor clam areas have been identified in Chiniak Bay, Ugak Bay, Tugidak tide flats, the area between Tugidak and Sitkinak islands, Ocean Bay, Rolling Bay, Alitak Lagoon, Bumble Bay, Halibut Bay, Karluk Anchorage, and Sevenmile Beach. Of these areas only the five-mile stretch at Halibut Bay is rated as having a good abundance of razor clams (ADF&G 1978).

In August and September adult shrimp migrate into the estuaries. All estuarine areas around Kodiak Island and Afognak Island are classified vital to shrimp reproduction and rearing (ADF&G 1978, Map 6).

Finfish. Herring rely heavily on Kodiak's estuarine systems. Most major herring concentrations occur in estuarine areas since these habitats are used for spawning, larval and juvenile development, and overwintering. Although herring do not necessarily return to natal estuaries

to spawn, several areas traditionally support major herring populations. On the east side of the islands, important estuaries include Sitkalidak Strait, Shearwater Bay, Chiniak Bay, Kizhuyak Bay, and Izhut Bay. On the west coast of the islands, important habitat is more extensive; it includes all estuarine areas north of Uyak Bay to Shuyak Strait, the Sturgeon River area, and the north shore of Sitkinak Island (ADF&G 1978, Map 6).

Anadromous Fish. Dolly Varden, steelhead trout, and salmon rely heavily on estuarine habitat as a staging area prior to running upstream to spawn; in some species for spawning; and as a nursery area for juveniles following downstream migrations. Important life history features of salmon are summarized in Table 3.4 and Figure 3.2. Pink salmon make extensive use of estuarine areas during larval and juvenile development. Larvae migrate to saltwater estuaries immediately upon hatching, where they school and probably remain all summer (AEIDC 1979). In addition, pinks often spawn intertidally in estuarine areas. Chum salmon also spawn intertidally, but to a lesser extent (ADF&G 1978). Since salmon are known to utilize streams within every estuary and Dolly Varden are believed to utilize all stareams that maintain flow during winter, all estuarine areas in the Kodiak Archipelago provide important habitat for anadromous fish.

Marine Mammals

Marine mammals comprise another important user group within Kodiak Archipelago estuaries. Harbor seals utilize all estuarine areas around the Archipelago for hauling out. Particularly large seal concentrations are found in estuaries along the eastern and southern shores of Kodiak Island, especially in Womens, Kalsin, Ugak, Kiliuda, and Deadman bays. On Afognak Island harbor seals congregate in Malina, Foul, Perenosa, and Seal bays (BLM 1980, 1981).

Sea lions also haul out in estuarine areas, particularly during winter months when they tend to move into more protected waters (ADF&G

1973). Estuaries used by sea lions include Vera Bay on Long Island, Deadman Bay, and Sulua Bay (ADF&G 1973, Map 4).

Although sea otter typically avoid the upper reaches of estuarine areas, medium to high densities of sea otter have been noted in all estuarine areas around Afognak Island and in Viekoda Bay on Kodiak Island. Low densities of sea otter frequent Kizhuyak Bay, Chiniak Bay (including Womens and Middle bays), Uyak Bay, Spiridon Bay, and Uganik Bay (BLM 1981).

Recent data indicate sightings of both endangered and nonendangered species of whales in estuarine areas around the Kodiak Archipelago (Table 3.8). Estuaries with several whale sightings include Uyak Bay, Uganik Bay, Uganik Passage, Chiniak Bay, Ugak Bay, Kiliuda Bay, and Sitkalidak Strait (BLM 1981).

River otters are reported to use many Kodiak estuaries heavily, although the locations of prime otter estuarine habitat within the Archipelago have not been identified (Bill Donaldson, personal communication).

Birds

Estuaries within the Kodiak Archipelago, with their abundant food supplies and protected waters, provide high-value bird habitat. Densities are most abundant and species composition most diverse during the winter, when breeding birds from northern nesting grounds gather in protected estuaries and lagoons. During this season waterfowl (particularly mallards, emperor geese, goldeneyes, and eiders) and marine birds (particularly cormorants, gulls, murres, murrelets, and crested auklets) are most common (Table 3.9). Bald eagles are also common during winter. During winter months, these birds are widely distributed throughout the Archipelago in the nearshore zone. Major concentrations recorded during a 1976 winter survey (Arneson 1977) occurred along the northern

Table 3.8. Whale sightings around the Kodiak Islands 1975-1980.

Location \ Species	Gray Whale[1]*	Humpback*	Fin*	Sei*	Minke	Killer
Perenosa Bay	X[2]					
Tonki Bay	X[2]					
Izhut Bay		X				
Chiniak Bay	X[3]			X		
Ugak Bay	X					
Kiliuda Bay		X				
Sitkalidak Strait	X				X	
Uyak Bay	X	X	X		X	X
Uganik Bay	X		X		X	X
Viekoda Bay			X			
Foul Bay			X			

Source: BLM 1981.

*Endangered species

[1]The migratory route of the gray whale is depicted as utilizing all estuaries on the east side of Kodiak Borough.

[2]Major spring whale concentrations are depicted in these bays.

[3]Major spring whale concentrations are depicted in Chiniak Bay, including Womens, Middle, and Kalsin bays.

Table 3.9. Seasonal avian utilization of Kodiak Archipelago bays and estuarine waters.

Family	Species	Bay and Estuarine Waters			
		Spring	Summer	Fall	Winter
Gaviidae	Common Loon	1	?	?	1
	Yellow-billed Loon	–	–	–	–
	Arctic Loon	1	–	?	1
	Red-throated Loon	1	1	1	1
Podicipedidae	Red-necked Grebe	1	–	–	1
	Horned Grebe	–	–	?	2
Diomedeidae	Black-footed Albatross	–	–	–	–
	Laysan Albatross	–	–	–	–
Procellariidae	Northern Fulmar	2	2	2	–
	Pink-footed Shearwater	–	–	–	–
	Flesh-footed Shearwater	–	–	–	–
	New Zealand Shearwater	–	–	–	–
	Sooty Shearwater	2	3	3	–
	Short-tailed Shearwater	2	3	3	–
	Manx Shearwater	–	1	–	–
Hydrobatidae	Scaled Petrel	–	–	–	–
	Fork-tailed Storm Petrel	–	2	2	–
	Leach's Storm Petrel	–	–	–	–
Phalacrocoracidae	Double-crested Cormorant	2	1	1	2
	Pelagic Cormorant	2	2	2	3
	Red-faced Cormorant	2	2	2	3
Anatidae	Whistling Swan	1	–	–	1
	Canada Goose	?	–	1	–
	White-fronted Goose	1	–	1	–
	Black Brant	2	–	–	–
	Emperor Goose	2	–	–	2
	Mallard	3	–	–	3
	Gadwall	2	–	–	2
	Pintail	3	1	1	2
	Green-winged Teal	1	1	1	2
	Blue-winged Teal	1	1	–	–
Anatidae	American Wigeon	2	?	?	2
	European Wigeon	1	–	1	–
	Northern Shoveler	1	–	1	1
	Redhead	–	–	–	1
	Canvasback	1	–	?	1
	Ring-necked Duck	1	–	–	1
	Tufted Duck	–	–	–	?
	Greater Scaup	2	?	?	2
	Lesser Scaup	1	–	–	1
	Common Goldeneye	3	?	2	2
	Barrow's Goldeneye	1	?	?	1
	Bufflehead	1	–	2	2
	Oldsquaw	3	–	–	4
Anatidae	Harlequin Duck	2	2	2	2
	Steller's Eider	2	–	2	3
	Common Eider	2	2	2	3
	King Eider	2	–	–	3

Table 3.9. (Concluded)

Family	Species	Bay and Estuarine Waters			
		Spring	Summer	Fall	Winter
	Spectacled Eider	–	–	–	1
	White-winged Scoter	3	1	2	3
	Surf Scoter	2	1	1	2
	Common Scoter	3	1	1	3
	Smew	1	–	–	?
	Common Merganser	1	?	?	1
	Red-breasted Merganser	1	1	1	1
Phalaropodidae	Red Phalarope	1	–	–	–
	Northern Phalarope	1	1	1	–
Stercorariidae	Pomarine Jaeger	2	2	2	–
	Parasitic Jaeger	2	2	2	–
	Long-tailed Jaeger	1	1	?	–
	Skua	–	1	–	–
Laridae	Glaucous Gull	1	1	1	1
	Glaucous-winged Gull	3	3	3	3
	Slaty-backed Gull	–	–	1	–
	Herring Gull	1	1	1	1
	Thayer's Gull	–	–	–	?
	Ring-billed Gull	–	–	–	–
	Franklin's Gull	–	–	–	–
	Bonaparte's Gull	–	1	–	–
	Mew Gull	3	3	3	3
	Sabine's Gull	–	1	?	–
	Black-legged Kittiwake	4	4	4	2
	Red-legged Kittiwake	–	–	–	–
	Arctic Tern	3	3	3	–
	Aleutian Tern	2	2	–	–
Alcidae	Common Murre	3	3	3	4
	Thick-billed Murre	1	1	1	1
	Pigeon Guillemot	3	3	3	3
	Marbled Murrelet	3	3	3	3
	Kittlitz's Murrelet	1	1	1	–
	Ancient Murrelet	1	1	1	1
	Cassin's Auklet	3	2	2	?
	Parakeet Auklet	–	1	–	–
	Crested Auklet	–	–	3	4
	Least Auklet	–	–	–	?
	Rhinoceros Auklet	–	2	2	?
	Horned Puffin	3	3	3	1
	Tufted Puffin	4	4	4	1

Source: SAI 1980.
1 = Probably less than 100; 2 = hundreds; 3 = thousands; 4 = tens of thousands.

and eastern coasts of Afognak and Kodiak islands (Figure 3.4). Chiniak and Kizhauyak bays the supported the most birds, with densities ranging from 51 to 70 birds per square kilometer.

Estuarine habitats are also heavily utilized during summer, primarily providing feeding habitat for waterfowl and marine birds nesting in adjacent areas. Shearwater, black-legged kittiwakes, and common murres dominate the summer community, although cormorants, fork-tailed storm petrels, northern fulmars, Arctic terns, gulls, and puffins are also common.

During spring migrations, estuaries provide primary avian staging, feeding, and resting habitat. Although distribution and utilization patterns during this period change daily, waterfowl typically dominate the scene. Loons, grebes, marine birds, and shorebirds are also common.

3.1.4 BARRIER ISLANDS AND LAGOONS

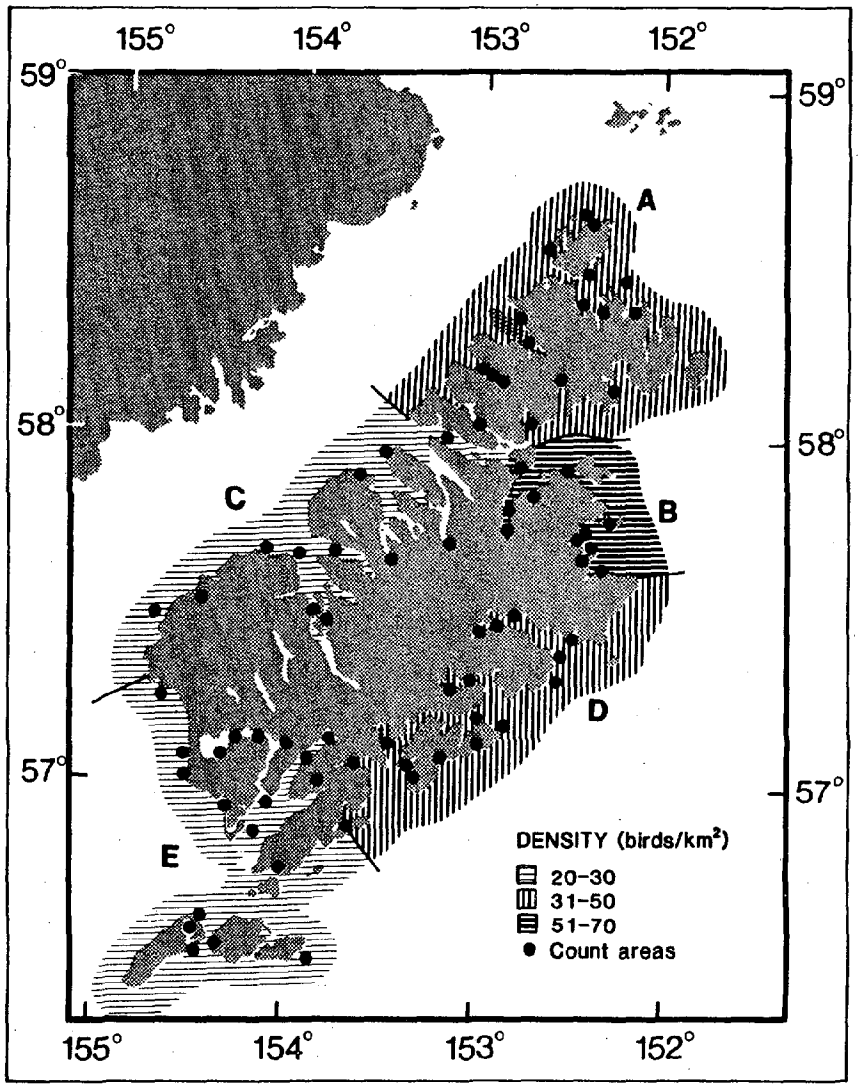
Definition

Barrier island and lagoon systems typically consist of elongated, low-profile nearshore islands that run parallel to the shore and protect a saltwater lagoon between the islands and the mainland. The protected lagoon has either free or intermittent exchange of water with the sea.

General Description

Within the Kodiak Archipelago, true barrier islands usually do not occur. In this area, lagoons are usually associated with and protected by coastal spits or shoals. Due to this morphology, Kodiak lagoons tend to be specialized estuarine systems with restricted exchanges of sea water. Two possible exceptions to this characteristic of Kodiak lagoons are Dry Spruce Bay and Anton Larsen Bay (ADNRa 1980). Since these areas are biologically more comparable to those covered under the estuarine habitat, however, they are included in that habitat.

Figure 3.4. Winter densities of Kodiak coastal birds.



Source: SAI 1980.

Lagoons are most prevalent in the south and southwestern portions of the Archipelago. Unlike other estuarine systems of the islands, lagoons included in this habitat are shallow and tend to have sandy or flat shorelines. Even those lagoons scattered around the remaining shores of Kodiak Island usually conform with these characteristics.

Marine and Upland Mammals

Given the general physical characteristics of Kodiak lagoons, more than one-fourth of the sandy beaches used for harbor seal pupping are within lagoons. Those lagoons with names include Sitkinak, Sukhoi, Grant, and McDonald.

Although the entire Kodiak Archipelago is considered prime habitat for river otter, tidal lagoons with salmon runs are considered the best sites. No surveys have been made, however, to correlate these areas with number of otter (RRA/IEC 1978).

Finfish and Shellfish

Lagoons meet some of the criteria for finfish and shellfish spawning and rearing. Among those most frequently used are McDonald Lagoon, Sitkinak Lagoon, Browns Lagoon, and Karluk Lagoon (AD&G 1978, Map 2). All but McDonald Lagoon are used for salmon spawning. McDonald Lagoon is vital for shrimp and Dungeness crab rearing. Spawning seasons and substrate preferences are comparable to those discussed under estuarine; wetland and tidal flat; and river, stream, and lake habitats.

Birds

Waterfowl and eagles are the dominant types of birds using lagoon habitats. Species composition, abundance, and seasonal distribution are comparable to those for estuarine habitats.

3.1.5 WETLANDS AND TIDEFLATS

Definition

Wetlands are permanently moist, shallowly submerged lands (such as marshes, wet tundra, swamps, or bogs) that support characteristic vegetative communities. Tideflats include those habitats that are alternately covered and uncovered by marine tidal changes. These two habitats frequently occur in combination at the heads of bays and fjords, and at the mouths of rivers. Freshwater wetlands also occur in inland lowlands. The coastal tideflat locations surrounding the Kodiak Archipelago have been mapped and classified to include shorelines that have either relatively flat intertidal areas of sand, gravel, or bedrock, or moderate slopes of sandy substrate (Sears & Zimmerman 1977).

General Description

The presence of coastal tideflats surrounding the Kodiak Archipelago is relatively low; however, the actual amount of habitat varies by region. Kodiak and Afognak islands have very limited tideflat wetland complexes. Hayes and Ruby (1979) indicate that 3.7 percent of the shoreline substrate on these islands is sand or mud. The coastal classification map (Map 3) indicates a greater percentage, since tideflats have been defined in this study also to include level gravel or bedrock beaches, in addition to the more commonly applied sandy or muddy bottom beaches. Extensive tideflat-wetland complexes usually occur only at the heads of bays or around lagoons on these islands. In addition to these saltwater habitats, large inland wetlands occur in the Karluk River and Ayakulik River drainages in southwestern Kodiak.

In sharp contrast to the availability of these habitat types on Kodiak and Afognak islands, shorelines around the Trinity Islands contain extensive tideflats, and most of the Tugidak Island mainland is wetland habitat. Hayes and Ruby identified 66.5 percent of these

shorelines as sandy substrate. All of the Tugidak Island shoreline and large portions of the adjacent Sitkinak Island coast fall into this category.

Tideflat-wetland complexes provide a valuable habitat for birds and mammals, particularly when used in combination with adjacent waters. In addition, the tideflat areas, especially those that are composed of sandy beaches, provide habitat for abundant clam and polychaete populations. Taxonomic variety and numbers of benthic individuals vary according to site-specific sediment characteristics (Table 3.10).

Birds

The coastal tideflat-wetland complexes are used primarily by birds as summer nesting, feeding, and migratory staging habitat. During winter months, however, this habitat, particularly lower tideflats, is used in conjunction with adjacent bays, lagoons and estuaries to serve as habitat for diving ducks and geese.

Most summer nesting occurs in coastal wetlands above high tide lines and in inland freshwater wetlands. Whistling swans, mallards, pintails, and shorebirds are dominant summer nesting residents.

The entire Archipelago provides high-quality bird habitat through its numerous complexes of wetlands; tideflats; and adjacent lagoons, estuaries, and bays. Hence, birds are widely distributed. However, some areas annually receive high seasonal use. Heavy winter use areas are in Chiniak, Uyak, Uganik, Alitak, Kizhuyak, Middle and Kalsin bays; intensive summer nesting occurs in the Karluk and Ayakulik River drainages and on Tugidak Island.

Marine Mammals

Coastal tideflats are also favored by harbor seals as pupping habitats. Concentrations of harbor seals during the pupping season occur

Table 3.10. Sediment characteristics, density of *Siliqua patula* (razor clam), and taxonomic diversity richness (counts) in the Kodiak area.

Site	Tide Level Stations Surveyed	Mean Grain Size	No. *S. patula* Sample	Number of Taxa	
				Bivalves	Polychaetes
Halibut Bay	10	0.21	268	7	8
Bumble Bay	6	0.60	4	1	3
Tugidak	5	0.23	23	1	5

Source: Kaiser and Konigsbert 1977. *In* SAI 1980.

on tidal beaches on Tugidak, Sitkinak, Geese, and Aiaktalik islands. Other tideflats used by seals include those located within Alitak Bay, Ugak Bay, Sukhoi Lagoon, Grant Lagoon, Terror Bay, Paramanof Bay, McDonald Lagoon, Ocean Bay, Rolling Bay, north of Driver Bay, the Ayakulik area, and West Amakuli Island (ADF&G 1973, SAI 1980, Map 4).

Upland Mammals

Upland mammals use these shores, primarily for forage. Red fox and Arctic fox depend upon beach fleas, clams, crabs, marine birds, fish, and beach carrion for food. (SAI 1980); Sitka black-tailed deer depend upon beach grass, sedge, and kelp during the winter season when other food sources are not available (SAI 1980).

3.1.6 ROCKY ISLANDS AND SEACLIFFS

Definition

This classification includes rocky islands, offshore reefs, and all vertical seacliffs with no intertidal area. Rocky islands generally have rock or cliff-lined shorelines. Occasionally rocky islands have tundra-vegetated interiors or areas along their coasts that are fairly level. This habitat category applies to most of the offshore islands. Along the coast of the major islands, however, this habitat type is limited to those shores with vertical cliffs. Occasionally a steep slope area is included if the substrate is bedrock and the contours indicate very limited intertidal area.

Marine Mammals

Offshore rocky islands and seacliffs are particularly important to marine mammals and marine birds. Almost one-third of the known harbor seal haulout sites within the Archipelago are on rocky islands and reefs (ADF&G 1973; BLM 1980). Many of these sites are along the east coast of Kodiak Island in the vicinity of Chiniak and Ugak bays. The remaining sites are distributed around the Archipelago.

Sea lions also have a strong affinity for rocky island and seacliff habitats. Major sea lion pupping rookeries occur in this habitat type on Chirikof, Sugarloaf, and Marmot islands (BLM 1980). These traditional sea lion pupping areas provide almost all of the annual recruitment for the Kodiak Archipelago and a majority of the recruits for the Gulf of Alaska. Areas used by sea lions and harbor seals as haulout grounds include Twoheaded Island, Gurney Bay, Barren Islands, Latax Rocks, and Nagai Rocks. Sea lions also use Sea Lion Rocks off the coast of Tonki Cape (Figure 3.3)(Map 4). Sea lions are most abundant in the coastal area during the spring season.

Birds

Marine birds are a dominant feature of the Kodiak coastal zone. They are abundant during all seasons, and are widely distributed throughout the Archipelago. At least 23 species are known to occur regularly (MacIntosh 1980); approximately 253 major nesting rookeries exist and support approximately 1.2 million nesting marine birds (Sowls, et al. 1978). Rocky island and seacliff ledges provide the preferred nesting habitat for most species. Exceptions include tufted puffins and fork-tailed storm petrels, which prefer to dig nesting burrows and hence are associated with soil bluffs. Common murres, tufted puffins, fork-tailed storm petrels, and black-legged kittiwakes are most abundant. Other birds common in this habitat include double-crested cormorants, pelagic cormorants, glaucous-winged gulls, Arctic terns, pigeon guillemots, and horned puffins.

The Barren Islands support the largest concentration of marine birds within the Kodiak Archipelago. Most of the remaining major rookeries are located on the northern and eastern coasts of Kodiak and Afognak islands (Map 8). Some of the more important areas on these coasts include Flat Island, West Boulder Bay, The Triplets, Ermine Point Island, Eider and Nelson islands, Island Bay Islands, and Anton Larsen Bay.

Seacliffs also provide nesting habitat for raptors, particularly peregrine falcons. The peregrine falcon that occurs in the Kodiak Archipelago is the nonendangered Peale's subspecies (Falco peregrinus pealei). The population status and distribution of this bird is not known, however, it is believed to be widely distributed along the coastal zone throughout the Archipelago. Some birds may also nest on inland cliffs.

3.1.7 EXPOSED HIGH-ENERGY COASTS

Definition

Exposed high-energy coasts are directly exposed to ocean-generated waves and storm surges. Intertidal areas are subject to dynamic shoreline processes, such as erosion and deposition. Beach sediments range from coarse sand and gravel to boulders and rocks.

Exposed high-energy coasts became an all-encompassing shoreline category in the Kodiak Archipelago for several reasons. First other habitat definitions could not be modified to include additional shoreline types without losing their viability. For example, although most shorelines are within estuaries, the estuarine habitat is restricted to the coastal zone below MLLW. Alternatively, definitions for wetlands and tideflats, and for rocky islands and seacliffs refer to highly specialized coastal forms. Although these definitions are extended to shores only marginally applicable, much of the shoreline still remains without designation.

Second, exposed high-energy coasts could be applied to remaining shores on the basis of substrate characteristics. Energy levels are difficult to assess in the Kodiak Archipelago. Local variations in wind, combined with the highly convoluted shorelines, significantly affect local circulation and, therefore, energy levels (Hayes and Ruby 1979). As a result, it is not always possible to determine accurately the energy levels associated with site-specific bedrock, boulder, or gravel beaches.

(Note: Hayes and Ruby's classifications consistently apply to energy levels only with respect to protected headlands. Descriptions associated with other categories at specific sites indicate that their remaining categories can apply to a range of energy levels.)

General Description

Exposed bedrock shores comprise approximately 50 percent of Kodiak and Afognak islands. Almost 90 percent of the Barren Islands are exposed bedrock (Sears and Zimmerman 1977). Exposed bedrock shores usually have moderate to steep gradients. Approximately 86 percent of the Archipelago is erosional (Hayes and Ruby 1979). Erosion is considered a relatively slow process in the islands, however, because of the resistant nature of bedrock (AEIDC 1975).

Biological Resources

Exposed high-energy coasts provide habitat for a variety of marine littoral-zone flora and fauna, which in turn are used by important fish and wildlife resources. In addition, high-energy coasts provide feeding and nesting habitat for a few bird species and a food source and resting habitat for marine mammals.

Rocky intertidal areas of exposed high-energy coasts of the Kodiak Archipelago have been classified into three biotic zones:

Zone 1: Supralittoral fringe (splash zone)--Extends from mean higher high water (MHHW) to the highest reach of spray.

Zone 2: Littoral Zone--extends from MHHW to the low water of spring tides. This zone is further divided into four subzones, reflecting temporal differences in tidal coverage and different predominant species.

Zone 3: Infralittoral fringe--Extends from low waters of spring tides to true subtidal.

The relative biotic cover in each of these zones is depicted in Figure 3.5. Significant features of the splash zone are that this zone support only a thin veneer of bluegreen algae and a small number of snails and amphipods. The uppermost area of the littoral zone, covered only at MHHW, is primarily characterized by bare rock. In the midlittoral zone, algal and invertebrate cover is almost complete and is dominated by rockweek, a brown algae; barnacles and mussels also are prevalent. Below the midlittoral level is a dense band of red algae, and chitons appear. Eelgrass, found in the lower reaches of rocky intertidal and nearshore areas, provides critical habitat for king and Dungeness crab (BLM 1981). The most complete biological break evidently occurs in the fourth subzone, below mean lower low water (MLLW). Above MLLW small foliose red and brown algae dominate. Below MLLW large-bladed brown kelp dominate. In the infralittoral fringe, brown kelp continues to dominate, though with different species prevalent (Figure 3.5).

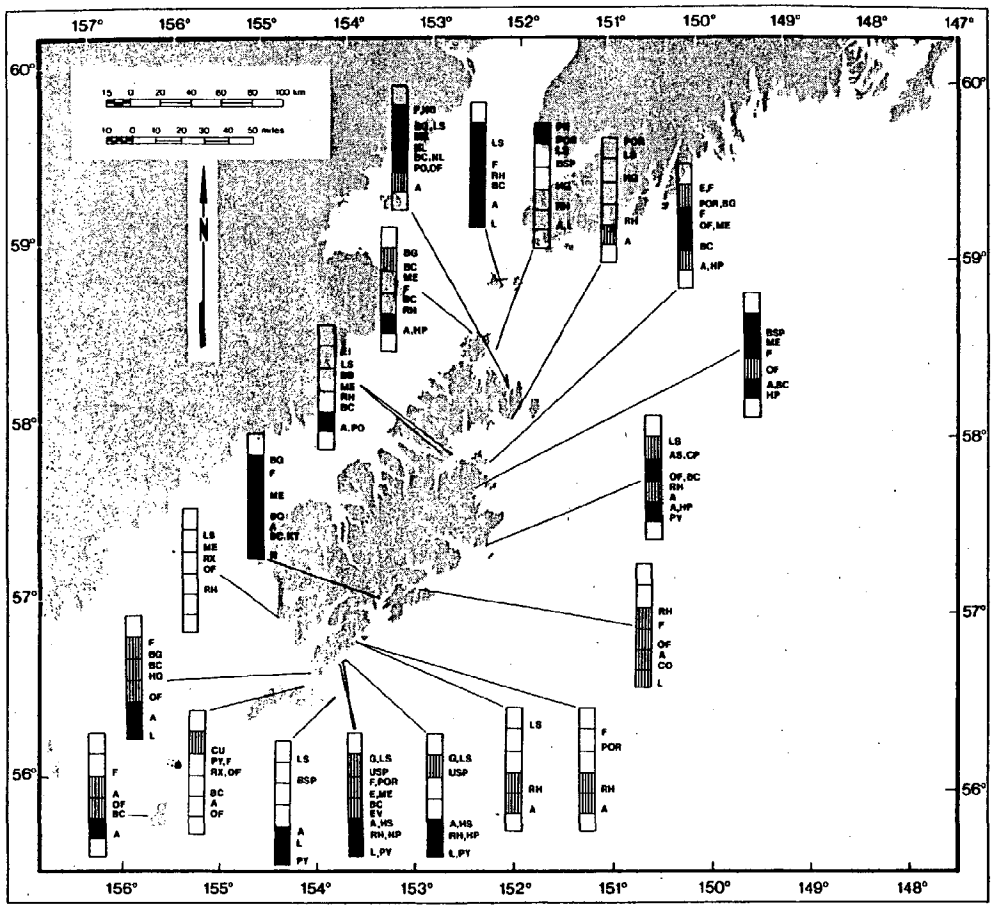
Site characteristics modify the above generalized zones. Modifying factors include wave exposure, beach profile, and substrate. Critical factors influencing specific sites appear to be:

- Bedrock and large boulder substrates promote the development of a taxonomicaly rich community with large amounts of biomass.

- High wave exposure with small boulders on the site yields low variety and abundance.

Mammals

Another factor modifying shoreline communities is the presence of sea otters. Sea otter activities are concentrated along shores characterized by high-energy coasts (Maps 3 and 4).Within this area, sites frequented by sea otter are typified by a community structure exhibiting extensive marine algae beds; fewer barnacles, mussels, sea stars, and snails; and high-density populations of amphipods, isopods, mysids, and predacious fish.



SPECIES KEY

A - Alaria sp (brown kelp)
AS - Acmaea scutum (limpet)
BB - Balanus balanoides (barnacles)
BC - Balanus cartosus
BG - Balanus glanduta
BSP - Balanus sp.
CO - Coralline algae
CP - Collisella pelta (limpet)
CU - Cucumaria sp. (sea cucumber)
E - Endocladia muricata (red algae)
EI - Enteromorpha intestinalis
EV - Evasterias (sea star)
F - Fucus distichus (rockweed)
G - Gigartina sp
HC - Halosaccion glandiforms (red algae)
HP - Halichondria panicea (sponge)
HS - Hedophyllum sesslis (brown kel
KT - Katharina tunicata (chiton)
L - Laminaria sp (brown kelp)
LS - Littorina sitkana (snail)
ME - Mytitus edulla (mussel)
N - Nereocystis luetkeana (floating kelp)
NL - Nucella lamellosa (snail)
OF - Odonthatta floccosa (red algae
PO - Pleaster ochraceus (starfish)
POR - Porphyra sp (leafy red algae)
PR - Prasiola meridionalla (green algae)
PY - Phyllospadix (flowering surf a
RH - Rhodymenia palmaia (red algae)
RX - Rhodymenia larix (red algae)
USP - Ulva sp (green algae)

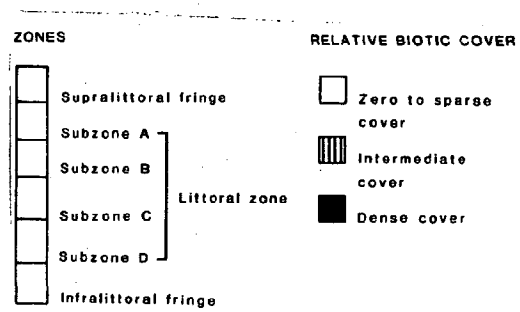


Figure 3.5. Relative biotic cover at intertidal sampling sites.

Source: Zimmerman et al. 1978, In SAI 1980.

Both harbor seals and sea lions heavily utilize high-energy coasts for hauling out. Harbor seals, though located throughout the Archipelago, concentrate their activities on the south and eastern shores. Sea lion sites are less abundant but are also distributed throughout the islands. Major sea lion rookeries are located on, or adjacent to, high-energy coasts on Sugarloaf, Marmot, and Chirikof Islands. Both seals and sea lions are most abundant in coastal waters and on haulout areas during spring and summer months.

Of the upland mammals, Sitka black-tailed deer are the most active users of high-energy shores. Deer utilize and rely upon intertidal areas along these shores for forage during severe winter months. Deer occupy most of Afognak and Kodiak islands, although they are most abundant in the northern portion of Kodiak Island.

Birds

Bird use of high-energy coasts is generally limited to the few species, particularly shorebirds, that use these habitats for nesting and feeding. Black oystercatchers, black turnstones, surfbirds, and rock sandpipers are most frequently encountered. In addition to shorebird use, other birds, including gulls, terns, bald eagles, ravens, crows, and many songbirds, frequently visit these areas in search of food.

3.1.8 RIVERS, STREAMS, AND LAKES

Definition

Rivers, streams, and lakes provide critical aquatic habitat for resident and anadromous populations. In addition, they support summer and winter activities of local bird and mammal (particularly bear, beaver, and land otter) populations. Rivers and streams are the conduit for the freshwater component of estuarine systems, and serve as a valuable link between upland and marine environments.

General Description

The largest lakes and longest rivers within the Borough are located in southwest Kodiak Island. Major southwest lakes include Karluk, Frazer, Red, Akalura, and South Olga lakes. Other important lake systems on Kodiak Island, such as Spiridon, Little River, Uganik, Terror, Buskin, and Lake Rose Tead, are significantly smaller. Very small pothole and high mountain lakes are also prevalent. Pothole lakes are generally found along the Upper Ayakulik River, between Olga Bay and the ocean, at the mid-reach of the Karluk River, on the Lower Aluilik Peninsula, and throughout Tugidak Island. Pothole lakes are also prevalent in the north and northeast sections of Afognak Island and on Shuyak Island. Major lakes on Afognak Island include: Selief Lake, Afognak Lake, Big and Little Kitoe lakes, Pauls, Laura, and Gretchen lakes, Portage Lake, Little Waterfall Lake, Hidden Lake, and Upper and Lower Melina lakes.

With the exception of the Ayakulik and Karluk rivers in southwest Kodiak Island, rivers in the Archipelago tend to be short and steep, often originating in small mountain lakes or small glaciers (AEIDC 1975). Almost all rivers support populations of anadromous fish, whose spawned-out carcasses supply essential phosphorus and nitrogen for phytoplankton production (AEIDC 1979). Bear and raptors, particularly the bald eagle, can be found along many of the streams, usually feeding on spawning salmon.

Fisheries Resources

One of the significant features of the freshwater systems in the Kodiak Archipelago is their abundant anadromous fish populations. General-life history features of these fishes are summarized in Table 3.4 and Figure 3.2. Dolly Varden char, as both anadromous and resident populations, are the most widely distributed freshwater or anadromous fish in the Kodiak region (ADF&G 1978). Anadromous Dolly Varden are fall spawners, returning to streams from midsummer through late fall. Spawning occurs between September and the end of December. After spawning, anadromous Dolly Varden seek lake-river systems in which to overwinter.

Although Dolly Varden always return to their natal stream to spawn, they have no equivalent homing instinct for the system in which they overwinter. Kodiak Island lakes known to be important Dolly Varden overwintering sites include: Buskin, Barabara, Saltery, Uganik, Little River, Frazer, Red, Karluk, and Akalura lakes, Upper Station (Olga Bay) and Lake Rose Tead. On Afognak Island the lakes include Afognak, Upper and Lower Melina, and Portage (ADF&G 1978). Dolly Varden fry hatch in the spring and remain in the streams for three to four years before migrating to sea. They remain at sea only six to eight weeks before returning to freshwater lakes for overwintering (ADF&G 1978).

Major native steelhead runs occur on the Karluk River, Ayakulik (Red Lake) drainage, Afognak River, Frazer Lake system, and Uganik River. Other systems where steelhead are present include South Olga Lakes, Portage Lake, Pauls Lake, Melina River, Saltery Creek, and Buskin River. Steelhead enter fresh water from late August through November, overwinter, and spawn the following spring. Fry remain in fresh water three to four years.

Distribution of rainbow trout, a permanent freshwater resident, closely coincides with that of steelhead. Both typically inhabit lake-river systems. The most important rainbow trout drainages include the Karluk, Ayakulik (Red), Portage, and Afognak (ADF&G 1978). Rainbow trout are also stocked in a number of lakes around the City of Kodiak.

All five species of salmon spawn in the Kodiak Archipelago. Each has a different development pattern and often a different stream preference (Table 3.4) Escapement figures vary considerably among the drainages (Table 3.11).

Pink salmon utilize nearly all drainages identified as anadromous fish streams, and are the only species recorded to spawn on Chirikof Island. The only river systems they do not appear to use are on Tugidak Island, intertidally off Sukhoi Lagoon, and in Russian Harbor (ADF&G 1978). In 1979, principal pink salmon return were on the east and west

Table 3.11. Selected Kodiak area peak salmon escapement counts for 1979.

ADF&G Stream No.[1]	Stream Name	Pinks[2]	Chum[3]	Red[4]	Coho[5]	King	Percent of Total Kodiak Escapement
251-105	Malina Creek	19,000		21,200			
302	Thorsheim	15,000		1,200			
304	E. Paramanof	13,000					
825	Perenosa Creek	71,000		8,500	1,480		
828	Paul's Lake			8,415			
252-314	Big Kitoi	15,988					
332	Big Danger	24,000					
334	Marka	41,500					
342	Afognak			82,703	4,920		
	Afognak Total[6]	257,191	2	123,018	9,630	0	9
Percent of Kodiak Escapement by Species[7]		10%	<.01%	9%	10%		
252-364	Goat Creek	12,000					
365	Kizhuyak Creek	29,600	31,200				
366	Pestchani Point	16,500					
371	Sheratin	38,000	11,150				
382	Red Cloud Creek	16,200					
253-121	E. Uganik	99,000	2,000	55,000			
331	Terror River	80,000	5,000				
332	Beaumans	18,100					
254-101	Little River	36,000		9,500			
201	West Uyak	19,000					
202	South Uyak	147,000					
203	East Uyak	58,000					
301	S.E. Zachar	43,000	2,900				
401	Spiridon River	18,000	21,000				

Continued

Table 3.11. (Continued).

ADF&G Stream No.[1]	Stream Name	Pinks[2]	Chum[3]	Red[4]	Coho[5]	King	Percent of Total Kodiak Escapement
255-101	Karluk	82,973		513,137	45,262	9,555	
201	Red River	10,878		223,070	2,047	4,833	
401	S. Sturgeon	45,000	150,000				
	Westside Totals[6]	812,289	226,403	801,707	47,319	14,392	43
Percent of Kodiak Escapement by Species[7]		32%	54%	60%	50%	~100%	
257-304	Upper Station			174,211	11,555		
402	Horse Marine		2,800	21,000			
403	Dog Salmon	95,178		126,742			
404	Little Dog Salmon	17,000					
502	Deadman River	97,500	2,400				
603	N. Sulua	10,500	3,200				
701	Humpy Creek	306,000					
	Alitak Total[6]	569,185	9,815	332,325	11,605	53	21
Percent of Kodiak Escapement by Species[7]		23%	2%	25%	12%	<.5%	
258-207	W. Kiliuda	22,000	11,000				
304	Ghost Rocks Creek	11,000					
522	Barling Bay	67,500	3,000				
541	Kaiugnak Point	13,000					
542	Kaiugnak Lagoon	17,000					
552	Cape Kiavak Creek	11,500					
602	N. Kaguyak	33,000	6,000				
701	Seven Rivers	100,700					
703	Tundra Lakes Cr.	10,000					
259-211	Buskin River	51,000		5,500	1,010		
222	Russian River	24,200					
223	Salonie Creek	19,500					
231	American River	45,300	5,000				
242	Sid Olds Creek	80,000	6,000		1,355		

Continued

Table 3.11. (Concluded).

ADF&G Stream No.[1]	Stream Name	Pinks[2]	Chum[3]	Red[4]	Coho[5]	King	Percent of Total Kodiak Escapement
259-251	Rosalyn Creek	11,500			5,825		
301	Sacramento Creek	23,000			7,000		
410	Pasagshak Trail	14,000					
412	Miam River	71,000			1,000		
414	Hurst Creek	17,000					
415	Saltery Creek	68,000	3,000	43,000	4,000		
424	Eagle Harbor	57,300	10,900				
	General Area Total	879,682	186,180	76,700	25,186		27
Percent of Kodiak Escapement by Species[7]		35%	44%	6%	27%	0%	

[1] Stream numbers are those designated by ADF&G for managing the salmon fishery. Escapement figures for 1979 generally fall toward the upper end of the range for each system.

[2] Those streams with return of 10,000 or more pink salmon.

[3] Partial listing, those streams with returns of 1,000 or more chum salmon. Other chum streams with peak escapement of 1,000 or more chum salmon are Santa Flavia (258-201) 18,000; Shearwater (258-202) 12,000; Dog Bay Creek (258-204) 9,000; Coxcomb Point (258-205) 14,000; Pass Creek (258-208) 9,000; Amee Bay (258-301) 3,200; McCord Bay (258-302) 3,800; Nut Island Creek (258-305) 1,200; Ocean Beach (258-401) 13,000; Newman Bay (258-513) 7,500; Midway Bay (258-521) 1,000; Old Harbor Creek (258-523) 1,300; Strip Creek (258-808) 1,350; Rough Creek (259-416) 12,000; Finger Creek (259-421) 2000; Seal Creek (259-423) 2,000; Gull Point Creek (259-426A) 2,800; and Gull Cape Creek (259-426B) 26,000.

[4] Partial listing, those streams with returns of 5,000 or more red salmon. Other red salmon streams with peak escapement of 5,000 or more red salmon are: Akalura Lake (257-302) 7,500; Ocean Beach (258-401) 15,000; and Pagagshak River (259-411) 12,000.

[5] Partial listing, those streams with returns of 1,000 or more coho salmon. Other streams with peak escapement of 1,000 or more coho salmon are Selief Creek (251-101) 1,000; Malina Bay Creek (251-202) 1,200; and Pasagshak River (259-411) 2,103.

[6] Since only selected streams are presented, totals are greater than the figures listed in the table.

[7] Kodiak fishing district minus counts for Alaska mainland.

Source: ADF&G 1979.

coasts of Kodiak Island. On the west coast more than 50 percent of the escapement entered the East Uganik, Terror, South Uyak, and Karluk river systems. On the east coast Sid Olds Creek and Seven Rivers received the most pink salmon. The single largest return was to Humpy Creek in the Alitak area (Table 3.11). Traditionally, the largest spawning populations seem to be on the Ayakulik (Red) and Karluk river systems. In addition to using more than 300 streams, pinks also make extensive use of intertidal areas for spawning. Pink salmon have evolved into two distinct classes - those that spawn in even-numbered years, and those that spawn in odd years. In the Kodiak Archipelago, the even-year run is more abundant (ADF&G 1978).

Chum salmon are second in abundance to pink salmon on Kodiak Island, spawning in streams in all major estuarine systems and occasionally in intertidal areas (ADF&G 1978). More than half the 1979 chum salmon escapement was into river systems on the west coast of Kodiak Island. Of these, more than half returned to the South Sturgeon River. Most of the remaining 1979 escapement was distributed among rivers on the east and west coasts of Kodiak Island, particularly between Kiliuda Bay and the southern tip of Aliulik Peninsula (ADF&G 1979). Historically, chum salmon are the only species to spawn on Tugidak Island, in Sukhoi Lagoon, and in about half the drainages on Sitkinak Island. On Afognak Island chum salmon are identified as spawning only at the headwaters of Kazakof Bay and Afognak Bay (ADF&G 1978). Afognak Island escapement equaled less than 1 percent of the natural chum salmon escapement in 1979. In Izhut Bay, the Kitoi Bay Hatchery releases 25 to 30 million pink and chum fry with an expected return of 250,000 to 300,000 adults (ADF&G, no date).

Sockeye salmon frequently spawn in lakes. Freshwater systems that have extensive sockeye spawning and are of major importance include Olga Bay (Upper Station), Red Lake, Frazer Lake and drainage area, Karluk Lake and drainages, and the Karluk River. Both the Frazer Lake system and the Karluk Lake system have ADF&G projects to enhance the sockeye population. Less extensive sockeye spawning areas are located in Selief Lake, Afognak

Lake, Pauls and Laura lakes, and Upper Malina Lake. Both Portage Lake and Pauls and Laura lakes have fish passes to extend spawning areas. Numerous streams around Afognak Island have shorter segments subject to sockeye spawning. On Kodiak Island, short stream segments for spawning include streams in Ocean Bay, Horse Marine Lagoon, Little River Lake, Uganik Lake, Barabara Cove, Buskin Lake, Pasagshag Bay, Portage Bay, and Saltery Cove (ADF&G 1978). A hatchery on Devils Creek (Buskin drainage) is used for incubating sockeye eggs to the eyed stage of larval development (ADF&G, no date). After years of population decline, 1979 red salmon escapement equaled or set the upper limit of historical escapement in almost half of the more productive red salmon systems (Table 3.12).

Coho salmon prefer heads of riffles in small tributaries or narrow side channels for spawning, although they also spawn in lakes. After hatching, fry school in shallow waters but disperse quickly as they establish territories in sheltered stream segments, where they remain for one to two years. The Karluk and Red River drainages in southwest Kodiak Island are the primary coho drainage systems (Table 3.13). However, most salmon spawning drainages on Raspberry, Shuyak, and Afognak islands have short to moderate stream segments where coho spawn (ADF&G 1978). Fish passes have been provided on Little Kitoi Lake, the Pauls-Laura-Gretchen lake system, and Portage River to extend the spawning areas accessible to salmon (ADF&G, no date). In northeast Kodiak Island, spawning sites are usually confined to the lower reaches, except for streams entering the southern shores of Chiniak Bay and the northern shores of Ugak Bay. The Devils Creek Hatchery is also used to augment the coho population. In the southern portion of Kodiak Island only three streams have coho spawning sites, one on the Aliulik Peninsula and two entering Deadman Bay (ADF&G 1978).

King salmon spawn only between the lower reaches of the Karluk River and Karluk Lake, and the upper reaches of Ayakulik River. King salmon have been introduced into the Frazer Lake system through the Frazer Lake Fishpass and Salmon Development Project of ADF&G. The hatchery at Devils Creek is also used to provide king salmon (ADF&G, no date).

Table 3.12. 1979 Red salmon escapements to major and minor systems.

Stream Name	Stream Number	1979 Escapement	Average[1] Escapement	Historical Escapement Range
Akalwra[2]	257-302	8,107	44,000	1,828 - 252,193
Afognak River[3]	252-342	82,703	22,892	100 - 93,861
Barabara Cove[3]	252-363	1,000	590	10 - 3,200
Buskin Lake[3]	259-211	5,367	3,017	65 - 5,367
Dog Salmon (Fraser Lake)[4]	257-403	126,742	40,000	6 - 126,762
Horse Marine[3]	257-402	23,000	5,243	15 - 23,000
Kaflia[2]	262-301	36,000	8,446	100 - 36,000
Karluk[2]	255-101	513,137	573,000	137,647 - 1,375,659
Little River[3]	254-101	9,500	11,365	300 - 38,500
Malina[3]	251-105	21,000	6,206	300 - 21,200
Miam[3]	259-412	1,200	1,450	300 - 4,600
Ocean Beach[3]	258-401	15,000	2,913	100 - 15,000
Pasagshak[3]	259-411	12,000	3,704	150 - 12,000
Pauls Lake[3]	251-828	415	13,570	150 - 50,993
Perenosa[3]	251-825	2,510	4,029	141 - 12,474
Red River (Red Lake)[2]	255-201	223,070	211,000	28,395 - 1,156,630
Saltery Lake[3]	259-415	43,000	13,105	1,000 - 43,000
Selief Bay[3]	251-101	1,000	1,075	400 - 2,800
Silver Salmon[3]	257-303	265	1,202	15 - 3,045
Swikshak[3]	262-151	41,000	8,155	1,500 - 41,000
Thorsheim Creek[3]	251-302	1,200	733	100 - 1,200
Uganik Lake[3]	253-122	55,000	26,682	1,500 - 77,000
Upper Station (Olga Bay)	257-304	174,211	175,000	22,603 - 616,064

Source: ADF&G 1979.

[1] Averages computed by using only those years when fish were observed in the Stream. Many years no surveys were flown or surveys were flown at the wrong time for observation of red salmon escapements.

[2] Average and historical escapement ranges based on weir counts between 1929 and 1979 and using only those years when fish were observed.

[3] Escapement counts based on aerial and foot surveys.

[4] Red salmon run was initiated in the 1950s. The first count of six salmon was reported in 1956. In 1980 escapement reached a new high of 405,535.

Table 3.13. Present and potential ADF&G rehabilitation and enhancement projects within Kodiak Island Borough.

PROJECT LOCATIONS	Sock-eye	Coho	Pink	Chum	King	Rain-bow	Project Type
EXISTING PROJECTS							
Kodiak Island							
Karluk System							
Upper Thumb R.	X						Incubator
E & N Forks Upper Thumb R.	X						Rehabilitation
Alder and Little Lagoon Creek	X						Incubator
Upper and Lower Thumb River	X						Egg take site
Frazer Lake	X		X	X	X		Fishpass
Devils Cr (Buskin R)	X	X	X		X	X	Hatchery
Afognak Island							
Kitoi Bay[1]				X	X		Hatchery
Little Kitoi Lake	X	X				2	Fishpass
Pauls-Laura-Gretchen Lks.	X	X					2 fishpasses
Seal Bay			X				Fishpass
Portage R.		X	X				2 fishpasses
PROPOSED PROJECTS							
Kodiak Island							
Kizhuyak River				X			Hatchery
Horse Marine Lake	X		X				Fishpass
POTENTIAL PROJECTS							
Kodiak Island							
Karluk System							
Spring Lake	X						Incubator
Thumb Lakes	X						Fertilizer Experiment
Red Lake	X						Egg Take
Akalura Lake	X						Hatchery
Upper Station	X	X					Egg take & incubation
Browns Lagoon			X				Fishpass
Spiridon Lake				X			Rechannel or hatchery
Terror Lake			X	X			Flow control
Pillar & Monashka Cr		X	X				Hatchery
Buskin Lake			X	X			Hatchery
Raspberry Island							
Selief Bay	X	X	X				Incubator
Afognak Island							
Afognak Lake[2]	X						Fishpass
Little Waterfall Lake			X				2 fishpasses
Hidden Lake			X	X			Fishpass and incubator
Paramanof Bay				X			Incubator
Malina Lake	X	X					Incubator

Source: ADF&G, no date.

[1] Potential supply of sockeye for Karluk Lake

[2] Potential use for rainbow trout.

[3] Considered most critical site of all

Present and potential ADF&G rehabilitation and enhancement projects within the Borough indicate that sockeye receive the main emphasis in the program. Much of the work to date has centered on the Karluk system.

Mammals and Birds

The abundant food source provided by local salmon runs encourages the use of freshwater systems by other animals. Harbor seals frequently congregate at the mouths of salmon streams to feed on migrating salmon. Bear also rely heavily on this food source, and congregate on most salmon streams during summer and fall months. During these periods brown bear are widely distributed throughout Kodiak and Afognak islands; however, areas on the western side of Kodiak Island - particularly the Karluk River drainage; Connecticut Creek near Red Lake; Dog Salmon River; Kaiugnak River; and areas around Uyak, Uganik, Terror, and Kizhuyak bays - support particularly dense bear populations (AEIDC 1979 Troyer and Hensel 1977).

River otter and beaver depend on streams and rivers throughout the year. The entire Archipelago is considered to be prime river otter habitat, although there are no documented areas of concentration (Donaldson, personal communication 1981). Beaver are also widely distributed throughout Kodiak Island. During a spring 1980 survey to assess potential problems caused by beaver dams on the upstream migration of spawning salmon, the staff from the Kodiak National Wildlife Refuge identified 400 active beaver colonies in the western and southwestern portions of Kodiak Island. Most beaver colonies were located in backwater areas with a firm substrate, to minimize the danger of heavy runoff destroying their dams. Areas of highest concentration included Karluk Lake and River, Red Lake-Ayakulik River, Deadman River, and Spiridon River and Lake (Table 3.14) Limiting factors on beaver populations include severe winters, marginal food supplies, trappers, and bear (Zwiefelhofer 1981, personal communication).

Table 3.14. Beaver colony distribution.

Major Salmon Spawning Drainages	No. of Active Colonies
Frazer Lake - Dog Salmon River	38
Karluk Lake and River	56
REd Lake - Ayakulik River	43
Deadman River	45
Spiridon River and Lake	58
Zachar River	18
Uganik Lake and River	17
Terror Lake and River	9
Browns' River	11
Upper Olga Bay and Flats	32

Minor Salmon Spawning Drainages	No. of Active Colonies
Aliulik Peninsula	10
Horse Marine River and Lake	5
Olga Moser Bay Narrows	13
SUlua Portage Bay	5
Uganik Bay and Island	33
Viekoda Bay	7
Total Number of Colonies	400

Source: Zwiefelhofer 1981, personal communication.

Many birds utilize riverine and lake habitats, particularly for nesting and feeding activities. Waterfowl, shorebirds, gulls, and terns utilize waterbodies for feeding and raising young, and vegetated fringes (particularly wetlands) as nesting habitat. Wooded riparian areas provide high-quality feeding and nesting habitats for a variety of other birds, including songbirds, kingfishers, woodpeckers, and bald eagles.

It is estimated that there are approximately 200 bald eagle breeding pairs within the Kodiak National Wildlife Refuge (Zwiefelhofer 1981, personal communication). Eagles also occur on Afognak, as well as on most of the other islands within the Archipelago.

Eagles concentrate their activities near coastal waterbodies. Most nests are in mature cottonwood trees adjacent to salmon streams or along the coast. In areas where cottonwood trees are limited, or do not occur (such as on Tugidak Island), eagle nests are also located on the ground or on ledges. Eagles are common in coastal areas during all seasons.

3.1.9 IMPORTANT UPLAND HABITAT

Definition

Upland habitats occur from above the intertidal splash zone to inland mountainous areas where soils are well drained.

General Information

The Archipelago uplands can be subdivided into three general areas based primarily on vegetative and terrain features. These areas are: (1) those north of Kodiak Island, (2) the major portion of Kodiak Island, and (3) southwest of Kodiak Island, lower Aliulik Peninsula, and the Trinity Islands (Map 1).

Shuyak, Afognak, Raspberry, Whale, Spruce, and Marmot islands fall into the first category. These areas are characterized by well-developed stands of mature Sitka spruce. The best developed stands are the most northerly. In general, distribution of Sitka spruce stands is expanding in a southwesterly direction at about one mile per century (AEIDC 1975).

The major portion of Kodiak Island forms the second category of uplands. Habitat distributions are closely related to differences in elevation. At very high elevations, unconsolidated material is generally absent (AEIDC 1979). Below the peaks, mountainous areas typically have an alpine vegetation of sedges, mosses, lichens, heather, heath, and dwarf willows (AEIDC 1975, 1979). Steep mountains below 3,000 feet have dense shrub and ground cover dominated by alder, willow, salmonberry, elderberry, and devil's club. Grass-herb meadows are dominated by bluejoint; other common species are bluegrass, brome grass, devil's club, and salmonberry. Lower slopes and valley floors are covered by sand and gravel of glacial origin, valley alluvium, alluvial fans, talus deposits, and ash from the 1912 eruption of Mt. Katmai. Cottonwood and occasionally Kenai birch, are common stands along the lower reaches of major drainages (AEIDC 1975, 1979).

The third distinctive region includes southwest Kodiak Island and the Trinity Islands. This region escaped glaciation and is vegetatively and topographically different from the rest of the Kodiak Archipelago. Plants are uniquely similar to species found in the Alaskan Arctic and unlike those found elsewhere in the Archipelago. Even some of the insects of this region are unique (AEIDC 1975). The area is characterized by extensive moist and wet tundra surrounded by rounded low hills.

Upland Mammals

Uplands provide habitat for river otter, ermine, red fox, tundra vole, brown bear, Dall sheep, reindeer, snowshoe hare, red squirrel, Sitka black-tailed deer, elk, and mountain goats. Only the first five mammals inhabited the islands before the Russians arrived. All others

were subsequently introduced. Some, like Dall sheep, were introduced as recently as 1965. In this discussion, important upland habitats will be identified for brown bear, Sitka black-tailed deer, elk, mountain goats, and reindeer.

Brown bear are present from Shuyak Island in the north to the southern tip of Kodiak Island, including Sitkalidak Island. Of the total 2,408 brown bear estimated to be on Kodiak Island in 1977, 2,161 were within the National Wildlife Refuge boundary. Some of the best bear habitat on Kodiak Island includes the drainages of the Karluk River, Connecticut River near Red Lake, Dog Salmon River, Kaiugnak River, major valleys tributary to the lower Terror River, and the Uganik River (AEIDC 1979; Troyer and Hensel,1977). Optimum bear habitats provide sufficient food and cover to meet the seasonal needs of bears. Favorite seasonal food resources include new spring vegetative growth and tubers in alpine meadows and along riparian zones; summer and fall salmon resources in rivers and lakes; and abundant fall berry crops on lower slopes (AEIDC 1980).

Required seasonal habitats of brown bears include areas of winter denning, and spring, summer, and fall feeding. Denning occurs primarily between mid-November and mid-April. The best snow conditions for denning occur on northern slopes between 1,200 feet and 2,400 feet in the sub-alpine ecotone. Therefore, there generally is no denning on the major Kodiak mountain ridge, which runs northeast-southwest from Kizuyak Bay in the north to Kaiugnak Bay in the south. Rather, denning occurs on the slopes leading away from this central ridge (ADF&G 1973, Map 9). Brown bear denning occurs on Afognak, Raspberry, and Kodiak islands. Denning sites on Afognak and Raspberry islands are geographically smaller than on Kodiak Island. On the west coast, denning extends north to the head of Foul Bay. On the east coast, denning ends at Tonki Cape. Extensive denning areas on Kodiak Island include the peninsula between Ugak Bay and Kiliuda Bay, between Frazer Lake and Karluk Lake on both sides of Larsen Bay, between the two branches of the Sturgeon River, around Spiridon

Lake, Campbell Lagoon, and the center of Uganik Island (ADF&G 1973). Denning also occurs on smaller sites between Elbow Creek and Kizhuyak Bay, the head of Saltery Creek, Narrow Strait, the northwest shore of Middle Bay, around Olga Bay, and between the Sturgeon River and the headwaters of the Ayakulik River (ADF&G 1973).

During spring to early summer, bears concentrate feeding activities on newly developing herbaceous vegetation, especially that on south- facing slopes and along streams (AEIDC 1979). Maps of spring feeding distributions indicate that the north shore of Raspberry Strait, the east shore of Kazakof Bay, and the east shore of Tonki Cape provide desirable habitat on Afognak Island (ADF&G 1973). On Kodiak Island, spring concentrations of bear occur at the head of Kaiugnak Bay, the head of Spiridon Bay at Weasel Cove, and between the head of the east arm of Uganik Bay across to the northwest arm (ADF&G 1973).

Some areas that support intensive spring feeding also provide abundant berry crops and are again heavily used by bears during the fall months. Areas that support intensive use in both spring and fall include two fairly extensive regions outside the boundaries of the National Wildlife Refuge - the head of Ugak Bay and along its south arm, and from Shearwater Bay in Kiliuda Bay across to Eagle Harbor in Ugak Bay. Three smaller areas occur within the refuge boundaries: the head of Uyak Bay, the head of Deadman Bay and Alpine Cove, and the head of Sulua Bay in Portage Bay.

By midsummer, when anadromous fish begin to return, bears abruptly move to the salmon streams (AEIDC 1979). Salmon streams are identified in the previous section. Some of the larger and more intensively used areas include the Olds River, Saltery Creek, Sacramento River, Dog Salmon Creek, Ayakulik River, Sturgeon River, Karluk River, the unnamed river at the head of Spiridon Bay, Uganik River, and Terror River. Bears generally continue to concentrate their activities along salmon streams, with expeditions to adjacent berry patches, until late fall. Shortly after the salmon runs are depleted, most brown bears move to midslope denning areas and after several weeks begin preparing winter dens.

Sitka black-tailed deer were introduced in 1934 around the City of Kodiak. Since then, they have extended their range north to Shuyak Island and south about to a line extending across Kodiak Island from the head of Uyak Bay on the west to Three Saints Bay on the east (ADF&G 1973, Map 8). Major concentrations of deer are more geographically restricted, limited primarily by the availability and quality of winter range. During the winter, deer are frequently restricted to the shores where warm air limits snow accumulation (AEIDC 1975). Deer typically inhabit a single drainage basin year round, moving seasonally from the alpine ranges used during the summer, to the lowland timber areas after the first heavy frost, to the shorelines during the winter. A mix of high and low-density range sites extends along the shores of Kodiak Island from Uganik Passage on the west, around the north shore, and south to Dangerous Cape just beyond Ugak Bay. The only breaks in that band occur at Port Lions, the head of Sharatin and Anton Larsen bays, and from Monashka Bay to Womens Bay. Low-density winter range on the west coast extends further south along Spiridon Bay and onto Amook Island.

Only isolated pockets of major deer concentrations exist on Afognak Island. These include areas around Kazakof, Izhut, Tonki, and Foul bays; Afognak Lake; an unnamed river at the head of Paramanof Bay; and the landward tip of Ban Island. Low-density winter range on Afognak Island exists around Duck Bay.

Elk, introduced in 1928, are present only on Afognak, Raspberry, Little Raspberry, and Shuyak islands. Primary elk range is limited to the first two islands. Preferred habitat is spruce forest with open grassy meadows and stands of willow, alder, and elderberry. Elk forage on elderberry, fireweed, and grasses during the summer and on willow, elderberry, devil's club tips, and fern root buds during the winter (Troyer, no date).

During winter, elk generally move to lower elevations where less snow cover allows easier foraging (ADF&G 1973; Map 8). During this

period, elk occupy and share most of the previously mentioned deer winter range located on Afognak Island, plus four additional areas: (1) the perimeter of Perenosa Bay from Discoverer Bay to Big Waterfall Bay; (2) a section across Afognak Island from the head of Kazakof Bay to the northern arm of Paramanof Bay; (3) an area extending from the west edge of Afognak Lake, along Raspberry Strait and Afognak Bay, and back to the east end of Afognak Lake (an area also noted as subject to intensive spring use by bear); and (4) the southwest corner of Raspberry Island from Onion Bay across to Driver Bay, an area only slightly more extensive than that identified as denning sites for bear (ADF&G 1973, Map 9).

Summer elk range occurs at higher elevations along the perimeter of winter range, and extends into several new areas. Summer range identified by ADF&G includes the northwest corner of Raspberry Island; almost all lands between Raspberry Strait and Malina Bay; above the winter range between Raspberry Strait and Afognak Lake; most lands between Malina Bay and Paramanof Bay and extending inland to include Paramanof Mountain; Afognak Mountain; Hachery Peak; three fingers of land around Tonki Bay; two sites west of Kazakof Bay; ridges running southwest-northeast at the head of Foul Bay; and four smaller sites between Tonki Bay and Paramanof Mountain (ADF&G 1973). All but the last three sites are also bear denning sites (the area around Malina Bay is a suspected denning area). Tonki Cape Peninsula, which provides both summer and winter range for elk, is used intensively by bear during the spring. Despite this overlap, bear predation is minor, limited primarily to a few calves during early summer (Troyer and Hensel 1977).

Mountain goats were introduced into the Hidden Basin region south of Crown Mountain on Kodiak Island in 1952 and 1953. Since this time they have extended their territory in three broad bands extending from Crown Mountain - one north toward Kizhuyak Bay, one southeast toward Saltery Cove, and one southwest behind Hidden Lake halfway to Kiliuda Bay (ADF&G 1973, Map 8). Goats have recently been observed in pockets of

suitable range from Watchout Creek to Elbow Mountain and Sharatin Mountain in the north, and as far south as Oak Harbor (AEIDC 1980). Goat winter range includes alpine and subalpine habitat. Alpine habitat extends from the alder line to the higher limits of vegetative cover, at approximately 1000 to 2000 feet, where goats forage for coiled sedge and rough rescue grasses on windblown slopes, exposed ridges, and rock outcrop areas, which are less apt to be snow covered. Subalpine habitat is dominated by alder-bluejoint communities. Here, goats forage on rhizomes of lady fern (AEIDC 1980; Smith 1980). The principal area providing this habitat is in the Hidden Basin-Wild Creek drainage of Crown Mountain (AEIDC 1980).

Summer mountain goat range is at higher elevations, where the population disperses along high alpine meadows close to the summit. Mountain goats tend to favor south-facing slopes adjacent to steep and broken terrain that provides an escape route (AEIDC 1980).

Reindeer, introduced in 1921, are suffering a progressive decline in population. The herd numbered 740 in 1957, 553 in 1965, and were estimated at a maximum of 250 in 1977. Herds generally consist of mature bulls; very few calves are evident. The herds have concentrated in the northern portion of their range - a small area between Halibut Bay and Grant Lagoon (Vivion 1978). The reindeer, which also forage primarily on grasses and forbs, are in direct competition with the brown bear that occupy the same range (RRA/IEC 1978).

Birds

In addition to mammals, uplands provide valuable habitat for many bird species. Of particular importance among these are raptors, passerines, and ptarmigan.

Fifteen species of raptors are known to occur in the Archipelago (MacIntosh 1980). Most of these are annual residents with primary nesting

and feeding affinities for upland habitats. Bald eagles, the most abundant raptor, are most directly associated with coastal aquatic habitats, and have been discussed previously. Rough-legged hawks are probably the most abundant raptor associated with uplands. Other species include goshawks, sharp-shinned hawks, golden eagles, marsh hawks, peregrine falcons, boreal owls, hawk owls, and short-eared owls.

Rough-legs, golden eagles, and peregrine falcons nest on ledges and cliffs primarily in mountainous terrain. Goshawks, sharp-shinned hawks, boreal owls, and hawk owls prefer to nest in large, mature trees, while short-eared owls and marsh hawks nest on the ground in open meadows and tundra.

The specific distribution and population status of these birds are not well understood; however, it is believed that they are generally distributed throughout the Archipelago within their individual habitat preferences.

Willow and rock ptarmigan are common annual residents in upland habitats. They are believed to have wide distribution throughout the Archipelago. These birds are most strongly associated with alpine and subalpine tundra during summer and with alder-willow shrub thickets on lower slopes and along riparian zones during winter.

Among the upland habitats, riparian zones, shrub thickets, and meadow-tundra communities probably support the most activity by the greatest number of species. Belted kingfishers, downy woodpeckers, black-capped chickadees, winter wrens, golden-crowned kinglets, northern srikes, pine grosbeaks, pine siskins, song sparrows, and snow buntings are amoung the most abundant annual residents. Although most available upland habitats support annual activities of the smaller birds, particularly passerines, woodpeckers, and kingfishers, specific distributions depend upon individual habitat requirements.

3.1.10 LITERATURE CITED

Alaska Department of Fish and Game (ADF&G). 1973. Alaska's wildlife and habitat. R.A. Hinman, Ed. Anchorage, Alaska.

ADF&G. 1978. Alaska's fisheries atlas, Vols. I & II. ADF&G, Juneau, Alaska.

ADF&G. 1979. Kodiak management area, 1979 finfish annual report. Juneau, Alaska.

ADF&G. 1980. Westward region Tanner crab report to the Alaska Board of Fisheries, Dec. 1980. Kodiak, Alaska

ADF&G. 1981a. Westward region shellfish report to the Alaska Board of Fisheries, March 1981. Kodiak, Alaska.

ADF&G. 1981b. Draft natural resource inventory maps of Kodiak Archipelago. Prepared for Kodiak Island Borough.

ADF&G. No Date. Present and potential ADF&G rehabilitation and enhancement projects in the Kodiak Island Borough.

Alaska Department of Natural Resources. (ADNR), Division of Parks. 1980a. 1980. Recreation, scenic, and heritage areas of particular concern: Kodiak Archipelago.

ADNR. Division of Research and Development, Land and Resource Planning Section. 1980b. Public interest lands in Alaska's municipalities.

Arctic Environmental Information and Data Center (AEIDC), Institute of Social, Economic, and Government Research. 1974. The Western Gulf of Alaska: A summary of available knowledge. Prepared for Marine Minerals Division, Bureau of Land Management, Dept. of the Interior.

AEIDC. 1975. Kadyak: A background for living. Anchorage, Alaska.

AEIDC. 1979. An assessment of environmental effects of constructiton and operation of the proposed Terror Lake hydroelectric facility. Prepared for Kodiak Electric Association, Inc. Kodiak, Alaska.

AEIDC. 1980. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility. Brown bear studies and mountain goat studies. Prepared for the Kodiak Electric Association, Inc. Kodiak, Alaska.

AEIDC. 1981. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility. Final report. Prepared for Kodiak Electric Association, Inc. Kodiak, Alaska.

Arneson, P. 1977. Identification, documentation, and delineation of coastal migratory bird habitat in Alaska. NOAA/OCSEAP Ru #3, Annual report 2:1-95.

Bureau of Land Management (BLM). 1980. DEIS: Proposed outer continental shelf oil and gas lease sale 46, Western Gulf of Alaska, Kodiak. Washington, D.C.: U.S. Dept. of the Interior.

BLM. 1981. FEIS: Proposed outer continental shelf oil and gas lease sale 60, Lower Cook Inlet-Shelikof Strait.

Hayes, M.O. and C.H. Ruby. 1979. Oilspill vulnerability, coastal morphology, and sedimentation of the Kodiak Archipelago. Final Report, NOAA/OCSEAP RU 59. Boulder, Colorado.

MacIntosh, R. 1980. Birds of the Kodiak Island Archipelago. Unpublished.

Manthey, K. 1980. Salmon report to the Alaska Board of Fisheries, Dec. 1980. ADF&G, Kodiak Alaska.

North Pacific Fisheries Management Council (NPFMC). 1979. Fishery management plan for the Gulf of Alaska groundfish fishery. NPFMC, Anchorage.

Owen, D.L. and J.E. Backburn. 1981. Northern Shelikof Strait bottomfish otter trawl survey, summer 1980. ADF&G. Kodiak, Alaska.

R.W. Retherford Associates and International Engineering Co., Inc. (RRA/IEC). 1978. Application for License, Project No. 2743, Volume 2, Exhibit W. Terror Lake hydroelectric project, Kodiak Island, Alaska. Prepared for Kodiak Electric Association, Inc.

Rogers, D.E. et al. 1979. Seasonal composition and foodweb relationships of marine organisms in the nearshore zone of Kodiak Island, including ichthyoplankton, microplankton (shellfish), zooplankton, and fish. Annual Report Contract #03-5-022-67. RU 553.

Ronholt et al. 1978. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass, 1948 to 1976 (a historical review). Vols. 1-4. Seattle, Washington, U.S. Dept. of Commerce, National Marine Fisheries Service.

Science Applications, Inc., (SAI). 1980. Environmental assessment of the Alaskan continental shelf, Kodiak interim synthesis report. Prepared for the U.S. Dept. of Commerce NOAA, Boulder, Colorado.

Sears and Zimmerman. 1977. Alaska intertidal survey atlas. National Marine Fisheries Services, Auk Bay Biological Laboratory, Auk Bay, Alaska.

Selkregg, L. (ed). 1974. Alaska regional profiles, southcentral region. AEIDC, Anchorage, Alaska.

Smith, R. 1980. Goat winter range surveys and brown bear sightings, Terror Lake project area. ADF&G, Kodiak, Alaska.

Sowls, A.L. et al. 1978. Catalog of Alaskan seabird colonies. USDI, FWS.

Treyer, W. No date. The Roosevelt elk on Afognak Island, Alaska. Alaska Refuge Branch, USDI, Bureau of Sport Fish and Wildlife, (BSFW), Kodiak, Alaska.

Troyer, W.A. and R.J. Hensel. 1977. The brown bear of Kodiak Island. USDI, BSFW.

U.S. Dept. of the Interior, (USDI), Fish and Wildlife Service, (FWS), National Wildlife Refuge System, (NWRS). 1978. Kodiak national wildlife refuge, Kodiak, Alaska. Annual Narrative Report, Calendar Year 1977.

USDI. 1980. FWS, NWRS. Kodiak national wildlife refuge, Kodiak, Alaska. Annual Narrative Report, Calendar Year 1979.

Vivion, M. 1978. Reindeer survey, file memo. U.S. Dept. of the Interior, Fish and Wildlife Service, Kodiak National Wildlife Refuge. .

Watson, L. and J.E. Blackburn. 1980. Pacific cod distribution in summer king crab pots: 1972-1978. ADF&G, Kodiak, Alaska.

Woodward-Clyde Consultants. 1977. Oil terminal and marine service base sites in the Kodiak Island Borough, final report. Prepared for Alaska Department of Community and Regional Affairs, Division of Community Planning.

3.2 PHYSICAL RESOURCE INVENTORY

3.2.1 METEOROLOGY

Meteorological conditions for the Kodiak region are strongly affected by maritime influences, dominated during winter by the Aleutian low-pressure center and during summer by the Pacific high-pressure center. Average winter temperatures range from 20° to 40° F. Average summer temperatures range from 40° to 62° F. Precipitation varies considerably according to local topography (Table 3.15). The City of Kodiak receives an average of 56.9 inches per year. Extremes range from 23 inches at Larsen Bay to 98 inches at Shearwater Bay (Selkregg, 1974). In Kodiak there is little seasonal variation in amount of rainfall or number of rainy days; it rains about 50 percent of the days each month. The dryest months are April, with an average of 3.15 inches of rain, and July, with an average of 3.4 inches. September, with 6.1 inches of rain, and October, with an average of 5.6 inches, are the wettest months. Fog is prevalent and is most common from June through September (BLM 1980).

Winds are primarily northwesterly from late fall through spring; shifting to southwesterly until late September. However, intense storms during winter often produce strong easterly to northeasterly winds. Summer winds from the southwest create favorable conditions for coastal upwelling (BLM 1980). Upwelling brings important nutrients to the surface, which enhances primary production that in turn supports the high level of productivity of the marine ecosystem on the coast of Kodiak. In coastal areas local topography greatly influences wind speed and direction (Hayes and Ruby 1979). Surface winds along the coast are stronger and more persistent than at inland areas. Sustained extreme speeds have been observed at 50 to 75 knots, with gusts to 100 knots. Wind speeds over water are higher due to less surface friction, and for an unusually intense storm, a sustained wind of 100 knots is possible. Considering the frequency and intensity of storms along the Aleutian storm track on the south side of the Alaska Peninsula, an average of one sustained 100-knot wind can be expected to occur annually. Because winter storms are sometimes slow-moving or nearly stationary, such situations can produce

Table 3.15. Climate information for Kodiak Island Borough.

	Summer	Winter	Extremes	Precipitation
Sitkinak	43°-58°F	26°-34°F	3°-76°F	51" (including 28" snow)*
Larsen Bay	41°-62°	21°-45°	-5°-83°	23" (including 22" snow)
Shearwater Bay	40°-62°	24°-37°	-1°-86°	98" (snow unknown)
Kodiak	40°-62°	20°-40°	-1°-86°	54" (including 75" snow)
Kitoi Bay	42°-60°	22°-35°	-12°-82°	60" (including 71" snow)

Source: BLM (1980) and Selkregg (1974).

*Snow precipitation is measured as the amount of water it contains.

stable winds that are persistent in direction and intensity; thus creating wave conditions that are potentially hazardous to exposed coastal or offshore areas.

3.2.2 AIR QUALITY

The Kodiak Island Borough is located in the Cook Inlet and south-central Alaska Intrastate Air Quality Control Region (AQCR). The environmental Protection Agency has found that air quality in the Borough meets Class II National Ambient Air Quality Standards. Certain activities in and around Kodiak do create air pollution, consisting primarily of pungent odors. Efforts are being made by the State Department of Environmental Conservation and Borough officials to reduce the odors emitted by the fish processing plant, land fill, and asphalt plant. In some cases air pollution is hard to control or eliminate, while in other cases it may be allowed if it is in the national interest to do so. For example, a toxic ammonia odor, emitted biannually by the Biodry fish waste plant, does not meet state air quality standards but continues to occur without state authorization. Smoke emitted during Coast Guard fire training maneuvers is allowed even though it does not meet air quality standards.

3.2.3 WATER RESOURCES INVENTORY

Surface-Water Resources

General. Surface-water resources within the Kodiak Island Borough include streams, lakes, and occasional springs. Streamflow, in conjunction with man-made reservoirs, accounts for most of the water supply for the City of Kodiak and other communities in the Borough. Mean annual precipitation generally increases from less than 40 inches along the Shelikof Strait coastline to over 80 inches on the Pacific Ocean side of the islands (Lamke 1979). Larsen Bay averages only 23 inches per year (Jones et al. 1978).

Mean annual runoff ranges from 2.6 to 5.2 million gallons per day (mgd) per square mile (sq. mi.)of contributing drainage area, increasing from the Shelikof Strait to the Pacific Ocean coast (Jones et al.1978). Streamflow would be much larger than mean annual flow in spring and early summer as the snowpack melts, and in late summer and fall in response to rainstorms. Streamflow from December through April would likely average less than the mean annual runoff value. However, rainstorms and resulting floods also occur in the winter when channels are ice-covered.

The seasonal distribution of runoff is an important factor to consider when surface water is to be used for a water supply. Relatively shallow bedrock allows very little storage as groundwater; thus, runoff is rapid in response to rainfall events, causing high streamflow during and for a short time after the rainfall. Flow then decreases fairly rapidly to low values between rainfalls. This is most evident in small streams. Large streams, streams with large lakes, streams with deep alluvium in their valleys, and streams fed by glaciers or large snow-fields will exhibit less flow variation than smaller streams. Due to the variability of the streamflow, reservoirs or storage tanks would likely be necessary if streams are to be used as water supplies.

Natural lakes may provide a water source for small water quantity requirements. Large withdrawals can lower lake levels, affecting shore-line habitats and outlet channel flow characteristics. Although not common in the Borough, springs could possibly provide a water source.

Water quality samples from streams and lakes show that these sources generally have dissolved-solids concentrations less than 60 milligrams per liter (mg/l) (Jones et al. 1978). This is well below the maximum of 500 mg/l for water supplies established in the Alaska water quality standards. Stream water is predominantly the calcium bicarbonate type, whereas lake water ranges from the calcium bicarbonate type to the sodium chloride type (Jones et al. 1978). Surface water quality appeared to be acceptable for anticipated uses based on the water bodies sampled (Jones et al. 1978).

City of Kodiak and Vicinity. The City of Kodiak obtains most of its water from surface water supplies. A series of man-made reservoirs and a storage tank (Table 3.16) store the water for domestic, commercial, and firefighting uses.

Table 3.16 Man-made reservoirs and storage tank capacities for the City of Kodiak water supply system.

Reservoir	Storage Capacity (gallons)
Monashka Creek Reservoir	50,000
Pillar Creek Reservoir	100,000
Upper Reservoir	30,000
Lower Reservoir	63,000
Storage Tank	100,000

Source: KCM 1978.

Current water use varies from 3.0 to 3.5 mgd when the major seafood processors are not in operation to 10 to 12 mgd when the processing plants are operating [Kramer, Chin & Mayo, Inc. (KCM) 1978]. During periods of dry weather, the current storage system may be inadequate to supply the maximum level of demand. Additional storage on Monashka Creek is planned. Water for the U.S. Coast Guard facility is pumped from Buskin Lake at an average rate of 1.15 mgd (KCM 1979). Domestic water storage is provided by three tanks with a total capacity of 1.3 million gallons; separate storage is provided for emergency supply to the central power plant and fire protection. The water supply for the former U.S. Air Force station at Cape Chiniak was freshwater lakes; water was pumped from the lakes into two storage tanks with a total capacity of 180,000 gallons (Office of Economic Adjustment 1976).

Akhiok.The water supply for the village of Akhiok is primarily surface water (Dworsky, personal communication, 1981). An earth dam on a very small stream creates a reservoir estimated to hold 500,000 gallons of water. A 20,000-gallon storage tank provides additional storage. The drainage area contributing to the reservoir is fairly small and relatively flat. Shallow groundwater likely contributes to the reservoir

as it is drawn down. The water supply appears to be sufficient to meet the current domestic needs of the community. There are no current major commercial water users in the Akhiok area. The water is slightly colored, but otherwise the quality is good (Dworsky, personal communication, 1981). Streamflow measurements for a hydropower reconnaissance study (Jack West Associates 1980) obtained 4 to 5 mgd from a 1.53 sq. mi. drainage area on 31 August 1980, or 3 mgd/sq. mi. Mean annual flow is likely to be about 5.2 mgd/sq. mi. in this area (Jones et al 1978).

Karluk. The water supply of the relocated village of Karluk is a springfed stream that runs along the west side of the village. The water quality is good and the quantity is sufficient to serve the current domestic water demand while leaving a flow of 10 to 100 (gpm) gallons per minute in the stream (Dworsky, personal communication, 1981). The new school uses water piped from a stream; the quality of this supply is apparently fair to poor, as coliform contamination was found in April 1977 [Alaska Department of Environmental Conservation (ADEC) 1977]. The clinic and lodge use water from their own springs; the quality of these sources is unknown (ADEC 1977). There is no current major commercial water use in Karluk. Water from the stream is held in a 100,000-gallon storage tank. The drainage area contributing to the stream and the subsurface aquifer are likely to be small. Mean annual runoff in this area is about 2.6 mgd/sq. mi.

Larsen Bay. The water supply of Larsen Bay is Trout Creek. Water is pumped from the creek into a 100,000-gallon storage tank for domestic use in the village. The water quality is good and the quantity is sufficient to meet current domestic water demands (Dworsky, personal communication, 1981). The Kodiak Island Seafood Inc. (KISI) cannery has its own water supply system; it includes a concrete dam on Trout Creek upstream of the domestic water intake facility and 3000 feet of wood stave pipeline (ADEC 1977). Trout Creek appears able to support both the water use demands of the cannery and the village's domestic needs. The school has its own well. The drainage area of Trout Creek is roughly 6 sq. mi. Mean annual runoff in this area is about 2.6 mgd/sq. mi.

Old Harbor. The domestic water supply for the village of Old Harbor is provided by two surface water sources (ADEC 1977). The older of the systems comprises a dam on a small stream and a 100,000-gallon storage tank. The drainage area contributing to the stream above the dam is small. A newer system includes an infiltration gallery, with one of the four intake lines running beneath Old Harbor Creek, and a 120,000-gallon storage tank (Dworsky, personal communication, 1981). The drainage area contributing to Old Harbor Creek is also small. The new system will eventually replace the old one. Water quality is good. The school, community building, clinic, stores, and recreation house all use the community water supply. No major commercial water users are presently located in the Old Harbor area. Two streams, each about 1 mile from the old town site, were investigated for their potential to support commercial development (Weeks 1970). One stream, located southwest of the old townsite, was estimated to have a mean annual flow of about 6.5 mgd and an average winter flow of about 1 mgd. The other stream, located northeast of the old townsite, was estimated to have a mean annual flow of about 8.5 mgd and a winter flow on the order of 1 mgd. The quality of the flow in these streams is good, except that the water is very soft.

Ouzinkie. The water supply for Ouzinkie is Spruce Creek. A screened pipe intake collects water for 30,000-gallon and 100,000-gallon storage tanks (Dworsky, personal communication, 1981). The school and store also use this water supply. The quality is fair, with color, taste, and odor problems (Dworsky, personal communication, 1981). Spruce Creek appears to maintain sufficient flows to supply the current water needs of the community. Before it burned, the Glacier Bay Seafoods cannery also used Spruce Creek water, but operation has not resumed since the fire. Mean annual runoff in the Ouzinkie area is about 5 mgd/sq. mi.

Port Lions. The water demands of Port Lions are supplied entirely by surface water sources. A wood-and-steel dam on Branchwater Stream forms a reservoir that feeds a gravity system to 15,000-and 60,000-gallon storage tanks (Dworsky, personal communication, 1981). The 15,000-gallon storage tank provides the majority of the storage for the community; a

125,000- gallon tank is proposed to provide additional storage (Dworsky, personal communication, 1981). The 60,000-gallon tank is located across Settler Cove near the wharf. A pump in a sump at the confluence of Branchwater and Bourbon creeks provides additional capacity when the gravity system is inadequate to meet demand. The school, clinic, and motel use the community water supply; floating canneries also apparently use the system periodically. The piping is designed for commercial use (Dworsky, personal communication, 1981). There is an ample supply of water available in the present water supply system for all current users. The watershed area of Branchwater and Bourbon creeks is roughly 4 sq. mi. Mean annual runoff in the Port Lions area is about 4 mgd/sq. mi. The quality of the stream water is good except for some coloration.

Ground-Water Resources

General. Generally speaking, ground water is a limited resource in the Kodiak Island Borough. This is due primarily to widespread shallow-lying, dense, and nearly impermeable bedrock (Jones et al. 1978). Variable amounts of water can be obtained from wells drilled into bedrock, the minimum likely to be sufficient for a single-family residence (Jones et al. 1978). Generally, better yields can be obtained from wells drilled into unconsolidated deposits, such as alluvial deposits in stream valleys. However, in many areas, the alluvium is too thin to yield significant quantities of water.

The quality of ground water appears to be generally acceptable for most uses, although the reliability and areal distribution of the data base is poor (Jones et al. 1978). Wells drilled in unconsolidated materials yielded diluted calcium bicarbonate-type water with dissolved solids concentrations less than 100 mg/l. Water from two wells drilled into bedrock yielded water of the sodium bicarbonate type with dissolved solids concentrations of 170-250 mg/l (Jones et al. 1978). Wells located near the coastline could become contaminated by saltwater intrusion if excessive drawdown results from pumping.

City of Kodiak and Vicinity. Ground water use in the City of Kodiak area is minimal compared with use of surface-water supplies. Well data in the area are summarized in Table 3.17. It can be seen that the well yield is quite variable, generally with low yield from bedrock and moderate to high yield from unconsolidated deposits.

Akhiok. The water supply for the village of Akhiok is primarily surface water (Dworsky, personal communication, 1981). However, three wells have been drilled near the village (Jones et al. 1978). Data from two of these indicate that bedrock lies 3 to 16 feet below the surface. One well yields 9 gpm from the sand and gravel overlying the bedrock. Yields of the other wells are unknown.

Four wells drilled near Lazy Bay (4 miles southwest of Akhiok) documented from 10 to 26 feet of material overlying bedrock (Jones et al. 1978). Well yields range from 12 to 500 gpm in unconsolidated materials; one well drawing from bedrock yields 125 gpm (Jones et al. 1978).

Karluk.The water supply of the relocated village of Karluk is a springfed stream. Other than that spring which identifies the existence of a subsurface aquifer, no other data on ground-water resources were found for the Karluk area.

Larsen Bay. The majority of the water needs for Larsen Bay are supplied by surface-water sources. However, the school has its own well, which apparently yields sufficient quantities to meet its needs. The water contains high concentrations of iron (ADEC 1977), but is otherwise apparently of acceptable quality. The Public Health Service drilled a well in 1959 (which yielded 60 gpm) to serve eight houses (ADEC 1977). The current status of this well is not known. The identification of a spring in the area (Jones et al. 1978) indicates the potential for further use of the ground-water resource.

Old Harbor. Very few data are available on the ground-water resources of the Old Harbor area. There are no known wells currently in use. It is unlikely that ground water is available in significant quantities (Weeks 1970).

Table 3.17. Selected well data in the vicinity of the City of Kodiak.

Well Number	General Area	Well Depth (feet)	Depth to Water (feet below surface)	Well Yield (gallons per minute)	Depth to Bedrock (feet below surface)	Water-bearing Material
26009	Peninsula	260	25	1-2	--	Bedrock
26501	Northeast of	155	15	12-15	4	Bedrock
26052	City	144	18	4-5	7	Bedrock
26053	of	148	10	8-10	5	Bedrock
26054	Kodiak	173	15	2-3	5	Bedrock
26043	Gibson Cove	76	8	250	56	---
26044	1.5 miles	73	7	250	65	Gravel
26045	Southwest of	152	5	95	22	Bedrock
26046	City of Kodiak	126	7	20-30	31	Bedrock
25010	Buskin River	46	3.5	---	42	Gravel
25021	valley	29	7	4	29	Gravel
25026	and	50	16	1,320	--	Gravel
26036	flats	145	12	3	6	Bedrock
25001	Bells Flats,	33	18.5	3	--	Sandy gravel
25005	Sargent,	32	9	2	31	---
26018	and	135	12	2	7	Bedrock
26021	Russian	135	10	50	4	Bedrock
26024	Creeks	176	10	12	11	Bedrock
26034	Kalsin Bay	38	--	---	--	Sand and gravel
26028	Chiniak	100	Flowing	10	8	Bedrock
26032		144	15	3-5	7	Bedrock

Source: Jones et al. 1978.

Ouzinkie. Very few data are available on the ground-water resources of the Ouzinkie area. The existence of springs in the area (Jones et al. 1978; ADEC 1977) indicates the presence of an underground aquifer, but quantifying the extent of the aquifer and potential well yield would require further study.

Port Lions. No data could be located on the ground-water resources of the Port Lions area. The potential supply is anticipated to be fair.

3.2.4 LITERATURE CITED

Alaska Department of Environmental Conservation (ADEC). 1977. Village sanitation in Alaska. Village Safe Water Program and U.S. Public Health Service, contents periodically updated.

Buck, E.H. et al. 1975. Kadyak - a background for living. Arctic Environmental Information and Data Center, Univ. of Alaska, Anchorage. 326 p.

Bureau of Land Management (BLM). 1980. DEIS: Proposed outer continental shelf oil and gas lease sale 60, Lower Cook Inlet-Shelikof Straight.

Corps of Engineers (COE). 1978. Special flood hazard information - Monashka Creek Reservoir, City of Kodiak, Alaska. Prepared for the Kodiak Island Borough and City of Kodiak.

COE. 1979. Special flood hazard information - Lake Bettinger Reservoir, City of Kodiak, Alaska. With CH_2M-Hill, Inc. for the Kodiak Island Borough and City of Kodiak.

Dworsky, M.D. 1981. Personal Communication. Senior Field Engineer, U.S. Public Health Service, Anchorage, Alaska.

Hayes, M.O. and C.H. Ruby. 1979. Oilspill vulnerability, coastal morphology, and sedimentation of the Kodiak Archipelago. Final Report, NOAA/OCSEAP RV 59. Boulder, Colorado.

Jack West Associates. 1980. Reconnaissance of micro-hydroelectric potential, Akhiok Village, Kodiak. With Fryer:Preasley:Elliot for Kodiak Island Borough. 28 p. + appendices.

Jones, S.H., R.J. Madison, and C. Zenone. 1978. Water resources of the Kodiak-Shelikof subregion, southcentral Alaska. U.S. Geological Survey, Hydrological Investigations Atlas HA-612.

Kramer, Chin, & Mayo, Inc. (KCM). 1978. Kodiak Island Borough, Regional Plan and Development Strategy, Summary Report. Prepared for Kodiak Island Borough and the Division of Community Planning, Dept. of Community and Regional Affairs. 84 p.

KCM. 1979. U.S. Coast Guard Support Center, Kodiak, Alaska - development plan. Prepared for 17th Coast Guard District, Juneau, Alaska. pp. A3.18 to A3.21.

Lamke, R.D. 1979. Flood characteristics of Alaskan streams. U.S. Geological Survey Water Resource Investigations 78-129, Anchorage. 61 p.

Office of Economic Adjustment. 1976. Defense impact on Kodiak Island, Alaska. West Coast Regional Office. 29 p.

Selkregg, L. (Ed). 1974, Alaska regional profiles, southcentral region. AEIDC. Anchorage, Alaska.

Weeks, J.B. 1970. Water-resources reconnaissance of the Old Harbor area, Kodiak Island, Alaska. U.S. Geological Survey, Water Resources Division, Alaska District, Open File Report. 8 p.

3.3 GEOPHYSICAL HAZARDS

3.3.1 OF GEOLOGIC ORIGIN

Introduction

This geologic hazards investigation involved a literature review and brief aerial reconnaissance of the geology at the six coastal villages and Kodiak City on April 27 and 28, 1981. The purpose of the study is to make a preliminary identification of the geologic hazards present at the communities. The geologic hazards maps included in this study are of a general nature. Hazards information was compiled at a scale of 1: 63,360 from maps of unconsolidated deposits, landslides (AEIDC 1975), island-wide geology (U.S. Department of Interior, 1977) and soil associations at scales ranging from 1:1,000,000 to 1:1,584,000. Hazards mapping at a larger scale for site-specific planning should be conducted for future developments and better resolution of tentatively identified hazards.

A number of ongoing studies address specific geologic hazards relevant to the Kodiak Island group. H. Pulpan and J. Kienle of the Geophysical Institute, University of Alaska, are continuing their study of the seismic risk to onshore and offshore development, and of volcanic risks in the area. R. Updike of the Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, is monitoring Pillar Mountain. M.A. Fisher, T.R. Burns, R.E. Von Huene, et al. of the Department of Interior, USGS, are analyzing the transverse tectonic boundaries near Kodiak Island, as well as mapping the nearsurface structure of the Kodiak shelf.

In the following subsections the regional plate tectonics and geologic setting of the Kodiak Archipelago are described and geologic hazards related to seismic, volcanic, and mass wasting origins are identified. An analysis of the geologic hazards at the six village sites and the City of Kodiak is presented, and followed by recommendations for further study. Figure 3.6 is a glossary of geologic terms.

Figure 3.6 Glossary of geologic terms.

Andesite - a type of volcanic rock composed essentially of andesine, a mineral containing sodium, calcium, aluminum, silicon, and oxygen.

Biogenic - pertaining to a deposit resulting from the physiological activities of organisms.

Deformation - any change in the original volume or form of rock masses produced by tectonic forces, i.e., faulting and folding.

Lithify - to turn to rock; to consolidate, such as the process of induration of loose sediment.

Semilithified - partially turned to rock.

Tectonic - of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust.

Terrigenous - produced from or of the earth.

Unconformable - having the relation of unconformity to the underlying rocks. (See unconformity.)

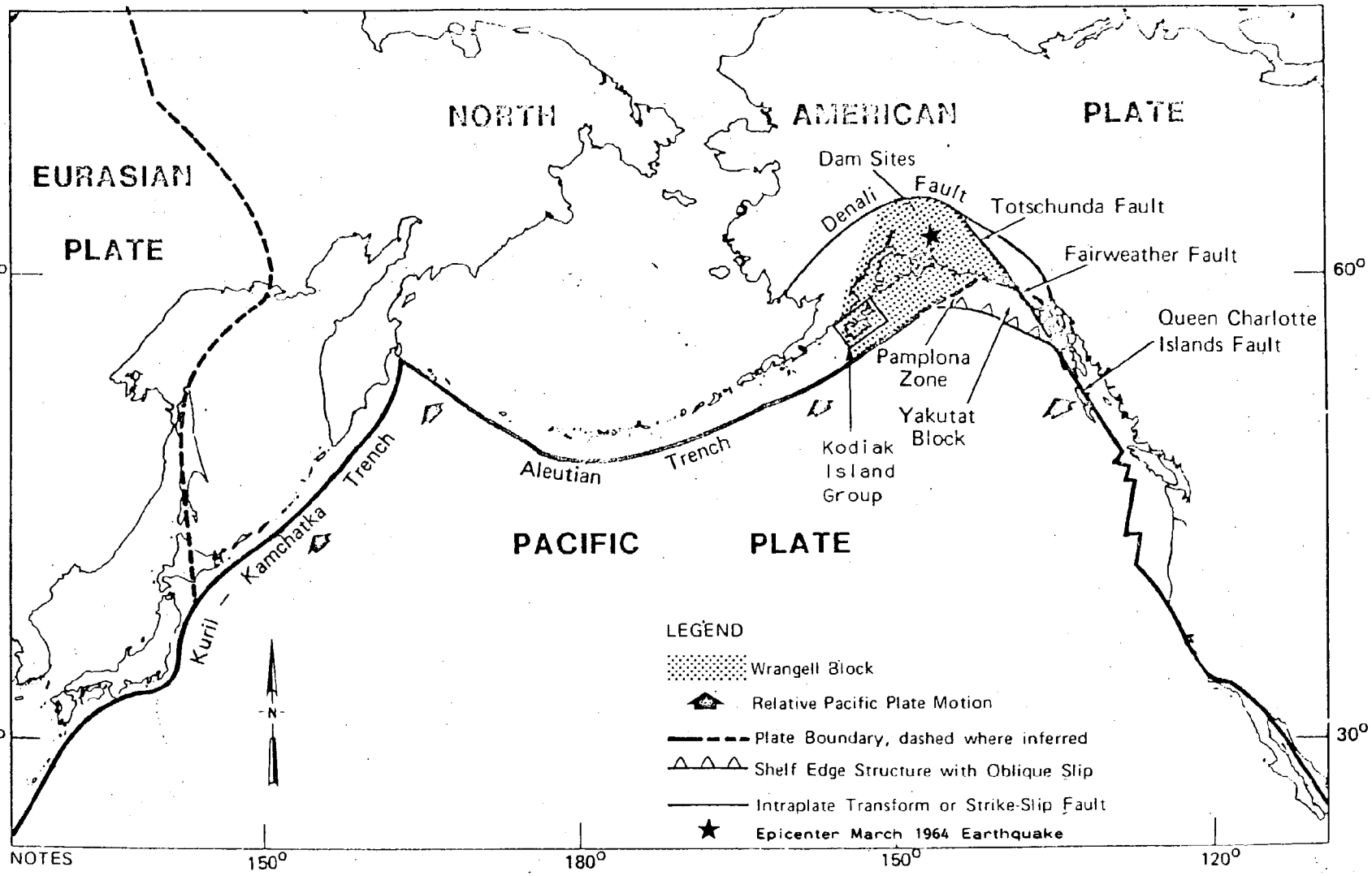
Unconformity - a surface of erosion that separates younger strata from older rocks.

Geologic Setting

Regional Geology.

Plate Tectonic Setting - The Kodiak Archipelago consists of Kodiak Island, Afognak Island, and numerous adjacent smaller islands. These islands are located along the convergent margin of the North American plate where it is being underthrust by the Pacific plate (Figure 3.7). Plate tectonics explains the underlying cause of the geologic and seismic activity in southcentral Alaska as the product of the subduction of the Pacific plate at the Aleutian trench as the plate spreads northward from the east Pacific Rise (Isacks et al. 1968; Tobin and Sykes 1968). This northward movement occurs at a rate of approximately 2.4 inches/year (6 cm/year) relative to the North American Plate. As a result of this active underthrusting, the Kodiak Archipelago is located in an area of abundant earthquake activity and active volcanism. At least 12 volcanoes classified as active or recently active are located along the Alaska Peninsula adjacent to the Kodiak Archipelago. These volcanoes are a surface expression of the subducting Benioff seismic zone located at an approximate depth of 100 km (Hampton et al. 1979).

Geologic History - During late Paleozoic and early Mesozoic time the Kodiak area was occupied by a deep sea with an adjoining volcanic island arc similar to the present-day Aleutian arc (AEIDC 1975). The area occupied by the island arc was uplifted and deformed during middle Mesozoic time, depositing black siliceous muds and volcanic flows into the adjacent marine basin. There was probably an ancient oceanic trench along the northwest coast of Kodiak Island, and volcanic activity predominated in the Alaska Range area associated with the volcanic island arc system. During late Mesozoic time the Kodiak area was likely a site of deepwater sedimatation adjacent to a broad continental shelf basin. By early Cenozoic time a deep-sea trench had developed off the Kodiak shelf and several cycles of uplift, erosion, and deposition ensued. Middle Cenozoic time was marked by deposition in marine basins on all the shelf areas of the Kodiak Island group (AEIDC 1975). In late Cenozoic time during the Pleistocene epoch, glacial ice probably covered the entire



NOTES

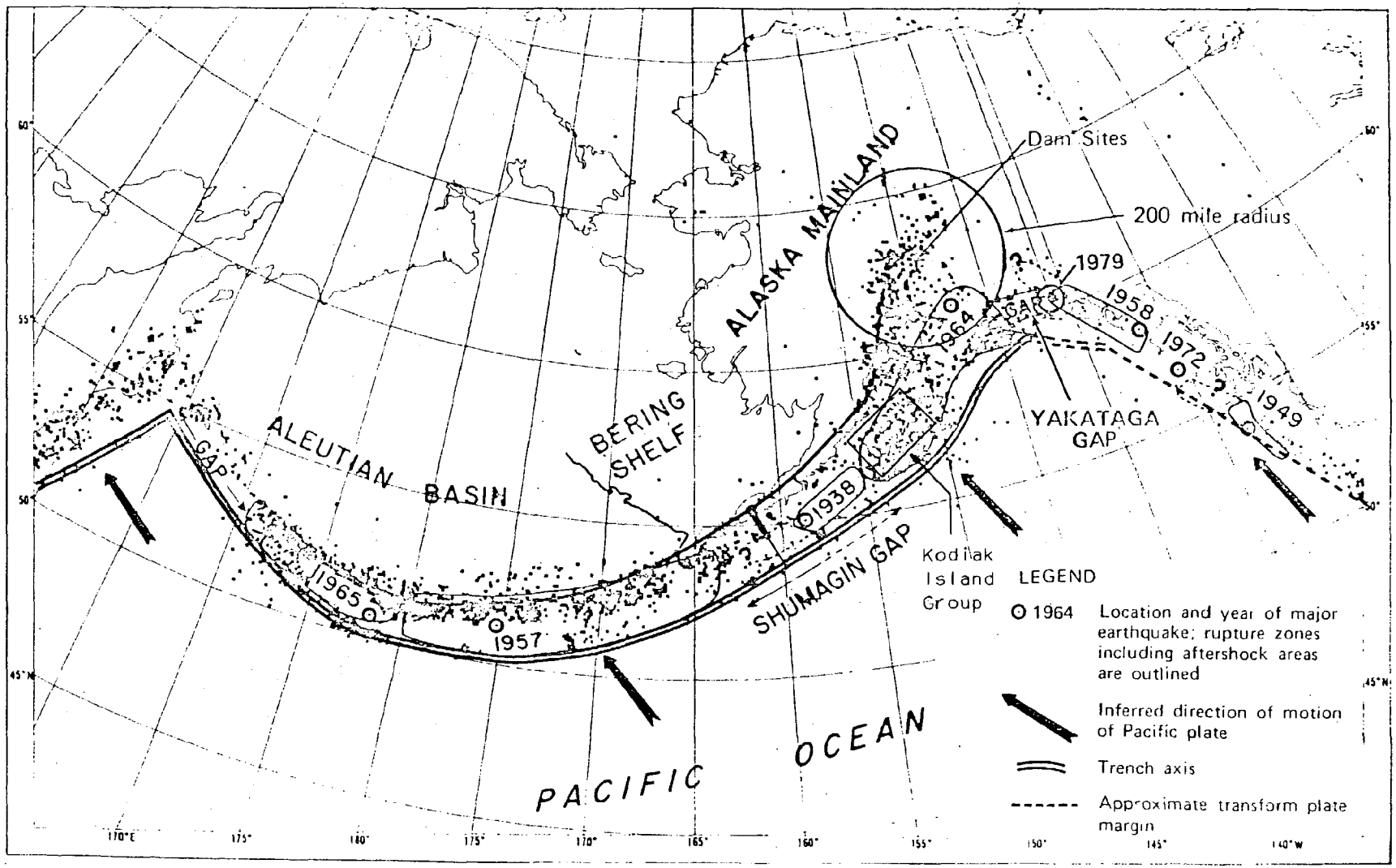
1. Base map from Tarr (1974).
2. After Packer and others (1975), Beikman (1978), Cormier (1975), Reed and Lamphere (1974), Plafker, and others (1978).
3. Adapted from WCC (1980).

Figure 3.7. PLATE TECTONIC MAP

region except for a small area on the southwest portion of Kodiak Island. The glacial advance was probably south and east over the continental shelf, sculpturing the island surface and offshore terrain into landforms evident on the islands today (AEIDC 1975). All these events have yielded the present geologic structure of the Kodiak Island group.

Seismicity - The Kodiak Islands are located in one of the most seismically active areas on earth, accounting for about 7 percent of the annual worldwide release of seismic energy (AEIDC 1974). Kodiak Island is located approximately 140 km northwest of the active zone of subduction along the Aleutian Trench (Figure 3.7). This is a major thrust zone and region of frequent earthquake activity. A plot of the hypocenter distribution of instrumentally-located earthquake activity defines a shallow dipping plane of concentrated earthquake activity. This kind of subcrustal seismic zone is called a Benioff zone. A seismic activity gap, according to plate tectonic theory, is a candidate for a major seismic event. The area between Kodiak and Unimak Islands is characterized by such a gap, and is referred to as the Shumagin Gap (Figure 3.8). Studies suggest that this area may experience a major earthquake in the near future (AEIDC 1975). A concentration of earthquake epicenters exists offshore of the Trinity Islands, south of 57°N and between 152°W and 154° W. This is the most tectonically active area of the Kodiak shelf. Faults with youthful scarps occur offshore near the southeastern coastline of Kodiak Island and on the continental slope (Figures 3.8 and 3.9) (U.S. Department of Interior, 1977). The Great Alaska Earthquake of 1964 is the largest magnitude (8.4 to 8.5 on the Richter Scale) earthquake to affect the Kodiak Archipelago in historic time. There was widespread vertical and horizontal displacement, surface faulting sediment compaction, landslides and submarine slides, and tsunamis. Tsunamis took the most lives, and landslides caused the most damage (AEIDC 1975).

Geology of the Kodiak Archipelago. The rocks of the Kodiak Archipelago may be grouped into: (1) lower Mesozoic sedimentary and metamorphic rocks; (2) Mesozoic through middle Cenozoic deformed sedimentary deposits; and (3) upper Mesozoic to lower Cenozoic plutonic rocks (Figure 3.9 and 3.10) (Von Huene, Fisher, and Hampton 1980). The contact between



NOTE

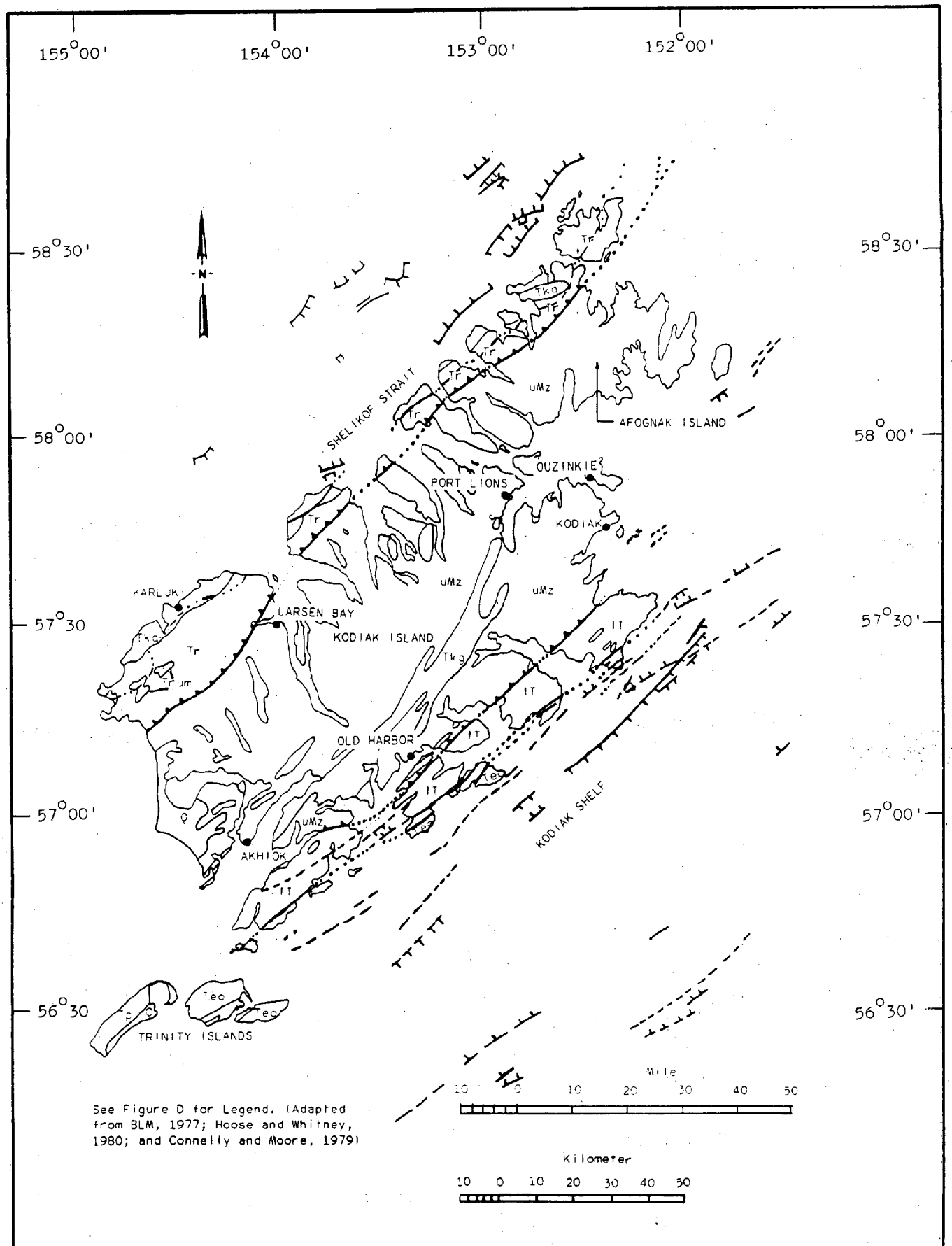
1. Modified after Davies and House (1979).
2. Adapted from WCC (1980).

Figure 3.8. MAJOR EARTHQUAKES AND SEISMIC GAPS IN SOUTHERN ALASKA

the lower Mesozoic rocks and the Mesozoic and lower Cenzoic rocks is an extension of the Border Ranges fault (Von Huene, Fisher, and Hampton 1980). Rocks on the northwest side of the fault are of lower Mesozoic age; those on the southeast side are Mesozoic and lower Cenozoic sedimentary rocks in belts that trend northeast. Strata within the belts decrease in age southeastward from the Border Ranges fault to the Pacific shore of Kodiak Island. A major northeast trending thrust fault separates the upper Cretaceous rocks of central Kodiak Island from the lower Cenozoic rocks along the southeastern coastline (Von Huene, Fisher, and Hampton 1980). A series of high angle faults separates the various lower Cenozoic rock formations along the southeastern coastline (Figure 3.9 and 3.10). The majority of these high angle faults have been classified as active (U.S. Department of Interior, 1977). Intruded into the upper Mesozoic and lower Cenozoic rocks are middle Mesozoic to lower Cenozoic plutonic rocks. The main body of these igenous rocks forms an axial spine through the central portion of Kodiak Island. Overall, the geologic units trend northeast parallel to the regional trend, and the dips are dominantly northwest. Deformation generally decreases toward the southeastern coastline, as do the rock ages.

Geology Offshore of Kodiak Island. Shelikof Strait, northwest of the Kodiak Island group, is a structural trough which is underlain by folded and faulted Mesozoic and Tertiary strata (Hampton and Winters 1981). These strata are blanketed unconformably by relatively undeformed Quaternary sediments. The surficial sediment in the northeastern end of the strait is sand, and grades southwestward into fine sand and mud (U.S. Department of Interior 1981). Five distinct fault scarps that displace surface sediment occur within the Shelikof Strait and may be classified as potentially active (Figures 3.9 and 3.10) (Hoose and Whitney 1980). The faults trend parallel to the axis of the strait, perpendicular to the direction of plate convergence. Present-day processes in the Shelikof Strait define it as a depositional sedimentary environment.

The Kodiak shelf southeast of the Kodiak Island group is an erosional environment (Von Huene, Fisher, and Hampton 1980). The distribution of unconsolidated sediment is related to shelf physiography, the



See Figure D for Legend. (Adapted from BLM, 1977; Hoose and Whitney, 1980; and Connelly and Moore, 1979)

Project No. 60666A WOODWARD-CLYDE CONSULTANTS	General Geologic Map of Kodiak Island Group	Figure 3.9

CENOZOIC

Quaternary

Q Quaternary Deposits - Alluvium, dune sand, beach deposits, and glacial deposits on Kodiak Island and on the Trinity Islands.

Tertiary

Tp Pliocene Rocks - On Tugidak and Chirikof Islands, includes interbedded sandstone and siltstone of the Tugidak Formation.

Teo Oligocene and Eocene Marine Rocks - In fault slices along the southeast side of Kodiak Island includes 3,000 m of Eocene and Oligocene flysch of the Sitkalidak Formation, which is conformably overlain by the Sitkinak Formation.

lT Lower Tertiary Rocks - Strongly deformed zeolite-bearing tuffaceous sandstone, basalt, claystone, sandstone, tuff, and graded beds of the Ghost Rocks Formation of Eocene and Paleocene age on Kodiak and adjacent islands.

MESOZOIC

Cretaceous

Tkg Tertiary and Cretaceous Granitic Rocks - Quartz diorite on Kodiak Island.

Cretaceous and Upper Jurassic

uMz Cretaceous and Upper Jurassic Rocks - Sparsely fossiliferous graywacke, slate, argillite, with minor conglomerate, volcanic detritus, and interbedded mafic volcanic rocks metamorphosed, locally, to greenschist and amphibolite facies.

Triassic

Tr Triassic Rocks - Shale, limestone, chert, schistose tuff, sandstone and beds of pillow basalt. Includes Uyak Formation on Afognak Island.

PALEOZOIC

Trum Triassic Ultramafic Rocks - Serpentinized dunite, pyroxenite, and gabbro on Kodiak Island.

Active Faults with Youthful Scarps; dashed where approximately located

Inactive Thrust Fault; dashed where inferred; hatchures on downthrown side

High Angle Fault; dotted where concealed by sediment; movement not defined

(Adapted from BLM, 1977; Hoose and Whitney, 1980)

Figure 3.10. Lengend for general geologic map of Kodiak Island Group.

shelf being divided into a series of basins and troughs with banks. The direction of sediment transport is generally from the banks into the troughs. An exception is Stevenson Trough offshore of Afognak Island, which is a route for high-energy bedload transport of sediements across the shelf. Surficial unconsolidated sediment consists of various proportions of terrigenous-glacial, volcanic, and biogenic debris (Hampton et al. 1979). This sediment forms a thin blanket over much of the shelf, but broad areas have exposures of semilithified to lithified siltstone and fine-grainned sandstone of Tertiary to Pleistocene age.

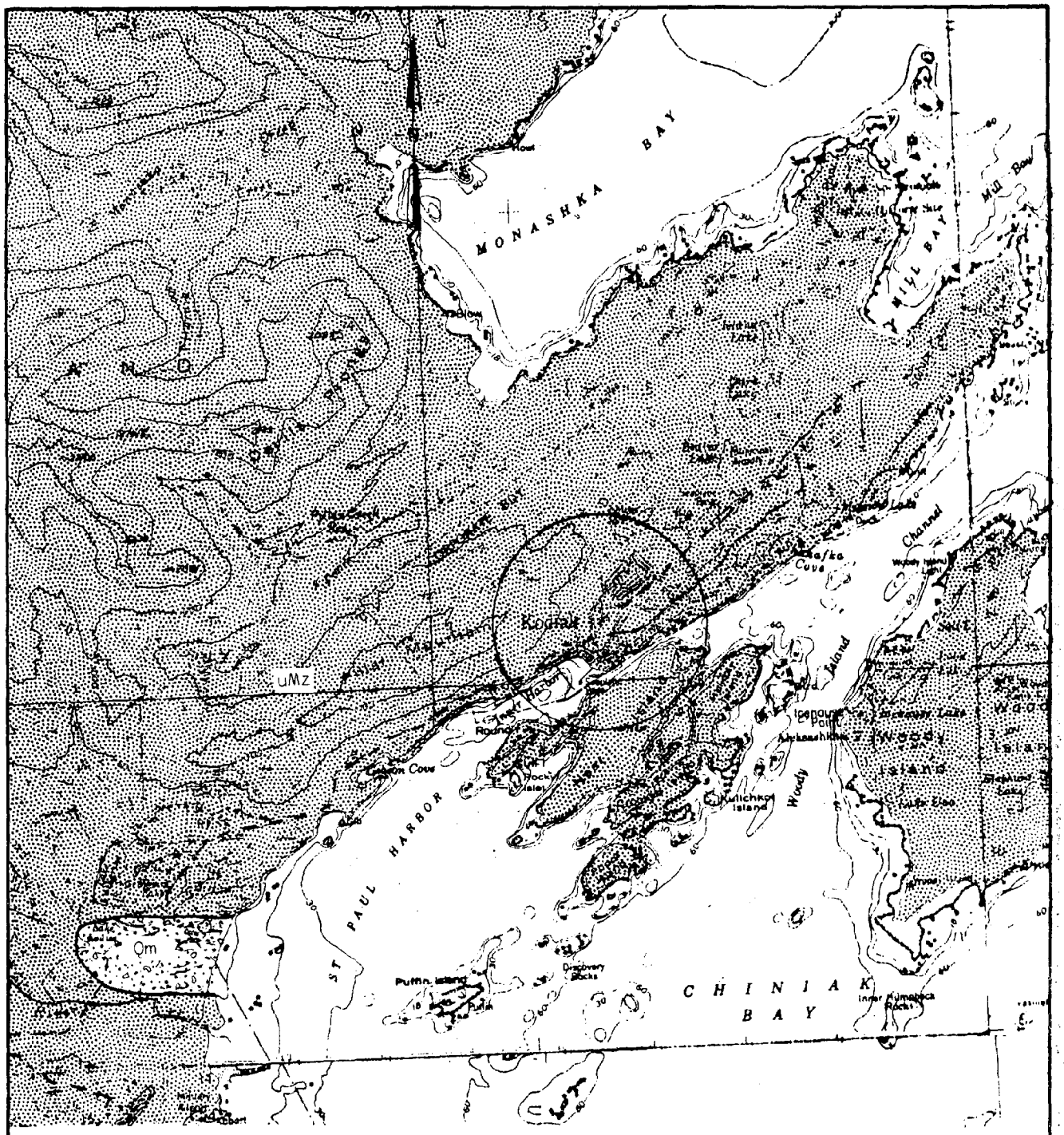
Geologic Hazards

Introduction. As discussed under Regional Geology, the majority of the geologic hazards that affect the Kodiak Islands are seismotectonic in origin. These include active faults, earthquakes and their attendant landslides and submarine slumps, liquefaction, and tsunamis; volcanism and its associated ash falls, acid rains, and climatic and atmospheric changes. Other hazards are related to mass wasting phenomena. The following subsections outline the potential geologic hazards that can affect the Kodiak Archipelago.

Seismic Hazards. As a result of its tectonic setting, the Kodiak Archipelago has a high seismic risk rating. Earthquakes are a prominent geologic hazard of the island group. The recurrence of such great earthquakes as the 1964 Alaska earthquake is estimated to range from a minimum of 33 years to a maximum of 800 years (U.S. Department of Interior 1981). The area southwest of Kodiak Island known as Shumigan Gap is due for a major earthquake in the near future. A seismically active area offshore of the Trinity Islands is another area of seismic concern. (See Section 3.3.1, Seismicity, and Figures 3.8 and 3.9). Figure 3.9 shows the distribution of active onshore and offshore faults, the major zone being along the southeast coast of Kodiak. Strong ground shaking, fault rupture, sediment displacement, and tectonic deformation of the seafloor have all occurred on or adjacent to the Kodiak shelf, and can be expected in the future (Von Huene, Fisher, and Hampton 1980). The area offshore of the southwest edge of Kodiak Island has no faults mapped to date (Hampton et al. 1979).

Damage due to earthquakes is caused primarily by ground rupture and ground shaking. Secondary destructive mechanisms are seismic seawaves (tsunami), regional and local uplift and subsidence, liquefaction, and landslides. Records from the 1964 Alaska earthquake indicate that the primary destructive force was ground shaking, which triggered numerous landslides along the southeastern coast of Kodiak. Areas that experienced the most structural damage were located in thick, loosely packed, water-saturated deposits; rocky areas experienced the least damage (AEIDC 1974). Loose sediments also settled differentially and had partial liquefaction. Regional subsidence of 2 to 6 feet damaged every community except Akhoik and Karluk. The most destructive secondary mechanism was the tsunami, which took the most lives and caused damage to port facilities and boats. The Kodiak shoreline, particularly Marmot, Chiniak, Ugak, and Kiliuda Bays, is exposed to tsunamis generated anywhere in the Pacific, especially along the Aleutian seismic belt. Based on historical events, the zone of greatest susceptibility to tsunami damage has been between mean sea level and elevation 16 meters. Preliminary geologic hazard maps (Figures 3.11 through 3.17) show the potential for seismic hazards in the major population centers of the Kodiak Island group.

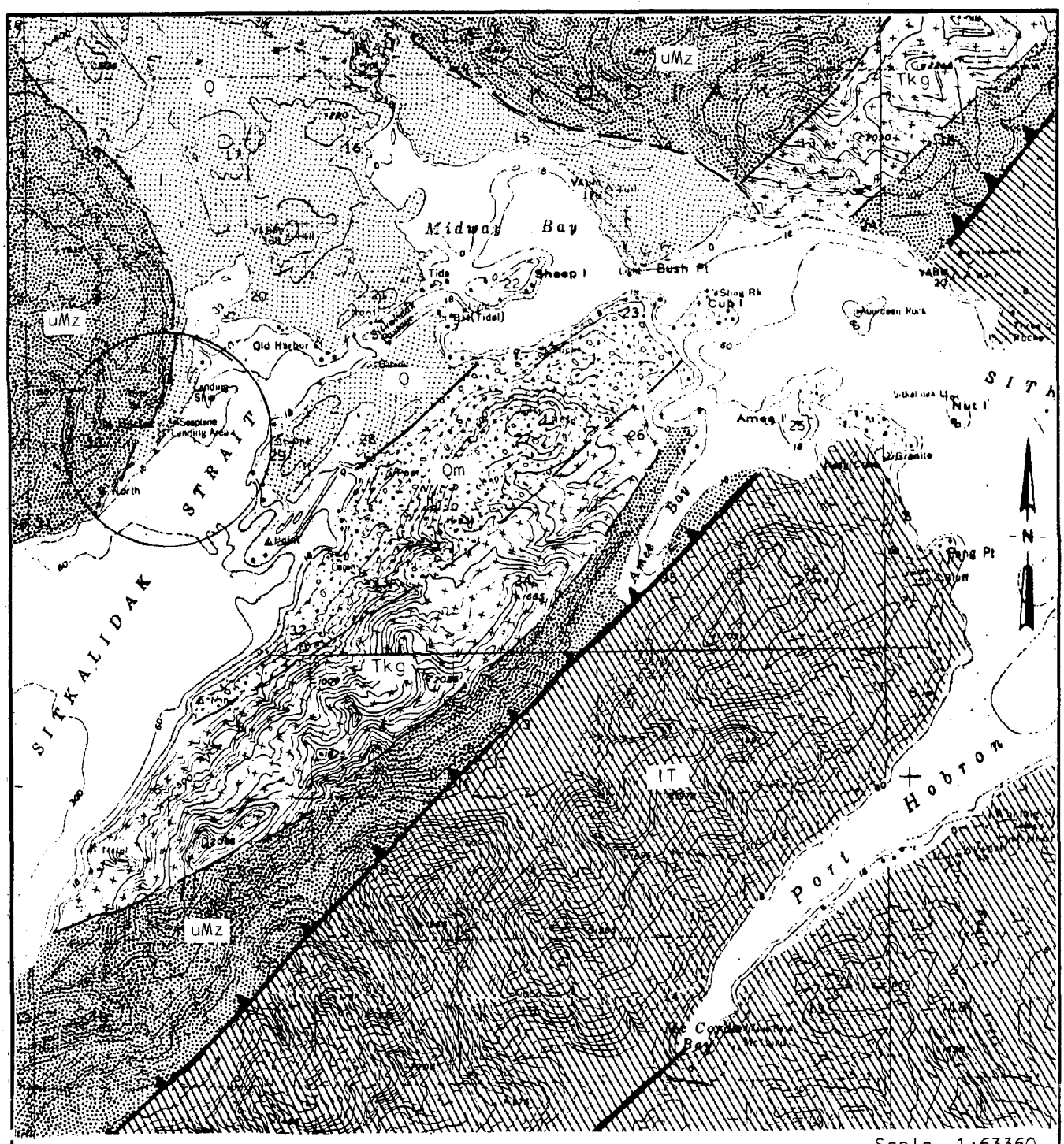
Volcanic Hazards. The chain of active andesitic volcanoes on the Alaska Peninsula adjacent to the Kodiak Islands poses several geologic hazards associated with their characteristic violent eruptions. Because of the distance separating the volcanoes from the island, 75 kilometers, volcanic hazards are limited to those of aerial extent. Turbulent ash clouds, which are bursts of gas, steam, and ash that rise vertically to heights of 15,000 to 30,000 meters, can be hazardous to aircraft in the area. Airborne ash can be transported great distances and produce physically uncomfortable conditions. For example, an ash deposit about 10 cm thick covered Afognak Island and the northern half of Kodiak Island from the eruption of Mt. Katmai in 1912. Corrosive rains caused by acidic volcanic gases mixing with precipitation can fall on communities and cause damage. Acid rains associated with the 1912 Mt. Katmai eruption fell on Cordova at a distance of 750 km northeast of Mt. Katmai. Other secondary volcanic phenomena that could be hazardous are earthquakes, seawaves, lightning discharges, and landslides. Protection from the



Scale 1:63360

Soil: silty volcanic ash with infrequent peat
Quaternary deposits: (Qm) glacial moraine and drift
Bedrock: (uMz) Cretaceous and upper Jurassic graywacke, slate, argillite, some metamorphic greenschist facies
Faults: none mapped, linements mapped by R&M on Pillar Mountain
Landslides: Pillar Mountain and Old Womens Mountain potential landslides
Water table: depth to water below ground surface ranges 4 to 25 ft
Seismic risk: high potential for earthquake and damage
Information Sources: BLM (1977); R. Updike, DGGS; AEIDC (1974); aerial photographs

Project No. 60666A **WOODWARD-CLYDE CONSULTANTS**	Preliminary Geologic Map - Kodiak	Fig 3.11



Scale 1:63360

Soil: silty volcanic ash with infrequent peat

Quaternary deposits: (Q) undifferentiated, (Qm) moraine and drift

Bedrock: (uMz) Cretaceous and upper Jurassic graywacke, slate and argillite; (Tkg) late Cretaceous and early Tertiary quartz diorite (IT) lower Tertiary tuffaceous sandstone, basalt, claystone, sandstone and tuff

Faults: (▲▲▲) major thrust fault 5 km SE and (——) an active high angle fault 9 km SE

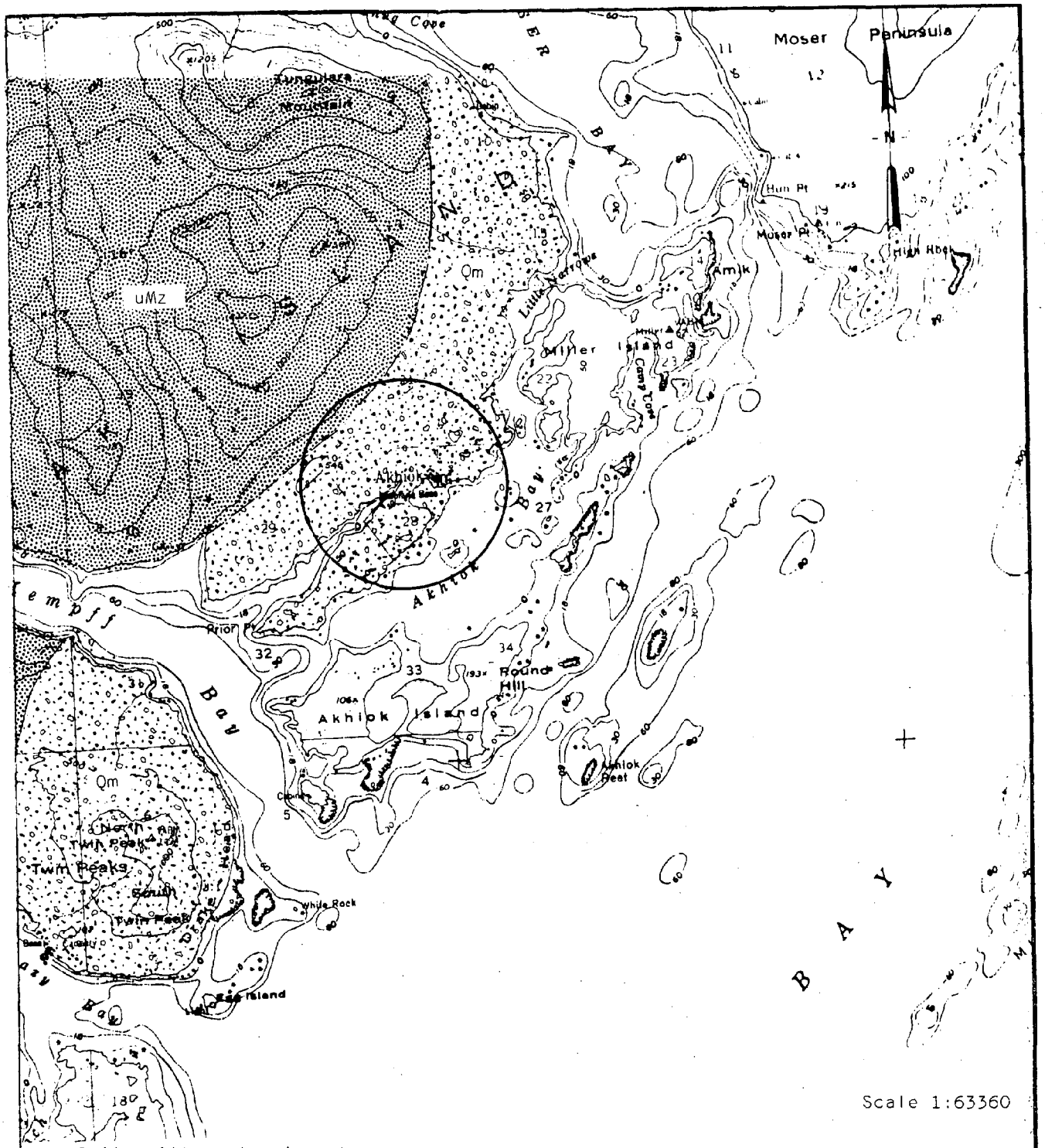
Landslide: potential near old town site

Water table: depth to water below ground surface is 17 ft

Seismic risk: high potential for earthquake and damage

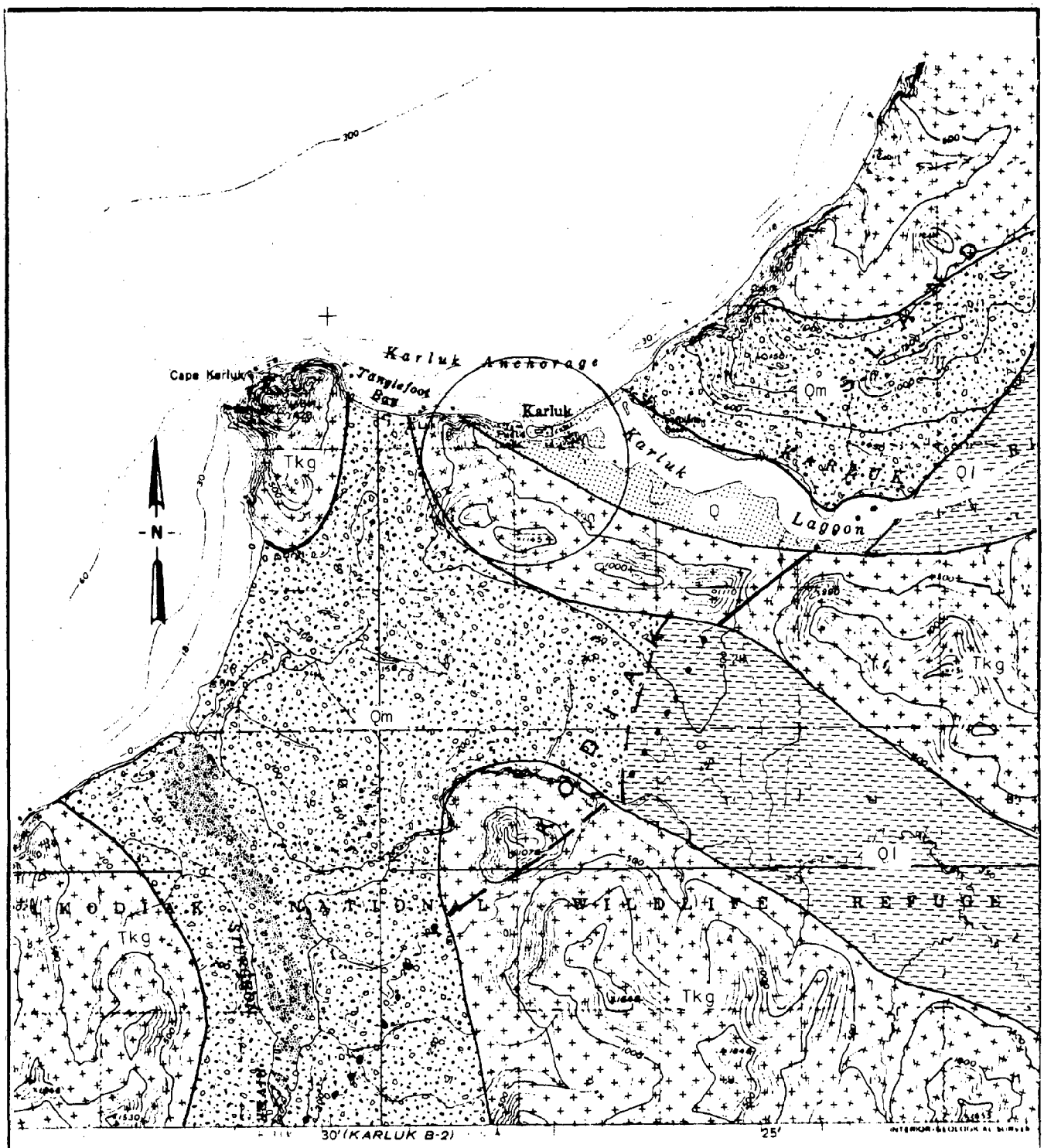
Information Sources: AEIDC (1974); BLM (1977); aerial photographs

Project No. 60666A WOODWARD-CLYDE CONSULTANTS	Preliminary Geologic Map - Old Harbor	Fig. 3.12



Soil: silty volcanic ash
Quaternary deposits: (Qm) glacial moraine and drift
Bedrock: (uMz) Cretaceous and upper Jurassic graywacke, slate, argillite, some metamorphic greenschist facies
Faults: none mapped
Landslides: none
Water table: high, depth to water is 2 ft
Seismic risk: high potential for earthquake and damage
Information Sources: AEIDC (1974); BLM (1977); aerial photographs

Project No. 60666A **WOODWARD-CLYDE CONSULTANTS**	Preliminary Geologic Map - Akhiok	Fig. 3.13



Soil: silty volcanic ash with infrequent peat

Scale 1:63360

Quaternary deposits: (Q) undifferentiated, (Qm) moraine and drift, (Ql) glaciolacustrine

Bedrock: (Tkg) late Cretaceous and early Tertiary quartz diorite

Faults: (—— ···) Fault, dotted where concealed, 3.5km SE

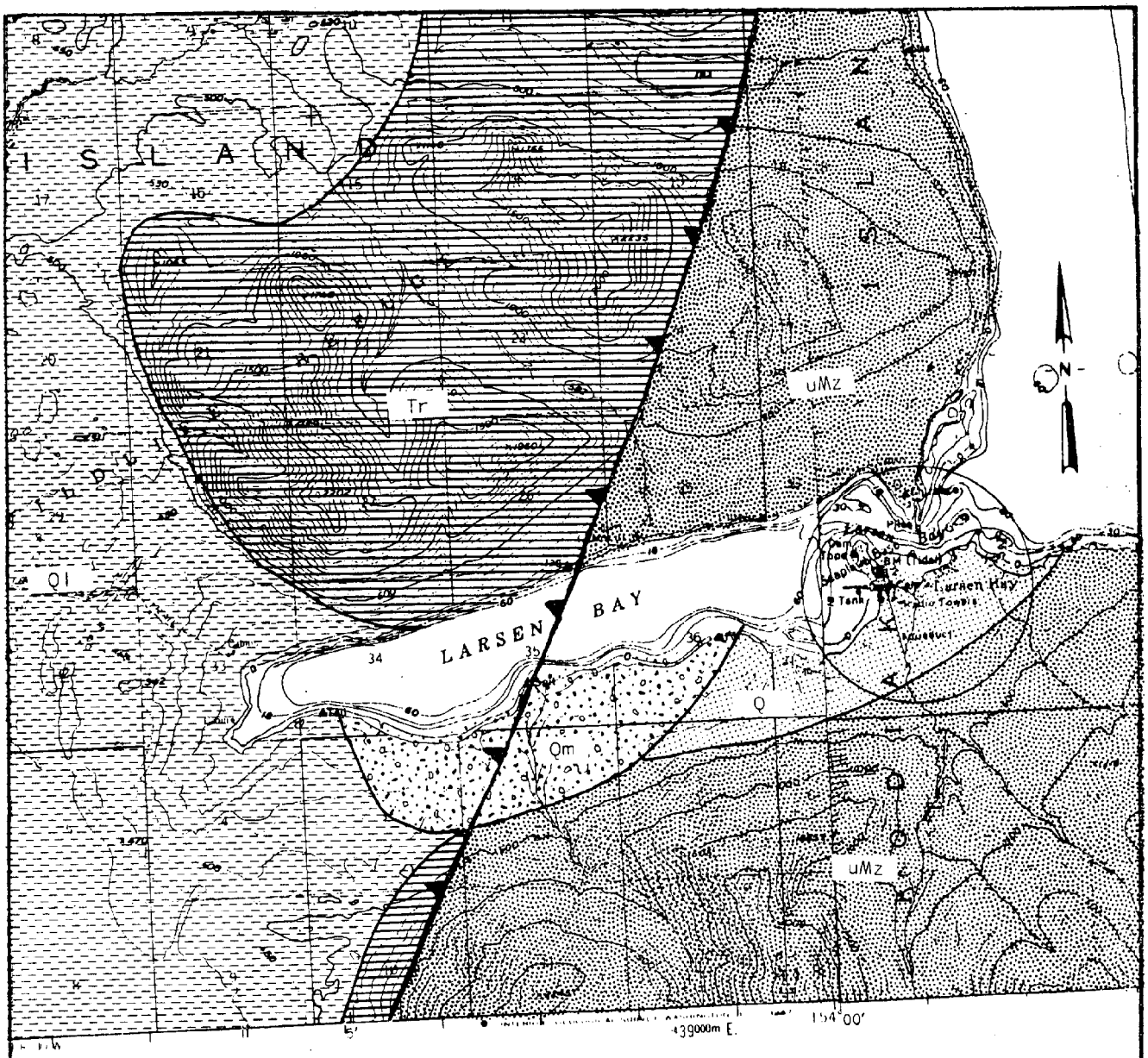
Landslides: none mapped

Water table: no information

Seismic Risk: high potential for earthquake and damage

Information Sources: AEIDC (1974); BLM (1977); aerial photographs

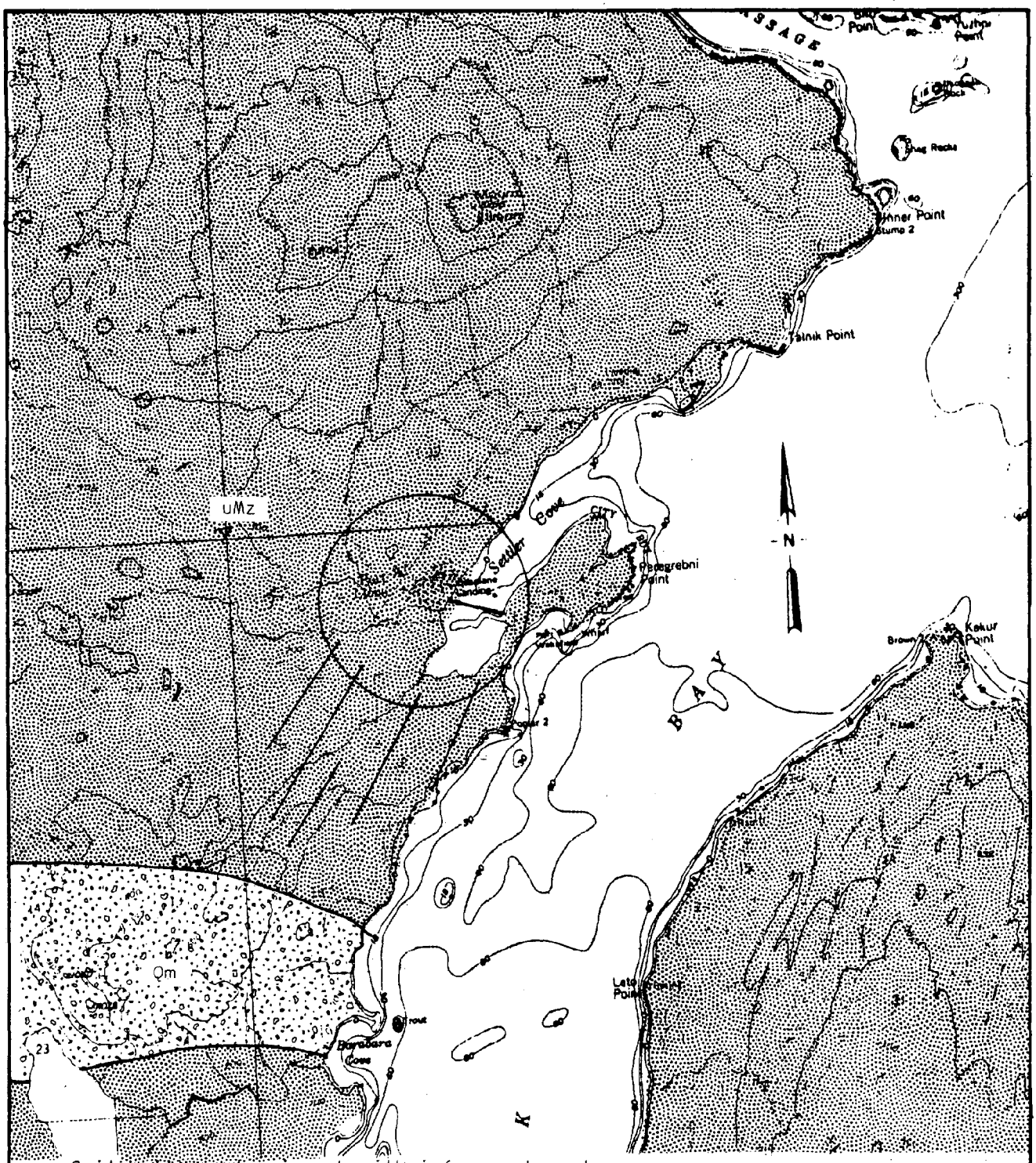
Project No. 60666A WOODWARD-CLYDE CONSULTANTS	Preliminary Geologic Map - Karluk	Fig. 3.14



Scale 1:63360

Soil: silty volcanic ash
Quaternary deposits: (Q) undifferentiated, (Qm) glacial moraine and drift, (Ql) glaciolacustrine
Bedrock: (uMz) Cretaceous and upper Jurassic graywacke, slate and argillite, (Tr) Triassic shale, limestone, chert, schistose tuff, sandstone and pillow basalt
Faults: (▲▲) major thrust 3.5 km west, hatches on downthrown block
Landslides: none mapped
Water table: high, wells and springs
Seismic risk: high potential for earthquake and damage
Information Sources: AEIDC (1974); BLM (1977); aerial photographs

Project No. 60666A **WOODWARD-CLYDE CONSULTANTS**	Preliminary Geologic Map - Larsen Bay	Fig. 3.15



Soil: silty volcanic ash with infrequent peat

Scale 1:63360

Quaternary deposits: (Qm) glacial moraine and drift

Bedrock: (uMz) Cretaceous and upper Jurassic graywacke, slate, argillite, some metamorphic greenschist facies

Faults: none mapped; linears from aerial photographs

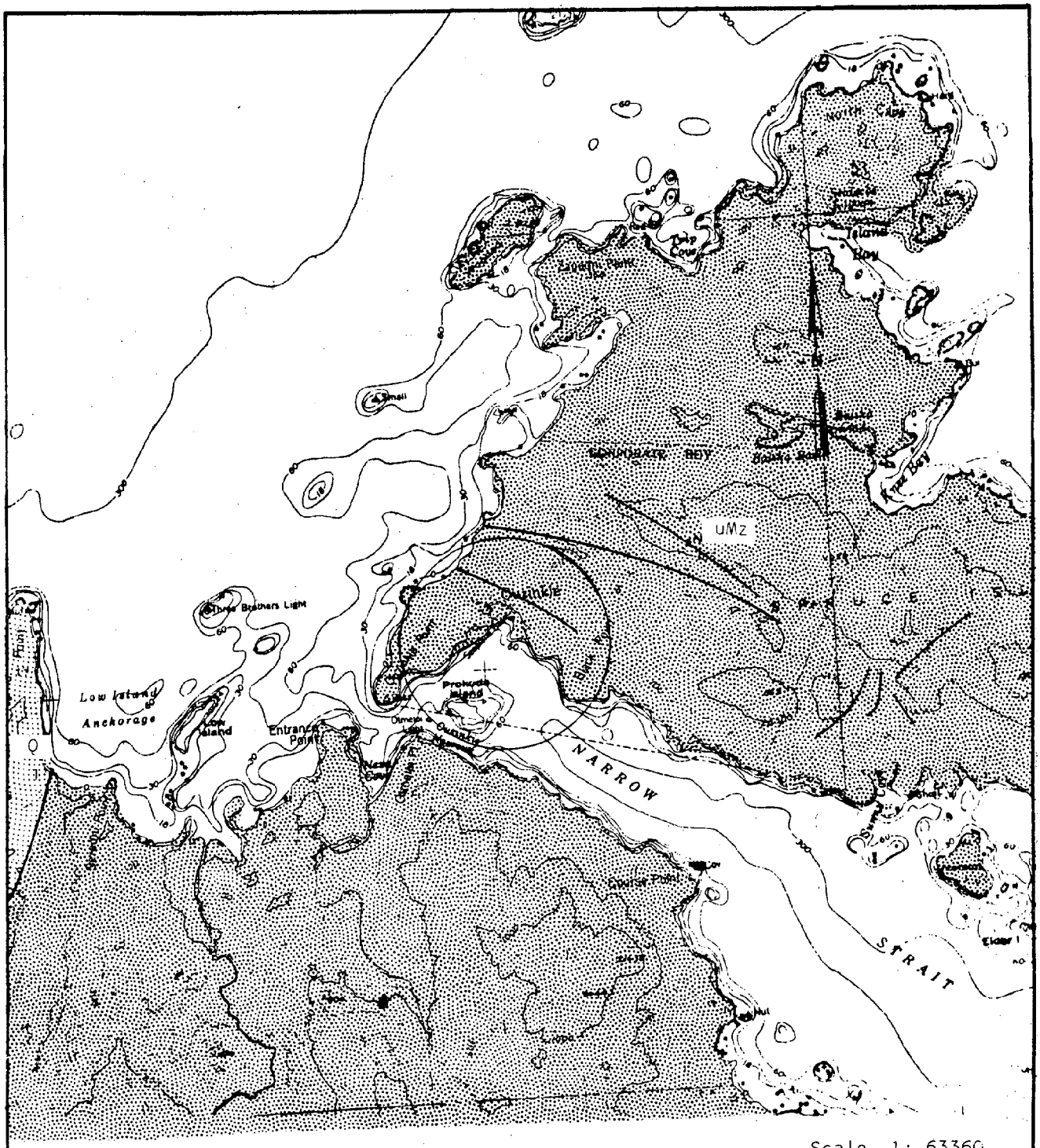
Landslides: none mapped

Water table: no information

Seismic risk: high potential for earthquake and damage

Information Sources: AEIDC (1974); BLM (1977); aerial photographs

Project No. 60666A **WOODWARD-CLYDE CONSULTANTS**	Preliminary Geologic Map - Port Lions	Fig. 3.16



Scale 1: 63360

Soil: silty volcanic ash with infrequent peat
Quaternary deposits: (Q) undifferentiated
Bedrock: (uMz) Cretaceous and upper Jurassic graywacke, slate, argillite and some metamorphic greenschist facies
Faults: none mapped; linears from aerial photographs
Landslides: none mapped
Water table: no information
Seismic risk: high potential for earthquake and damage
Information Sources: AEIDC (1974); BLM (1977); aerial photographs

Project No. 60666A **WOODWARD-CLYDE CONSULTANTS**	Preliminary Geologic Map - Ouzinkie	Fig. 3.17

atmospheric effects of a violent volcanic eruption could be mitigated by adequate public notice of volcanic activities.

Mass Wasting. Hazards related to mass wasting include landslides, submarine slumps with resultant tsunamis, rockfalls, and avalanches. Landslide describes the downhill movement of earth, rock, mud, or debris. Avalanche refers to similar movements of snow and ice. Processes which trigger landslides are rainfall, erosion, earthquakes, and man-induced cutting and filling. Earthquake-induced slides do not require a steep slope, as was noted on Kodiak Island during the 1964 Alaska earthquake. Almost 2,000 slides were triggered, most of which occurred along the southeast coast of Kodiak Island on moderately steep slopes, deeply weathered and mantled with thick deposits of glacial till, volcanic ash, and colluvium. Most of the slides on the southeastern coast were controlled by local lithology and structure. The combination of steep topography, unconsolidated materials, considerable precipitation, faults and joints, and earthquake activity makes landslides potentially very hazardous to many communities on Kodiak and surrounding islands. Pillar Mountain and Old Womens Mountain have been identified as the potentially most dangerous unstable slopes near a coastline community. It has been estimated that a 3 meter high seawave would be generated if Pillar Mountain slid into Saint Paul Harbor (U.S. Department of Interior 1980).

Figures 3.11 through 3.17 delineate areas of high landslide potential based on the following criteria: (1) relatively low-strength materials like clay, siltstone, and tuff; (2) numerous faults and joints which reduce shear strength in Mesozoic bedrock; (3) thick accumulations of weathered Tertiary bedrock; (4) steep-sided stream valleys and wave-cut cliffs with no lateral support; (5) high water table; and (6) unconsolidated Quaternary deposits.

Submarine slides are rare on the Kodiak shelf, whereas slides are abundant on the adjacent continental slope. Some slides have been noted on the trough banks that cross the shelf. No evidence of massive slumps,

liquefaction, or debris flow have been found in the Shelikof Strait (U.S. Department of Interior 1981). Rockfalls pose a potential hazard in scattered areas of Kodiak and surrounding islands in areas of consolidated rock. Avalanche hazard is directly related to snow accumulation and a critical 30° to 45° slope. Spring runoff on south-facing slopes creates a high avalanche risk in areas of steep slopes. Most areas with high avalanche risk are in the uninhabited interior of Kodiak Island; an exception is Anton Larsen Bay, 15 km northwest of Kodiak.

Site-Specific Geologic Hazards Analysis

Introduction. The site-specific analysis of geologic hazards at the six villages and the City of Kodiak consisted of a brief aerial reconnaisance on April 27 and 28, a review of published literature, and a brief aerial photographic analysis. Geology of the islands was derived from the geology and structure map (Department of Interior 1977) at a scale of 1:680,000 and the geologic features map of Shielikof Strait by P. J. Hoose and J. Whitney (1980) at a scale of 1:250,000. Hazards information was compiled on a base map scale of 1:63,360; information accuracy is typically generalized in such a data transfer. Additional detailed studies of the geologic hazards would provide needed information of their extent and likelihood of occurrence.

City of Kodiak. The City of Kodiak is located in a high seismic risk zone because of its regional proximity to the seismically active eastern coastline (Figure 3.11). The risk is high in terms of the likelihood of earthqauke occurrence and degree of damage that would result. Based on analysis of the effects of the 1964 Alaska earthquake, ground shaking, landslides, and tsunamis are the primary causes of damage. The structure relationships of the Mesozoic graywacke and argillites near Kodiak are potentially susceptible to landslides at Pillar and Old Womens Mountain (R. Updike, DGGS, personal communication 1981). A combination of steep dips (50°W), extensive jointing, and man-induced undercutting have contributed to the potential hazard. The U.S. Geological Survey has posted an alert for Pillar Mountain and a verbal alert for Old Womens

Mountain (J. Staford, personal communication 1981). R. Updike recently completed a two-year monitoring of Pillar Mountain, during which no apparent movement was noted. It is theorized that movement would be an all-in-one collapse of the mountain rather than a slow creep mechanism. An estimated 3 meter high seawave would be produced if Pillar Mountain slid into the harbor (U.S. Department of Interior 1980b).

Tsunami damage to the City of Kodiak was considerable as a result of the 1964 earthquake. The line of maximum inundation was 22 feet along Benson Street, and a 30-foot wave washed 30 homes from the Shahafka Cove area into Potato Patch Lake (AEIDC 1975).

Old Harbor. The village is situated on undifferentiated, unconsolidated deposits of undetermined thickness at the base of a steep slope which is underlain by Mesozoic graywacke, slate, and argillite (Figure 3.12). Depending on the angle of dip of these rocks and the fracture patterns, there could be a potential for a Pillar Mountain-type slide in the area. Local field mapping of structures needs to be conducted to verify this potential. The unconsolidated Quaternary deposits may form unstable foundation materials in the event of ground shaking. Old Harbor is 5 km northwest of a major regional thrust fault which may be inactive, and 9 km northwest of an active high angle fault (U.S. Department of Interior 1977). Maximum tsunami run-up height from the 1964 earthquake measured 12 feet above tide level and destroyed all structures except the church and school buildings. Due to its proximity to the active fault zone and its vulnerability to tsunamis, the village is placed in a high seismic risk category.

Akhiok. Akhiok village is located on Quaternary glacial moraine and drift deposits that are largely unmodified (Figure 3.13). Depth to the Mesozoic bedrock has not been determined. No major or active faults are mapped in the area. Tsunami risk is moderate due to the village's location leeward of a barrier island configuration. Seismic risk is high for Akhiok, based on the potentially unstable nature of the saturated Quaternary deposits and the regional seismicity.

Karluk. The village is built on undifferentiated Quaternary deposits of possible glacial origin (Figure 3.14). It is located at the base of a steep slope composed of quartz diorite. Local rock structure is presently poorly understood, but tentatively the igneous rocks appear to be stable, based on aerial photographic analysis of linears. A regional fault is mapped 3.5 km southeast of the village. Its location on the southwest side of the island makes the village less prone to tsunami damage generated from a Pacific Ocean source. Earthquake likelihood is high based on the regional seismotectonic setting. Its location on unconsolidated deposits contributes to possible ground shaking, subsidence, and liquefaction damage. Such damage is also dependent on other factors such as duration of shaking, response spectra, earthquake magnitude, depth of focus, and building design and contruction. Secondary volcanic phenomena are a potential risk to Karluk since it borders the active Alaska Peninsula volcano zone.

Larsen Bay. The community rests on Quaternary deposits of possible glacial origin (Figure 3.15). A major inactive thrust fault lies 3.5 km west of the village site (U.S. Department of Interior 1977). The graywacke, argillite, and slates south of town appear stable topographically, based on a limited aerial photographic study. Across the bay the steep scarp slope of the same rock types could pose a landslide threat if the dip of the rock unit is steep and daylights into the scarp and fractures are extensive. Data from wells and springs indicate a high water table, which would make the unconsolidated deposits of the village site unstable under ground shaking conditions. The tsunami threat is low because of the location of the village on the west side of Kodiak Island. Seismic risk is high due to regional tectonism.

Port Lions. Large-scale geologic mapping places Port Lions on bedrock of graywacke, slate, and argillite (Figure 3.16). There does not appear to be a landslide problem based on aerial photographic analysis. No faults are mapped in the area. Regional seismic risk is high due to tectonism.

Ouzinkie. The village is located on graywacke, slate, and argillite bedrock (Figure 3.17). There is no landslide threat, as determined by the low relief. No faults are mapped near the town. Seismic rating is high due to regional tectonism.

3.3.2 OF OCEANIC ORIGIN

Oceanographic Setting of the Kodiak Region

Surface water circulation in the Gulf of Alaska traces a generally counterclockwise pattern (Figure 3.18). Water is carried eastward across the Pacific Ocean by the Subarctic Current. Upon entering the Gulf of Alaska, this current splits to form the northward Alaska Current and the southward California Current. Following the Alaska coastline, the Alaska Current passes southwest of Kodiak Island, where, as it narrows and becomes more intense, it is known as the Alaska Stream. Some of the Alaska Stream reenters the Subarctic Current to complete the circuit, while the remainder is believed to flow northward through various Aleutian passes into the Bering Sea. Direct measurements of the Alaska Current indicate that current speeds are greatest over the continental slope, and are as much as 1.5 knots south of Kodiak Island.

Circulation along the Gulf of Alaska continental shelf is also affected by strong tidal activity, wind stress, and surface water runoff from the land masses. Tidal activity produces as much as 85 percent of the variance in current measurements (Buck et al. 1975). Nearer to Kodiak, current patterns can vary dramatically, especially close to shore where both tides and winds can affect them. Inshore water circulation is altered substantially during runoff season by the influx of large volumes of river water. In some embayments the runoff can retard the flood tide and enhance the ebb flow. Locally intense winds, known as "williwaws," can also affect nearshore currents substantially and create occasionally hazardous sea wave conditions.

Tides in the Kodiak region are semidiurnal (two highs and two lows per 25-hour period) in character. Mean tidal amplitudes along the Gulf of Alaska coast range from 6 to 12 feet, with flood currents usually

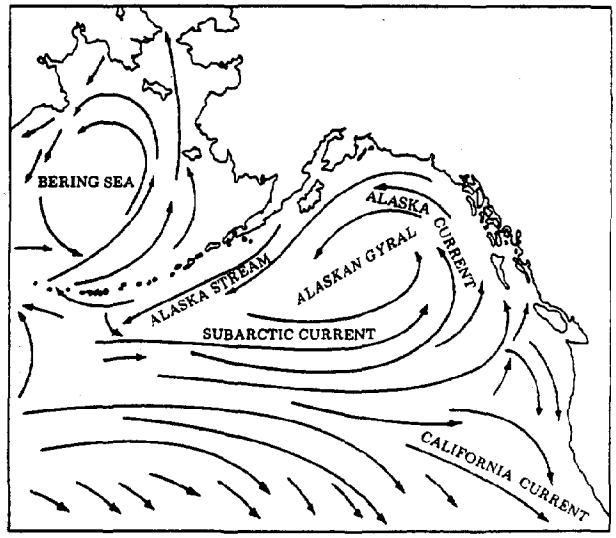


Figure 3.18. Surface water circulation in the Gulf of Alaska.

trending northward and ebb currents to the south. However, since the pattern of tidal currents can be extremely variable and complex due to local influences, further generalization is impractical. Tidal currents can reach significant speeds: for example, 4 to 5 knots at the Larsen Bay entrance; 3 knots at Sitkalidak Passage; and 2 to 3 knots at the north entrance to Kodiak Harbor. Major tide rips occur in Sitkinak Strait, over 17-Fathom Bank, and in Stevenson Passage. When opposing trains of waves encounter these rips, potentially hazardous sea conditions develop as a result of the random and chaotic nature of the wave and current interaction.

Sea ice formed in Upper Cook Inlet is transported southward by northerly winds and tidal currents. This sea ice is rarely observed any farther south than Cape Douglas on the west shore of Lower Cook Inlet or Anchor Point on the east shore. No sea ice forms around Kodiak Island, but occasional small bergs, calved from tidewater glaciers in South-central Alaska, have been observed near Kodiak.

Oceanic Hazards

Storms are the source of the most persistent of all potentially hazardous agents in the coastal environment. By their action over long stretches of the ocean surface, storm winds produce waves that vary in size (i.e., height, length, and period), according to the exposure (i.e., "fetch"), duration, and intensity of the wind. Such waves, generated by the wind, are known as "sea waves." These waves can transmit substantial amounts of energy which, when expended on a shoreline, can be either erosional or accretional to the beach, with both effects sometimes occurring within a short distance. For coastal zone management purposes, it is important to identify areas that are particularly susceptible to the erosional effects of sea waves. This is accomplished by consideration of the area exposed to potentially destructive sea waves and also the material composition of the shoreline. A rocky headland is not generally vulnerable to significant wave damage, while a sedimentary shoreline deserves special attention in this context; that is, any

development of the latter should be consistent with the usually transient character of sedimentary shorelines, or substantial efforts will be necessary to protect or preserve the beach and whatever development is permitted upon it, or even nearby.

Another storm effect of potential concern is "storm surge," which is also known as the "meteorological" tide. A storm over nearshore waters can generate large fluctuations in sea level if the storm is sufficiently strong and the nearshore region is shallow over a large area. Storm activity can cause either a rise (set-up) or a fall (set-down) of the water level at different locations and times, with the set-up predominating in magnitude, duration, and areal extent. Because of the relatively narrow continental shelf around the Kodiak Archipelago, it is unlikely that storm surge is a factor of genuine concern, except possibly in shallow lagoons that are exposed directly to the open ocean.

Seismic and volcanic activity, which often results in severe earthquakes and produces landslides or avalanches, provides yet another source of water disturbances that qualify as hazards of oceanic origin. Tsunamis are the long ocean waves produced by an abrupt uplift or subsidence of the ocean floor. These waves travel rapidly and are capable of wreaking havoc by impact on and inundation of coastal areas. Waves produced by landslides or avalanches are sometimes referred to as tsunamis but, in most cases, would be more correctly identified as "seiche." The latter term applies to standing waves in a body of water, produced by some impulse and manifest by the "rocking" of the water back and forth within its basin. Any region that is subject to frequent seismic activity can be expected to be susceptible to both wave forms.

Coastal Erosion. Many beaches along the southern coast of Kodiak Island were flattened and subsequently receded shoreward as a result of the 1964 Alaska earthquake. A regional zone of tectonic subsidence is located along most of Kodiak Island adjacent to the Kodiak Mountain range. Widespread subsidence of this range, triggered largely by earthquake displacement, has been occurring for the past several centuries

(Plafker and Meyer 1967; Plafker and Kachadoorian 1966). During the 1964 earthquake, the northern section of the tectonic zone subsided more than 6 feet. According to Plafker and Kachadoorian (1966), "Southern shores were repeatedly washed by destructive waves having run-up heights along exposed coasts approximately 40 feet above existing tide levels, and another 8 to 20 feet along protected shores."

Surficial subsidence of unconsolidated deposits as well as tectonic subsidence can greatly alter beach formations. The earthquake caused beach berms and stream deltas to shift landward in subsided areas. Shorelines composed of poorly consolidated deposits were brought within reach of the tides and rapidly eroded by wave action at the higher sea levels. Surficial subsidence also contributed to the formation of tidal lagoons where beach-barred lakes had existed at bay heads or stream mouths.

Most Kodiak beaches are narrow and composed of sand and gravel. These sand and gravel deposits are found in the narrow valley bottoms at heads of bays. Sandy barrier islands and spits are also present, usually within the same area. Approximately 10 to 15 percent of the island coastline is composed of these unconsolidated sediment materials. The deposits are thin, not more than 30 to 40 feet, and most occur along the southwestern end of the island (Buck et al. 1975).

The prevailing wind direction at Kodiak is northwest from August to April, shifting to east from May through July. During autumn and late winter, winds are strongest in the Kodiak region, with waves higher than 17 feet occurring often (Buck et al. 1975). Although prevailing winds are from the west to northwest, intense storms in the Gulf of Alaska will produce strong easterly winds, accompanied by high waves that pound east-facing coastlines. Sustained easterly winds sometimes require removal of small boats from Kodiak Harbor, so that they will not be damaged by being battered against the docks. Some of the worst sea conditions occur when the tide ebbs southward out of Shelikof Strait under opposing waves from the southwest. Given the exposure of the Kodiak

Archipelago and the combination of prevailing and storm winds, there is hardly a section of the coastline that is not subject to occasionally severe wave conditions (Map 10).

Tsunami Flooding. Coastal flooding by tsunamis generated during the 1964 Alaska earthquake produced some severe beach erosion. This occurred on Kodiak Island along exposed southern-coast beaches where the beach subsided and allowed waves to reach above the high tide mark. The tsunami waves climbed beyond the beach face, causing scour erosion and alteration of beach features. The highest waves struck during high tide. Tsunami run-up heights ranged from a minimum of 5 feet or less to 31.5 feet between Chiniak and Narrow capes. Exposed beaches received the highest run-up (Plafker and Kachadoorian 1966). Those beach features that were altered or destroyed reappeared and stabilized in their normal shapes within a few months after the earthquake. Within protected shores, more uniform recession of the beach face area took place because tsunami wave action was less dynamic. Presumably, this was because the beach face was flatter and composed of sand which is less readily moved by wave action (Stanley 1971). Within sheltered embayments, such as Kaguyak, a run-up of 17 feet occurred. Tsunamis altered and destroyed spits, bay-mouth bars, and barrier beaches found in the vicinity of bays located at the southeast end of Kodiak Island. The waves scoured channels through ridges and spits and formed new outlets. Tsunami run-up within Shelikof Strait and Stevenson Entrance was only slightly above normal high tide levels. Flooding did not occur along the southwest shore of Kodiak or at Sitkinak Island. Although this discussion has focused on the 1964 tsunami, Table 3.18 indicates that such phenomena are not uncommon for these shores.

Existing data on the extent and magnitude of oceanic hazards in the seven borough communities is extremely limited. Table 3.19 shows data on damage sustained during the 1964 earthquake and resulting tsunami. Figures 3.19 through 3.27 (Buck et. al. 1975; Sears & Zimmerman 1977) show reported coastal erosion in the vicinity of the seven borough communities.

Table 3.18. Tsunamis observed within the Kodiak Archipelago.

Date	Cause	Origin	Where Observed	H* feet	t* hours	T* min.	Observations and Remarks
July 22, 1788		Alaska Peninsula	Kodiak Island - Three Saints Bay				Continental Shelf origin indicated.
Aug. 13, 1868		Northern Chile	Kodiak, Alaska			22	Thousands killed by tsunami in Chile.
Aug. 27, 1883	Krakatoa explosions	Java, Indonesia	Kodiak, Alaska	0.3			Small waves, generated by atmospheric pressure waves resulting from explosion of Krakatoa.
Nov. 5, 1952	Earthquake of magnitude 8.25	East Kamchatka					Great tsunami.
Nov. 4, 1952			Kodiak Island - Womens Bay	1.3	5.8	6.2	
Mar. 9, 1957	Earthquake of magnitude 8.3	Unimak Island	Kodiak Island - Womens Bay	0.7	2.2		Considerable damage to areas in the Hawaiian Islands and parts of Japan.
May 22, 1960	Earthquake of magnitude 8.5	Southern Chile	Kodiak	2.3	19.2		Tremendous damage and many casualties in Chile, Hawaii, and Japan.
Mar. 27, 1964	Earthquake of magnitude 8.3	Prince William Sound, Alaska	Throughout Kodiak Island Group	Refer to Text			Refer to text for detailed discussion.
Feb. 3, 1965	Earthquake of magnitude 7.75-8	Rat Islands, Aleutian Islands	Kodiak	0.3			

Source: Buck et al. 1975.

Note: H = maximum run-up height or wave height; t = travel time from origin; T = period between wave crests.

Table 3.19. Damage sustained during 1964 earthquake and resulting tsunami.

	Tsunami Highest Level Run-up in Feet Above MLLW	Shoreline Inundation	Major Property Damage	Seiche Occurrance
Kodiak	12.8-20.0		X	Terror River Uganik River Myrtle Creek
Old Harbor[1]	22.5-30.5	X		
Akhiok	6.4	X		
Karluk	1.5	X		
Larsen Bay	4.2	X		Spiridon Lake Outlet
Port Lions[2]	---	X		
Ouzinkie[3]	15.7-22.0	X	X	

[1] Old Harbor - almost completely destroyed by tsunami (22.5-30.5').

[2] Port Lions - relocated village of Afognak abandoned due to regional subsidence of 4.5'.

[3] Ouzinkie - substantial inundation - 15.7-22.0' above MLLW.

Kaguyak - completely destroyed, survivors moved to Akhiok and Old Harbor (25-32').

Figure 3.19. Kodiak. Coastal erosion from sea wave action - amount of shoreline affected is unknown.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

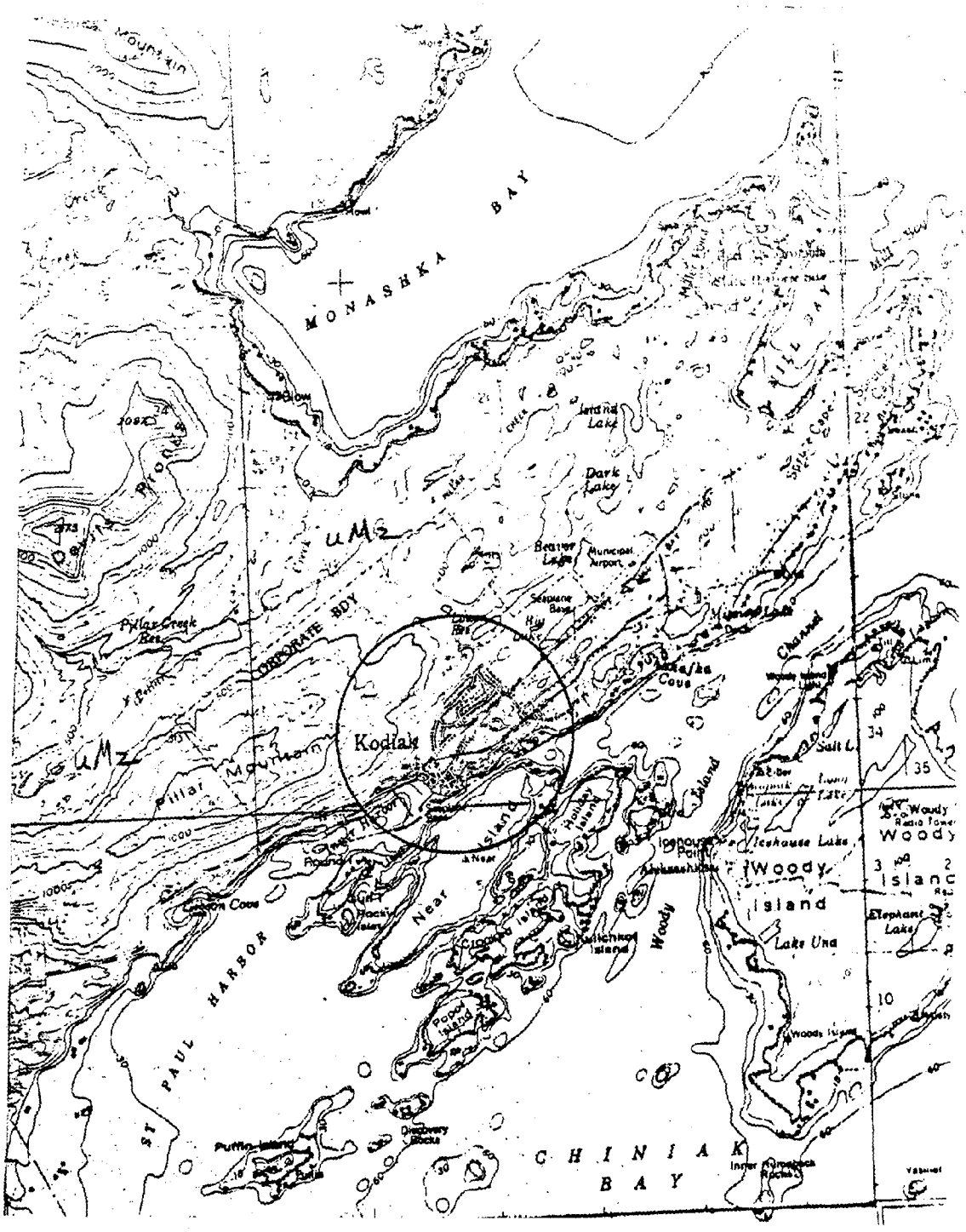


Figure 3.20. City of Kodiak. Coastal erosion from sea wave action - amount of shore line affected is unknown.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

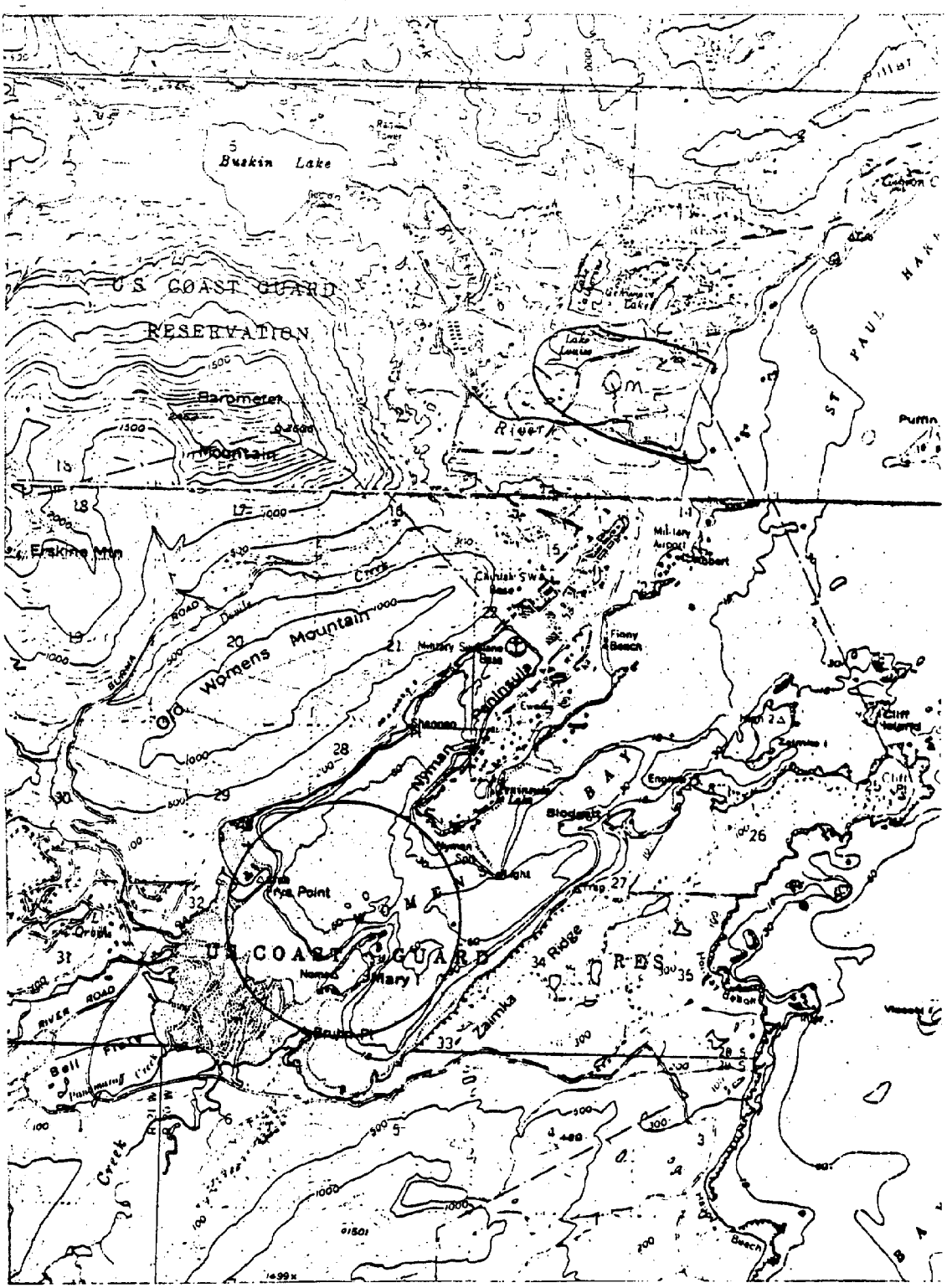


Figure 3.21. City of Kodiak - Womens Bay. Coastal erosion from sea wave action - amount of shoreline affected is unknown.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

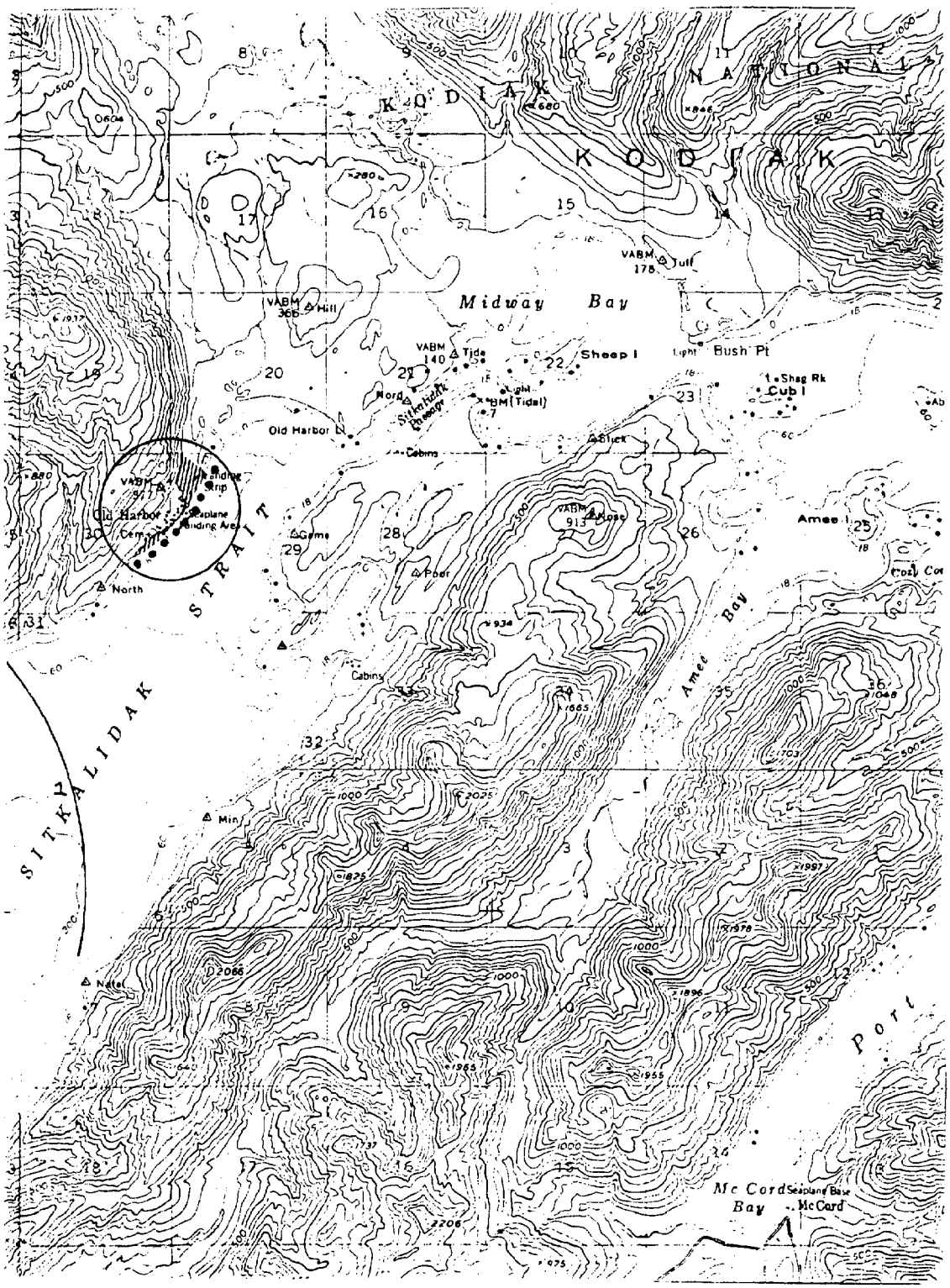


Figure 3.22. Old Harbor. Coastal erosion from sea wave action - 1.0 miles of shoreline affected.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

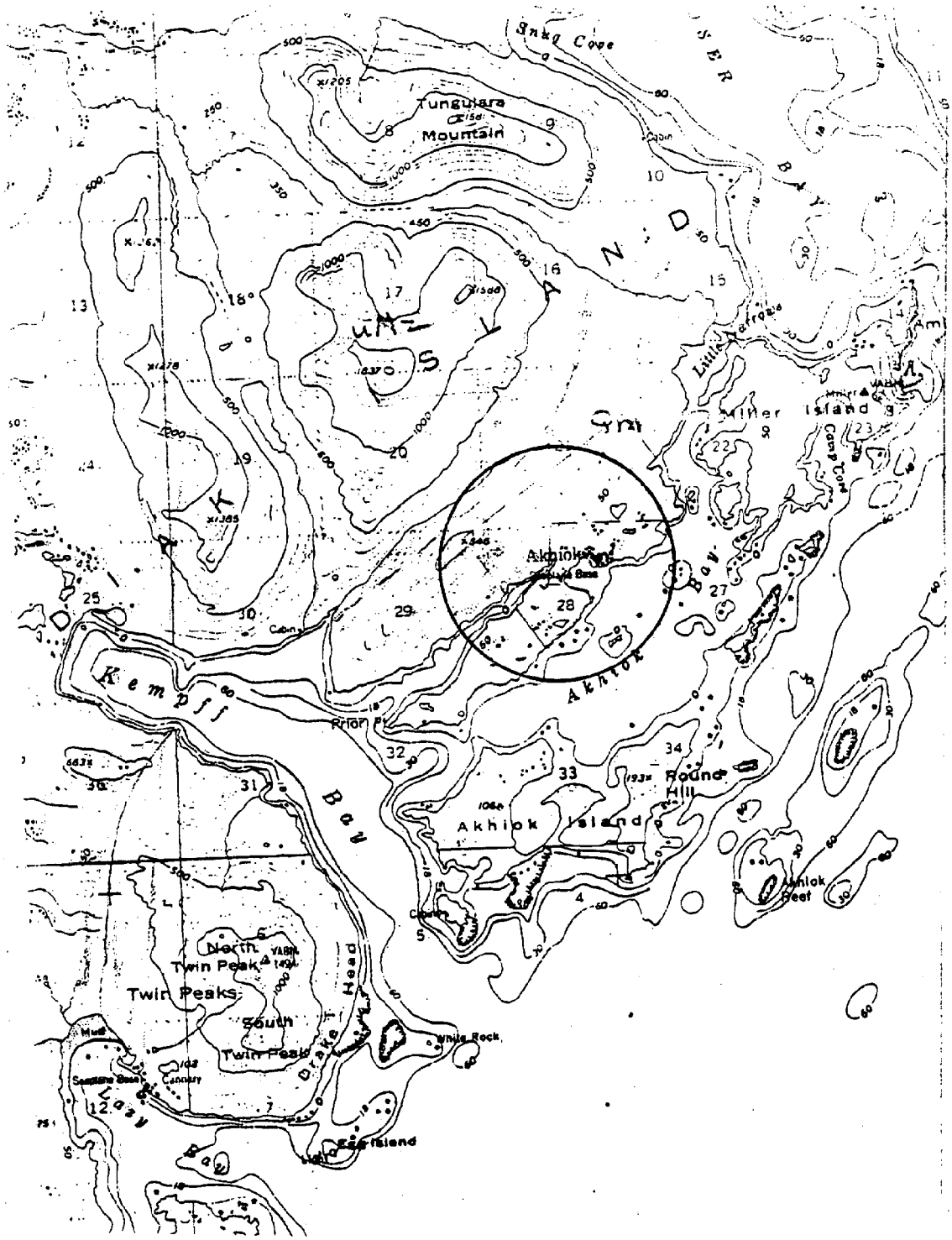


Figure 3.23. Akhtok. Coastal erosion from sea wave action - amount of shoreline affected is unknown.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

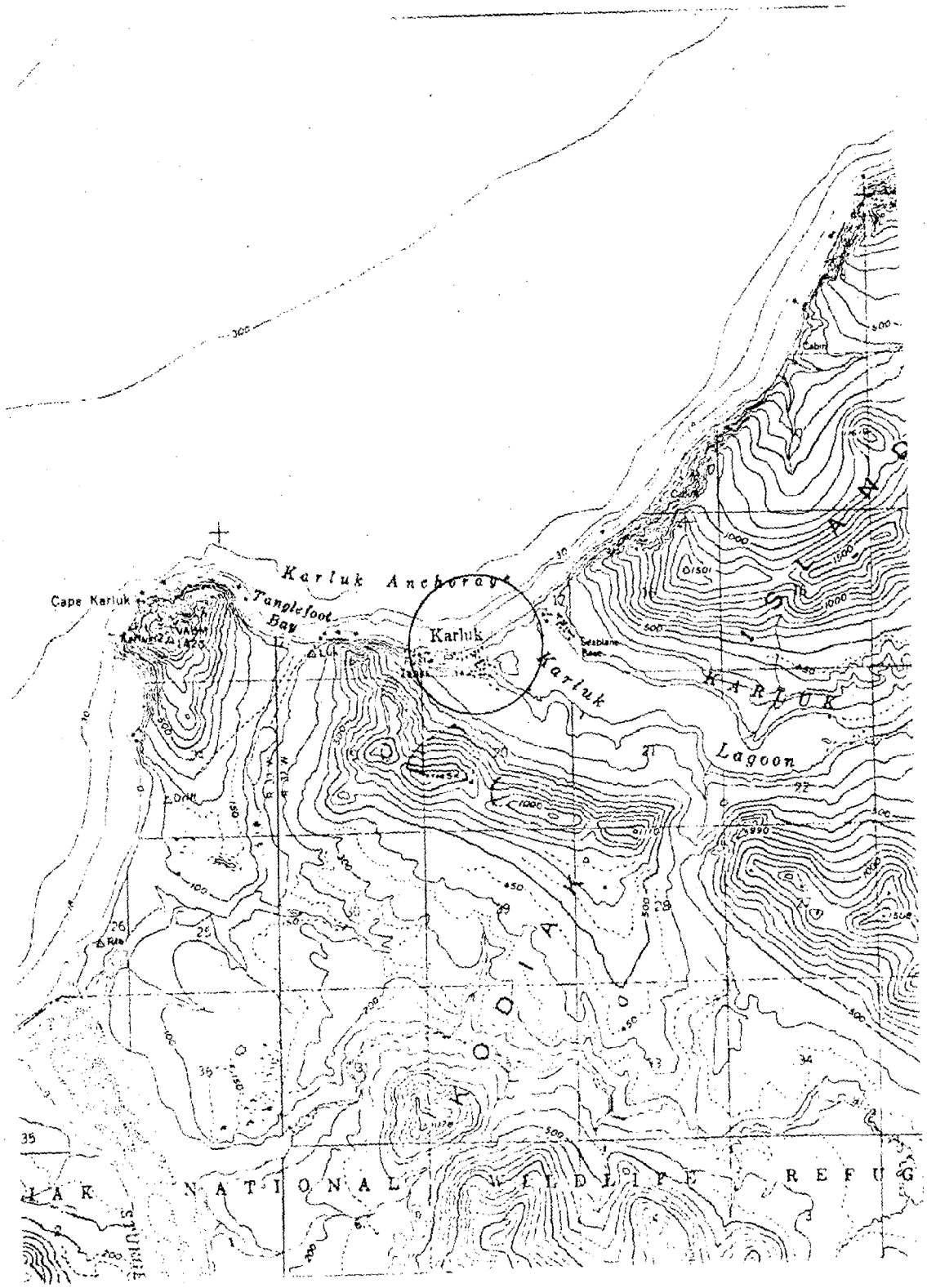


Figure 3.24. Karaluk. Coastal erosion from sea wave action - 1.0 miles of shoreline affected.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

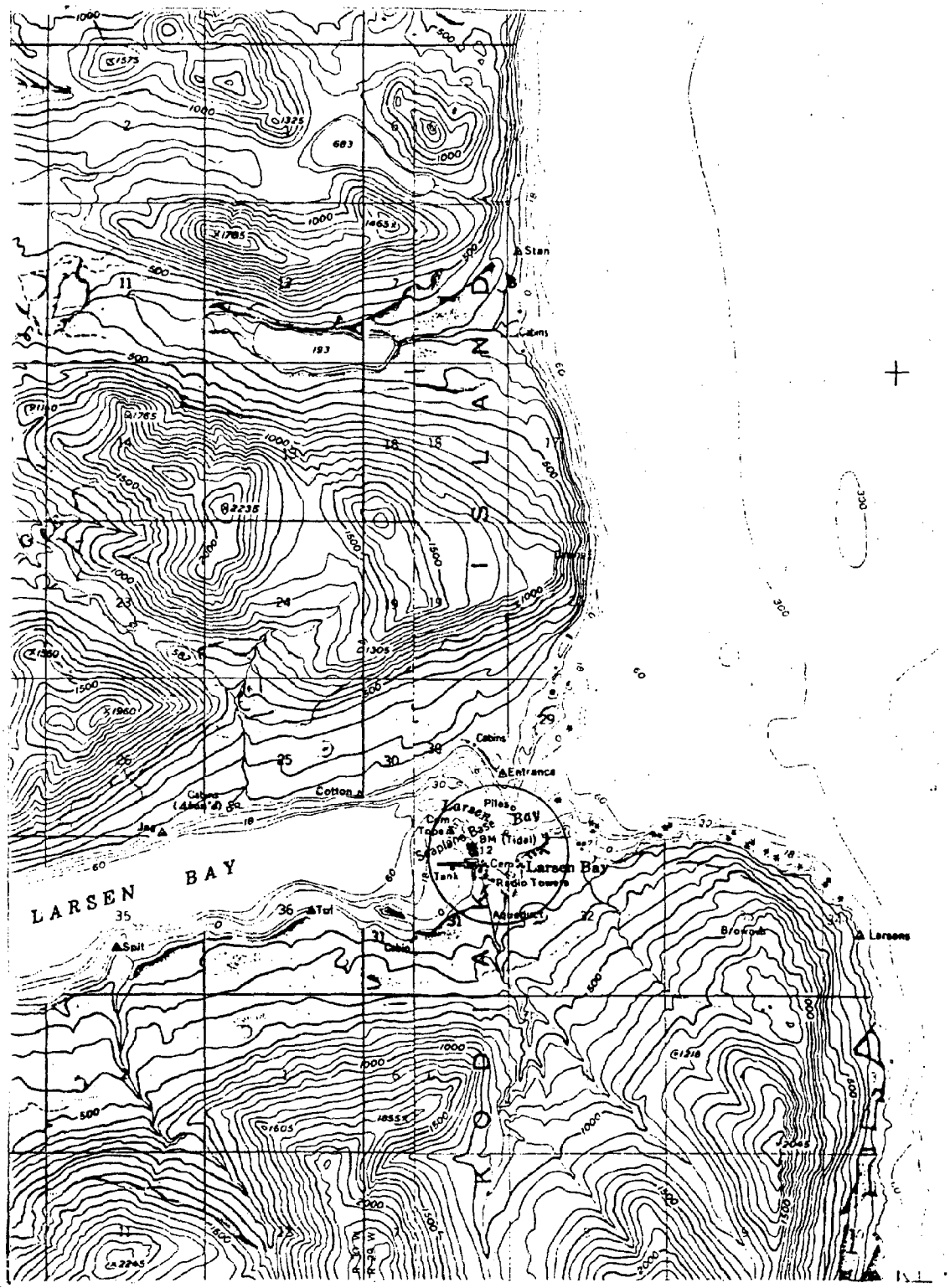


Figure 3.25. Larsen Bay. Coastal erosion from sea wave action - 1.0 miles of shoreline affected.

Source: Buck et al. 1975; Sears and Zimmerman 1977/

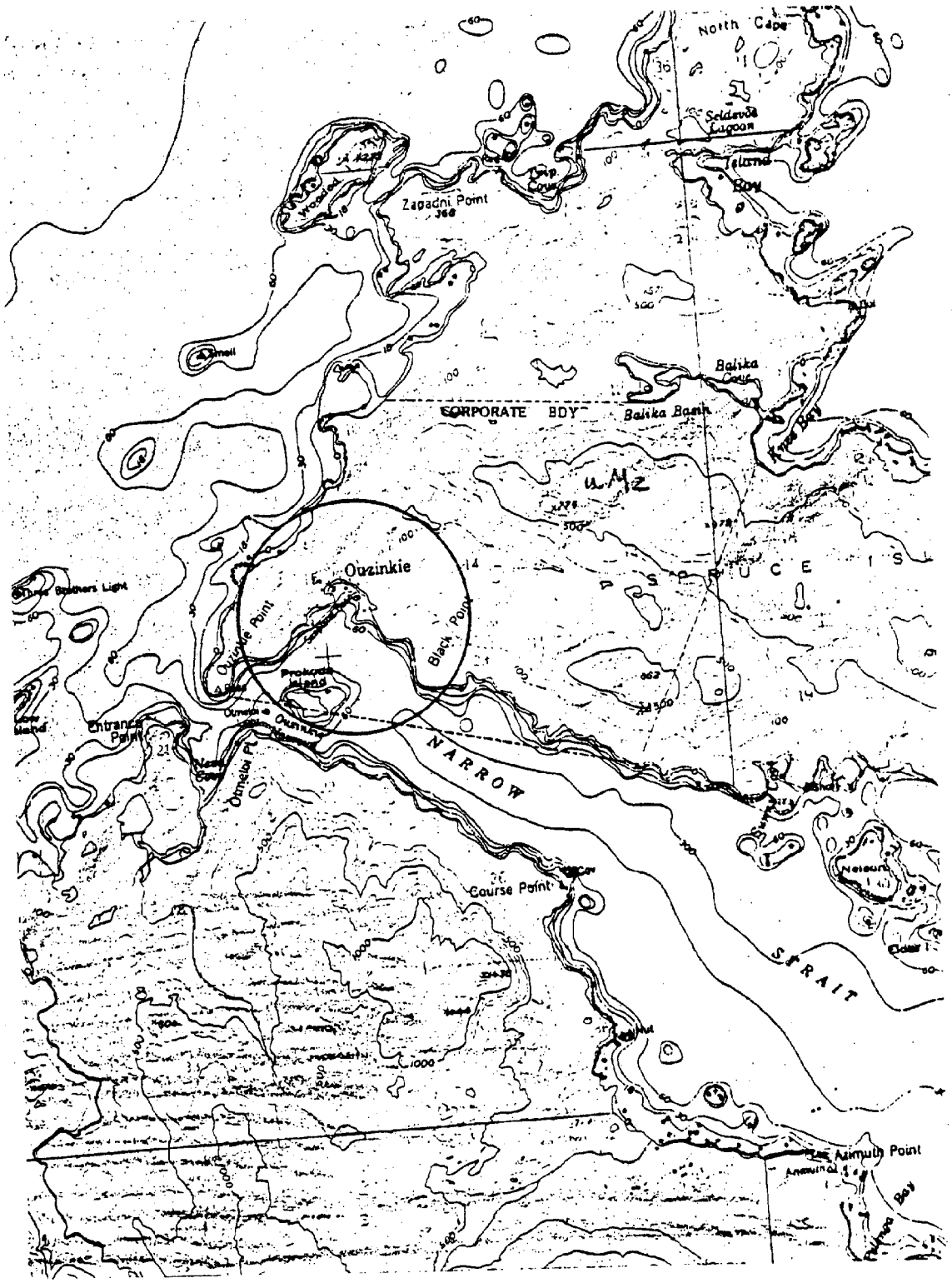


Figure 3.26. Ouzinkie. Coastal erosion from sea wave action - amount of shoreline affected is unknown.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

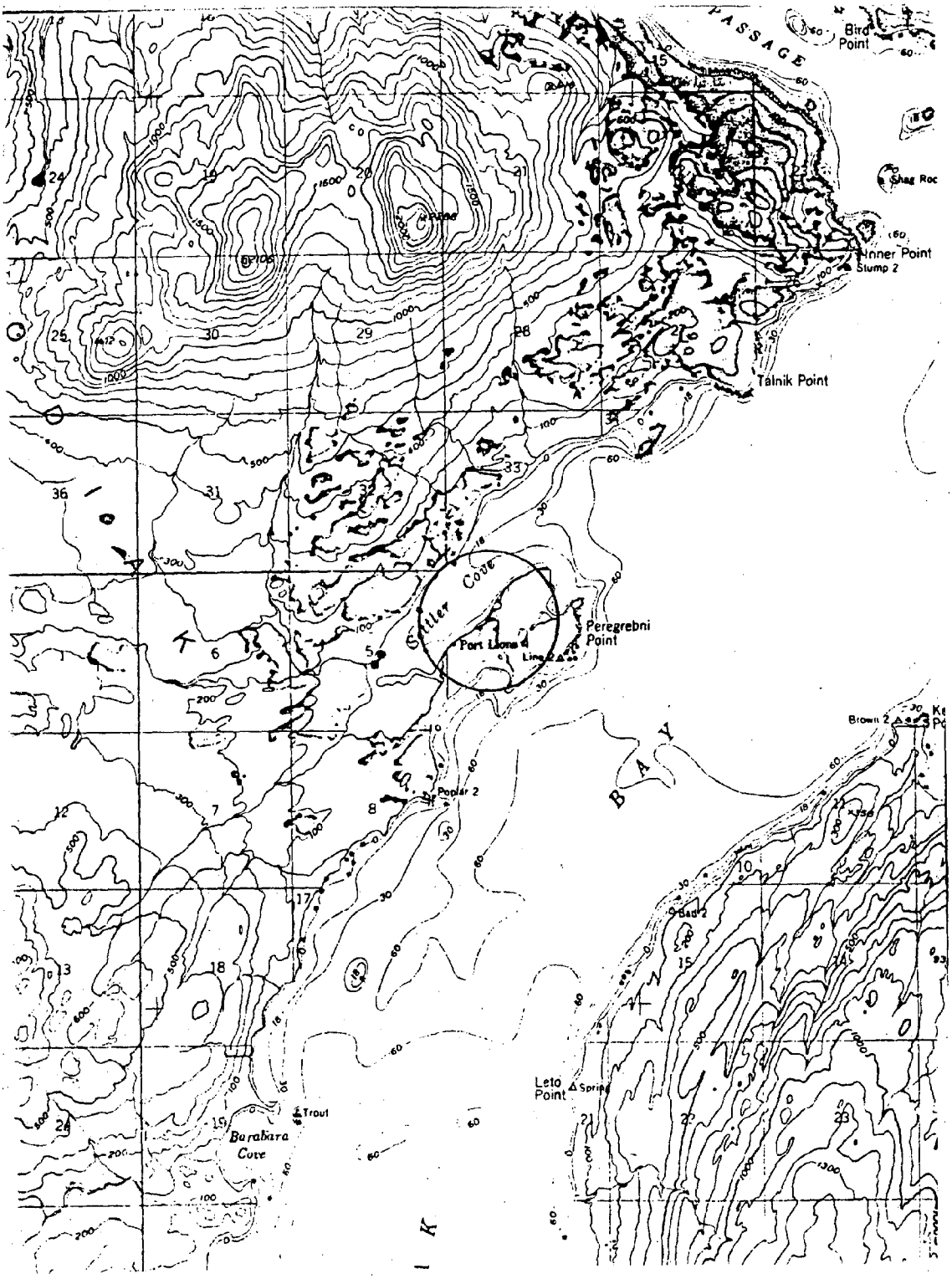


Figure 3.27. Port Lions. Coastal erosion from sea wave action - 0.5 miles of shoreline affected.

Source: Buck et al. 1975; Sears and Zimmerman 1977.

3.3.3 OF HYDROLOGIC ORIGIN

Riverine Flooding

Streams in Kodiak Island Borough are characterized by small drainage basins, steep gradients, shallow layers of unconsolidated materials over bedrock, and short lengths. As a result of these characteristics, runoff from storms is among the highest in the state (Buck et al. 1975). Maximum known floods in the study area are listed in Table 3.20. Mean annual floods (average of highest flow each year) range from about 50 cubic feet per second (cfs)/sq. mi. near Karluk and Larsen Bay to 100 cfs/sq. mi. in the mountains and on the southeast side of Kodiak Island (Buck et al. 1975).

Floodplains (areas that are inundated during floods) are generally narrow, a result of the small drainage basins and steep topography. However, flooding also occurs in winter, when the stream channels are filled with ice; such floods can inundate larger areas than would summer floods of the same magnitude. Delineation of floodplains would require detailed studies such as those performed by the Corps of Engineers (1978 and 1979) in the vicinity of the City of Kodiak.

City of Kodiak and Vicinity. Riverine flooding is not anticipated to be a major hazard in the vicinity of Kodiak. Small streams in the area would likely have relatively narrow floodplains; however, some inundation of developed areas may occur along some streams, including Buskin River, Devils Creek, Sargent Creek, and Russian Creek. Flooding as a result of dam breaks has been investigated for Lake Bettinger Reservoir (Corps of Engineers 1978). It is predicted that a dam break on Lake Bettinger Reservoir would inundate numerous homes and commercial property in its two-mile path to the dock and bay. There is little development downstream from the proposed Monashka Creek Reservoir.

Akhiok. Riverine flooding is not anticipated to be a significant problem in the Akhiok area. Small streams in the area will likely overtop

Table 3.20. Maximum known floods at U.S. Geological Survey gaging stations in Kodiak Island Borough.

Station No.	Stream	LOCATION Latitude	LOCATION Longitude	Drainage Area (mi^2)	Period of Record (years/dates)	MAXIMUM KNOWN FLOOD Date	Gage Height	Discharge (ft^3/s)	Discharge $[(ft^3/s)/mi^2]$
15295500	Little Kitoi C nr Afognak	58°11'45"	152°21'65"	2.63	1(1960-61)	Jan. 20, 1961	2.64	42	16.0
15295600	Terror R. nr Kodiak	57°39'10"	153°01'30"	15.0	6(1962-68)	Aug. 29, 1963	5.92	4,590	306
15295700	Terror R at mouth nr Kodiak	57°41'50"	153°10'10"	46.0	5(1964-68)	Sept. 26, 1966	6.48	3,820	83.0
15296000	Uganik R nr Kodiak	57°41'06"	153°25'10"	123	25(1951-76)	Oct. 3, 1952	10.65	13,700	111
15296300	Spiradon L O nr Larsen Bay	57°40'40"	153°39'00"	23.3	4(1962-65)	Mar. 27, 1964	1.72	189	8.11
15296500	Falls C nr Larsen Bay	57°16'30"	153°59'03"	5.67	2(1974-75)	Sept. 25, 1975	2.73	174	30.7
15296520	Canyon C nr Larsen Bay	57°17'00"	153°58'52"	8.82	2(1974-76)	Sept. 17, 1976	2.31	450	51.0
15296550	Upper Thumb R nr Larsen Bay	57°21'03"	153°58'04"	18.8	2(1974-76)	Sept. 18, 1976	2.90	1,000	53.2
15296600	Karluk R at outlet nr Larsen Bay	57°26'37"	154°06'41"	100	1(1975-76)	June 14, 1976	1.93	843	8.4
15296950	Akalura C at Olga Bay	57°10'00"	154°13'35	18.4	1(1975-76)	Sept. 22, 1975	1.72	166	9.0
15297000	Dog Salmon C nr Ayakulik	57°12'30"	154°04'15"	72.9	2(1960-61)	Sept. 24, 1961	2.08	777	10.6
15297200	Myrtle C nr Kodiak	57°36'16"	152°24'09"	4.74	14(1963-76)	Sept. 14, 1969	5.02	1,110	234
15297300	Kalsin Bay Tr nr Kodiak	57°35'25"	152°25'55"	2.35	7(1963-69)	Sept. 14, 1969	13.20	250	106
15297450	M F Pillar C nr Kodiak	57°47'58"	152°27'00"	2.02	2(1968-70)	June 8, 1969	2.14	364	180
15297470	Monashka C nr Kodiak	57°50'34"	152°26'44"	5.51	5(1972-76)	Aug. 3, 1972	9.81	562	102
15297500	Red Cloud C Tr nr Kodiak	57°49'00"	152°37'20"	1.51	10(1963-76)	June 8, 1969	12.52	690	457

Source: Lamke 1979.

periodically, causing flooding in adjacent low-lying areas. Quantification of the limits of these floodplain areas would require further study.

Karluk. Riverine flooding of the new townsite of Karluk by the Karluk River is not anticipated because of the high banks along the Karluk Lagoon, and the modifying effects of the lagoon and 9500-acre Karluk Lake on the flood characteristics of the Karluk River. Small streams in the vicinity of the townsite are not anticipated to cause widespread flooding; occasional overtopping of their banks may cause inundation of facilities located near the streams. The small dam on a stream near Karluk has washed out at least twice (Buck et al. 1975), indicating that floods can be substantial in the small streams. Further study would be required to quantify potential extents of riverine flooding.

Larsen Bay. Riverine flooding is not anticipated to be a problem in the Larsen Bay area. A relatively narrow zone of flooding could occur along all streams in the area. The floodplain along Trout Creek would likely become wider in the flat area near its mouth, potentially inundating a several-hundred-foot-wide area. Some structures in this area could be inundated during flood events. Detailed delineation of the riverine flood limits would require further study.

Old Harbor. Riverine flooding is not anticipated to be a problem in the Old Harbor area. Floodplains bordering the small streams in the area are likely to be relatively narrow. Quantification of the boundaries of such floodplains would require further study.

Ouzinkie. Riverine flooding is not anticipated to be a significant hazard in the Ouzinkie area. The small streams in the area likely overtop their banks periodically, inundating the low-lying areas bordering the stream. These floodplain areas are likely to be relatively narrow; quantification of floodplain widths would require further study.

Port Lions. Riverine flooding is anticipated to be an annual problem in Port Lions (Corps of Engineers 1980), as channel icings reduce the capacity of the stream to carry flow and cause winter floods to overtop the bank. Several homes may be inundated during such floods. Quantification of flood limits would require further study.

Stream Bank Erosion

Stream bank erosion is not anticipated to be a major hazard anywhere in Kodiak Island Borough. Existing development is generally located along the coast, and relatively short lengths of small streams pass through the developed areas. Thus, exposure to stream bank erosion hazards is minimal.

City of Kodiak and Vicinity. Stream bank erosion is not anticipated to be a major hazard in the City of Kodiak area. Small areas of local stream bank erosion may occur, affecting development along Buskin River, Devils Creek, Sargent Creek, Russian Creek, and other streams in the area.

Akhiok. Stream bank erosion is not anticipated to be a major hazard in the Akhiok area. However, 10 homes are documented as in danger from river erosion (Corps of Engineers 1981).

Karluk. Stream bank erosion has recently become a hazard that threatens the village of Karluk (Dworsky, personal communication, 1981). The bank of the Karluk Lagoon at the new townsite was mined for gravel for use in developing the new townsite; this has caused bank instability and back-eroding of the bank toward the village (Dworsky, personal communication, 1981). Further study would be needed to document the mechanism and the rate of this erosion hazard.

Larsen Bay. Riverine bank erosion is not anticipated to be a problem in the Larsen Bay area.

Old Harbor. Riverine bank erosion is not anticipated to be a problem in the Old Harbor area.

Ouzinkie. Stream bank erosion is not a significant hazard in the Ouzinkie area.

Port Lions. Stream bank erosion is not anticipated to be a major hazard in the Port Lions area.

Icings

Icings form as water overflows onto land or ice and freezes. Small icings are likely to occur in various areas within the Borough. Documentation of specific areas of icing occurrence and their size would require further study.

City of Kodiak and Vicinity. No icing hazards have been identified in the Kodiak vicinity. However, small icings are likely to occur in some locations around the area.

Akhiok. Icings are a documented hazard in the Akhiok area (Corps of Engineers 1980). The specific location and the degree of the hazard were not identified. Icings should be considered a moderate hazard in the Akhiok area.

Karluk. The presence of springs indicates that there is a high potential for the development of icings in the vicinity of Karluk. No specific icings have been identified.

Larsen Bay. The occurrence of icings in the Larsen Bay area is unknown. There is a potential for icings to occur.

Old Harbor. Although there is a potential for their development, icings have not been documented in the Old Harbor area, and they are not considered a major hazard.

Ouzinkie. Documentation of springs in the area (Jones, Madison, and Zenone 1978; ADEC 1977) indicates the potential for icings to occur. However, specific icing problems have not been documented, and thus icings are not considered a major hazard in the Ouzinkie area.

Port Lions. Channel icings result in annual flooding of several houses (Corps of Engineers 1980). Icings should thus be considered a significant hazard that must be dealt with in the Port Lions area.

3.3.4 GEOLOGIC AND OCEANOGRAPHIC HAZARDS - LITERATURE CITED AND REFERENCES

Arctic Environmental Information and Data Center and Institute of Social, Economic Government Research. 1974. The Western Gulf of Alaska: A summary of available knowledge, 559 p.

Arctic Environmental Information and Data Center. 1975. The Western Gulf of Alaska: A summary of available knowledge.

Berg, E., K. Susumu, and J. Kienle. 1967. Preliminary determination of crustal structure in the Katmai National Monument, Alaska. Bulletin of the Seismological Society of America 57(6) Dec. 1967, pp. 1367-1392.

Bouma, A.H., and M.A. Hampton. 1976. Preliminary report on the surface and shallow subsurface geology of Lower Cook Inlet and Kodiak Shelf, Alaska. USGS Open File Report 76-695, 36 p.

Brown, D.L. 1964. Tsunami activity accompanying the Alaska earthquake of March 24, 1964. Prepared by U.S. Corps of Engineers, Anchorage, Alaska. 40 p.

Buck, E. et al. 1975. Kadyak: A background for living. Arctic Environmental Information and Data Center, University of Alaska. 326 p.

Burk, C.A. 1965. Geology of the Alaska Peninsula - island arc and continental margin. Geological Society of America Memorandum 99. 250 p.

Capps, S.R. 1937. Kodiak and adjacent islands, Alaska. U.S. Geological Survey, Bulletin No. 880-C. pp. 111-184.

Committee on the Alaska Earthquake, Division of Earth Sciences, National Research Council. 1971. The great Alaska earthquake of 1964. National Academy of Sciences, 8 volumes.

Connelly, W. 1977. Geologic map of the northwest side of Kodiak Island, Alaska. USGS Open File Report 77-382.

Connelly, W. and J.C. Moore. 1975. Tectonic mixing during subduction, Kodiak Island, Alaska. Geological Society of America Abstract with Programs 7(3) 306 p.

Dillon, J. 1979. Evaluation of seismicity in the Western Gulf of Alaska, Cook Inlet area. Alaska Division of Geology and Geophysics Survey, Dept. of Natural Resources.

Donn, W.L. 1965. Alaskan earthquake of 27 March, 1964: Remote seiche stimulation. Science 145(3629) pp. 261-62.

Donn, W.L., and E.S. Posmentier. 1965. Ground-coupled air waves from the great Alaskan earthquake. Jour. Geophys. Research 69(5357-5361). p. 24.

Estes, S.A. 1978. Seismotectonic studies of Lower Cook Inlet, Kodiak Island and the Alaska Peninsula areas of Alaska. Master's thesis, Univ. of Alaska, Fairbanks.

Fisher, M.A. 1979. Geophysical Investigation - Cook Inlet, Shelikof Strait, Kodiak Shelf. U.S.G.S. Open File Report (study in progress), 10/78 to 10/79.

Gedney, L.D. and J. Van Warmer. 1973. ERTS-1, earthquake and tectonic evolution in Alaska. In Proceedings of Earth Resources Technology Satellite 1 Symposium. Washington, D.C. pp. 745-756

Gedney, L. and J. Van Warmer. 1973. Seismically active structural lineaments in south-central Alaska as seen on ERTS-1 imagery. Geophysical Institute, Univ. of Alaska. 7 p.

Gedney, L. et al. 1977. Summary of Alaska earthquake. Alaska Earthquake Analysis Center Seismological Bulletin (1) July-Sept., 1977. 33 p.

Hampton, M.A. et al. 1979. Geo-environmental assessment of the Kodiak Shelf, Western Gulf of Alaska. In Offshore Technical Conference, Proceedings, 1(11) pp. 365-76.

Hampton, M.A. and W.J. Winters. 1981. Environmental geology of Shelikof Strait, OCS Sale Area 60, Alaska; Presented at the Offshore Technology Conference in Houston, Texas, May 4-7, 1981.

Hanson, W.R. and E.B. Eckel. 1966. The Alaska earthquake, March 27, 1964: Field investigations and reconstruction effort; A summary description of the Alaska earthquake - its setting and effects. 111 p.

Hayes, S.P. 1979. Gulf of Alaska study of mesoscale oceanographic processes. U.S. Marine Environmental Laboratory, Seattle, WA, 10/78 to 9/79.

Hein, J.R. et al. 1979. Clay mineralogy, fine-grained sediment dispersal, and inferred current patterns, Lower Cook Inlet and Kodiak Shelf, Alaska. Sediment. Geol. 24(3-4) pp. 291-306.

Hoose, P.J., and J. Whitney. 1980. Map showing selected geologic features of outer continental shelf, Shelikof Strait, Alaska. USGS Open File Reports 80-2031 through 80-2036.

Ingraham, W.J. Jr., A. Bakum,, and F. Favorite. 1976. Physical oceanography of Gulf of Alaska. NOAA/OCSEAP Final Report. 351 p.

Isacks, B., J. Oliver, and L. Sykes. 1968. Seismology and the new global tectonics. Journal of Geophysical Research 73. pp. 5855-5896.

Kachadoorian, R., and W.H. Slater. 1978. Pillar Mountain landslide, Kodiak, Alaska. U.S.G.S. Open File Report 78-217. 24 p.

Kachadoorian, R. and G. Plafker. 1972. Effects on the communities of Kodiak and nearby islands. In The Great Alaska Earthquake of 1964. N.A.S., Washington, D.C. 1972. pp.-539-540.

Kienle, J. and D.L. Turner. 1976. The Shumagin-Kodiak batholith - a Paleocene magmatic arc? Alaska Division of Geology and Geophysics Survey; Short Notes on Alaskan Geology. p. 9-12.

Latham, G.V. 1979. Coordinated ocean bottom seismograph measurements in the Kodiak Shelf Area. Univ. of Texas, Marine Science Institute, Galveston, TX, 12/78 to 12/79.

Latham, G.V. and J. Dorman. 1979. Progress report on ocean bottom seismology in the Gulf of Alaska. Alaska Sci. Conf. Proceedings, No. 30. 70 p.

McGee, D.L. 1972. Kodiak Island and vicinity, Alaska; geology and mineral resources. State of Alaska, Division of Geological and Geophysical Surveys Open File Report 18.

Miyashita, K. and Matsu'Ura, M. 1978. Inversion analysis of static displacement data associated with the Alaska earthquake of 1964. Jour. of Physical Earth (Tokyo) 26(4) pp. 333-48.

Moore, G. W. 1967. Preliminary geologic map of Kodiak Island and vicinity, Alaska. U.S.G.S. Open File Map.

Moore, J.C. and W. Connelly. 1967. Mesozoic tectonics of the southern Alaska margin in islands arcs, deep sea trenches, and bach-arc basins. Am. Geophys. Union, Maurince Ewing Services, Vol. 1. pp. 71-82.

Moore, J.C. and R.L. Wheeler. 1978. Structural fabric of a melange, Kodiak Islands, Alaska. Am. J. Sci. 278(5). pp. 739-765.

Nilsen, T.H. and G.W. Moore. 1979. Reconnaissance study of Upper Cretaceous to Miocene strategraphic units and sedimentary facies, Kodiak and adjacent islands, with a section on sedimentary petrography by G.R. Winkler. Geological Survey Professional Paper 1093. 34 p.

Papper, B.B. 1979. Historical survey of U.S. siesmograph stations in Alaska. In Geological Survey Prof. Paper 1096. P. 8-31 & 389.

Plafker, G. 1969. Tectonics of the March 27, 1964 Alaska earthquake - regional effects. USGS Prof. Paper #543-I. 174 p.

Plafker, G. et al. 1978. Petroleum potential, geologic hazards, and technology for exploration in the outer continental shelf of the Gulf of Alaska tertiary province. U.S.G.S. Open File Report #78-490. 33 p.

Plafker, G. and R. Kachadoorian. 1966. Geologic effects in the Kodiak Island area. In The Great Alaska Earthquake of 1964, Geology, Parts A-B. pp. 177-226.

Plafker, G. and R. Meyer. 1967. Vertical tectonic displacements in south-central Alaska during and prior to the great 1964 earthquake. Journal of Geosciences, Osaka City Univ. pp. 53-67.

Plafker, G. and L.R. Mayo. 1965. Tectonic deformation, subaqueous slides, and destructive waves associated with the Alaska March 27, 1964 earthquake - an interim geologic evaluation. USGS Open File Report. 1969. 21 p.

Pulpan, H. 1979a. Operation of a telemetered seismic network on the Alaskan Peninsula. Univ. of Alaska, Geophysical Institute, 7/73 to 5/80.

Pulpan, H. 1979b. Strong earthquake motion studies on the Kodiak shelf. Univ. of Alaska, Geophysical Institute, 7/79 to 11/79.

Pulpan, H. and J. Kienle. 1979. Seismic and volcanic risk studies - Western Gulf of Alaska. In Environmental Assessment of the Alaskan Continental Shelf--Annual Reports of Principal Investigators for the Year Ending March 1979. Vol. 9. pp. 425-492.

Pulpan, H. and J. Kienle. 1979. Western Gulf of Alaska seismic risk studies. Offshore Tech. Conf., Proc. 4(11). Pp. 2209-2218.

Ruby, C. 1981. Shelikof Strait shoreline vulnerability survey - biology/geomorphology. Research Planning Institute, Columbia, S.C. 12/79 to 6/81.

Science Applications Inc. 1980. Environmental assessment of the Alaskan continental shelf: Kodiak interim synthesis report. Outer Continental Shelf Environmental Assessment Program, NOAA Environmental Research Laboratory, Boulder, CO. 215 p.

Sears and Zimmerman. 1977. Alaska intertidal survey atlas, National Marine Fisheries Services, Auk Bay Biological Laboratory, Auk Bay, Alaska.

Shapero, L., L.D. Gedney, and J. Van Warmer. 1974. Tectonic lineaments and plate tectonics in south-central Alaska. In Proceedings of the First International Conference on the New Basement Tectonics. Utah Geological Association Publication #5. pp. 26-34.

Shor, G.G., Jr. 1980. Seismic refraction studies off the coast of Alaska, 1956-1957. Seismology Society of America Bulletin. Vol. 80. pp. 1889-1902.

Spaeth, M.C. and S. C. Berkman. The tsunami of March 28, 1964 as recorded at tide stations. U.S. Coast and Geod. Survey 1065. 59 p.

Stanley, K.W. 1971. Effects of the Alaska earthquake of March 27, 1964 on shore processes and beach morphology. USGS Professional Paper 543-J. In The Great Alaska Earthquake of 1964, Geology - Part A. pp. 229-249.

Sykes, L.R. 1971. Aftershock zones of great earthquakes, seismicity gaps, and earthquake prediction for Alaska and the Aleutians. Journal of Geophysical Research Vol. 75. pp. 8021-8041.

Thenhaus, P.C. et. al. 1981. Probablistic estimates of maximum seismic acceleration in rock in Alaska and adjacent outer continential shelf. U.S. Dept. of Interior, and USGS Interagency Report to the Bureau of Land Management.

Thrasher, G.P. 1979. Geologic map of the Kodiak outer continential shelf, Western Gulf of Alaska. USGS Open File Report 79-1267.

Tobin, D. G. and L. R. Sykes. 1968. Seismicity and tectonics of the northeast Pacific Ocean. Journal of Geophysical Resources, Vol. 73. pp. 3821-3845.

Turner, B.W. 1981. Interpretation of the bathymetry and shallow sub-bottom features, Kodiak shelf, Alaska. USGS Maps 79-263.

Tudor, W.J. 1964. Tsunami damage at Kodiak, Alaska and Cresent City, Calif. from Alaska earthquake of 27 March 1964. Port Hueneme, Calif, U.S. Naval Civil Eng. Lab. Tech. Note N-622. 124 p.

Updike, R.G. 1980. Surface monitoring of the Pillar Mountain landslide, Kodiak Island. Alaska Dept. of Natural Resources.

U.S. Coast and Geodetic Survey. 1964. Prince William Sound Alaska earthquake, March-April 1964--preliminary report. 83 p.

U.S. Corps of Engineers. 1967. Karluk ocean waves and tidal erosion - tenative plan of survey.

U.S. Geological Survey. 1968. Seismic seiches from the March 1964 Alaska earthquake. USGS Prof. Paper #544-E. 43 p.

U.S. Geological Survey. 1976. Strong-motion earthquake accelerograms digitization and analysis, 1971 Records. USGS Open File Report 76-609.

U.S. Dept. of Commerce, NOAA, ERL, and U.S. Dept. of Interior, BLM. 1980. Environmental assessment of the Alaskan continental shelf - Kodiak interim synthesis report.

U.S. Dept. of Interior, BLM, Alaska Outer Continental Shelf Office. 1977. Draft EIS, Western Gulf of Alaska-Kodiak, Alaska, OCSO, Oil and Gas Lease Sale No. 46, Graphic No. 12.

U.S. Dept. of Interior, BLM. 1980a. Draft environmental impact statement, Kodiak outer continental shelf.

U.S. Dept. of Interior. 1980b. Final EIS, Western Gulf of Alaska - Kodiak, Alaska OCSO, Oil and Gas Lease Sale No. 46, Graphic No. 1.

U.S. Dept. of Interior, BLM, ALaska OCS office. 1981. Proposed oil and gas lease sale 60, lower Cook Inlet-Shelikof Strait. Final Environmental Impact Statement. 263 p.

Van Warmer, J. 1974. Seismicity and plate tectonics in south central Alaska. Seismological Society of America Bulletin 64(5). pp. 1469-1475.

Von Huene, R. 1972. Structure of the continental margin and tectonism at the eastern Aleutian trench. USGS., Menlo Park, Calif. Geological Society of America bulletin. Vol. 38. pp. 3613-3626.

Von Huene, R., M. A. Fisher, and M.A. Hampton. 1980. Petroleum potential, environmental geology, and the technology for exploration and development of the Kodiak Lease Sale Area No. 61. USGS Open File Report 80-1082. 70 p.

Von Huene, R. et al. 1976. A Summary of petroleum potential environmental geology, and the technology, time frame, and infrastructure for exploration and development of the Western Gulf of Alaska. USGS Open File Report 76-325. 92 p.

Von Huene, R. et al. 1979. Cross section Alaska Peninsula-Kodiak Island-Aleutian Trench. Geol. Soc. Am. Bull. 90(5). pp. 427-430.

Wilson, B.W. 1968. The tsunami of the Alaska earthquake, 1964. Engineering evaluation. (Sect. IV 137-189), 401 p.

Wright, F.F. 1970. An oceanographic reconnaissance of the water around Kodiak Island, Alaska. Report R 70-19. Institute of Marine Science, University of Alaska, Fairbanks. 23 p.

HYDROLOGIC HAZARDS - LITERATURE CITED AND REFERENCES

Alaska Dept. of Environmental Conservation (ADEC). 1977. Village sanitation in Alaska. Village Safe Water Program and U.S. Public Health Service, contents periodically updated.

Buck, E.H. et al. 1975. Kadyak: A background for living. Arctic Environmental Information and Data Center, Univ. of Alaska, Anchorage. 326 p.

Corps of Engineers (COE). 1978. Special flood hazard information, Monashka Creek Reservoir, City of Kodiak, Alaska. Prepared for the Kodiak Island Borough and City of Kodiak.

COE. 1979. Special flood hazard information, Lake Bettinger Reservoir, City of Kodiak, Alaska. With CH_2M-Hill, Inc, for the Kodiak Island Borough and City of Kodiak.

COE. 1980. Alaska communities flood hazard and pertinent data - updated to 8 May 1980. Alaska District, Corps of Engineers. p. 188.

Dworsky, M.D. 1981. Personal communication. Senior Field Engineer, U.S. Public Health Service, Anchorage, Alaska.

Jack West Associates. 1980. Reconnaissance of micro-hydroelectric potential, Akhiok Village, Kodiak. With Fryer: Preasley: Elliot for Kodiak Island Borough. 28 p. + appendices.

Jones, S.H., R.J. Madison, and C. Zenone. 1978. Water resources of the Kodiak-Shelikof subregion, southcentral Alaska. U. S. Geological Survey, Hydrological Investigations Atlas HA-612.

Kramer, Chin, & Mayo, Inc. (KCM). 1978. Kodiak Island Borough, regional plan and development strategy, summary report. Prepared for Kodiak Island Borough and the Division of Community Planning, Dept. of Community and Regional Affairs. 84 p.

KCM. 1979. U.S. Coast Guard Support Center, Kodiak, Alaska - development plan. Prepared for 17th Coast Guard District, Juneau, Alaska. pp. A3.18 to A3.21.

Lamke, R.D. 1979. Flood characteristrics of Alaskan streams. U.S. Geological Survey Water Resource Investigations 78-129, Anchorage. 61 p.

Office of Economic Adjustment. 1976. Defense impact of Kodiak Island, Alaska. West coast regional office. 29 p.

Weeks, J.B., 1970. Water-resources reconnaissance of the Old Harbor Area, Kodiak Island, Alaska. U.S. Geological Survey, Water Resources Division, Alaska District, Open File Report. 8 p.

3.4 HUMAN RESOURCES INVENTORY

3.4.1 CULTURAL/HISTORIC SITES

Map 11 indicates the cultural/historic sites identified by the Alaska Historical Resource Survey (AHRS) within the Borough. Several sites have been placed on the National Register of Historic Places or have been declared eligible. These sites are described below.

AHRS Site Kod 207

The Russian Kiln Site is located on Long Island off the east shore of Kodiak Island. This is one of the few historic sites associated with brickmaking, which was a subsidiary industry of the Russian American Company. The 3000 to 6000 bricks that were produced annually were used as ballast in the company's ships, in the construction of stoves to heat employee quarters, and in bathhouses. The quantity of bricks produced would have been considerably larger if more lime had been available; as it was, the industry relied on burned sea shells as its source for this necessary ingredient. This site is considered to be significant for its contribution to the industrial history of Alaska. Due to subsidence from the 1964 earthquake, the site is subject to tidal erosion, and brick debris is scattered along the beach (ADNR unpublished).

AHRS Site Kod 123

The Erskine House is located at Main and Mission Streets in the City of Kodiak. It is the only remaining structure known to be associated with the Russian American Company and the Alaska Commercial Company, which were the two commercial enterprises that were controlling factors in the early administration of Alaska. Local tradition states that the building was erected by Alexander Baranof about 1792-3 as an office and fur warehouse. The building was constructed in a typical Russian-American style with rough-hewn square logs and a hipped roof. Numerous alterations have been made to the building, and it is now being used as a historical museum (ADNR unpublished).

AHRS Site Kod 137

Fort Abercrombie State Historic Site is located on Kodiak Island approximately five miles north of the City of Kodiak. The site is strategically located atop a high headland, and commands a view of the surrounding straits and bays. A natural camouflage is provided by the dense, mature spruce stands in which the site is located. It is representative of north Pacific coast defense installations of the type operative during World War II. The area was withdrawn as a military reservation in 1941 but remained operational until 1945. The fort was named in honor of Lieutenant William H. Abercrombie, who was a noted explorer in Alaska in the late nineteenth century. Although Fort Abercrombie was never engaged in battle, its ruins are remnants of a time when foreign invasion was anticipated on American soil. The remains of the fort consist of concrete beds for gun emplacements, fragments of exploded armaments, cavernous magazines, and building foundations. The site is presently open to the public primarily for day-use activities (ADNR unpublished).

AHRS Site Kod 124

The Three Saints Site is located on the southeastern shore of Kodiak Island on the western shore of Three Saints Bay. It is a multicomponent site, consisting of a prehistoric occupation dating from 0-900 A.D., followed by a historic occupation beginning in the 1700s. Excavation and analysis of the prehistoric site provided the basis for the definition of the Three Saints Bay Phase of the Kachemak Bay Tradition in Kodiak prehistory. In 1784 the first Russian colony in America was established at Three Saints Bay and for eight years the colony served as the headquarters of the Shelikhov-Golikof Fur Company. The colony consisted of numerous log buildings including dwellings, bunkhouses, warehouses, commissary, barns, storage buildings, smithy, carpentry shop, and ropewalk. All of the buildings were destroyed as the result of subsidence resulting from earthquakes, and today there are no surface remains (ADNR unpublished).

AHRS Site Kod 195

Holy Resurrection Orthodox Church, while less than 50 years old, is the most distinguished architectural feature of the Kodiak skyline. The frame church, built on the apsidal and transect ground plan is covered with white shingles. All the windows are center pointed. A single extended church tower at the front is capped with the traditional Orthodox onion dome, painted blue. A second onion dome and supporting hexagonal tower surmount the medium gable transept roof. A detached bell tower and several graves marked with marble monuments are also on the site.

A church built between 1843 and 1867 and destroyed by fire in 1943 originally occupied the site. The existing structure was erected in 1945. Only the detached bell tower is believed to have survived from the earlier church. Icons and religions objects, some dating from the early nineteenth century, adorn the interior. One icon, that of the Holy Resurrection (date 1793), was brought by Saint Herman (then Monk Herman) from Russia with the original party of Orthodox missionaries in 1794. The church is still used for Orthodox services (ADNR unpublished).

AHRS Site Kod 132

Other than the surroundings - and the settling and shifting of pits, mounds, markers, and headstones; the expected attrition of age - the American Cemetery physically appears much as it did when abandoned in 1940. Other than the Orthodox church graveyard, the American Cemetery is the only historic cemetery in or near Kodiak that has not been obliterated.

The American Cemetery originated as a military cemetery to serve Fort Kodiak. This fort and military post was established with the American occupation of Alaska (Russian America) immediately after the purchase of the Territory. This cemetery received its name because it was used for the burial of Americans rather than Russians or natives.

Five of the soldiers from the original fort are known to be buried there. Their names are listed in the National Archives, Old Military Records. In addition to these men, there exist two graves of Unknown Soldiers, and many local residents from 1868 to 1940, including G.G. Holt, the first white man to cross Chilkoot Pass.

The Cemetery continued to be used by the Village and then the City of Kodiak until 1940 (ADNR unpublished).

AHRS Site Kod 011

This site, located on the southeastern shoreline of Middle Bay, may be the site of a colonial Russian brick kiln. Test excavations have uncovered a portion of a brick platform, remnants of two brick walls, and a small standing brick arch. The site has been affected by erosion, and by people who have collected the bricks.

The standing arch may have been one of a number of features constructed to (a) support the kiln floor and (b) house the kiln fires. Kilns similar to this one continue to be used in the Near East. Brick kilns having arches for firing purposes were certainly being used in seventeenth century England. Such kilns allowed the hot air to circulate upward among the green bricks stacked within the kiln, the bricks being "baked" or "fired" in the process. While the documentary search did not uncover any references to Russian kilns, it is quite possible that brick firing techniques used in Western Europe would have been used in European Russia, and subsequently Russian America, as well.

The structural remains uncovered at the KOD-011 site may represent an important subsidiary industry of Russian America. These features currently suggest that the site may have been the location of a type of kiln in general use for thousands of years, a type that might have been feasible for use by Russian colonists in America. The Kodiak-011 Site may have enormous potential for increasing our understanding of Russian colonial brickmaking operations in the Western Hemisphere (ADNR unpublished).

Under section 14(h)(1) of the Alaska Native Claims Settlement Act, each regional corporation may apply for the conveyance of historic and cemetery sites. Koniag, Inc. has applied for a number of sites under this section, as can be seen on Map 11. All sites that are transferred to the regional corporations under section 14(h)(1) will be considered eligible for inclusion on the National Register of Historic Places, as agreed by the Department of the Interior, the National Advisory Council for Historic Preservation, and the Alaska State Historic Preservation Officer. Field work will begin in the summer of 1981 to determine eligibility for transferrence.

Marine Archaeology

Eustatic sealevel changes over the past several millenia have caused the coastline of the Kodiak Archipelago to vary greatly. At the lower sea stands, it is possible that early peoples could have occupied lands that are presently submerged. It appears that potentially valuable archaeological evidence may remain on the sea floor.

3.4.2 POPULATION CHARACTERISTICS

The population of Kodiak Island Borough and its communities from 1950 to 1980 is given in Table 3.21. The 1980 U.S. Census shows that the population of the Borough grew by 5.6 percent from the 1970 level. The change in the Borough population since 1970 is broken down into several components. The Census reports a decrease of 599 in the military population and a natural increase in population of 1887. The implied net civilian outmigration is 780 persons. The additional decrease in the number of military dependents, civilians employed by the military, and their dependents, resulting from the phasing out of Navy operations on Kodiak in 1970-1971, may account for a significant part of the net outmigration. This is despite the small increase in Coast Guard personnel and dependents on the base since the Coast Guard took it over in 1972.

Seasonal fluctuation is a component of population data that is not available.

Table 3.21. Population of Kodiak Island Borough and Village Populations, 1950-1980.

	1950	1960	1970	1980	1970-1980 % Change
Road-connected area of Kodiak[1]	5539	6292	8245	8806	+6.8
City of Kodiak	1710	2628	3798	4756	+20.1
Coast Guard Base (Military and Civilian)	-	1807	3052	1370	-55.1
Persons Living Outside of City and Base	3829	1857	1395	2680	+92.5
Other[2]	725	882	1164	1139	-2.1
Borough Total	6264	7174	9409	9945	+5.4
Village Populations					
Afognak	158	190	-	11	-
Akhiok	72	84	115	105	-8.7
Karluk	143	129	98	94	-4.1
Kaguyak	-	-	59	-	-100.0
Larsen Bay	53	72	109	145	+33.0
Old Harbor	121	193	290	338	+16.6
Ouzinkie	177	214	160	173	+8.1
Port Bailey	-	-	-	2	-
Port Lions	-	-	227	215	-5.3
Port O'Brien	-	-	-	1	-
Uganik	-	-	31	13	-58.1
Uyak	-	-	34	2	-94.1
Woody Island	-	-	41	3	-92.70

Sources: U.S. Census 1950, 1960, 1970, 1980.
University of Alaska, ISER, 1980.
Draft EIS, Lease Sale No. 46, 1977.

[1]Road-connected area = city, base, and other.

[2]People living neither in road-connected areas nor in villages.

The composition of the Borough's 1970 population displays peculiarly Alaskan characteristics, as shown in Table 3.22, figures for Kodiak Census Division. The male-to-female ratio is 57.1 percent to 42.9 percent. This can be accounted for by the presence of the military and the fishing industry. Compared with the national breakdown by age, the Borough's population is much younger. The median age of males is 23.1 and of females is 21.9 in the Borough, compared with national median ages of 28.6 for males and 29.3 for females. The percentages of whites, blacks, natives, and others are also shown. The Borough is predominantly white, with a sizable Native population of more than 20 percent.

The civilian population of the City of Kodiak increased by 20 percent from 1970 to 1980 (Table 3.21). The population characteristics of the City of Kodiak are presented in Table 3.22. Age and sex characteristics are similar to those of the Borough. The percentage of whites is higher - 81.5 percent to the Borough's 76.7 percent. This is explained by the higher percentage of Natives in the villages.

Village population changes on a percentage basis in the period 1970-1980 range from an increase of 33 percent at Larsen Bay to a decrease of 100 percent at Kaguyak (Table 3.21). Drastic population shifts during the 1960s and 1970s can be accounted for by two factors: the 1964 earthquake and the 1971 Alaska Native Claims Settlement Act (ANCSA).

The 1964 earthquake destroyed several villages and led to resettlement in other villages, both new and established. The residents of Afognak were relocated in a new village, named Port Lions. An unknown number of the villagers from Kaguyak reportedly resettled in Akhiok after the earthquake. The changes in land ownership during the 1970s due to ANCSA have also contributed to these shifts.

The population characteristics of the villages are not as well detailed as those of the City of Kodiak. The median age for males ranges from a low of 15.8 years in Akhiok to a high of 28.0 years in Larsen Bay.

Table 3.22. General population characteristics: Kodiak Census Division and the City of Kodiak, 1970.

Sex

	Male	% Male	Female	% Female
Kodiak Census Division	5,365	(57.1)	4,044	(42.9)
City of Kodiak	2,055	(54.1)	1,743	(45.9)

Race

	White	% White	Black	% Black	Alaska Native	% Alaska Native	Others	% Others
Kodiak Census Division	7,215	(76.7)	157	(1.6)	~1912	(20.3)	~125	(1.3)
City of Kodiak	3,094	(81.5)	44	(1.2)	563	(14.8)	97	(2.6)

Age

	Median Age		% Under 18 Years	% 18 Years and Older
	Male	Female		
Kodiak Census Division	23.1	21.9	38.4	59.4
City of Kodiak	25.3	22.9	37.2	60.1

Source: USDC, 1973; Alaska Dept. of Community and Regional Affairs, 1974; ISER 1973.

The median age for females ranges from a low of 13.4 years in Akhiok to 26.8 years in Ouzinkie. All the villages have median ages for both sexes lower than the national medians (Draft EIS #46 1977).

The racial composition of the villages ranges from more than 98 percent Native in Akhiok to 81 percent in Port Lions.

The population of the Borough, particularly the Kodiak area, shows a significant seasonal swing. An indication of the magnitude of this swing is given by the drop in the labor force of Kodiak by 1000 persons after the 1976 salmon season (#46 DEIS 1980). The seasonal fluctuation in population is decreasing due to the extended fishing and processing seasons in recent years.

3.4.3 LAND OWNERSHIP AND LAND USE

Kodiak Island Borough Land Ownership Patterns

The principal land ownership categories in the Kodiak Island Borough (KIB) are the federal government, Native corporations, State of Alaska, Kodiak Island Borough, and other private properties. The "other private properties" category accounts for less than 1 percent of the total land area.

The generalized ownership patterns are still in a state of flux as they relate to State of Alaska, Native village, and Kodiak Island Borough land selections. Final resolution is still several years away. The selection adjudication process is slowed by appeals, court challenges, and the lack of a cadastral survey for the lands involved.

The following narrative for each of the ownership categories identifies many of the contributing factors.

Federal Land Ownership. Kodiak National Wildlife Refuge - The major federal holding within the Kodiak Island Borough boundary is the

Kodiak National Wildlife Refuge (Bear Refuge). Executive Order (EO) 8344 dated 2/10/40, EO 8857 dated 8/19/41, Public Land Order (PLO) 1634 dated 5/9/58, and PLO 2417 dated 6/26/61 all contribute to the establishment of the Refuge. Approximately 1,820,000 acres are involved. PLO 2417 contained other major land decisions that laid the groundwork for the land change:

- It revoked EO 8344 and withdrew 2,500,000 acres on Kodiak Island for classification and aid to legislation;

- It determined that lands under grazing leases were not available for homesteading until suitable areas were withdrawn from the grazing leases and made available;

- It provided for the State of Alaska to exercise a 90 preference right to make state land selections of vacant, unappropriated, and unreserved federal land;

- It reserved a one-mile-square area surrounding Old Harbor, Akhiok, Larsen Bay, Uganik, Uyak, Alitak, Ayakulik, and Kaguyak (all located in the Refuge) for each Native village. The village areas were not available for state land selection.

A 35,200-acre Indian Reservation continued to be reserved within the Bear Refuge for the native village of Karluk.

The Bear Refuge boundary remained intact until withdrawals were made for village land selections as provided in the Alaska Native Claims Settlement Act (ANCSA). The impact on the Bear Refuge will be covered in the section on ANCSA.

U.S. Forest Service, Afognak Island - prior to ANCSA and the Alaska National Interest Lands Conservation Act, PL 96-487 (commonly referred to as the D-2 bill), all of Afognak Island was part of the Chugach National Forest. ANCSA provided for Native village selections

within the National Forest, and Section 1427 of PL 96-487 effectively redesignated all the remaining National Forest land on Afognak Island. The only remaining federal land on Afognak Island will be the Red Peaks area in the northwest corner, which is now part of the Kodiak National Wildlife Refuge. Submerged lands adjacent to and seaward of Afognak Island from the line of mean high tide to the exterior boundary of the former Afognak Forest and Fish Culture Reserve are not included within the Alaska Maritime National Wildlife Refuge.

Alaska Maritime National Wildlife Refuge - This refuge was established by PL 96-487 on December 2, 1980. It consists of eleven existing refuges and includes island, islets, rocks, reefs, spires, and designated capes and headlands in the coastal areas of Alaska. The Kodiak Island Borough boundary falls within the Gulf of Alaska Unit of the Refuge. It includes the Barren Islands and all other unnamed islands, islets, rocks, reefs, and spires not previously appropriated in the Kodiak Archipelago.

Military Lands including U.S. Coast Guard - Prior to and during World War II, a number of installations were set aside in the Borough by executive order. Since then, most of the areas have been restored to the public domain. The former U.S. Navy Base at Womens Bay is the largest installation remaining; the base proper, which consists of the buildings and docks, has been reassigned to the U.S. Coast Guard. The ANCSA was a major contributing factor in reducing the military holdings, since all surplus lands were made available to fulfill the Native land selection entitlements. This includes U.S. Coast Guard facilities and FAA installations in the Archipelago.

Public Domain Lands - Not all of the federal land outside of the Refuge was seleted by the State of Alaska. Land encumbered with federal grazing leases was not available for selection. Only those graziers wishing to come under state jurisdiction opted to relinquish their federal grazing leases to allow state selection. All of the grazing

leases fronting on Ugak Bay, one lease in Middle Bay, and one lease in Anton Larsen Bay remain on federal land. Federal grazing leases are usually written for a 20-year term and are renewable.

State Land Ownership. The State of Alaska selected all of the available land possible in the Kodiak Island area. At one time the state selections involved 624,000 acres. This included the following islands: Shuyak, Marmot, Raspberry, Whale, Spruce, Woody, Long, Sitkalidak, and the Trinity Islands. Lands encumbered with consenting grazing lessees also went to the state and became subject to a grazing lease similar to the one issued by the Bureau of Land Management. The State of Alaska passed a special law to cover the situation (AS 38.05.075).

Very little of the state-selected acreage has been patented to the state. The selected areas have not to this date, 20 years after selection, been surveyed to provide an adequate legal land description for title purposes. This non-patented land status allowed the state-selected and tentatively approved selections to be made available for Native village land selection. Each village is allowed to select up to three townships of this state land within its ANCSA Section 11(a)(1) withdrawals. The state may lose half of its selected acres to Native selections.

State land acreage is also being reduced through the Municipal Land Entitlement Act (AS 29.18.201-213). Under this act, the Kodiak Island Borough is entitled to receive 56,500 acres of state land.

The State of Alaska made a community grant land selection on Afognak Island while the island was still part of the Chugach National Forest. This selection is at Tonki Cape and is provided for in Section 1427 of PL 96-487. The selection was made for recreation values.

No state game refuges have been established within the KIB boundary to date. A bill died in the 1980 session of the Legislature to establish a refuge on Tugidak Island. Legislation is to be introduced in 1981 to propose a state park and state game refuge on Shuyak Island.

State land ownership includes tidelands (submerged lands extending three miles seaward of the mean high tide line) and shorelands (the bottoms of nontidal waters that are navigable). Title to these water bottoms was conveyed to the State of Alaska in the Alaska Statehood Act (PL 85-508 Section 6(m)). Exceptions to this are water bodies that were appropriated at the time of statehood and remain appropriated. The Afognak Forest and Fish Culture Reserve, established on December 24, 1892, is an example of this.

The state issues shore fishery leases on the tidelands. A shore fishery lease affords the lease holder exclusive rights to set nets within the leased area.

Native Corporation Land Ownership. The ANCSA, passed in 1971, and subsequent amendments to the act, specifically Section 1427 of PL 96-487, have altered the ownership patterns of both federal and state land within the KIB boundary. The initial total acreage entitlement for Koniag, Inc., the regional corporation, and 17 identified villages was 1,420,000 acres. The ensuing years brought about challenges to the elibigility of seven villages and to the requirement that a sizable part of the selection be made on the Alaska Peninsula. The Alaska Peninsula selections were required because of selection limitations on refuge land, national forest land, and state-selected land. In addition, village selections within the Bear Refuge are subject to further limitations that are not comparable to fee title ownership. The limitations affecting acreages and degree of title on National Wildlife System lands are:

- No more than three townships of National Wildlife Refuge System land may be selected by a native village (ANCSA, Section 12(a)(1)).

- The subsurface estate (mineral estate) is not available for native selection on U.S. National Wildlife System land (ANCSA, Section 14(f)).

- The National Wildlife System reserves the right of first refusal for any former wildlife system lands offered for sale by a Native corporation (ANCSA, Section 22(g)). This condition could effectively prohibit any development of native lands by others.

When U.S. Forest Service or State of Alaska lands are involved, Section 12(a)(1) of ANCSA also restricts the number of acres a village can select. No more than three townships in each category may be selected. This restriction increased the need to make in lieu selections on the Alaska Peninsula.

Section 1427 of PL-487, which is known as the Koniag Amendment, is to resolve the problems of village eligibility and deficincy selections made on the Alaska Peninsula. In summary, the following apply to village and region selections:

- The seven challenged villages are to be recognized as village entities, with Bells Flats, Anton Larsen Bay, Port William, and Litnik not receiving any land. The villages of Uyak, Uganik, and Ayakulik are to be conveyed the surface estate to the one square mile of excluded land from the Bear Refuge by PLO 1634. Each of these three villages is to convey 20 of its acres to the state in trust for any municipal corporation established in the Native village.

- The surface estate of village and regional selections made on the Alaska Peninsula is transferred to Afognak Island; however, the subsurface estate for these Afognak lands is not to be conveyed to Koniag, Inc. The surface area transferred to Afognak Island is approximately 80,000 acres less than that selected on the Alaska Peninsula. No additional surface acreage is to be made available to compensate for the deficiency.

Final implementation of the Koniag Amendment is contingent on a series of agreements that are going through the process of adoption and approval.

As previously mentioned, this piece of legislation eliminated U.S. Forest Service presence on Afognak Island. It is not clear if Section K of ANCSA now applies to these former U.S. Forest Service lands.

Native villages and their land entitlements within the KIB boundary are:

Village	Village Corporation	Number of Acres
Afognak	Natives of Afognak, Inc.	115,200
Akhiok	Natives of Akhiok, Inc.	69,120
Kaguyak	Kaguyak, Inc.	69,120
Karluk	Karluk Native Corporation	92,160
Larsen Bay	Nu-Nachk Pit, Inc.	115,200
Old Harbor	Old Harbor Native Corporation	115,200
Ouzinkie	Ouzinkie Native Corporation	115,200
Port Lions	Port Lions Native Corporation	92,160
Woody Island	Lesnoi, Inc.	115,200
Kodiak	Natives of Kodiak	23,040

Afognak, Larsen Bay, Ouzinkie, and Woody Island had deficiency selections on the Alaska Peninsula that are now transferred to Afognak Island. The transferred acres go to a joint venture of these villages, the Koniag 12(b) Village Corporations, and Koniag, Inc., and therefore lose an individual village acre identity.

Besides the joint ventures and consolidation of villages required by PL 96-487, other village and regional mergers have taken place. Port Lions and Afognak villages merged and now go by the name Afognak. Akhiok and Kaguyak villages merged to form Akhiok. Koniag, Inc. put together a merger of itself, Akhiok, Karluk, Larsen Bay, Old Harbor, Woody Island, and Afognak to be called Koniag, Inc. The inclusion of Afognak in this merger is a matter of court litigation that has not been resolved at the time of this writing.

Kodiak Island Borough Land Ownership. The KIB received a land grant entitlement of 56,500 acres from the State of Alaska (AS 29.18. 201(9)). The land is to be selected from state lands within the Borough boundary. As of January 1, 1981, the KIB had a state patent to 2,206 acres and approved selections for 12,340 acres. Another 76,101 acres were under selection. This amounts to a 62 percent overselection. The overselection is to allow for adjustments if certain state tentatively-approved lands are conveyed to Native corporations. The land selection process and restrictions written into the conveyances have been challenged by the KIB. Resolution of the matter is being worked out in an out-of-court settlement. The settlement is to list acres to be conveyed to the KIB, acres to be relinquished back to the state, easement identifications, and a priority for adjustments if certain Native village-selected lands become available.

Only the surface estate is conveyed to the KIB. In this instance, gravel is considered a part of the surface estate and is conveyed to the KIB. State retention of the subsurface estate is required by state law (AS 38.05.125). The Borough-selected lands are not known to be mineralized, so no conflicting mineral estate use is anticipated at this time.

The KIB has offered most of its patented land for sale. Ninety percent of it lies within the City of Kodiak vicinity. Much of the other selected land, to which patent is anticipated, is not on a road system. Access will be limited to boats or float planes.

The KIB land and resource disposal procedures are found in Title 18 of the Kodiak Island Borough Code of Ordinances.

Private Land Ownership. Private lands, other than Native Corporation land, account for less than 1 percent of the total KIB. Areas of private ownership are limited to the cities, villages, and road system between Kodiak and Cape Chiniak. Scattered small-parcel ownership, usually 10 acres or less, can be found in the roadless areas. These result

from fish cannery sites and the State of Alaska Open-to-Entry land disposal program.

As previously mentioned, most of the KIB area has been withdrawn from entry under the federal settlement laws. Homesteading was not allowed, except by persons with grazing leases. The federal townsite program accounts for most of the private lands in the villages. Alaskan statehood, along with the formation of the KIB, accounts for most of the acreage sales outside of the City of Kodiak.

It is interesting to note that some of the oldest United States surveys exist on Kodiak Island. U.S. Survey Nos. 24, 40, and 82 are found in Karluk and were conveyed into private ownership in 1900 and 1901.

Map 12 shows the land ownership pattern as it exists May 1, 1981. Lands identified as conveyed Native selection, other private land ownership, and the unencumbered Kodiak National Wildlife Refuge are the only areas firmed up at this time. The final adjudication of the Native selections will determine overselections. The overselected acreage will then be restored to the refuge, public domain, or state, for administration by the appropriate land managing agency. Lands selected by native villages not qualifying for land (PL 96-487) are shown on the map for information purposes. Those selected areas will return to the appropriate agency. In instances where a land-qualifying Native corporation has top-filled over the non-land-qualifying corporation, the map shows only the valid selection.

Easements. Access across native lands onto public lands has been established at certain designated locations by the Bureau of Land Management and the U.S. Fish and Wildlife Service. These agencies have been directed to identify, map and publicize public easements under Section 17 of the Alaska Native Claims Settlement Act and CFR 2650.4-7: Public Easement Section. The BLM has located and mapped all easements within the Borough, however, they have not physically located these easements on the

ground. Maps showing the location of easements are available in the District BLM office in Kodiak and at the federal building in Anchorage. Streamside easements and recreation easements established by BLM prior to 1978 have been replaced by these public access easements and site easements. In case of trespass in unauthorized areas it is the responsibility of the local police department to arrest or cite the trespasser.

Public Interest Lands

Large amounts of state lands located within municipalities were made avaiable to the public in 1979 under Section 13, Chapter 85 of the State Lands Act. The majority of the land was selected for private use, and some lands were made available for residential development. Certain lands containing valuable natural resources were selected by the state to be managed for specific uses. Within the Kodiak Island Borough the state has claimed 529,100 acres of tentatively approved and patented lands. Of this land, 165,858 acres have been selected as Public Interest Land, consisting of public recreation, fish and wildlife habitat, watershed, forest, and mineral resources.

The Division of Parks and Recreation has selected 24 public recreation sites along various trails, highways, and marine waysides scattered through the Borough. Thirteen compsites and access areas and seven recreational easements have also been selected. In addition, 200-foot scenic view easements on either side of Cape Chiniak and Kalsin Creek highways have been selected.

The State Department of Fish and Game has selected five sites (containing 41,465 acres), necessitating special management designation and public access. These sites include Shuyak Island, where sea otter concentrate along the coast and two permanent eagle nest sites are found. A segment of this island has been nominated as part of the State Game Refuge. Marmot Island has been selected because it is a major sea lion pupping area for the gulf coast of Alaska. The head of Unnamed Bay between Eagle and Boulder Bay has been selected as a major deer wintering

range and a popular deer hunting area. Tugidak Island was selected to protect the habitat of the world's largest harbor seal population, a rich waterfowl population, and a diverse bird population. Sitkinak Island was selected to protect the wetlands, which provide an excellent waterfowl production area.

Three other resources nominated by the state for their public interest values include three watersheds, two forested areas, and ten material siters. The Peller Creek, Port Lions, and Port Baily watersheds were selected because they provide the primary source of water supplied to the Borough. Two state forest lands, located on Shuyak and Marmot Islands, were selected to be managed as multiple-use land. The ten material sites selected by the Department of Transportation and Public Facitlities are located along the major highways on Kodiak Island. These sites will provide sand, gravel, and fill for road maintenance and construction, and riprap for boat facilities.

Land Use and Management

Land use patterns in the Kodiak Island Borough are a product of steep topography, limited access, land ownership, and relatively isolated communities. The vast majority of the Borough is undeveloped, and development is limited to the seven Borough communities, with the exception of timber and agricultural uses. Land use planning has focused on the Kodiak road system area, although a Borough-wide comprehensive plan was prepared in 1979, and preparation of a comprehensive plan for Port Lions has been proposed.

Agricultural Use. Agricultural land use in the Kodiak Island Archipelago consists entirely of cattle grazing. Federal and state grazing leases currently account for all grazing activity, although the Borough has considered leasing land for grazing activities. Grazing use is concentrated along the Kodiak road system at Anton Larsen Bay, Middle Bay, Kalsin Bay, Pasagshak Bay, and Saltery Cove. The largest single grazing use area in the Borough is located on Sitkalidak Island.

Timber Use. Timber harvesting is limited to Afognak Island, where the extent of commercial timber and Native corporation land ownership are favorable to harvesting activities. Harvesting is concentrated in the central portion of Afognak Island, and both camp housing and log storage/export areas are located on the eastern shore of Kazakof Bay. Shuyak Island is the only other portion of the Borough with commercial timber potential, but recent land ownership agreements between the Alaska Department of Natural Resources and Kodiak Island Borough make timber use unlikely.

Residential Use. Areas of residential use are concentrated along the Kodiak road system and six villages; however, remote residences are scattered around the Borough. Road system residential areas are concentrated within Kodiak municipal boundaries, but other important residential areas include Monashka Bay, the Coast Guard Base, Bells Flats, and Chiniak. Residential areas in Akhiok, Ouzinkie, and Port Lions are concentrated in a single location each. Old Harbor and Larsen Bay each have two separate residential areas; Karluk's residences are concentrated in one area, but families still live in two older village sites.

Commercial Use. The City of Kodiak is the only major commercial center in the Borough. Commercial use is concentrated along the downtown waterfront, and along major arterial roads. In addition to commercial services to the general populace, commercial support of the fishing industry and recreation/tourism are key use components.

Commercial use in the outlying communities is limited to small stores, marine supplies and service, and lodging in Old Harbor, Ouzinkie, and Port Lions. There is virtually no commercial use in Akhiok, Karluk, and Port Lions.

Industrial Use. Fish processing accounts for the primary industrial land use in the Borough, and is concentrated in the City of Kodiak. Several large fish-processing plants are located along the waterfront to the immediate north and south of the small boat harbor. Other shore-based processors are located in the Larsen Bay and Akhiok areas; floating

processors temporarily locate near Karluk and Old Harbor during crab seasons.

The only other industrial use of significance is a gravel mining-processing operation in the Bells Flats area. This use in this area is currently creating conflicts with adjacent residential development.

Land Use Planning. Six land use planning studies have been prepared for the Borough or its various communities since 1968: the Borough-wide Comprehensive Plan (1968); Near Island Comprehensive Plan (1974); Port Lions Comprehensive Plan (1975); Kodiak Island Borough Regional Plan and Development Strategy (1978); Kodiak Island Borough OCS Impact Study/ Draft Kodiak Island Borough Village Sketch Plans (1977); and a Draft Five Year Capital Improvement Program. In addition, preparation of a new Port Lions Comprehensive Plan will be initiated this year. The Borough Regional Plan and Development Strategy project is an update of the 1968 Comprehensive Plan, and contains eight elements. The primary accomplishment for these various studies has been the scheduling and implementation of capital improvements aimed at upgrading community facilities, particularly in the village areas. The Borough's Zoning Ordinance and Subdivision Rregulations were also updated as part of the Borough Regional Plan and Development Strategy Study.

3.4.4 RECREATION RESOURCES

Kodiak Island is rich in recreation, scenic, heritage, and wilderness resources, attracting use by island residents and nonresidents. This use supports a significant portion of local hotels, air taxi services, and guiding operations.

Hunting and fishing are the two most popular recreation pursuits of residents and nonresidents. Notable attractions in the Kodiak Archipelago are hunting for brown bear, and elk, and steelhead and salmon fishing on the Karluk River. Hunting Sitka black-tailed deer, and waterfowl, fishing for salmon, and trout, clam digging, crabbing, and berry

picking are popular island-wide activities. In recent years, hiking, camping, kayaking, rafting, and sailing have grown in popularity.

Federal, state, and local government agencies have direct or indirect recreation management responsibilities, including operation of some recreation facilities. The Kodiak National Wildlife Refuge is a major attraction, and includes public and private cabin sites on both Kodiak and Afognak islands. Three state parks - Fort Abercrombie, Pasagshak, and Buskin River - are managed by the State Division of Parks. All three offer limited day use facilities; camping facilities are available only at Fort Abercrombie. The Kodiak Island Borough has prepared and adopted a Borough Park and Recreation Comprehensive Plan, and also sponsors various organized recreation facilities. The primary city governments participating in recreation management are Kodiak and Port Lions. Kodiak operates several recreation facilities and sponsors a wide range of recreation programs. Port Lions has recently prepared a comprehensive parks and recreation plan, which identifies city-operated local recreation areas and assigns priorities to future recreation management objectives.

Recreation and tourism have created conflicts with both subsistence activities and community lifestyle in several Borough communities. Conflicts result from nonresidents entering rural communities, competing for subsistence resources, trespassing on private lands, and generally disrupting the daily lifestyle. Nearly all village residents prefer to keep nonresident recreation out of the immediate village area.

Primary Recreation Attractions

Hunting. The most popular recreation attraction on Kodiak Island is the Kodiak brown bear. Trophy hunting for bear attracts people from other countries and the lower 48 states, while tourists come to photograph the animal. The second most popular recreation attraction is sport hunting for Roosevelt elk, found only on Afognak Island and Raspberry Island. The elk were transplanted, in 1929, to Afognak Island by the

U.S. Fish and Wildlife Service, along with Sitka black-tailed deer and mountain goat. The third most popular sport hunting attraction, the Sitka black-tailed deer, is hunted for both recreation and for subsistence. More residents hunt this animal than do nonresidents. Kodiak residents hunt deer along the road system and around the bays within the boundaries of the wildlife reserve (Troll 1979). Another popular recreation attraction for residents is duck hunting. Most duck hunting occurs around Kalsin Bay and Middle Bay (BLM 1980). Trapping has become an increasingly popular recreational attraction within the wildlife reserve during the past few years. Animals such as the red fox, lynx, mink, and muskrat can be trapped five to six months of the year.

Fishing. Sport fishing ranks second to big game hunting as a recreation attraction. The most popular sport fish on Kodiak Island are freshwater salmon and trout, representing approximately 80 to 85 percent of the recreational fishing occurring on the island (BLM 1980). Most fishing activity occurs close to the City of Kodiak. Of approximately 30 sport fishing locations identified by the State Division of Parks and Recreation, the most popular areas are located along the road system outside Kodiak. The American, Buskin, Kalsin, Olds, Roslyn, Sulaine, Saltery Creek and Pasagshak rivers are popular (Troll 1979). The rivers and lakes along the road to Chiniak Bay are stocked with rainbow trout, land-locked coho salmon, and Arctic grayling. The lakes on Woody Island and Long Island are also stocked with these fish. Freshwater fishing, particularly for rainbow trout, is also popular on Afognak Island. The best-known freshwater sport fishing area on Kodiak Island is the Karluk River, at the northwest end of the island. Both king salmon and steelhead trout are caught in this river. Salmon are caught in May and June, and steelhead are caught in October. Table 3.23 shows the total number of sport fish harvested by species between 1977 and 1979 (ADF&G 1979).

Saltwater fishing ranks second as a sport fishing activity. This activity occurs offshore within the coastal zone. Dolly Varden and a variety of salmon species (pink, sockeye, coho, king, and chum) are popular seasonal activities, with sport fishing for halibut and rockfish

Table 3.23. Sport fish harvest by species, Kodiak Region, 1977, 1978, and 1979.

Species	1977	1978	1979
Chinook	483	350	752
Sea-Run Coho Salmon	22,618	26,079	31,081
Land-Locked Coho Salmon	229	90	373
Sockeye Salmon	1,255	1,776	2,436
Pink Salmon	14,519	17,739	15,871
Chum Salmon	1,645	1,287	500
Steelhead	232	162	318
Rainbow Trout	1,472	994	972
Dolly Varden/Arctic Char	14,536	15,805	25,421
Arctic Grayling	54	325	127
Halibut	994	1,721	3,013
Rockfish	2,810	1,907	3,599
Smelt	5,652	0	943
Razer Clams	7,474	3,028	8,363
Other Fish	5,149	2,775	2,227

Source: ADF&G 1980.

occurring throughout the year. There is also some ice fishing, primarily by island residents. The BLM estimates that 750 to 1,000 angler-days each year are spent ice fishing (BLM 1980).

Boating. Boats are the most common mode of transportation used for recreation, allowing access into remote portions of the coastline. Boating activities occur near shore in inner bays, inlets, and fiords, where recreational opportunities abound. Photography and bird watching are associated with boat excursions into these areas (BLM 1980). Boats customarily moor in Kodiak Harbor, Anton Larsen Bay, Port Lions at the northeast end of Kodiak Island, and Old Harbor at the southwest end of the island.

Boating as well as some rafting, canoeing, and kayaking occurs on and around Kodiak, Afognak, and Raspberry islands. Saltwater excursions are popular within Eagle Harbor, Old Harbor, Barling Bay, Dry Spruce Bay, Monashka Bay, and Anton Larsen Bay. Boating on Afognak and neighboring islands occurs in such places as Tonki Bay, Kitoi Bay, Duck Bay, Paramanof Bay, Onion Bay, and Kazakof Bay. Many hunters and sport fishers depart from Anton Larsen Bay and boat into Kazakof Bay. Boaters like to stop here to picnic, explore, and walk the beaches while on their way through Raspberry Straits (Troll 1979).

Rafting and saltwater kayaking are growing in popularity. Bear and duck hunters often raft the Karluk River (Troll 1979), and Olga Bay provides excellent kayaking and sailboat opportunities. Opportunities also exist to canoe and raft from Red Lake to the mouth of Ayakulik River. Saltwater kayaking takes place in Seal Bay, along Afognak Island, and to a very limited extent along the northeast shore of Shuyak Island.

Other. Other recreation attractions that are most frequently enjoyed within the Kodiak Island Borough by residents and tourists alike are driving, picnicking, hiking, crabbing, clamming, beachcombing, photographing scenery and wildlife, berry picking, and wildlife observation (KCM 1978; Troll 1979; USF&WS 1980). Many residents, as well as tourists,

particularly enjoy driving along the road to Chiniak Cape. Clamming is popular at Buskin Beach and Middle Bay near Kodiak. In all island communities beachcombing and berry picking are very popular afternoon activities.

Recreation Use Characteristics

Information was obtained from the Alaska Department of Fish and Game District office in Kodiak showing the number of days residents and nonresidents spent hunting for Kodiak brown bear and deer in Unit 8 (Kodiak Island Group) during the 1980 hunting season. These statistics show that residents spent more days (1,873) hunting brown bear than did nonresidents (688), for a combined total of 2,561 use-days during the brown bear hunting season (April 1-May 15). Residents spent more days (8,741 compared with 3,674 for nonresidents) hunting Sitka black-tailed deer during the hunting season (August 1-January 15). A little over half of the days (1,315) spent hunting brown bear in Game Unit 8 took place in the National Wildlife Reserve on Kodiak Island. Approximately one-third of the total deer-hunting days were spent within the refuge. While data to indicate the number of resident and nonresident days spent hunting Roosevelt elk were unavailable, cumulative figures showed that during the 1980 season (August 1-December 31) hunters spent 2,281 days hunting elk. Island-wide use figures for migratory bird hunting are not available, but during the 1979-1980 hunting season (September 10-January 20), 168 days were spent hunting migratory birds within the National Wildlife Reserve.

Table 3.24 presents data on the number of anglers and angler-use days for the Kodiak region. Both show steady increases between 1977 and 1979. No figures that distinguish between resident and nonresident fishing participation are available. Both freshwater and saltwater fishing are open between January 1 and December 31 with a few exceptions. Information on bag limits and seasonal restrictions can be found in the Alaska Hunting and Sport Fishing Regulations.

Table 3.24. Kodiak region angler use characteristics.

Number of Anglers		
1977	1978	1979
2,955	3,182	3,418

Angler Use Days		
1977	1978	1979
41,563	44,502	59,045

Source: ADF&G 1980.

The Kodiak National Wildlife Refuge manager prepares an annual public use report containing the number of activity hours visitors spend (by month) within the reserve. The report shows that during a 12-month period (October 1979 to September 1980), 26,213 people visited the refuge. The highest number of visits (15,924) occurred during the 1980 tourist season, between June and September. The second highest visitor use period occurred during the Kodiak brown bear hunting season (October-November: 3,375; April-May: 3,133). Many visits to the refuge between December and April of 1979-80 are associated with trapping (247 days) and other small-game hunting activities. Approximately 985 visits were made to the refuge per month during this period.

Data extracted from the 1980 refuge public use report reflect the following trends in recreational visitor use of the refuge. Most camping, hiking, boating, and photography excursions occur during the tourist season. However, in 1980 more days were spent camping in the refuge during May than in June, July, August, or September. Much of the May camping activity is associated with Kodiak brown bear hunting outings. Hiking in the refuge was most popular in July and August, while most boating and photography excursions occurred in August. Those persons who engaged in clamming and crabbing did so during May and June, and to a lesser extent in September and October.

Recreation Facilities and Management Responsibilities

Federal. The Kodiak National Wildlife Refuge is Kodiak Island Borough's principal recreation attraction. People enter the refuge to fish and hunt in the interior reaches of the island. The U.S. Fish and Wildlife Service's principal responsibility is to manage the habitat of bear and other fish and game, marine mammals, and migratory birds. Use of refuge lands for recreation purposes is allowed to the extent that it does not conflict with refuge management objectives. Recreation use of the area is monitored through a special use permit system. These permits can be obtained at the game refuge headquarters in Kodiak.

The Fish and Wildlife Service maintains 12 cabins for public use within the refuge, and will eventually manage two additional cabins on Afognak Island that are located within the boundary of the new refuge. Hunters and fishermen are the primary users of these cabin facilities. Eight commercial guides and outfitters who transport hunters and fishermen into the refuge have eight additional campsites at their disposal. In 1981 they obtained special use permits to use six campsites.

One of four cabins on Afognak, Waterfall Lake Cabin, is located within the new refuge boundary. Currently these cabins are being managed by the Chugach National Forest. The Forest Service will continue to maintain and handle reservations for all four cabins during the 1981 use season. The other three cabins - Pillar Lake Cabin, Upper Malina Lake Cabin, and Laura Lake Cabin - are located on lands that have been selected by Koniag Inc., but until the land has been conveyed, the Forest Service will continue to manage these cabins as well.

There are many privately owned cabins located along the shoreline areas of the refuge. These cabins are used as base camps by gill net fishermen and occasional hunters. The U.S. Fish and Wildlife Service has allowed use of the private cabins to continue as long as the use does not conflict with refuge management objectives. Aircraft are allowed on the refuge, but may land only on lakes, rivers, or other water bodies, except in emergencies. Use of motorized vehicles such as jeeps, trail-bikes, dune buggies, and snow machines is not permitted in the refuge (USDI 1972).

State. The State Division of Parks and Recreation provides and maintains three state park facilities on Kodiak Island: Fort Abercrombie State Historical Park, Pasagshak State Park, and Buskin River State Park. Fort Abercrombie is managed by the Parks Division as a historical park. In 1970, the fort was listed on the National Register of Historical Places. There are 183 acres of land within the park boundary (KCM 1979). Park visitors come here primarily to fish, picnic, sightsee, and swim. The area is also used quite frequently by overnight campers on a year-

round basis; overnight accommodations are limited to seven campsites. Only five picnic sites are currently available.

Two fairly recent additions to the state park system are Pasagshak State Park and Buskin River State Park. Pasagshak Park is located on Pasagshak Bay, encompassing approximately 20 acres of land at the head of the bay near the mouth of the Pasagshak River. The Park Department secured the land to protect and provide river access for sport fishermen and to allow access to remote camping sites used during duck hunting season and sport fishing for salmon and Dolly Varden. Principal recreation activities enjoyed in this area include deer and small game hunting, beachcombing, picnicking, and off-road vehicle driving. A few picnic tables are located at the site.

The Buskin Lake, River, and Beach area is owned by the U.S. Coast Guard. The State Division of Parks has secured a 5-year lease for a 100-acre parcel near the lake that it intends to develop into a day and overnight use area. The Buskin River is the most heavily used sportfishing area in the region because it is the most accessible, has a large run of silver salmon, and has the longest fishing season. About a third of the Kodiak area sportfish salmon catch and over half of the Dolly Varden catch are taken from the Buskin system. Management of this area focuses on sportfishing and picnicking (Troll 1979).

Kodiak Island Borough. The Kodiak Island Borough recently obtained park and recreation powers by developing park and recreation policies consistent with its regional plan. The Borough's Comprehensive Parks and Recreation Plan (KCM 1979) identifies the location and types of facilities and programs Kodiak Borough residents are most interested in having. The policies outlined in the Parks and Recreation Plan reflect the activity preference patterns identified in a community survey and other sources of information. The survey results represent the opinions of the Kodiak Parks and Recreation Council, the City of Kodiak Parks and Recreation Advisory Board, and other community volunteers.

The Borough currently assists the City Parks and Recreation Department by providing some of the needed space to conduct many of the indoor activities the city sponsors. The Borough also provides indoor facilities through its "area-wide school powers" and "community schools concept" (KCM 1979). These are primarily Borough school facilities. The Borough does not have the jurisdiction to operate parks and recreation programs within the city. It can, however, recommend that the city provide recreation facilities and programs where they are needed.

The Borough does lease land for recreational purposes. It currently leases a campground site to the Boy Scouts at Island Lake, and leases land to the Veterans of Foreign Wars at Monashka Bay for a pistol and rifle range.

The City of Kodiak Parks and Recreation Department and the Kodiak Island Borough School District have entered into a joint-use agreement, which allows the city to use school gyms in exchange for conducting recreation programs in the high school swimming pool, as well as maintaining the facility. The city's 1980 Parks and Recreation Inventory of Programs and Facilities lists programs conducted in Borough school facilities and city facilities. City-owned park facilities include the Teen Center, Baranof Park, Hillside Park, Larch Street Park, and Spruce Street Park. The city also sponsors organized games during the annual May Crab Festival.

A number of Park and Recreation programs are conducted at the high school gym and swimming pool. These include youth basketball and youth baseball, open gym, ladies night-gym/pool exercise classes, open swim, adult and family swim, lap swim, and swimming lessons. Junior high school programs include City League basketball, power volleyball, badminton, a women's exercise program, and youth gymnastics. At East Elementary School the city conducts a 6-week youth summer program and provides special recreation activities for the mentally handicapped. This program also runs for 6 weeks during the summer.

The city sponsors dances at the teen center twice a month for junior high and high school students. This facility also functions as a leisure center, attracting persons 10 to 30 years of age. Many organized sports programs are conducted by the city at Baranof Park, including tennis tournaments; softball and baseball games for both men and women of various age groups; and a punt, pass, and kick after-school event that attracts youth 8 and 13 years of age. Hillside Park, Larch Street Park, and Spruce Street Park contain children's playground equipment. A grass baseball field complete with backstop, foul line fence, and team benches is located at Hillside Park. Games organized by the City Parks and Recreation Department for the May Crab Festival include badminton and tennis tournaments, a mile run, youth races, and an endurance race over Pillar Mountain.

Port Lions. The Port Lions Comprehensive Parks and Recreation Plan was written and adopted in 1979. Although parks and recreation were not given high priority with respect to other community needs, citizens did feel recreation opportunities for local residents should be available and expanded where necessary. It was also suggested that lands used for subsistence purposes be designated as parklands so that the lands could be preserved in their natural character. It is the opinion of the community that parkland classification may be the only way to preserve lands for subsistence use.

The plan identifies nine recreation facilities, three of which are proposed facilities. The City of Port Lions currently owns and operates four of the existing park facilities. The three proposed facilities will also be located on city property. The rifle range is located on property owned by Afognak Native Corporation, while the Kodiak Island Borough school district owns and operates another facility, the high school gym. Some of the activities are picnicking, beachcombing, swimming, snowmachining, 3-wheeling, skating, and hiking. Eleven public access routes to recreation areas such as beaches and rivers have been identified and acquisition or dedication of lands recommended. Fourteen indoor/outdoor recreation events, activities, and programs are discussed. Most are

sponsored by the school, KANA, and the community Health Representative Program. The level of participation in organized recreation in the community is high. These activities include volleyball, baseball, basketball, dancing, socials, and arts and crafts instruction.

Tourist facilities to accommodate recreational vehicles and tent campers were discouraged. Residents are not interested in encouraging tourists to visit the community. It was recommended that an overnight camp facility be provided for tourists who are stranded for a day or so while waiting for a ferry. Settler Cove Inn is the only lodging now available.

Use Conflicts

Recreation/tourism activities are viewed by many island residents as a mixed blessing. Resident and nonresident activities provide a major portion of income for many hotel/lodge operators, air taxis, and guiding outfits. However, in many areas, nonlocal resident recreation activities are perceived to conflict with subsistence hunting and fishing and with the community lifestyle. At the present time, conflicts take place in the vicinity of rural communities; village coastal management survey results showed uniform discouragement of recreation/tourism in the immediate vicinity of villages.

Of the seven Borough communities, existing recreation conflicts are limited to three villages: Karluk, Ouzinkie, and Port Lions.

Karluk. As previously mentioned, the Karluk River and Lake attract many visitors for fishing, hunting, and rafting/kayaking opportunities. Fishermen and hunters usually pass through the village or village corporation lands during their visits, often trespassing on corporation land, illegal camping, littering, and disruption of daily lifestyle. Because it has no store or general lodging/camping facilities, Karluk receives no benefits from this recreational use.

Karluk residents are also concerned about potential competition between recreation, commercial, and subsistence fishermen for Karluk fishery resources. If use increases to levels that require resource allocation, residents fear that subsistence harvests may be reduced to accommodate recreation use.

Ouzinkie. Icon Bay, on the east side of Spruce Island, is a popular recreational fishing area for Kodiak urban area residents. It is also an important historic site, as the burial place of St. Herman, and bears special significance to Ouzinkie residents and other Russian Orthodox Catholics. Recreation activities have sometimes resulted in trespass on village corporation lands, illegal camping, and littering. Local residents are concerned that site degradation will continue unless some action is taken.

Port Lions. Because of its connection to the state ferry system, recreational vehicle traffic, camping, hunting, and fishing by non-residents has increased. This has often resulted in trespass on private and village corporation lands, illegal camping, littering, and general disruption of community lifestyle. Recreation use increases during deer season (hunters are attracted by the four-deer bag limit) and has reduced the deer population in the immediate vicinity of town. Local residents feel that nonresident recreation hunting is affecting local subsistence harvests.

In response to the conflict, Port Lions has requested that the Kodiak Fish and Game Advisory Board reduce the deer bag limit in the immediate village vicinity to one deer. Residents hope that this will lessen the recreation use of the community by nonresidents.

3.4.5 TRANSPORTATION

Air and water provide the principal means of both intra-Borough and external transportation for people and goods. The highway network in the Borough is limited to the Kodiak urban area and its environs

(Map 14). There are a total of 94 linear miles of road, 19 of which are paved, under state jurisdiction in the Borough. Most are in the northeast portion of Kodiak Island. None of the villages are linked by overland routes. The cost of extension of road connections to the villages, widely separated by difficult topography, is prohibitive.

Since the economy of the Kodiak Archipelago is based on fishing, marine transportation services are of the utmost importance. The region's harbors are accessible to deep-draft, seagoing vessels; its sea routes are usually ice-free during the entire year.

Kodiak Island Borough is generally well served by local and regional air carriers as well as by on-call charter operations. Air travel to and from Kodiak has grown rapidly in recent years. The Borough's air transportation facilities are summarized in Table 3.25. There are airport or float plane landing sites at nearly every village in the Borough. Protected bays and coves provide seaplane landing sites most of the year. Severe crosswinds are a major problem at most village airstrips.

Kodiak Western Airlines serves many of the villages in the Borough through a postal delivery contract. The majority of village flights utilize amphibious aircraft. Service is once a day to Karluk and Larsen Bay (Monday through Friday) and twice daily to Akhiok, Old Harbor, Ouzinkie, and Port Lions. The airline also provides service, three times a week during the summer and twice a week in winter, to Bristol Bay. During 1979 Kodiak Western carried 25,000 passengers and 1.2 million pounds of freight. Port Lions also receives thrice-weekly service to Anchorage by Klondike Air.

Emergency transportation via helicopter is available from the Coast Guard Air Station in Kodiak.

City of Kodiak and Vicinity

Marine. Due to its strategic location, the Port of Kodiak is evolving as a very important consolidation and transshipment point for

Table 3.25. Kodiak Island Borough air facilities.

Airport Location	Runway Size (feet)	Runway Surface	Largest Aircraft	Other Information
Kodiak				
Civilian	7539 X 150	Asphalt	737	Lighted
Military	5379 X 150	Asphalt	720	Lighted
Military	5002 X 150	Asphalt		Lighted
Kodiak Muni	2883 X 100	Gravel		City run
Akhiok	2200 X 100	Gravel		
Karluk	2500 X 100	Gravel		
Larsen Bay	2400 X 100	Gravel		Home base for Uyak Air Service
Old Harbor	2000 X 100	Gravel	402	State maintained; runway to be surfaced in 1985
Ouzinkie	Seaplanes only			Airstrip to be constructed in 1986
Port Lions	2650 X 150	Gravel	402	State-maintained
Sitkinak CGS	4500 X 150	Asphalt		Lighted

Sources: U.S. Department of Commerce, NOAA, National Ocean Survey, 1975.
AEIDC/ISEGR, 1974.

cargoes to the smaller communities of the area. The City Dock is the center of activity. Its facilities include a 22,000-square-foot warehouse and two piers, 360 feet and 350 feet. Water depth alongside is 26 feet and 40 feet, respectively. There is also a marshalling yard for approximately two hundred and fifty 35-foot containers. Congestion has been reported at the City Dock due to problems with ship scheduling and shoreside freight handling and storage.

Sea-Land Service Company is the major freight supplier. The city provides dock facilities to Sea-Land under a preferential-use agreement extending to 1992. Between 1975 and 1980 the amount of freight handled by Sea-Land doubled.

Goods are delivered from Seattle or Anchorage on containerships. Due to the lack of storage area, the vans are then loaded on trucks and delivered to their destinations, where they remain until the ship returns. In 1979 there were 20 dockings, resulting in the movement of 30,000 containers.

American President Lines (APL) has bi-weekly service to Japan, hauling seafood products. The Maritime Shipping Act of 1936 prohibits APL from calling at other American ports after leaving Kodiak. If the move to relax this restriction is successful, APL would like to institute weekly service between Kodiak, Anchorage, and Seattle.

Petroleum products are delivered to Kodiak by Chevron's Alaska Standard, a shallow-draft tanker based in Valdez. This vessel has a bulk capacity of 18,000 barrels of diesel, heating, and motor fuel and 90 tons of capacity for other petroleum freight, such as barrelled aviation gas. The Alaska Standard delivers to the Chevron plant in Kodiak about once a month. Deliveries are also made to canneries and/or some of the villages of the Borough on a demand basis.

Unscheduled sailings through various carriers are arranged when additional freight requirements are justified. For 1981, Northland Marine

Lines plans two scheduled sailings from Seattle to Kodiak. Also to begin in 1981 is an inter-island freight service. Alaska Transfer, a local firm, plans to use a 90-foot landing craft for this service.

There are eight cannery wharves of varying lengths and depths within the city limits. At Womens Bay, 6 miles by road from Kodiak, are three large Coast Guard wharves and a private shipyard wharf. The Coast Guard wharf faces have lengths of 500, 600, and 1400 feet. The shipyard wharf has a 675-foot face with depths alongside ranging from 26 to 33 feet.

The Ferry Terminal is used primarily by the Alaska State Ferry, M.V. Tustumena. This 296-foot ferry can accommodate 200 passengers, including staterooms to sleep 58, and 54 standard size vehicles. Vans of 40 feet maximum length can be transported. The ferry uses an elevator system to load vehicles.

The Tustumena serves Kodiak three times a week from the end of March to early December on a Kodiak-Homer-Kodiak-Seward-Kodiak loop. Included in this loop are scheduled stops at Port Lions on the way to Kodiak on Monday and on the way to Homer on Tuesday. During the summer (May 29 to September 7) the ferry adds a Seward-Valdez-Cordova-Valdez-Seward run on the weekends. Truck trailer service between Kodiak and the Kenai Peninsula utilizes the ferry system. Ferry service is summarized below:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday*	Saturday*
Seward	Port Lions	Kodiak	Homer	Kodiak	Seward	Cordova
	Kodiak	Port Lions	Seldovia	Seward	Valdez	Valdez
		Homer	Homer			
		Seldovia				
		Homer				
		Kodiak				

*Summer (May 29 to September 7) only.

During 1979 the ferry began service from Kodiak to the Alaska Peninsula communities of Sand Point, King Cove, and Cold Bay. Three trips are planned for the summer of 1981. These communities are 450 straight-line miles to the southwest of Kodiak.

The City of Kodiak's small boat harbor (SBH) has 225 stalls, all of which are filled. There are 400 vessels, ranging in size from 17-foot recreation boats to 160-foot crab boats, on a waiting list for moorage space. During 1980 a total of 1575 vessels occupied some part of the city-operated facilities, an increase of 11 percent over 1979. Of these vessels, approximately 400 are year-round fishing boats; the remainder are transient, government, and recreational vessels.

The inadequate SBH facilities have prompted the city to actively pursue the proposed Dog Bay SBH, located at Near Island. A contract has recently been awarded for dredging and breakwater construction to be started in September 1981. Final plans and specifications for the $6.2 million SBH are being prepared. The facility will contain 268 stalls, the largest of which will accommodate 170-foot vessels. Construction is scheduled for the summer of 1982.

Air. The Borough's major airport is located on the Coast Guard Base, and is owned and operated by the state. In spite of a high incidence of inclement weather, the airport has a relatively good record of dependability. Its terminal facilities are owned by Wien Air Alaska and include ticket counters, security waiting area, car rental agencies, indoor baggage facilities, and aircraft fueling facilities. The existing passenger terminal facilities are barely adequate for present traffic.

Air service to and from Kodiak is provided by Wien, with twice-daily service to Anchorage, Kenai, and Seattle on 737 jets. During the summer, an extra flight is added Monday through Friday. In 1979 Wien carried approximately 100,000 passengers between Kodiak and these cities, and about 6 million pounds of freight and mail.

Air taxi service is available from Island Air Service, Flirite, Uyak Air, and Kodiak Air Taxi for chartered flights throughout the Kodiak area.

The City of Kodiak operates a small general aviation airport within the city limits. There is no formal city-maintained apron area; however, several gravel parking areas for private aircraft have been developed. Adjacent to the strip is Lilly Lake, which is used by float planes. Kodiak Western Airlines accounts for a significant portion of the float plane traffic and maintains hangar facilities at the municipal airport. There are no air or ground traffic control activities at the airport; however, the FAA does offer an air traffic advisory service from its tower on the Coast Guard Base.

Land. There are 14 miles of city roads on Kodiak Island. Sixty percent of the streets within the City of Kodiak are unpaved and the city maintains them as either gravel or seal-coated roadways. In recent years the city has been reconstructing and paving about 3/4 of a mile of road per year.

Afognak Island

Land. An unimproved road, approximately 5 miles long, extends from Afognak Bay to Afognak Lake, where there is a military reservation camp.

Logging roads are being built to harvest timber from the Perenosa sale. A total of 45 to 60 miles of mainline road, more than 200 miles including spurs, will be built. The roads go from Danger Bay to Discovery Bay and Izhut Bay. A road is yet to be built toward Seal Bay and Tonki Cape.

Akhiok

Marine. There are no docking facilities at the village, so skiffs are used to carry cargo and passengers to the beach from larger vessels.

Akhiok has received a Community Development Block Grant for construction of boat mooring facilities. Plans are being made to begin construction within the next two years.

Land. There are two roads within the village, one leading to the airstrip and the other leading to the landfill.

Karluk

Marine. There are no docking facilities at the village. Cargo and passengers are brought to the beach from larger vessels by skiffs.

Land. There are no roads in the City of Karluk.

Larsen Bay

Marine. Kodiak Island Seafood Inc. (KISI) owns the 1035-foot-long cannery pier with a depth of 8 feet at its outer end (DMJM Forssen 1980). A 5-ton crane is available. Sea-Land and Western Pioneer vessels make calls at the village when the cannery is operating. Chevron's Alaska Standard calls at the pier twice a year. Larsen Bay also has a dock for small boats.

Land. There are gravel roads within the town. The village has responsibility for maintenance, but due to lack of funds, the roads are very poorly maintained.

Old Harbor

Marine. An L-shaped pier with a 67-foot face is located here. Depth alongside the state-owned pier is about 15 feet, but it becomes dry at low tide. The Alaska Standard delivers fuel three times a year. There is also a dock for small boats.

Land. The village has a rudimentary road system. Maintenance responsibility is the village's, but due to lack of funds the roads are very poorly maintained.

Ouzinkie

Marine. The Ouzinkie pier is the former Columbia-Ward wharf, built after the 1964 earthquake. The L-shaped facility is owned by the Ouzinkie Village Corporation. It is 104 feet long, with a water depth of 28 feet. Currently the Alaska Standard delivers fuel to this wharf twice yearly. There is also a dock for small boats.

Land. The village road system consists of 3 miles of improved dirt road. The village has maintenance responsibility, but due to lack of funds the roads are very poorly maintained.

Port Lions

Marine. The former Wakefield Seafood processing plant wharf was donated to the city after a fire destroyed the plant in 1975. On Kizhuyak Bay 2 miles by road from the townsite, the L-shaped wharf extends 1000 feet before assuming a right angle. The outer face is 400 feet long, with depths alongside of 77 feet at MLLW. Shore facilities include a Ramey 2500-pound hoist and an 1800-cubic-foot freezer storage room. The M.V. Tustumena uses this wharf. Grants have been awarded to the village to repair damage to the dock caused by wind and fire, and to install a new lighting system.

A timber floating dock, 10 feet wide, is joined to the old cannery wharf. This dock provides 800 feet of docking space, enough for about 22 vessels (average length, 40 feet). During rough weather, many boats anchor away from the dock.

Transient fishing vessels visiting Port Lions during the year may number well over 100. Some 52 fishing vessels make the harbor a permanent home. The Corps of Engineers has begun construction of a break-

water for a small boat harbor (SBH) in nearby Settler Cove. The $1.7 million SBH will consist of a light-duty dock and a series of concrete floats. The main float will be 350 feet long with three radiating fingers, each 250 feet in length. Vessels up to 100 feet in length will be accommodated. The design capacity is approximately 30 to 35 vessels. The fueling facilities at the old Wakefield Wharf will continue to be utilized. Construction is scheduled for the summer of 1982.

Land. There are 4 miles of improved dirt road connecting the town with Port Wakefield and the airport. Average annual daily traffic is about 20 vehicles. This figure is subject to extreme seasonal variations. Within the village there is a one-mile gravel-surfaced street system that is village-maintained. Port Lions has been awarded a $95,000 Community Block Grant to upgrade the roads.

3.4.6 ENERGY FACILITIES AND RESOURCES

The Kodiak Island Borough is in the position of being an energy consumer and potential energy producer. As in other areas of "rural" Alaska, Borough residents are facing rapidly increasing costs for fuel for electric power generation and heat. Several villages are further handicapped by dependence on old and inefficient power generation equipment. Because all diesel and other fuel is shipped into the Borough, residents are also susceptible to rising transportation costs and weather delays in fuel delivery. At the present time, all electricity on the island is diesel fuel generated, and used for lighting, heating, and running applicances.

Generation of hydroelectric power for local consumption is the goal of several proposed projects and the subject of feasibility studies. The most publicized project is Kodiak Electric Association's (KEA) Terror Lake Project, 25 miles southwest of Kodiak. Port Lions is also investigating construction of a hydroelectric facility in conjunction with KEA, and a small hydroelectric feasibility study was conducted for the Corps of Engineers (CH2M Hill 1981). This study identified several potential sites in the vicinity of each of the Borough's communities.

Another potential energy resource, viewed with mixed feelings by Borough residents, is potential offshore deposits of oil and natural gas. Although the original lease sale was postponed, one federal and one state lease sale are scheduled offshore of Kodiak during the next three years. Local concerns focus on potential impacts of exploration, development, and production activities and accidents on Kodiak's fishing industry. Petroleum resources are discussed later in this section.

Existing Facilities

Energy-generating facilities and the potential for hydro-power in each of Kodiak's communities are discussed below.

City of Kodiak and Vicinity. Electrical energy is provided to the City of Kodiak area by the Kodiak Electric Association, Inc. In addition to supplying the city area, KEA also supplies power to Monashka Bay, 4 miles north of Kodiak. Bell's Flat, 11 miles southwest of Kodiak, receives its power from the Coast Guard (Kodiak Island Borough, personal communication 1981). Generating facilities consist of eleven diesel generators with a "nameplate" capacity of 25,000 kilowatts (kw). This nominal capacity can be misleading because much of the equipment is old and liable to breakdowns. A new 7,000-kw generator has recently been installed.

Due to the large cost increases for diesel fuel, new power sources are being investigated. Under study at the present time is a hydroelectric project at Terror Lake, 25 miles southwest of Kodiak. This project was first studied during World War II by the Army Corps of Engineers. As presently designed, the Terror Lake project would produce 30,000 kw and 175 million kw-hours annually. KEA has filed permit applications with the Federal Energy Regulatory Commission (FERC) to investigate the feasibility of developing the project. The Coast Guard would switch from generating its own power to purchasing power from KEA if the project is built. Two smaller sites with hydro-power potential have also been identified (COE 1980).

Akhiok. Electricity is supplied to the village from a new central generation plant consisting of a 55-kw diesel generator operated by the KANA Electrical Authority. The new underground distribution system has a history of problems and outages. Several households continue to get their electricity from individual 2 to 4 kw generators. A 60,000-gallon fuel tank is used for storage. The centralized system runs from 6 to 10 hours per day. The school is supplied separately from two 25-kw diesel generators, one of which is a backup. The school's four storage tanks can contain 20,900 gallons of fuel. The city consumes 386 barrels of diesel per year generating electricity and another 155 barrels are consumed per year by the school.

Oil is the primary source of heat. The village uses 1107 barrels of fuel per year for heating, cooking, and to heat water. Village residents use 1080 barrels per year and the school uses 27 barrels per year. Propane is occasionally used for cooking (CH2M Hill 1980). Fuel is delivered two or three times per year.

Three sites that have good hydro-power potential have been identified near Akhiok (COE, 1980). There is a steady prevailing westerly wind that may have wind-power potential. The closest source of driftwood is 7 to 8 miles away.

Karluk. The village owns a 15-kw generator that is hooked up to a few buildings. The reliability of this generator is poor, so it is not used very often. The other source of electrical power is an individual 4.5-kw generator at each residence. The school is supplied by two 7.5-kw generators.

Fuel is delivered approximately four times a year and stored below the ground in an 8,500 gallon tank. There is a 50,000-gallon storage tank on the beach that will eventually be hooked up. Fuel is sold to individuals in the community to operate electric generators and to heat homes.

The primary heating source for the village is oil. The school receives one shipment of fuel oil per year, which is extracted from the community reserve. This fuel is stored in 55-gallon drums.

Various small-scale power generation systems are being investigated, including wind power. Three sites that have good hydro-power potential have been identified (COE, 1980). See Map 14 for location of these sites.

Larsen Bay. Larsen Bay has no centralized electric system; approximately 20 individually owned and operated generators (5-kw Listers) provide electricity to 25 to 30 households. Electricity is usually generated only during the evenings, or when needed. Some households have wood stoves for heating. A new school, opened in 1980, has two 60-kw generators. The Kodiak Island Seafood, Inc. (KISI) processing plant operates its own generating plant for cannery operations and employee housing. KISI operates a 7.5-kw and a 30-kw diesel engine generator unit during the winter months and two 75-kw and three 200-kw units during the canning season (CH2M Hill 1980).

All diesel fuel deliveries are made to KISI, which then distributes it to the residents. Generation of electricity for homes uses 480 barrels per year (bbl/yr) and the school uses 299 bbl/year. The cannery uses 1198 bbl/year. Home and school heating consumes 90 bbl/year. Some stoves may be fueled with propane. Some homes have wood stoves for space and water heating (CH2M Hill 1980). Under consideration are hydroelectric and wind turbine projects. Three hydro-power sites have been identified (COE 1980). See Map 14 for location of sites.

Old Harbor. The village generation and distribution system is owned by Alaska Village Electrical Cooperative (AVEC) and operated by the village. Most of the homes are connected to the central system by an above-ground transmission line, but a few still use their own generators. The AVEC generation system consists of two 155-kw diesel units. Although

the system is only 3 years old, outages are common (CH2M Hill 1980). The eastern and western portions of the community are linked by an underground line.

Electricity generation consumes 620 bbl/yr. Total diesel fuel deliveries in 1979 were 820 barrels, leaving 200 barrels for uses other than generation. Total delivery of home heating fuel in 1979 was 1,910 barrels. Fuel delivery generally occurs four times a year. Fuel is delivered by tankers. Community storage facilities consist of a 60,000-gallon oil tank and a 10,000-gallon gasoline tank. An additional 60,000-gallon storage capacity is available, but is not now used. Wood stoves are also used for heating and cooking in some of the new homes; however, the only available wood is driftwood and it is in scarce supply. Propane is also used to fuel some stoves.

Hydroelectric and wind power alternatives and/or supplements are being studied. Two hydro-power sites have been identified (COE 1980). See Map 14 for location of sites.

Ouzinkie. Electrical power is provided to residents by the village of Ouzinkie. Ten homes are not connected to the system and continue to use individual generators. Power is supplied by an 85-kw generator, which operates between the hours of 7 A.M. and 10 P.M. The 85-kw generator is adequate, but will soon be replaced by a 150-kw generator with an attached heat recovery unit; the new generator is located near the school. A 50-kw standby generator is used by the school. Electrical meters have been installed, but currently a flat rate of $60 per month per residence is being charged for power. When the metered-rate system is begun, electricity costs for households will rise.

Electricity generation uses 360 bbl/year. Home heating uses 1070 bbl/year. Some new housing is being equipped with wood stoves for heating. The Village Corporation receives shipment of 40,000 gallons of diesel fuel oil three or four times a year. The fuel is used to run the

electrical generator and is sold to local residents for heating and cooking. Ouzinkie residents purchase gasoline and propane in Kodiak, for personal use.

Oil and wood stoves serve as the primary heating sources in the community. Increases in fuel costs have placed more emphasis on conversion to wood heat. One site has been identified for potential hydro-power generation (COE 1980). See Map 14 for location of site.

Port Lions. Port Lions is serviced by the Kodiak Electric Association (KEA), which operates four generators with 1,100 kw of capacity. There are two 350-kw generators and two 200-kw generators. usage peaks at approximately 70 kw. It is a three-phase system. Wood-burning stoves and fuel furnaces are used by most residents to heat their homes. The Standard Oil tanker delivers fuel oil, diesel fuel, and gasoline to Port Lions Oil Company. The community can store up to 215,000 gallons of diesel fuel and 19,000 gallons of gasoline.

Petroleum

The Borough contains portions of three separate sedimentary petroleum provinces or basins - the Mesozoic province, the Lower Cook Inlet-Shelikof Tertiary province, and the Kodiak Tertiary province.

The Mesozoic province consists of a belt of marine sedimentary rocks that extends the length of the southcentral region from the Wrangell Mountains to the tip of the Alaska Peninsula. These rocks outcrop all along the eastern portion of the Alaska Peninsula and probably extend for some distance offshore.

The resources in this province will be discussed with the Lower Cook Inlet-Shelikof Tertiary province.

The Lower Cook Inlet-Shelikof Tertiary province is the southern extension of the oil and gas-producing Tertiary, non-marine, sedimentary

rocks of the Cook Inlet Basin. These rocks are probably quite thin in Lower Cook Inlet, but they may thicken again in a subsidiary basin in Shelikof Strait. The presence of good reservoir beds in a setting similar to the producing Cook Inlet fields to the north could make this a favorable petroleum province.

There is a 95 percent probability that no commercial resources will be discovered (EIS No. 60, p. 23, 1980). Assuming a commercial find (with a 5 percent probability), the U.S. Geological Survey (USGS) has developed estimates for the mean resource level of recoverable oil and natural gas resources within the proposed lease area as follows:

Oil	335 million barrels
Gas	586 billion cubic feet (5 percent change) (EIS No. 60, p. 46).

Crude oil extracted from the Shelikof Strait is hypothesized to be transported by pipeline to an oil storage and tanker loading terminal located near Talnik Point on the shore of Marmot Bay. Natural gas produced in the Shelikof Strait would be piped to a gas compressor station located on the Kenai Peninsula.

No facilities exist on either Kodiak or Afognak Island to handle hydrocarbons produced from the Shelikof Strait. Several facility sites have been identified as being physically adequate (excluding biological considerations) for development (Map 14). The location and construction of a pipeline to an oil storage terminal at Talnik Point is just one of several options. For a review of potential development sites the reader is directed to the following works: Lower Cook Inlet/Shelikof Straits Petroleum Development Scenarios, Technical Report No. 43 prepared by Dames and Moore for BLM and the Oil Terminal and Marine Service Base Sites in the Kodiak Island Borough, prepared by Woodward-Clyde Consultants for the Kodiak Island Borough.

Map 14 shows some of the other sites that appear to be physically capable of hosting facilities should they be required. Even if facilities are required, most of the potential sites would not be used, since several alternatives have been identified for each site requirement. Conceivably, none of the sites may be used if other factors (community resistance, land use policies, restrictive zoning, etc.) limit or cause industry disinterest in these sites, and if other physically capable sites are more attractive.

The first federal offshore lease sale in Cook Inlet was held in October of 1977. At the present time, OCS leases in Lower Cook Inlet are in the post-sale exploratory phase. As of July 1980, ten exploratory wells and one Continental Offshore Stratigraphic Test (COST) well have been drilled in the area. No commercial finds have been announced.

The draft EIS for lease sale No. 60 was released in 1980 and the final EIS was released in March 1981. The combined Lower Cook Inlet and Shelikof Strait OCS lease sale No. 60 is scheduled for September 1981.

The Kodiak Tertiary province consists of a thick section of Tertiary marine and nonmarine sedimentary rocks that extends from Kodiak Island across the continental shelf to the continental slope. The geometry of the sedimentary rocks along the broad anticlinal arch at the edge of the shelf and the shallow drilling depths make this a favorable place for petroleum entrapment and exploration. The area has been explored by industry using geophysical methods but no wells have been drilled.

The probability of finding commercial reserves is only 8 percent. Assuming commercial resources are discovered, the estimates of recoverable gas condensate fluids and natural gas resources within the proposed lease area are as follows:

	Maximum	Mean	Minimum
Gas Condensates (million barrels)	501	176	22
Natural Gas (trillion cubic feet)	13.94	5.35	0.91

The first draft EIS on lease sale No. 46 was printed in April 1977. A change in the leasing schedule was announced shortly after publication, changing the proposed sale date to December 1980. Due to new information and new EIS writing procedures, a second draft EIS was prepared in December 1979. The lease sale was finally cancelled in July 1980 due to lack of industry interest and environmental opposition. Sale No. 61 (for the same area as Sale No. 46) was then scheduled for 1983 but the new 5-year lease schedule released in April 1981 does not include Sale No. 61. OCS lease sale No. 100, which includes the Cook Inlet, Kodiak, Shumagin, and other Gulf of Alaska areas, is scheduled for 1986.

3.4.7 COASTAL ACCESS

Coastal access characteristics of the Kodiak Island Borough relate to the ability to reach a coastline and the mode of transportation most commonly used. The discussion will also focus on two related elements of coastal access - land ownership and shorefront activity. For instance, shorelines in private ownership often have access restrictions, while publicly-owned shorelines have open access. Furthermore, shorefront use activities require certain access factors to accommodate particular types of uses.

Physical access to the coastline centers around the City of Kodiak and the six villages. Coastal access via boat and air service networks are the most viable transportation systems. A port facility is located at Kodiak, as it lies within close proximity to a major shipping route and the water depth can accommodate freighters and ferries with deep hulls. Coastal access to four village communities and Kodiak is also facilitated by the presence of small boat harbors. Boat docks and piers accommodate

inter-island freight service, recreational boating activities, and seafood processing activities. At Akhiok and Karluk coastal access is usually achieved by skiffs, which carry cargo and passengers to the beach from larger vessels. Local and regional air carrier service and charter operations also facilitate coastal access to Kodiak and village communities. Coastal access via vehicle is limited, as topographic features and cost restrict road construction. The highway network functions mainly to provide access to facilities and services within the immediate vicinity of the communities and is extensive only in the vicinity of the City of Kodiak. The road system outside the Kodiak urban area allows coastal access to recreation areas and facilities such as state parks. Refer to Map 14 for the location of roads, marine facilities, and airstrips.

Land ownership as it relates to coastal access can be discussed for the most part only in a tentative manner until proposed land selections are conveyed. Coastal access to lands selected by the federal government, state, Borough, and Native corporations may also present access restrictions. In most instances, some form of coastal access to public lands is assured. Boat access to the shoreline of the National Wildlife Refuge is guaranteed; however, airplane and motorized vehicle access is restricted. State-owned tidelands, submerged lands, and lands beneath navigable and public waters are open to public use. In addition, coastal access is guaranteed on state lands leased or purchased adjacent to the coastline. Provisions have been made in the Alaska Native Claims Settlement Act to allow coastal access across Native-selected lands via public access easements and site easements. These easements ensure that upland areas and major waterways remain accessible for recreational use. See Map 12 for the location of land selections.

Coastal access is necessary within the Kodiak Island Borough for the siting of industrial, transportation, energy, and recreation facilities. The physical character of the coastline influences the suitability of a site to accommodate certain types of activities. Some of the physical parameters delineating the minimum requirements for siting a facility have been identified. For siting of industrial facilities such as fish and timber processing plants, there must be sufficient

coastline to receive, possibly process, and ship products. Potentially limiting physical parameters might include a lack of sufficient acreage of relatively flat terrain and the presence of navigational hazards. Physical parameters pertinent to the placement of transportation facilities (ferry terminals, ports, small boat harbors, and airports) would include the availability of road access, coastal processes characteristics, and wave exposure. Potentially limiting physical parameters affecting energy facilities along the coastline include such factors as the presence of deep water near shore, adequate turning basins, and flat terrain with sufficient acreage to construct a terminal. Recreation activities such as boating, fishing, and hunting require coastal access. Some physical parameters limiting coastal access via boat and float plane are the availability of dock or moorage facilities, and protected waters where boats and float planes can be safely anchored offshore.

3.4.8 HOUSING

A shortage of housing exists throughout the Borough. Factors contributing to the shortage include lack of financing, a shortage of developable land, and shortages of available hookups for water and sewer in areas with centralized systems. The Kodiak Area Native Association (KANA) and the Bureau of Indian Affairs and the Department of Housing and Urban Development (BIA/HUD) are building homes in the villages as part of the Indian Housing Project. The homes are to be constructed and managed by the Kodiak Area Housing Authority. The existing and proposed housing stock in the City of Kodiak and in each of the villages is described below.

City of Kodiak and Vicinity

As of 1976 there were 1973 housing units, 60 percent single-family units, in the City of Kodiak. Excluding trailers, more than 40 percent of the housing units were in poor to fair condition when surveyed in 1976. A major constraint on new housing was land and hookup availability.

The Coast Guard Base contains an additional 557 units, excluding barracks.

Akhiok

As of October 1980, there were 28 single-family housing units within the community, 15 of which are newer BIA/HUD homes built in 1978. None of the houses is vacant and no additional home construction is planned. The average number of persons per household in 1980 was estimated at 3.3.

Karluk

A severe storm in 1978 led to the relocation of the village. The condition of the 32 homes in old Karluk ranges from excellent to poor; however, all but two homes have been abandoned. A total of 23 homes were built at the new site through the BIA/HUD program in 1978-1979.

Larsen Bay

As of October 1980, there were 48 single-family homes and one duplex in the village (CH2M Hill 1980). The housing stock is in need of repair. Beach erosion threatens several of the homes. The vacancy rate is zero and an average of 4.0 persons occupy each house. BIA/HUD is planning to build 15 to 20 single-family homes between 1981 and 1985. Residents are currently renovating many wood frame homes built over 40 years ago.

Old Harbor

In October 1980 available housing was estimated at 93 single-family homes (CH2M Hill 1980). The Bureau of Indian Affairs built 48 homes in 1964 following the earthquake, and another 45 homes in 1978-1979 (EIS No. 46). Twelve homes are to be built in 1981. Currently all homes are occupied, with an average occupancy of 4.5 persons per household (CH2M Hill 1980).

Ouzinkie

There are 59 single-family wood frame homes in the village. The vacancy rate is less than 2 percent. The average number of persons per household is four. The Bureau of Indian Affairs and HUD plan to build ten homes in 1981 (CH2M Hill 1980). Many of the older homes are in poor condition. Thirty-three of these homes were constructed after the 1964 earthquake.

Port Lions

There are 47 single-family homes in Port Lions, with an average of five persons per household. Most of the homes, which are wood frame structures, are in good condition. Many were built during the last 15 years. The Bureau of Indian Affairs and HUD have begun construction of 35 new homes.

3.4.9 COMMUNITY FACILITIES AND SERVICES

Water, sewer, and solid waste disposal systems within the Kodiak Island Borough are detailed below, by community. Information on village facilities was compiled from the draft Community Profiles (DOWL 1981).

City of Kodiak and Vicinity

Water. The largest public water system within the Borough is operated by the City of Kodiak. It supplies water for residential, industrial (primarily fish processing), and fire-fighting purposes. There is one reservoir on Monashka Creek and four on Pella Creek. The service area is mainly within the city limits, but an 8-inch line extends to the end of Mill Bay Road. Service extends to the southwest of downtown Kodiak as far as Gibson Cove. The Loran Station on Spruce Cape also gets its water from the city system.

The city fire department currently provides fire protection service to the already developed Island Lake and Mission Road areas. The water supply is not adequate to serve these areas properly (KCM 1978).

At present the water system is being used to its practical limit and any sizable population growth or additional large industrial users in the area will require expansion of facilities. Current water use varies from 3.0 to 3.5 million gallons per day (MGD), when the fish processing plants are not operating, to 10 to 12 MGD when they are. The current storage capacity is inadequate to insure supplies to industrial users during periods of low streamflow. This uncertainty could discourage construction of new processing plants. As demand has increased, water lines have been excavated and replaced with larger lines to increase the service capacity of the system. This will continue until the supply system and storage capacity are increased. A 20-inch line from the water tank to the upper reservoir will eventually provide interim relief.

To increase storage capacity, the most likely solution involves construction/expansion of the dam at Monashka Creek. Engineering has been completed for the project and a 24-inch line installed. However, the ownership of the land involved is in dispute. Until this is resolved, the project cannot move ahead.

Sewer. The City of Kodiak operates the sewer system. A 2.2 million gallon per day (gpd) secondary sewage treatment plant was completed in 1978. Recently the plant was reported to be operating well below capacity. The projected service population is 9500, so considerable capacity for expansion exists. There are several areas near the city where extension of service is being studied, including the Island Lake area and the Municipal Airport area. It may be necessary to increase the size of some portions of the downstream end of the system to accommodate these additions. Industrial wastes from fish processing are dried and used for fertilizer.

Before the building of the treatment plant, untreated sewage was handled by septic tanks or dumped into the ocean. Areas not connected to the system continue to use septic tanks.

Solid Waste. Kodiak's facilities for solid waste disposal are inadequate. Scarcity of soil requires use of a coarse rocky cover, which allows rainwater to percolate into the buried waste. Polluted leachate is working out to surface watercourses. The existing site is particularly unsuited for the disposal of sludge from the new wastewater treatment plant.

A CEIP Grant has been obtained to study a Solanie Creek site for solid waste disposal, but this site also has serious potential problems.

Akhiok

Water. Akhiok is supplied with treated water from a community supply dam, which holds approximately 500,000 gallons of water that runs through a gravity feed system with 3/4-inch lines. The system was built in 1969. The shallow depth of bury results in occasional freezing of the lines. There are two 10,000-gallon water storage tanks, the most recent of which was added to the village system in 1979. The Akhiok school has its own well.

Sewer. The Public Health Service installed the sanitary sewer system, which consists of collection line septic tanks and outfall into the lagoon. Generally all housing is connected to the system. It is reported that insufficient fall on the lines occasionally results in backing up of the system and overflow from the manholes. In addition, the outfall line is beginning to float due to insufficient cover over the pipe. The system is adequate for the community, but extensive maintenance and repair will be required to keep it functioning. Renovation of the sewer system is scheduled for 1981.

Solid Waste. A sanitary landfill was built by the Borough with Federal Housing and Urban Development Grant (HUD) funds in 1977, but is not being actively used. It is locted 1800 feet east of the center of the village. There is a lack of transportation to the landfill and there is no way to spread or cover the garbage. For these reasons garbage is often disposed of through tidal outflow.

Karluk

Water. The Public Health Service installed a community water system in 1979. Water is obtained from a creek south of town, where it is stored in a 35,000-gallon tank until transmittal to a treatment plant where chlorine and fluoride are added. The system is adequate for the community. The entire system is gravity flow and consumes no fuel. At the present, no charge is made for water use. Fire hydrants are attached to the water transmission lines and are located throughout the community.

Sewer. In 1979 the Public Health Service installed a community sanitary system. All houses in New Karluk are tied into the system. The waste is transmitted through collection lines to a septic-drainfield system northwest of the village. Expansion of the system to accommodate future growth should not present any problems.

Solid Waste. A temporary sanitary landfill is located north of the village. This location is unacceptable to the community and funds are being sought to establish a landfill at a more appropriate location. Pickup service is not provided. Each household is responsible for hauling its own waste.

Larsen Bay

Water. A community water system was installed in 1979 by the Public Health Service. All dwellings are connected to the system with the exception of some of the older dwellings, which have their own

wells. Water is obtained from Humpy Creek, south of town. The water is collected through an infiltration gallery, fluoridated and chlorinated, and pumped to a 100,000-gallon storage tank.

The system is adequate for the existing community, except that low flows in Humpy Creek in the winter occasionally require running the pump constantly to maintain water in the storage tank. Peak flows are reported to be 10,000 gpd. Fire hydrants are attached to the water transmission lines and are located throughout the community. The water system is scheduled for improvement in 1981.

Sewer. The Public Health Service installed a community sanitary system in 1979, which consists of a series of subsystems. These subsystems are required due to the sprawling nature of the community. Each subsystem serves one or more houses and consists of service connections, collection lines, a septic tank, and an outfall into Larsen Bay. All residents are connected to the sanitary system with the exception of a few dwellings on the outskirts of the community. Expansion to accommodate future growth should not present any problems. System improvements are planned for 1981.

Solid Waste. Solid waste is disposed of in an old rock pit in the middle of the community or piled on the beach to be washed away with the tide. The nearness of the pit to water sources has created problems with water quality. Birds attracted to the dump pose a safety hazard to aviation. Bears are also attracted to the uncovered waste. The Alaska Department of Environmental Quality has recommended that $140,000 of state money be spent to develop a new site northeast of town. The old dump would also need to be rehabilitated.

Old Harbor

Water. The water system is divided into a western and an eastern segment, which are interconnected with a 6-inch main to provide a balanced system. The western system obtains water from a dammed creek, and is completely gravity flow. The water is treated and stored in a

100,000-gallon tank. The eastern system obtains its water from an infiltration gallery. The water is pumped, treated, and stored in a 120,000-gallon tank. Eleven fire hydrants scattered throughout the community are connected to the systems. However, they are not adequate for fire fighting. The waterlines are to be extended in 1982.

Sewer. The U.S. Public Health Service has installed two sanitary sewer systems. The western system includes a collection system, a septic tank, and an outfall line into Akhiok Bay. The eastern system consists of a collection system, a sewer lagoon, and an outfall into Akhiok Bay. All housing is hooked into one of these systems. The systems are adequate for the existing community and for future expansion. The sewer lines are to be extended in 1982.

Solid Waste. The sanitary landfill is located between the two portions of the town north of the city docks. The landfill was constructed by the Kodiak Island Borough with Housing and Urban Development Community Block Grant funds. Collection is performed by the city at no cost on Mondays, Wednesdays, and Fridays, using a flatbed truck. Lack of earth-moving equipment makes it difficult to effectively cover the solid waste with fill material. In addition, a new road past the sewage lagoon and leading to the landfill is needed.

Ouzinkie

Water. The Public Health Service installed a community water system in 1966 and upgraded the system in 1978. All dwellings are connected to the system with the exception of a few residences on the outskirts of town.

Water is obtained from Spruce Creek east of town. A small dam ponds the water, which is then transmitted to the treatment plant. The water is passed through a sandfilter, chlorinated and fluoridated, and then pumped to a 30,000-gallon tank near the treatment plant or a 100,000-gallon tank near the town center.

The system is adequate for the existing population. However, low pressure is reported on the west end of town. To alleviate the low pressure problem, the installation of another 30,000-gallon tank is planned. Peak flows are in the range of 50,000 gpd. Fire hydrants are attached to the water transmission lines. Fire hose is available in town and a volunteer fire department is in the planning stages.

Water rates are $7.50 per month for a family of one or two, $10 for three to five, and $12 per month for a family of six or more.

The system has deteriorated in recent years, and is scheduled for upgrading by the Public Health Service in 1981.

Sewer. In 1966, the Public Health Service installed a community sanitary system consisting of a series of subsystems. These subsystems are required due to the sprawl of the community. Each subsystem connects one or more houses with the larger subsystems located in the center of the community. Each subsystem consists of service connections, collection lines, a septic tank, and an outfall into Narrow Straits. All residents are connected to the sanitary system with the exception of a few dwellings on the outskirts of the community. Expansion of the system to accommodate future growth should not present any problems. Improvements are scheduled for 1981.

Solid Waste. A sanitary landfill was constructed in 1977 by the Kodiak Island Borough, using HUD community grants. The landfill is approximately half a mile northeast of the community. Pickup services are not provided; each household is responsible for hauling its own solid waste. At the present time no machinery is available to cover the waste at the landfill; this presents a health hazard to the village. The traditional disposal method of depositing garbage on the beach is still utilized.

Port Lions

Water. Port Lions is served by a full community water distribution system, which was recently upgraded by the Public Health Service. Water is stored in a reservoir north of town. A 12,000-gallon wood stave storage tank serves both the original portion of the town and the new section built by Housing and Urban Development northwest of the original townsite. Water from a new 125,000-gallon wood stave storage tank will bypass the original townsite, and pumped across Settler Cove to serve the new HUD section of the city on the south side of the cove as well as the cannery. Port Lions maintains and operates the water supply and distribution system, which consists of 6- and 8-inch lines. Flouride is added to the water. In addition, a dry 60,000-gallon wood stave storage tank stands in the new section of town on the south side of the cove. Four-inch lines run from the tank to the residential area. Restoring the tank to servicable condition is currently under consideration.

Sewer. Community sewer service in Port Lions is operated by the city and consists of buried gravity-flow lines with two lift stations. An emergency outfall system is located at Settler Cove. This outfall has resulted in high levels of pollution in the cove. To comply with federal and state regulations, an adequate treatment plant is needed. A new 60,000-gallon septic system, which will serve the entire community, is under construction. In 1981 new lines are being built by the Public Health Service that will tie in all sections of new housing and outfall into Kizhuyak Bay. The system will adequately serve the community when upgrading is complete.

Solid Waste. A sanitary landfill is located northeast of the town at the old village dump site. It was built with HUD Grant funds in 1976 by the Kodiak Island Borough. Community residents pay $4.00 per month to have their garbage collected. Garbage is collected every Saturday with a flatbed garbage truck. The landfill was recently upgraded, and has an anticipated life of 15 years.

3.4.10 ECONOMY

The economy of the Borough is based on the harvesting and processing of seafood. The village economies are a combination of commercial seafood industry activities and subsistence activities. The economy of the City of Kodiak is based on the seafood industry, but is somewhat diversified.

The forest products industry is small but with good growth prospects. Agriculture is also small-scale but has potential. At present no mineral resources are being exploited, but there is very strong interest in the offshore petroleum resources.

Construction activities are largely dependent on the ups and downs of the seafood industry. The transportation, trade, and service industries are well developed due to Kodiak's relative isolation. The tourism and recreation industries are growing in importance as access to the Borough improves. Government activities, especially the Coast Guard, are an important part of the Borough's economy. There are virtually no manufacturing activities.

Overall, the Borough's economy in the past has been quite seasonal in nature, but the economy is now expanding and diversifying, which will reduce the fluctuations. The growth rate and direction of the economy are being determined by combined decisions of private industry, Native corporations, and the various levels of government.

Fish Processing

The most important industry in the Borough's economy is fish processing. The wholesale value to processors is around $200 million. Eight herring and salmon/shellfish processors are located in the Borough, all in, or around the City of Kodiak. There are ten processors handling only herring and salmon in the Borough, with four of these located around Kodiak. There are nine shellfish-only processors in the Borough, seven of

which are located around Kodiak. Other locations for processors included Alitak, Larsen Bay, Moser Bay, Port Bailey, Uganik, and Uyak. Some of the processors outside of Kodiak operate only during years of good forecasts. During the 1980-81 season there were also ten catcher/processors for king crab operating in the Westward Region, (Region IV) of the ADF&G's Commercial Fisheries Division.

Several Native corporations have bought processing plants during the past few years. Koniag, Inc. has purchased Kodiak Island Seafood Inc. (KISI), at Larsen Bay, and Swiftsure Alaska, in Kodiak. Ouzinkie Native Corporation has purchased the Columbia Ward Cannery and other holdings at Port Bailey.

The addition of shellfish and bottomfish catches to the traditional salmon, halibut, and herring processing activities are helping to make the Borough's seafood processing industry a diversified year-round operation.

Table 3.26 shows the value of the Kodiak area salmon fishery to processors in 1979. Salmon caught in other districts, such as Chignik and Bristol Bay, are also brought to Kodiak for processing. The catch of reds in the Bristol Bay area is predicted at between 21.2 and 28.6 million fish in 1981.

Seven processors in the Kodiak area handle bait and sac roe herring. Table 3.27 presents the 1979 data on this segment of the industry. Almost all of the roe is shipped to Japan.

With the large salmon catch and the short fishing season, canning facilities have been inadequate. As a result, a larger quantity of fish than desired has been canned in one-pound "talls" instead of the preferred ¼ and ½ pound cans.

Table 3.26. Value of the 1979 Kodiak area salmon fishery to processors.

TYPE OF PRODUCT	KINGS	REDS	COHO	PINKS	CHUMS	TOTAL
Canned Salmon[3] # of 48 lb. cases	296	21,450	6,974	549,257	25,562	603,539
Frozen Salmon[2] # of lbs.	7,861	2,343,558	631,918	3,743,287	1,044,452	7,771,076
Salmon Roe[2]	No species Breakdown					1,305,927
AVERAGE WHOLESALE VALUE PER CASE OR LB.[1]						
Canned Salmon $/case	72.50	81.00	70.00	65.00	60.00	
Frozen Salmon $/case	1.78	2.14	1.86	1.33	1.45	
Salmon Roe $/lb.	-	-	-	-	-	4.25 Average
WHOLESALE VALUE TO THE PROCESSORS IN DOLLARS[2]						
Canned Salmon	21,460	1,737,450	488,180	35,701,705	1,533,720	39,482,515
Frozen Salmon	13,992	5,015,214	1,175,367	4,978,572	1,514,455	12,697,600
Salmon Roe	-	-	-	-	-	5,550,190
	$35,452	$6,752,664	$1,663,547	$40,680,277	$3,048,175	$57,730,305

[1]Average prices as shown in Processors Annual Reports from five canneries.
[2]Figures based on Kodiak area frozen pack and roe pack as determined from Processors Annual Reports.
[3]Figures computed from statistical runs, subtracting frozen product and using 68% conversion factor from round weight.

Source: ADF&G 1979.

Table 3.27. 1979 Kodiak area herring processors summary.

Processing Plant	Location	Type of Product
King Crab Inc.	Kodiak	Bait and Sac Roe
Daerim Armerica Inc.	Kodiak	Sac Roe
Alaska Pacific Seafoods	Kodiak	Bait and Sac Roe
Western Alaska Fisheries	Kodiak	Sac Roe
Whitney Fidelgo	Kodiak	Bait and Sac Roe
Pacific Pearl Seafoods	Kodiak	Bait and Sac Roe
Swiftsure	Kodiak	Sac Roe

1979 Herring products in pounds including imports.

Raw Fish Bought Pounds	Frozen Bait[1]	Salted Sac Roe[1]	Herring Meal[2]
8,561,008	446,609	8,114,339	?

1979 Commercial value of herring fishery.

Dollar Value to Fisherman			Dollar Value to Processors		
Bait	Sac Roe	Total	Bait	Sac Roe	Total
$124,610	$4,387,068	$4,511,678	$602,840	$8,722,327	$9,325,167

Source: ADF&G 1979.

[1] About 4,643,000 lbs. (57%) of the herring roe and 197,000 lbs. (44%) of the herring bait purchased was imported from other areas of the State.

[2] Information on weight of herring meal made from herring roe carcasses donated to Bio Dry Inc. is not available, nor is the value of the herring meal.

Canning facilities are being expanded for the 1981 season, but due to the predicted low catch, the expansion is on a limited basis and primarily for the smaller size cans. Suitable machinery is not readily available, and is too expensive for most operators to finance even when obtainable.

Regarding the freezing of salmon, facility expansions during 1979, when the market for frozen salmon in Japan was promising, are now considered ample for the immediate future. Emphasis will be on quality rather than volume. This emphasis follows the product rejections and heavy financial losses suffered due to poor quality frozen salmon produced in 1980 for both export and domestic consumption. Controls have now been established to ensure a standard product, and inspections by the U.S. Food and Drug Administration (FDA) will be made both before freezing and throughout the operation.

An expanding market is being developed for fresh chilled salmon in many new areas throughout the United States. Again, emphasis is on quality, rather than quantity, of the product.

Alaska Food Company, which incorporated in Alaska to buy the former NEFCO processing plant at Gibson Cove, is the only bottomfish processor currently in operation. NEFCO had invested $1.1 million in 1978 to equip the plant to process pollock, but went bankrupt in April 1980. Alaska Food won a $1.7 million grant through the Alaska Fiseries Development Foundation to begin a large-scale cod and pollock processing operation. The grant money is to be used for equipment, construction, and a worker training program in handling techniques and finished product packaging. Alaska Food's goal is to process 20 million pounds of finished product. Marketing problems remain to be worked out before the plant can operate at full capacity. Presently about 100 employees are needed to handle the seasonal shrimp and crab processing also done at Gibson Cove. The firm plans to keep those 100 people working and to add 150 to 200 employees as bottomfish workers.

Halibut is a significant product of the Kodiak fish processing industry. In 1979 eight processors in Kodiak handled halibut with a wholesale value of $6.1 million.

A total of 27 processors handled king crab during the 1980-81 fishing season in the Westward Region. Ten of these were catcher/processors, and king crab was the only product they handled. Fifteen processors in the Borough handled Tanner crab during the 1980-81 season. Six processors in the Borough handled shrimp during the 1980-81 season, down from the nine processors active during the 1977-78 season. Four processors handled Dungeness crab during the 1980-81 season. Only one processor handled scallops, clams, and other miscellaneous species during the 1980-81 season.

There is also a plant in Kodiak that processes crab shells and fish wastes into fish meal and other products. It is the largest one of its kind in the Pacific Northwest.

Constraints on the fish processing industry include the availability of low-cost energy, waste disposal sites, and adequate supplies of water. In order to utilize their facilities more fully, processors would prefer to freeze the seafood after primary processing during the busiest time of the year. Later, the frozen product would receive secondary processing and be shipped out at a much lower cost. Energy costs for freezing and frozen storage are high in the Borough. If the Terror Lake hydroelectric project is built, electricity prices would no longer be tied to the rapidly escalating cost of diesel fuel.

There is also a shortage of available land with good marine access for warehouse space to store frozen products.

Fishing

Kodiak's present and future economic growth and prosperity is vitally dependent on the fishing industry. Currently, harvesting efforts

are directed at king, Tanner, and Dungeness crab; several species of shrimp; and five species of salmon. Lesser amounts of other species are also harvested. Growth is expected in both the traditional fisheries and from the recent expansion into bottom fisheries.

The Westward Region (Region IV) of the Commercial Fisheries Division of the Alaska Department of Fish and Game encompasses an area of 525,000 square miles. The Kodiak management units vary slightly for different species.

Kodiak is the home port of the largest commercial fishing fleet in Alaska, approximately 400 vessels, and is the second largest port in the United States in value of fish landed. In 1980 a total of 1575 fishing vessels made calls at the Port of Kodiak. The weight of all species landed in Kodiak in 1979 (including landings of catches from other areas) was 147.8 million pounds with an ex-vessel value to fishermen of $67.9 million (ADF&G 1979).

Shellfish

King, Tanner, and Dungeness crab, as well as many species of shrimp, are the principal commercial shellfish species landed. Additional small harvests of octopus, scallops, and razor clams are landed. Collectively, Kodiak Island Shellfish Management District production totaled 68.9 million pounds of shellfish in 1980, for a total estimated value to fishermen $41.4 million.

Kodiak Island king crab fishing began in the late 1940s. Table 3.28 presents the historic data on the king crab fishery. Since 1960, the fishery has expanded rapidly, growing to a historic high harvest of approximately 94.4 million pounds during the 1965-66 fishing season. Continued increases in vessels, effort, and gear efficiency, coupled with declines in stock abundance during the late 1960s and early 1970s, resulted in lowered harvests, with a low commercial catch of 10.9 million pounds in the 1971-1972 fishing season. More recently, successive years of good recruitment produced catches of approximately 24 million pounds

Table 3.28. Historic commercial king crab catch and effort for the Kodiak registration area (K), 1960-61 through 1980-81 fishing seasons.

Fishing[1] Year	Number of[4] Vessels	Commercial Catch Number of Pounds	Average Price Per Pound
1960-61	143	21,064,871	.085
1961-62	148	28,962,900	.095
1962-63	195	37,626,703	.10
1963-64	181	37,716,223	.10
1964-65	189	41,596,518	.10
1965-66	175	94,431,026	.128
1966-67[2]	213	73,817,779	.11
1967-68	227	43,448,492	.26
1968-69	178	18,211,485	.26
1969-70[3]	136	12,200,571	.28
1970-71	100	11,719,970	.30
1971-72	89	10,884,152	.39
1972-73	88	15,479,916	.55
1973-74	129	14,397,287	.45
1974-75	158	23,582,720	.45
1975-76	169	24,061,651	.66
1976-77	195	17,966,846	1.37
1977-78	179	13,503,666	1.34
1978-79	194	12,021,850	1.60
1979-80	247	14,608,900	.95
1980-81	164	20,448,654	1.05
Total	-	587,752,180	-
Average	167	27,988,199	-

[1] Fishing year defined as May 1 - April 30.

[2] July 1 - August 30 season established.

[3] August 15 - January 15 established.

[4] Number of vessels shown are those actually registered through 1969-70 season. Number of vessels fishing and average number of vessels is shown from 1970-71 season.

Source: ADF&G 1981.

in the 1974-75 and 1975-76 seasons. Lowered stock abundance during the period 1976-78 caused a reduction in the seasonal harvest. However, an increase in recruitment observed recently has reversed this downward trend, resulting in an upswing in the commercial harvest during the 1979-80 and 1980-81 seasons. The 1980-81 harvest amounted to 20.4 million pounds taken by 164 vessels. This is a 40 percent increase over the 1979-80 catch and a 70 percent increase over the 1978-79 catch. The 1980-81 catch had a value of $20.8 million.

The Tanner crab fishery has been in existence since 1967. The historic data are presented in Table 3.29. As king crab abundance declined in the early 1970s, markets opened up for Tanner crab, prices increased, and more vessels participated in the fishery. By 1972-73, Tanner crab was established as the dominant winter and spring shellfishery. The 1979-80 fishery resulted in a harvest of 18.6 million pounds by 211 vessels. This catch had a value of $10.3 million. Information available from studies indicates a declining trend in the harvestable abundance of legal crab.

The Dungeness crab fishery began in the Kodiak area in 1962. The historic data are presented in Table 3.30. As a result of favorable market conditions and unexploited stocks, commercial harvests increased, peaking in 1968 with a harvest of 6.8 million pounds. During the early 1970s the fishery declined due to biological and environmental factors accompanied by adverse marketing conditions. In recent years, weak markets and other, more lucrative fisheries have kept Dungeness production at a low level. The 1980 harvest of 2.0 million pounds had a value to fishermen of $905,000 from 21 vessels.

The Kodiak shrimp fishery began in 1958. The historic data are presented in Table 3.31. The shrimp grounds were steadily developed, peaking in 1971 with a harvest of 82 million pounds. In 1972, quotas limiting the total yearly harvest were established. The historic commercial shrimp catch for the Kodiak district showed a continued decline from 58 million pounds in the 1974-75 fishery season to 12.8 million pounds in the 1979-

Table 3.29. Commercial catch and effort for Tanner crab, Kodiak Management District, 1967-1980.[1]

Year	No. of Vessels	No. of Lndgs.	No. Crab	No. Pounds	Pots Lifted	Avg.Wt.	CPUE	Price Per Lb.
1967		83		110,961				.07
1968		817		2,560,687				.10
1969	85	955		6,827,312	72,748		43	.11
1969-70[2]	67	833	3,237,224	8,416,782	78,266	2.6	42	.11
1970-71	82	453	2,686,067	6,744,163	60,967	2.5	44	.11
1971-72	46	505	3,878,618	9,475,902	65,907	2.4	59	.13
1972-73	105	1,466	13,609,668	30,699,777	188,158	2.3	67	.17
1973-74[3]	123	1,741	11,857,573	29,820,899	217,523	2.5	59	.20
1974-75[3]	74	471	5,459,940	13,649,969	73,826	2.5	83	.17
1975-76[4]	104	1,168	10,748,958	27,336,911	199,304	2.5	64	.20
1976-77[5]	102	998	7,830,727	20,720,079	164,213	2.6	48	.33
1977-78[6]	148	1,483	12,401,243	33,281,472	251,621	2.6	49	.43
1978-79[7]	218	1,225	10,702,829	29,173,807	275,455	2.7	38	.55
1979-80[7]	211	1,385	6,813,128	18,623,875	282,946	2.7	24	.55
TOTAL	-	11,728	89,255,955	227,943,636	1,858,186	-	-	-
AVERAGE	116	1,066	8,111,452	20,722,149	168,926	2.5	48	.27

[1]Data Source: Alaska Department of Fish & Game Annual Board of Fish & Game Reports and Annual Kodiak Area Management Report.

[2]Fishing year July 1 - June 30.

[3]Legal season November 1 - June 30. Season terminated May 15 due to onset of mating period.

[4]Legal season November 1 - April 30.

[5]Legal season January 1 - April 30.

[6]Legal season January 1 - May 15.

[7]Legal season January 5 - May 15.

Source: ADF&G 1980.

Table 3.30. Dungeness crab commercial catch and effort by fishing year (unweighted) for the Kodiak Management District, Statistical Area (J), 1962-1980.

Year	Number of Landings	Number of Vessels	Commercial Catch: Number of Crab	Commercial Catch: Number of Pounds	Number of Pot Lifts	Average Catch Per Landing: Pounds	Avg. Crab Per Pot	Avg. Price Per Pound	Ex-Vessel Value
1962	149	-		1,904,567		12,782		.09	171,400
1963	354	-		2,487,512		7,026		.09	224,000
1964	395	29		4,162,182		10,537		.09	375,000
1965	351	25		3,311,571		9,434		.12	397,000
1966	144	12		1,148,600		7,976		.13	149,000
1967	439	18		6,663,668		15,179		.13	866,000
1968	536	43		6,829,061		12,741		.14	956,000
1969	455	29		5,834,628	190,967	12,823	12	.16	934,000
1970	318	33		5,741,438	249,800	18,055	9	.14	804,000
1971	173	24	515,653	1,445,864	90,913	8,358	6	.18	260,000
1972	316	34	766,960	2,059,536	140,921	6,517	6	.40	824,000
1973	487	42	879,484	2,000,526	251,467	4,108	3	.50	1,000,000
1974	172	23	337,839	750,057	104,062	4,361	3	.47	353,000
1975	154	15	307,272	639,813	76,411	4,154	4	.61	390,000
1976	6	4	38,072	87,110	4,410	14,518	9	.15	13,000
1977	16	2	46,333	113,026	3,805	7,064	12	.30	34,000
1978	173	20	618,357	1,362,306	93,633	7,875	6	.75	1,022,000
1979	237	28	595,850	1,313,650	137,951	5,543	4	.75	943,000
1980	197	21	968,829	2,011,736	107,261	10,212	9	.45	905,000
TOTAL	5,072		5,074,649	49,866,851	1,451,601				
AVERAGE	267	24	507,465	2,624,571	120,967	9,435	7		

Source: ADF&G 1981.

Table 3.31. Historic commercial shrimp catch and effort for the Kodiak District of Westward Statistical Area (J), 1960 through 1980-1981 season.

Calender Year	Fishing Year	No. Vessels	No. Landings	Commercial Harvest Pounds	Commercial Harvest Price
1960		11	94	3,197,985	.039
1961		12	203	11,083,500	.04
1962		11	204	12,654,027	.04
1963		-	-	10,118,472	.043
1964		6	-	4,339,114	.04
1965		11	320	13,823,061	.04
1966		17	551	24,097,141	.045
1967		23	-	38,267,856	..045
1968		16	-	34,468,713	.04
1969		26	935	41,353,461	.055
1970		18	1,024	62,181,204	.04
1971		49	1,746	82,153,724	.04
1972		63	1,398	58,352,319	.04
1973		50	1,283	70,511,477	.055
	1973-74	63	1,029	56,203,992	.08
	1974-75	75	1,100	58,235,982	.08
	1975-76	58	884	49,086,591	.08
	1976-77	62	762	46,712,083	.10
	1977-78	58	653	26,409,366	.13
	1978-79	50	328	20,506,021	.165
	1979-80	37	242	12,863,536	.225
	1980-81	67	468	27,803,009	.290
TOTAL				764,422,634	
AVERAGE (fishing year)		59	734	34,746,483	.08

Source: ADF&G 1981.

80 season. The 1980-81 shrimp harvest increased considerably and had a value of $8.0 million to the fishermen. The length of the fishing season differs in various areas of the Borough, in response to stock conditions and abundance.

The giant Pacific octopus is quite numerous in the Kodiak district. Most recorded catches have been incidental to other commercial fishery activities such as crabbing and bottom fishing. Table 3.32 presents the historic data, which indicate steady growth. During 1980, the octopus fishery expanded to nearly 19,342 pounds landed.

The scallop fishery began in the Kodiak area in 1967. The historic data are presented in Table 3.33. Total production through 1976 resulted in 6.5 million pounds of shucked meat. There was no fishery in 1977 and 1978, however the fishery resumed in 1979. Fishing by seven vessels yielded 371,018 pounds at a value of $1.2 million. It is felt that lack of large-scale fishing in recent years should have allowed a good recovery in most areas.

Historic data on the razor clam catch and value are presented in Table 3.34.

Salmon. The 1980 Kodiak salmon harvest was the largest in the past 30 years. A total of 69.8 million pounds of salmon were caught. Of this total, 56.9 million pounds were pink salmon - the highest pink catch ever recorded. The 1981 pink catch is predicted to be 4.4 million fish. The estimated values of the salmon catch to fishermen in 1978 and 1979 are presented in Table 3.35. The historic data are shown in Table 3.36. Since 1976 the trend for total salmon caught is upward. Recent chum and coho catches have been very good. The sockeye runs have steadily been rebuilding in terms of escapement, catches are remaining at favorable levels, and most stocks are considered to be in good shape. It is felt that the upward trend will continue with odd years having lower catches than even years. Weather conditions appear to have a great effect on the survival

Table 3.32. Commercial catch, effect, and value for octopus in the Kodiak Management Area, 1977-1980.

Year	Number of Vessels	Number of Landings	Commercial Catch (pounds)	Avg. Price Per Pound	Estimated Value Ex-Vessel (dollars)
1977	5	9	1,000	.71	1,136
1978	11	21	3,336	.75	2,502
1979	20	43	6,978	.74	5,164
1980	27	61	19,342	.75	14,506

Source: ADF&G 1981.

Table 3.33. Historic commercial catch, effort, and value of weathervane scallops, Kodiak Managment District, 1967-1980, excluding 1977 and 1978, when no effort occurred.

Year	Number of Vessels	Number of Landings	Commercial Catch (pounds)	Avg. Catch Per Landing (pounds)	Avg. Price Per Pound	Estimated Value Ex-Vessel (dollars)
1967	2	6	7,788[1]	1,298	.07	500
1968	8	89[2]	872,803[3]	8,983[2]	.85	618,000
1969	11	86	1,012,860	11,777	.85	861,000
1970	7	102	1,417,612	13,898	1.00	1,500,000
1971	5	48	841,211	17,525	1.05	883,000
1972	5	68	1,038,793	15,276	1.15	1,200,000
1973	4	42	935,705	22,279	1.20	1,123,000
1974	3	14	147,945	10,568	1.30	192,000
1975	3	29	294,142	10,143	1.40	412,000
1976	1	6	75,245	12,541	1.59	119,000
1979	1	4	24,826	6,206.5	2.78	69,000
1980	7	33[4]	371,018[5]	11,045[4]	3.60	1,275,000
TOTAL[6]		511	6,860,453			
AVERAGE[6]		46	623,678	13,558		

[1] Unshucked scallops only.
[2] 80 landings of shucked scallops, 9 landings unshucked. Average pounds/landing based on shucked weight and landings.
[3] 718,671 pounds of shucked scallops; 154,132 pounds unshucked.
[4] 32 landings of shucked scallops, 1 landing unshucked. Average pounds/landing based on shucked weight and landings.
[5] 353,443 pounds of shucked scallops; 17,575 pounds of unshucked scallops.
[6] 1968-80 total and average, shucked scallops only.

Source: ADF&G 1981.

Table 3.34. Historic commercial razor clam catch, effort, and value for Kodiak Managment District, 1960-1980.

Year	Number[1] Registered Diggers	Number of Landings	Commercial Catch (pounds)	Avg. Catch Per Landing (pounds)	Avg. Price Per Pound	Estimated Value Ex-Vessel (dollars)
1960	76		420,636		.105	44,000
1961	95		381,971		.105	40,000
1962	66		297,516		.105	31,000
1963	39		323,757		.11	35,600
1964	2		0		-	-
1965	4		20,000		.25	5,000
1966	29		15,429		.38	6,000
1967	9		2,155		.40	900
1968	19		6,384		.40	2,600
1969	5	6	12,029	2,005	.40	4,812
1970	6	32	132,261	4,133	.40	53,000
1971	73	82	190,394	2,322	.30	57,000
1972	95	128	152,116	1,188	.35	53,000
1973	64	140	165,282	1,181	.40	66,000
1974	58	74	198,381	2,681	.50	99,000
1975	18	5	6,188	1,238	.50	3,000
1976	9	0	0	0	-	-
1977	8	1	400	400	1.00	400
1978	[2]	1	1,352	1,352	.73	1,000
1979	[2]	0	0	0	-	-
1980	[2]	8	8,006	1,001	.79	6,325

[1] Represents registered diggers, not actual diggers.
[2] Data unavailable due to "statewide" issuance of Interim Use Permits.

Source: ADF&G 1981.

Table 3.35. Value to fishermen of salmon catch, Kodiak area, 1978 and 1979.

Species	1978 Price Per Pound	1978 Value	1979 Price Per Pound	1979 Value
King	1.00	32,273	.88	25,320
Reds	1.00	6,431,000	1.20	4,629,206
Coho	.85	370,500	.90	1,011,785
Pinks	.37	22,206,013	.395	16,793,178
Chums	.60	3,175,800	.57	1,623,848
Total		32,215,586		24,083,337

Estimated average catch by gear type.

Gear Type	Units of Gear 1978	Average Earnings	Units of Gear 1979	Average Earnings
Purse Seine	375	$74,700	401	$48,906
Beach Seine	31	$20,800	31	$18,838
Set Gillnet	158	$22,400	169	$23,006

Source: ADF&G 1979.

Table 3.36. Kodiak area salmon catch by species in pounds of fish.

YEAR[1]	KINGS	REDS	COHOS	PINKS	CHUMS	TOTAL
1966	8,625	3,537,218	568,680	41,946,770	5,873,298	51,934,591
1967	30,152	1,852,536	83,867	788,815	1,858,784	4,614,154
1968	29,427	4,410,279	464,358	29,811,615	6,078,467	40,794,146
1969	19,211	3,207,865	318,731	51,031,227	4,202,872	58,770,906
1970	16,690	5,484,019	528,908	43,834,219	6,552,567	56,416,403
1971	11,636	3,071,143	155,440	16,744,774	11,201,220	31,184,213
1972	15,136	1,310,843	119,827	9,075,717	9,098,580	19,620,103
1973	10,653	1,091,853	24,304	2,068,089	2,709,526	5,904,425
1974	7,588	2,611,570	114,703	11,268,189	2,118,618	16,120,668
1975	1,671	826,713	203,907	12,470,661	641,305	14,144,257
1976	13,700	4,056,252	205,030	44,639,533	6,340,353	55,254,868
1977	12,343	4,240,370	242,287	25,844,663	9,774,701	40,114,364
1978	39,190	6,865,805	416,027	55,958,003	7,270,160	70,549,185
1979	28,773	3,857,672	1,124,205	42,514,374	2,848,857	50,373,881
1980	9,381	3,517,831	1,059,349	56,976,037	8,247,528	69,810,126

Source: ADF&G 1979.

[1] Years 1965 through 1968 taken from Catch and Production Statistical Leaflets. 1969 through 1980 thaken from statistical runs.

of fish. The 200-mile limit seems to have a slight effect, but the extent of its effect is not yet known.

Herring. The herring roe, bait, and food fisheries as well as other forage-fish fisheries are currently in a state of expansion and development throughout the nearshore waters of Kodiak. Historically, large quantities of herring were harvested, primarily for food and also for reduction, in the Kodiak area. Substantial herring catches have been made incidental to shrimp trawling in the fall near Kodiak. The historic data on the herring fishery are presented in Table 3.37.

The increasing demand for herring for bait and food prompted development of a trawl fishery in the spring of 1978. Although this fishery developed during a time when the herring did carry roe, it was basically a bait and food fishery. The total value to Kodiak fishermen in 1979 was approximately $2.5 million.

The roe fishery is presently limited by a guideline harvest level of 2400 tons. The food and bait fishery is expected to expand dramatically, not only as a target species, but also incidentally to development of bottomfish fisheries. Other forage species are also expected to be exploited along with development of the bottomfish fisheries.

Bottomfish. Bottomfish, consisting primarily of pollock, cod, flounder, and sablefish are a developing fishery. At present, 99 percent of the fish are taken by foreigners, and most of the fish harvested by United States fishermen are delivered to foreign processors in a joint venture. In 1979, 5.5 million pounds of bottomfish were landed at Kodiak with a value of $1 million. Of this total, one million pounds were used as bait, while the remaining 4.5 million pounds were processed as a seafood product. It is felt that 200 million pounds (100,000 tons) per year could be harvested if processing facilities and a market were available.

Table 3.37. Kodiak area herring harvest, 1952-1979.

YEAR	TONS HARVEST	NUMBER COMPANIES	NUMBER VESSELS
1952	1,389.0	1	4
1953	725.0	1	1
1954	No Harvest	-	-
1955	No Harvest	-	-
1956	13,524.0	1	4
1957	21,818.5	2	8
1958	1,711.0	2	4
1959	3,831.0	2	6
1960	No Harvest	-	-
1961	No Harvest	-	-
1962	No Harvest	-	-
1963	No Harvest	-	-
1964	567.8	2	-
1965	657.2	2	-
1966	2,769.3	5	-
1967	1,662.4	3	5
1968	2,000.6	4	10
1969	1,130.0	9	21
1970	341.6	-	-
1971	284.3	-	-
1972	215.0	1	4
1973	831.0	4	11
1974	868.0	4	26
1975	8.0	3	2
1976	4.6	1	1
1977	338.44	3	11
1978	903.6 [1]	7	42 [2]
1979	1,735.7	8	173 [3]

Source: ADF&G 1979.

[1] Only 621 tons were sold as roe herring. The remaining 282 tons were sold for bait.

[2] For the first time trawls, drift gillnets and set gillnets were used in the fishery. 29 seiners, 2 trawlers, and 11 gillnetters participated in the 1978 fishery.

[3] 58 purse seiners, 43 drift gillnetters, 71 set gillnetters, and 1 beach seiner (no trawlers).

Bottomfish require more delicate handling than other fish; on board bleeding, heading, and gutting are required if the fish are not delivered to a processor very soon after they are caught. Many boats now under construction are designed for participation in this fishery.

Halibut. In 1977 Kodiak landed 2.7 million pounds of halibut with an ex-vessel dollar value of $5.4 million.

Employment Statistics. Employment statistics for the fishing industry are not directly available. A large proportion of fishermen are self-employed and therefore not included in the Alaska Department of Labor employment statistics. Using gear restriction data, multiplying the various types of vessels by normal crew sizes, and then converting employment to an annual average year-round basis, an estimated 850 people in the Kodiak area were engaged in fishing in 1977 (Alaska Consultants 1979). Fishermen probably account for 15 to 20 percent of the labor force. Estimates of the incomes earned by fishermen are also difficult to determine.

Forest Products

The forest products industry is a minor but significant segment of the Kodiak economy. Table 3.38 presents data on the predominantly Sitka spruce forest resources in the Borough. Almost all of the timber in the Borough is on the northern islands and on the north end of Kodiak Island.

Sawtimber quality over the Kodiak Archipelago is not especially good. The trees are comparatively short, approximately 90 feet (27 meters) in height at maturity as compared with 200 feet (60 meters) in portions of Southeast Alaska. High-grade sawlogs are rather rare, and since few mature forest stands have formed, the trees are bushy, with many limbs, and produce knotty lumber.

Table 3.38. Forested and nonforested land area.[1]

	AFOGNAK	KODIAK	SHUYAK	OTHER	TOTAL
FOREST LAND					
Commercial	230,000	2,800	22,600	14,400	269,800
Noncommercial	48,500	42,900	24,200	24,400	140,000
Total	278,500	45,700	46,800	38,800	409,800
NONFOREST	180,300 includes water	no data	no data	no data	180,300 plus

Source: AEIDC 1975 Regional Profiles - Southcentral.

[1] Includes Raspberry, Little Raspberry, Spruce, Dry Spruce, Marmot, Bare and Whale Islands.

During World War II the U.S. Army had a logging and milling operation on Afognak Island, which logged 440 acres in the vicinity of Danger and Afognak bays. The timber was sawn into construction lumber at a mill located at Kazakof Bay for use at military installations in the Aleutian chain. The project was abandoned in 1945. The first commercial sale in the Borough was the "Valley" sale in 1955 but prior to 1972 (when cutting of the Afognak Straits No. 3 sale began) only local use was made of the Borough's timber.

The first large timber sale in the Borough was the 1968 Perenosa sale on 120,000 acres of Chugach National Forest land on Afognak. Harvesting and export did not begin until 1975. Twelve million board feet (MMBF) of logs were barged to Seldovia and Seward for primary processing, as required for timber harvested from federal or state lands. The cants and chips were then exported, primarily to Japan.

Around 1977 Koniag, Inc. and Afognak Village Corporation gained title to much of Afognak. Round logs then became the main export product since primary processing is not required for privately owned timber. Some of the lower quality timber is still being processed into chips at Seward and Sitka.

Logging of Afognak Village Corporation timber lasted one and a half years and was completed in 1980. A total of 29.5 MMBF were harvested; of this, 25.0 MMBF were exported.

The timber on Koniag, Inc. lands is being managed by KONCOR, a corporation established to assist the Kodiak Natives in managing their timber. As of March 31, 1981, a total of 65.4 MMBF had been harvested. A reforestation program has been initiated on the island.

Almost all of the timber sold on Afognak by both the Forest Service and the Native groups has been purchased by Kodiak Lumber Mills, Inc., a Japanese firm. John Daly, of the Anchorage office of Kodiak Lumber Mills, estimates another 7 to 10 years of operations left on Afognak.

At present, both the timber and chip markets are down. In 1980, an average of two freighters per month, each loaded with 2 MMBF of timber, left for Japan. Currently only one ship per month is being loaded.

The timber on Afognak Island is being cut by Afognak Logging, Inc. The company maintains an office in the City of Kodiak and a modern $1.5 million, 130-man camp on Afognak Island at Danger Bay, which includes 20 mobile homes for families, 7 bunkhouses, a mess hall, a shop, and a school. Afognak Logging presently employs more than 100 people, including local Natives, and spends approximately $6 million annually on payroll and local purchases.

Afognak Logging has built approximately 30 miles of main logging road plus additional spur roads. Logs are loaded onto barges from the beach. The easier method of loading the logs from the water is not used, in order to protect water quality. The timber in the barges is then loaded onto freighters in deeper waters.

In 1971 the smaller Afognak Straits No. 3 sale on Afognak Island was held. The successful bidder was Dalmond Valley, which subsequently third-partied it to Southcentral Timber Development Corporation, a Japanese-controlled firm. A total of 8.1 MMBF of timber were harvested from 1972 to 1976, barged to Southcentral's mill at Jackolof Bay near Seldovia, and then exported.

There are two small mills on Kodiak Island that produce lumber for local use. The Timberline mill, with a 10 MMBF capacity, employs five men and produces in excess of 2 MMBF annually. The Island Lake Sawmill employs two men, has a capacity of 1 MMBF, and in recent year has produced 0.5 MMBF annually.

The latest data indicate an average of 306 people employed by the lumber and wood products industry in the Borough (not including self-employed). The average monthly wage is $2378 and the total payroll is $2.2 million (DOL 1980).

Shuyak Island has the best potential for future timber operations.

Agriculture

Cattle ranching has existed on a small scale from the time the Russian traders first brought cattle to the island. Production has grown slowly in recent years, but growth prospects for the future are good. There are approximately 500,000 acres of grazing land on Kodiak and adjacent islands. These lands are owned by the federal government, the state, and the Native corporations. Currently around 120,000 acres are being leased to the six ranching operations in the Borough. While some of the grazing lands have been selected by the Natives, the existing long-term leases are expected to be honored. The grazing season is 10 to 12 months long, so winter feed requirements are much smaller than in other areas of the state.

The total number of cattle in the Borough is approximately 2000, mostly in the northeastern area of Kodiak Island. Ranchers graze 300 to 400 head on their leases, which average 20,000 acres in size. The grazing areas on Kodiak and adjacent islands could support 10,000 animals, or five times the current number. Underutilization of the range resources is due to the undeveloped meat industry of the state. The market for domestically produced meat is of a size that requires an integrated industry in the southcentral and interior regions of the state.

During October and November, 30 to 300 head per year are butchered in the cooperatively-owned slaughterhouse located in the Belle Flats area, 9 miles out of Kodiak. The slaughterhouse is approved and has an inspector on site, which allows sales to the public, but the meat is not USDA graded. Most of the beef is used locally, with occasional shipment to Anchorage. The ranchers do most of the processing work themselves but sometimes hire extra help. This facility could handle 2000 animals per year.

Several livestock developments currently in the works could very well expand the red meat industry in the state. A good supply of feed

grains is being developed in the Delta region, and feedlots and a slaughterhouse are being planned for Interior and/or Southcentral Alaska. These developments will dramatically increase the demand for feeder cattle. Kodiak's mild weather and extensive grazing lands make it one of the better areas in the state for this purpose.

Metallic Minerals

Kodiak Island Borough contains two regional metal provinces - areas characterized by a distinct association or anomalous concentrations of metals. These provinces are also characterized by the potential for mineral development and concentrations of mining claim activity.

The two metal provinces occupy the northwest half of the Borough. The province that extends along the northwest coast of the Borough is rated high for the occurrence of chromium and copper. The second province, which extends from near the northwest coast to the middle of the Borough is not rated as high. The major commodities are gold and copper; the minor commodities are lead, zinc, silver, and tungsten.

Exploration for minerals in the Borough has been sporadic and limited to areas of easy access. Nearly all the mineral claims and areas of related activity are located near water passages. The interior portions of the islands are relatively unexplored. It has been estimated that less than 20 percent of the Borough has been adequately prospected. Although no commercial metallic deposits have been discovered in the Archipelago, the potential is present in the form of adequate intrusive units and widespread host rocks. Historically, gold has been the major commodity found in the Borough, in both placer and lode deposits.

Metallic mineral resource development has occurred in the past on a small scale, but at present there are no commercial-scale mining activities.

Placer Deposits. Placer deposits occur along beaches and are believed to be the result of wave and current action on the tills and

gravels that form the sea cliffs along portions of the northern and western coasts. A direct genetic relationship between the placer gold and the gravels and tills has not be established since gold has not been found in these sediments. The ultimate source of the placer gold is probably quartz veins in the slates and graywackes of the interior part of the island. The probability of offshore placer gold deposits is considered low.

Gold placer deposits occur along the beaches on the northern side of the Borough from Miners Point to Broken Point; along the southern beaches of Raspberry Islands; from Rocky Point to Bear Point; and along Bumble Bay (Red River) on the west side of Kodiak Island.

Placer operations have generally been small-scale and worked from time to time. It has been estimated that $150,000 worth of gold was recovered from the beach sands in the early twentieth century. Very minor quantities of platinum and chromite were recovered with the placer gold. Magnetite and pyrite have also been recovered from placer deposits.

Renewed interest has been shown in the Borough's placer deposits in recent years.

Lode Deposits. Lode gold prospects, mainly in quartz veins, occur throughout the Borough. The gold lode deposits are associated with the quartz intrusives and with dikes and sills that are probably related at depth to the intrusives. The host rocks are generally slates and graywackes.

The lode deposits were discovered in the late 1800s, and have been sporadically explored and worked since. Lode mining took place mostly before World War I, and to a lesser extent until about 1935, after the price of gold was raised. None of the attempts to mine lodes has been commercially successful - with the possible exception of the Amok Claim at Uyak Bay, which produced at least an estimated $8000 of gold. Several other gold lodes were prospected in the Uyak Bay area around

the turn of the century. Some gold was probably taken out of these lodes by their discoverers, but there is no recorded production, and after minor development, they were abandoned. Assays on lode of the east shore of Uganik Passage showed high gold tenor, and a small mill was installed on the property in 1935. There is no recorded production.

Scheelite (tungsten ore) was found disseminated as fine grains and veinlets in quartzitic zones in graywacke on Chalet Mountain near the head of Anton Larsen Bay. Investigations on this ore in the late 1950s concluded that these deposits are not commercial. A copper prospect located on the northwestern side of Sitkalidak Island was examined in the late 1930s and early 1940s. At the time, the deposit was not considered commercial. Lode occurrences of other commodities, such as silver, lead, and zinc, have been reported. The occurrence of placer deposits of chromite and platinum suggests the presence of lode deposits along the northwest coast.

Nonmetallic Minerals

Thin beds of coal have been reported in Tertiary sediments in the eastern part of Kodiak and on Sitkinak Island. None of the coal exposed in surface outcrops has sufficient reserves to be considered commercial. A large sand and gravel deposit is located on one of the Trinity Islands.

3.4.11 EMPLOYMENT AND INCOME

Table 3.39 presents the average number of employees in each industry for the Kodiak Island Borough for 1979. These statistics do not include self-employed persons, such as fishermen.

Table 3.39 also presents a seasonality index for each industry in 1979. The index is calculated by dividing third-quarter employment by first-quarter employment for each industry. The closer the ratio is to 1.0, the less seasonal the industry. The most-seasonal large industry is manufacturing, primarily seafood processing. The construction;

Table 3.39. 1979 Kodiak division employment.

Industry	Average Number of Employees[1]		Percent
		Seasonality	
Mining	0	0	0
Construction	149	0.76	3.3
Manufacturing[2]	1,526	0.53	34.1
Transportation, Utilities and Communication	317	0.72	7.1
Trade	667	0.96	14.9
Finance, Insurance, and Real Estate	100	0.97	2.2
Services	551	0.76	12.3
Agriculture, Forestries, and Fisheries	8	0.29	0.2
Government	1,160	0.99	26.0
Total	4,478		100.1

Source: Alaska Department of Labor, 1979.

1 Shows no self-employed persons.

2 Includes fish processing.

transportation, utilities, and communication; and service industries also show a seasonal pattern. The trade industry has shown a larger seasonal change in other periods (0.76 - first quarter of 1980 and third quarter of 1979).

The seasonal nature of the Kodiak economy is reflected in the variation in the size of the labor force and employment within each year. In 1980 the labor force varied from 4247 people in March to 6473 people in July, an increase of 52 percent. The number of employed persons in 1980 varied from 3845 in March to 5770 in July, an increase of 50 percent. This variation is due to a combination of transient labor and some residents not working year-round. This is evident from the unemployment statistics. Unemployment rates in 1980 varied from 13.3 percent in March to 5.2 percent in August.

Employment and income data for the second quarter of 1980 are presented in Table 3.40, which provides a more detailed breakdown of employment within each industry. This table also presents monthly wage information.

It is difficult to trace trends in employment by industry due to the fact that until 1976 the employment statistics contained a "miscellaneous" category. In 1976 this category included 10 percent of employed persons. This category no longer exists,and it is difficult to determine how this 10 percent is presently accounted for. Statistical handling of self-employed persons has also changed.

The manufacturing industry accounted for 24 percent of total employment in 1976, and 34 percent in 1979. The construction industry (1.5 to 3.3 percent), the trade industry (11.1 to 14.9 percent), and the services industry (6.1 to 12.3 percent) showed a larger percentage of employment in 1979. The only decline was in the government sector, which declined by 0.9 percent (26.9 to 26.0 percent), but this does not account for all the gains in the other industries. These shifts are partially accounted for by changes in the structure of the economy, and by changes in data collection.

Table 3.40. Kodiak Division nonagricultural employment and payroll industry series, second quarter, 1980.

Industrial Classification	Reporting Units 2/	Number of Employees April	May	June	Average	Avg. Mo. Wage	Total Payroll
KODIAK DIVISION							
Total - Nonagricultural Industries	378	4,559	5,124	4,661	4,781	1,495	21,444,730
Insured by State Law	360	4,227	4,787	4,319	4,444	1,461	19,492,688
PRIVATE OWNERSHIP	341	3,387	3,949	3,750	3,695	1,365	15,131,606
Mining	0	0	0	0	0	0	0
10 Metal Mining	0	0	0	0	0	0	0
14 Nonmetallic Minerals, Ex. Fuels	0	0	0	0	0	0	0
Construction	38	107	123	102	111	2,457	815,971
15 General Building Contractors	11	37	31	19	29	1,656	144,144
16 Heavy Construction Contractors	4	*	*	*	*	*	*
17 Special Trade Contractors	23	*	*	*	*	*	*
Manufacturing	39	1,549	2,034	1,885	1,823	1,366	7,473,571
20 Food & Kindred Products	27	1,235	1,683	1,516	1,478	1,163	5,156,997
23 Apparel & Other Textile Products	1	*	*	*	*	*	*
24 Lumber & Wood Products	4	280	317	322	306	2,378	2,186,021
27 Printing & Publishing	4	23	22	22	22	1,034	69,289
34 Fabricated Metal Products	1	*	*	*	*	*	*
37 Transportation Equipment	2	*	*	*	*	*	*
Transportation - Communication & Utilities	33	403	405	401	403	1,631	1,972,768
41 Local & Interurban Passenger Transit	9	35	35	25	32	342	32,541
42 Trucking & Warehousing	7	71	78	83	77	1,962	455,225
44 Water Transportation	4	*	*	*	*	*	*
45 Transportation by Air	5	87	94	90	90	1,594	432,052
47 Transportation Services	2	*	*	*	*	*	*
48 Communication	4	96	95	98	96	1,298	375,172
49 Electric, Gas & Sanitary Services	2	*	*	*	*	*	*
Wholesale Trade	7	*	*	*	*	*	*
50 Wholesale Trade - Durable Goods	3	*	*	*	*	*	*
51 Wholesale Trade - Nondurable Goods	4	*	*	*	*	*	*
Retail Trade	69	566	563	565	565	1,231	2,086,570
52 Building Materials & Garden Supplies	7	106	101	93	100	1,622	486,809
53 General Merchandise Stores	1	*	*	*	*	*	*
54 Food Stores	6	137	141	137	138	1,028	426,663
55 Automotive Dealers & Service Stations	7	63	59	63	62	1,655	306,324
56 Apparel & Accessory Stores	5	*	*	*	*	*	*
57 Furniture & Home Furnishings Stores	4	11	13	16	13	808	32,340
58 Eating & Drinking Places	19	132	131	134	132	999	396,756
59 Misc. Retail	20	106	109	113	109	1,285	421,514
Finance - Insurance & Real Estate	18	97	94	96	96	1,505	432,081
60 Banking	2	*	*	*	*	*	*
63 Insurance Carriers	1	*	*	*	*	*	*
64 Insurance Agents, Brokers & Service	0	0	0	0	0	0	0
65 Real Estate	10	37	36	36	36	1,901	207,218
66 Combined Real Estate, Insurance, etc.	0	0	0	0	0	0	0
67 Holding & Other Investment Offices	5	15	14	16	15	1,200	54,014
Services	86	555	584	597	579	1,107	1,920,998
70 Hotels & Other Lodging Places	3	32	52	61	48	1,165	168,988
72 Personal Services	4	17	18	20	18	761	41,904
73 Business Services	11	55	53	81	63	1,093	206,615
75 Auto. Repair, Services & Garages	4	22	20	24	22	1,240	81,902
76 Misc. Repair Services	4	16	15	19	17	1,928	96,400
78 Motion Pictures	1	*	*	*	*	*	*
79 Amuse. & Recreation Services	2	*	*	*	*	*	*
80 Health Services	10	146	151	150	149	1,298	580,499
81 Legal Services	5	6	7	6	6	943	17,922
83 Social Services	14	57	59	48	55	768	126,087
84 Museums, Galleries, Gardens	1	*	*	*	*	*	*
86 Membership Organizations	18	173	177	168	173	1,046	541,616
89 Miscellaneous Services	9	9	7	8	8	953	22,886
Agriculture, Forestry & Fisheries	48	*	*	*	*	$ *	$ *
02 Agricultural Production Livestock	1	*	*	*	*	*	*
07 Agricultural Services	1	*	*	*	*	*	*
08 Forestry	2	*	*	*	*	*	*
09 Fishing, Hunting & Trapping	44	21	32	28	27	1,221	98,962
99 Nonclassifiable Establishments	3	*	*	*	*	*	*
Government	37	1,172	1,175	911	1,086	1,938	6,313,124
Federal Government	10	285	289	295	290	2,129	1,850,946
State Government	13	207	196	208	204	2,344	1,432,291
Local Government	14	680	690	408	593	1,704	3,029,887

Source: Alaska Dept. of Labor, Statistical Quarterly, 1980.
* No employment recorded during reporting period.

Even though the construction, trade, and service sectors have grown and account for a larger share of total employment, the economy is still very dependent on the fishing/fish processing industry. Despite the diversification of the seafood industry and the resultant longer operating seasons, the economy is still dependent on only one industry, which may present a problem due to cyclical variations.

Without oil development, future employment forecasts for the Kodiak area estimate that employment will grow to 10,628 by 2000. This is an overall increase of about 79 percent, or equivalent to an average annual growth rate of about 2.7 percent.

The basic employment categories of manufacturing (largely logging and fish processing) and agriculture, forestry, and fisheries (largely fishing) are projected to grow by about 75 percent by the year 2000, accounting for about 40 percent of all employment growth in the forecast, and setting the pace for the secondary economy. Trade and services exhibit the fastest growth rate, together generating about 36 percent of all new jobs. Together, these four economic sectors provide about three-quarters of the Kodiak area's economic growth.

The remaining sectors of contract construction; transportation; finance, insurance, and real estate; and mining comprise a minor, if essential, share of about 10 percent of the baseline employment, and will maintain that share through the forecast period.

Village Employment and Income

The six villages on Kodiak Island lack stabilized employment opportunities. The majority of the village residents are still dependent on salmon fishing during the summer months. In past years, fishing limitations have been imposed and harvesting has been allowed only two or three days per week during the summer fishing season. Except for a couple of villages, it appears that village residents will not move toward diversified fisheries (crab, shrimp, etc.) for some time due to lack of capital

to purchase larger boats. Lack of water and sewage treatment facilities also contributes to the limited economic base.

Most of the people living in the villages in the Koniag Region are employed in the fisheries industry - in the harvest phase as fishermen or in the processing phase as cannery or cold storage workers. The employment is highly seasonal (Table 3.41) and competitive, due to the large number of transients seeking seasonal work.

Akhiok. Fishing is the basis of Akhiok's economy. There are no commercial fishing facilities in the town; however, there is a cannery 5 miles south at Alitak owned by Pacific American. Ninety-five percent of the community are commercial fishermen. According to the KANA 1979 Overall Economic Development Program (OEDP), the total labor force was 40 people. Eighty percent of the workforce had only summer employment, 7 percent had nine-month employment, and 12 percent were employed year-round. Income for an average family of 4.06 members was $6,932.46; 73 percent of Akhiok families are considered at the poverty level. Employers in Akhiok include the school (2 positions), KANA (3 positions), and occasional temporary jobs associated with construction. The Japanese are working on the possibility of establishing an aquaculture project for scallops. If the venture succeeds, it will add greatly to the economy as a "cottage industry."

Karluk. Fishing is the primary source of livelihood for the residents of Karluk. The Karluk Lagoon cannot accommodate large commercial fishing vessels, so residents fish from small power boats, and catches are delivered to floating processors. Approximately 10 percent of the work force elects to work on larger fishing vessels elsewhere. Kodiak Island Seafoods, Inc. operates a major cannery at Larsen Bay, 18 air miles east of Karluk, which provides some employment when open. The cannery is jointly owned by The Karluk Village Corporation and the village corporations of Larsen Bay and Old Harbor. The cannery will not be opened for the 1981 fishing season, as it has become uneconomical to operate.

Table 3.41. Types of village employment.

	Total Labor Force	Summer Employment		Year-round Employment		Nine-month Employment	
Akhiok	40	32	80%	5	12%	3	7%
Karluk	31	20	64%	5	16%	3	19%
Larsen Bay	52	100	100%	6	11.5%	6	11.5%
Old Harbor	190	100	100%	13	7%	31	16%
Ouzinkie	64	55	86%	6	9%	3	5%
Port Lions	166	52	31.3%	26	15.7%	88	53%

Source: Kodiak Island 5-Year Health Plan (1979).

According to the KANA 1979 OEDP, the average income for a family of 3.87 was $5,489.39. Fifty-two percent of the households in the village were considered at the poverty level. Of a total work force of 31 persons, 64 percent had only summer employment, 19 percent were employed for a nine-month period, and 16 percent were employed year-round.

Kodiak Community College employs two adult basic education instructors; the school employs five people; KANA employs one preschool teacher, the clinic employs three people; and the tribal council employs a clerk, a community aide, and a heavy equipment maintenance man.

The excellent local salmon fishing attracts sport fishermen. There is a small lodge and a store in the village.

Larsen Bay. The economy of Larsen Bay is primarily based on fishing and cannery work. Almost all the males and a few females 12 years of age and older fish for a living. A large salmon cannery operated by Kodiak Island Seafoods, Inc. (KISI) is located in the town, and employs 5 percent of the local work force. The cannery will not be opened for the 1981 fishing season, as it has become uneconomical to operate. Some diversification into shrimp and crab processing has been considered, which could extend the operating season. Floating tenders come into the area to buy fish from the commercial fishermen.

According to the KANA 1979 OEDP, the average income was $7,530 for 4.46 family members. Sixty percent of the households in Larsen Bay were considered at the poverty level. Of a total work force of 52 for that year, 100 percent were employed all summer, but only 11.5 percent were employed year-round or for nine months.

Job positions in Larsen Bay include four teachers, one school aide, two health aides, one postmaster, two store clerks, and a KISI cannery winter watchman. The Tribal Council employs one clerk and one maintenance man. The council occasionally hires two or three workers to maintain the airstrip, as needed. The city employs one maintenance man.

KANA employs two family activity workers and one recreation director, who also maintains the water system. Two or three people trap land otter and fox. There are no lodges, restaurants, or guiding services.

Old Harbor. A large majority of Old Harbor residents are commercial fishermen. There are approximately 42 fishing boats in Old Harbor year-round, and up to 100 during fishing season. Shellfish, salmon, halibut, herring, and bottomfish are harvested. Until 1975 there was a fish processing plant on the floating freezer. This plant burned in 1975, however, and the work force drawn from Old Harbor became unemployed. Due to the lack of an industrial supply there has been a reluctance to rebuild the cannery.

In 1979 the average income for a family of 3.06 in Old Harbor was $7,242.82. According to the KANA 1979 OEDP, 42 percent of Old Harbor's households were below the poverty level. Two stores in the town provide one job each. The post office has one full-time and one part-time employee, and Alaska Village Electrical Cooperative (AVEC) has one employee. The garbage collector and telephone operator are funded partly by CETA and partly by KANA.

Ouzinkie. Ouzinkie's economic base is primarily commercial fishing. There is a small resident fleet of commercial fishermen; however, there have been no fish processing facilities in the village since the Glacier Bay cannery burned in 1976. The nearest facilities are now in the City of Kodiak and Port Lions.

Several villagers work in the timber industry on Afognak Island. A family-owned and operated boat building business operates outside of town.

Two people are employed at the Columbia Ward grocery store in Ouzinkie. There are six public service employees and six teachers employed by the school district. According to the KANA 1979 OEDP, the average income for a family of 2.13 was $9,267.76. Approximately 47

percent of the households in Ouzinkie were considered at the low income level. Of a total work force of 64 for that year, 86 percent were employed all summer, 9 percent were employed year-round, and 5 percent were employed for a nine-month period.

Port Lions. The economy of Port Lions is based primarily upon commercial fishing and seafood processing. A fire in 1975 destroyed the Wakefield Fish and Shellfish processing plant, which had been the major employer. The Port Lions Native Corporation formed a subsidiary called Northern Light Seafood, which leased the city dock facilities, land in the area, and van tractors for the floating processor Smokwa. Northern Light Seafood employs 25 people when it processes king crab in early fall, and Tanner crab in later winter/early spring. Employment, however, can vary depending on the tides, the quantity of crab delivered, and quotas set by Department of Fish and Game regulations.

There are 12 local commercial fishing boats, 38 to 52 feet in length, in Port Lions. During the summer, a fleet of 30 to 45 boats anchor in the harbor.

Until 1976 a small sawmill operated in Port Lions. Other commercial establishments offering employment opportunities include a lodge and restaurant (three positions), cafe (two positions), general store and fuel sales (five positions), Kodiak Electrical Authority (one full-time, one part-time position), boat harbor (two local positions), and Port Lions Oil Company (one position). The school employs thirteen people, and Kodiak Area Native Association (KANA) employs four people, the city employs eleven people, and the health clinic employs five people.

In 1979 Port Lions had a total workforce of 166 people. In the summer 31.3 percent of the population is employed, 53 percent are employed for 9 months, and 15.7 percent year-round.

3.4.12 SUBSISTENCE

Nearly all Kodiak Island Borough residents use the island's fish and wildlife resources for subsistence. However, the degree of reliance on these resources as subsistence food sources varies, and is a function of income, food costs, traditional use, culture, and resource abundance.

The villages and rural areas of Kodiak Island have a long history of subsistence use of resources. Village sites were often strategically located to take advantage of fish and wildlife resources, which, prior to the establishment of a fishing industry and a cash income, were the sole source of food. Reliance on subsistence hunting and fishing also reinforced village social relationships and strengthened the associated traditions. As the commercial fishing industry developed, the associated cash income to those participating in fishing reduced the economic necessity of subsistence. However, income fluctuates with the annual salmon catch, and not all residents could participate in commercial fishing. In addition, the isolation of remote villages means high transportation costs to bring in food supplies. Availability of cash income also does not replace the social values of subsistence and dietary preferences for local fish and wildlife.

As in other areas of Alaska, subsistence has become controversial as use of finite resources for subsistence and recreation purposes increases. Historically, sport hunting and fishing have attempted to reflect subsistence through bag limits based on resource abundance (species population dynamics), user demand levels, and sustainable harvest. Increased competition could require resource allocation among users. Subsistence and reliance on subsistence are difficult to define, which complicates equal allocation of resources.

Local subsistence hunting and fishing activities are focused around the seven island communities. Subsistence resource harvest areas by community are shown on Map 15.

City of Kodiak and Vicinity

The primary subsistence resources utilized in the Kodiak metropolitan area are shellfish (razor and butter clams, Dungeness and king crab), fish (salmon, trout and char, halibut, and rockfish), waterfowl (ducks and geese), and big game (deer). Subsistence hunting and fishing take place along the road system (Monashka Bay, Chiniak-Sequel Point, Pasagshak-Narrow Cape, Saltery Cove, and Anton Larsen Bay) and at areas accessible by skiff and larger boats.

More than in any other area on the island, it is difficult to distinguish between Kodiak urban resident subsistence and recreation hunting and fishing. Competition for resources is high, due to greater concentrations of population and hunting and fishing by nonresidents. Higher employment and income levels make economic reliance on subsistence less than in most village areas.

City of Kodiak resident hunting and fishing overlaps with two village areas: Anton Larsen-Kizhuyak bays (Port Lions) and Spruce Island-Narrow Strait (Ouzinkie).

Akhiok

The primary subsistence resources utilized in Akhiok are shellfish (butter clams, cockles, octopus, king crab), fish (salmon, trout and char, halibut), bird eggs (gulls, terns), waterfowl (ducks), marine mammals (seals), and big game (deer, reindeer). Subsistence hunting and fishing take place over a large area around Akhiok; generally, activity takes place between Flat Island-Kaguyak to the north, Olga Bay to the northwest, and Aiaktalik Island to the south. Subsistence areas important to Akhiok in the immediate village vicinity are Akhiok Island, Miller Island, Fox Island, Middle Reef, Humpy Cove, Drake Head, and Tanner Head. Important areas farther from the village are Olga Bay (waterfowl, crab, and deer), Red Lake uplands (reindeer, deer), Deadman-Portage bays (fish, seal, deer). Access to subsistence hunting and fishing areas is primarily by boat and on foot.

Akhiok residents are heavily dependent on subsistence resources, both economically and socially. Approximately 73 percent of Akhiok families are considered to be at the poverty level (DOWL 1981). Employment, and hence income, is limited to some commercial fishing and seasonal cannery employment, and transportation costs for bringing food supplies into the village are high. Akhiok and relocated Kaguyak residents have traditionally utilized a variety of subsistence resources.

At the present time, conflicts with recreation and other subsistence resource users are minimal. Akhiok subsistence areas overlap with Karluk in the Red Lake-Olga Bay area to the northwest, and to a lesser extent with Old Harbor around Kaguyak.

Karluk

The primary subsistence resources utilized by Karluk are shellfish (crab), fish (salmon, trout and char), bird eggs (gull), waterfowl (ducks), marine mammals (seals), and big game (deer, reindeer). Subsistence hunting and fishing take place over a large area surrounding Karluk; general activity takes place between Cape Ugat north of Uyak Bay, Uyak Bay to the east, and Bumble Bay to the south. Subsistence areas important to Karluk in the immediate village vicinity are Karluk Lagoon and River (salmon, trout, and char), Gurney Bay-Cape Uyak (crab), Sturgeon Head (seal), Rocky Point (seal), and Halibut Bay (waterfowl). Important areas farther from the village are north of Red Lake (reindeer) Middle Cape-Bumble Bay (seals), and Uyak-Spiridon-Zachar bays (duck, seal, bird eggs, deer). Access to subsistence hunting and fishing areas is primarily by boat and on foot.

Karluk residents are dependent on subsistence resources, both economically and socially. Employment, and hence income, is limited to some commercial fishing and seasonal cannery employment, and transportation costs for bringing food supplies into the village are high. Approximately 52 percent of Karluk families are considered at the poverty level. Karluk residents have traditionally used a variety of subsistence resources (DOWL 1981).

At the present time, there is a potential conflict between subsistence/commercial and recreation use of the Karluk Lake-River-Lagoon system. While recreation harvests have not measurably decreased local salmon and trout catches, there is local concern that increased recreation fishing will lessen local harvests and necessitate fish allocation between users. Karluk subsistence areas overlap with Larsen Bay in Uyak-Spiridon-Zachar bays to the north, and with Akhiok in the Red Lake area to the south.

Larsen Bay

The principle subsistence resources utilized by Larsen Bay residents are shellfish (crab, shrimp, clams), fish (salmon, trout, grayling), waterfowl (ducks), marine mammals (seal), and big game (deer). Subsistence hunting and fishing activities center around Uyak Bay and surrounding uplands. Subsistence areas important to Larsen Bay are Uyak Bay (crab, shrimp, clams, ducks, seal, and salmon), along with Zachar and Spiridon bays. The uplands surrounding the bays are hunted for deer, with some upland lakes fished for trout, and salmon. Access to subsistence hunting and fishing areas is primarily by boat and on foot.

Larsen Bay residents are dependent on subsistence resources for economic and social reasons. Because both commercial fishing participation and cannery employment is greater than at Akhiok or Karluk, reliance on subsistence may not be as economically important. However, fishing and cannery employment depend on the success of the fishing season, and transportation costs for bringing food into Larsen Bay are high. Approximately 60 percent of Larsen Bay families are at the poverty level (DOWL 1981). Larsen Bay residents have traditionally harvested a variety of subsistence resources.

At the present time there is no conflict between subsistence, recreation, and commercial fish and wildlife resource uses. Larsen Bay subsistence areas overlap with Karluk resident use of Uyak, Zachar, and Spiridon bays.

Old Harbor

The primary subsistence resources utilized by Old Harbor residents are shellfish (crab, clams, shrimp), fish (salmon, trout), bird eggs (gull and tern), waterfowl (ducks), marine mammals (seal), and big game (deer). Subsistence hunting and fishing take place over a large area around Old Harbor, from Kiliuda Bay to the north to Kaguyak Bay to the south, including Sitkalidak Island. Subsistence areas important to Old Harbor residents in the immediate vicinity of the village are Sitkalidak Straight (crab, clams, bird eggs, seal), Sitkalidak Island (salmon, trout, deer), the head of Barling Bay (ducks), and upland areas around the village (deer). Important areas further from the village are Kiliuda Bay (ducks, deer), Kaiugnak Bay (seal), and Kaguyak Bay-Twoheaded Island (crabs, seal). Access to subsistence hunting and fishing areas is primarily by boat and on foot.

Old Harbor residents are dependent on subsistence resources for economic and social reasons. Commercial fishing participation by village residents is relatively high but the loss of the local cannery has limited cannery employment to floating processors. In addition, transportation costs to bring food supplies into Old Harbor are high. Approximately 42 percent of Old Harbor families are at the poverty level (DOWL 1981). Old Harbor residents have traditionally harvested a variety of subsistence resources.

At the present time, there is no conflict between subsistence, recreation, and commercial fish and wildlife uses. Old Harbor subsistence areas border the Kaguyak area, which is infrequently used by Akhiok residents.

Ouzinkie

The primary subsistence resources utilized by Ouzinkie residents are shellfish (crab, shrimp, and clams), fish (salmon, halibut), waterfowl (duck), small game (rabbit), and big game (deer). Subsistence hunt-

ing and fishing take place over a large area around Ouzinkie, from Kazakof (Danzer) and Duck bays on Afogonak Island, south through Spruce Island and Sharatin Bay and west to Whale Island. Subsistence areas important to Ouzinkie residents in the immediate vicinity of the village are Spruce Island (salmon, rabbit, deer), the east side of Ouzinkie Narrows (deer), and Marmot Bay (crab, shrimp, halibut). Important areas further from the village are Kazakof-Duck bays (crab, salmon, trout, duck, deer), Anton Larsen Bay (crab, deer), Sharatin Bay (crab, salmon, deer), and Whale Island (deer). Access to subsistence areas is primarily by boat and on foot.

Ouzinkie residents are dependent on subsistence resources for economic and social reasons. Transportation costs for bringing food supplies into Ouzinkie are high. Approximately 47 percent of the households in Ouzinkie are considered to be at the low income level (DOWL 1981). Ouzinkie residents have traditionally harvested a variety of subsistence resources.

At the present time, there is a potential conflict between subsistence and recreation users concerning deer hunting at the Otmeloi-Coarse Points area if a road is extended from Monashka Bay. Ouzinkie subsistence resource areas overlap with Port Lions along Kizhuyak Bay, Whale Island, and Marmot Bay. They also overlap with recreational use of Marmot Bay by Kodiak residents.

Port Lions

The primary subsistence resources utilized by Port Lions residents are shellfish (crab, shrimp, clams), fish (salmon, trout, grayling), waterfowl (ducks), and big game (deer). Subsistence hunting and fishing take place over a large area surrounding Port Lions, from Raspberry Island to the northwest, north of Afognak Bay, west to the Kupreanof Peninsula, and south to the head of Kizhuyak Bay. Subsistence areas important to Port Lions residents in the immediate vicinity of the village are Kizhuyak Bay (crab, clams, shrimp, salmon, duck, and deer) and

upland areas west and north of Port Lions (trout, grayling, duck, deer). Important areas farther from the village are Raspberry Island (salmon, deer), Afognak Bay and uplands (crab, clams, salmon, duck, deer), Kupreanof Peninsula (deer), and Whale Island (deer). Access is primarily by boat, motorized vehicles west of Port Lions, and on foot.

Port Lions residents are dependent on subsistence resources for economic and social reasons. Transportation costs for bringing food supplies into Port Lions are high. While Port Lions is not a "traditional village" at its present location, residents have traditionally harvested a variety of subsistence resources.

Recently there has been a growing conflict over subsistence and nonresident harvesting of deer, facilitated by ferry access from Homer, Seward, and Kodiak. A request for reduction of the deer limit in the immediate village vicinity from four to one is pending before the local Fish and Game Advisory Board to make the area less attractive to nonlocal hunters. Port Lions subsistence resource areas overlap with Ouzinkie in eastern Kizhuyak Bay, Whale Island, and Afognak Bay.

3.4.13 EDUCATION

The following discussion of educational facilities was obtained from the Draft EIS, Lease Sale No. 60, Lower Cook Inlet-Shelikof Strait (BLM 1981).

Borough

As a second-class borough, the Kodiak Island Borough is responsible for the construction, maintenance, and operation of the public school system throughout the Borough. The Borough operates a total of 13 schools: 8 village schools, 3 elementary schools, a junior high school, and a senior high school in the City of Kodiak. Although the Kodiak Aleutian High School was originally designed to be the secondary facility for the entire Borough, the Borough has recently begun to provide secondary education programs in the villages as well.

City of Kodiak

Table 3.42 presents a summary of school facilities in the City of Kodiak.

Elementary students in Kodiak attend one of three public schools: East Elementary School, Peterson Elementary School, or Main Elementary School. All Kodiak seventh and eighth graders attend Kodiak Junior High School. Kodiak Aleutian High School serves students in grades 9 through 12. Although Kodiak's population has increased since 1970, total school enrollment has declined. By far the largest decline has taken place in the elementary school population. The high school decline can be explained in part by the gradual introduction of secondary programs in the villages, thereby reducing the number of boarding students.

According to school district personnel, Kodiak's elementary schools are currently operating at capacity, and substantial increases in Kodiak's population could require the construction of new elementary facilities. The Main Elementary Junior High School complex is in marginal condition and deteriorating rapidly. It is obvious that theh plant will require substantial investments in the next several years to bring it up to operating standards. Kodiak Aleutian High School is in good physical condition and is large enough, according to school district personnel, to accommodate double its current enrollment without excessive crowding.

Akhiok

Akhiok School serves grades kindergarten through 12. The school was constructed in 1968, and has an area of 4140 square feet. The four classrooms include kindergarten, elementary and secondary rooms, and a library. There is a playground at the school. Two teachers instruct 20 students. There are plans to build a new school in Akhiok in the summer of 1981.

Table 3.42. Summary of school facility information, City of Kodiak.

Facility	Grade	No. of Classrooms[1]	No. of Teachers	Enrollment
East Elementary	K-6	19		
Peterson Elementary	K-6	22		
Main Elementary	K-6	20	52[2]	971[3]
Kodiak Junior High	7-8	20	18	235
Kodiak Aleutian High	9-12	20	42	502

Source: BLM 1981.

[1] Classrooms only and does not include shops, gyms, special purpose rooms, etc.

[2] Total elementary teachers in three Kodiak schools.

[3] Includes all elementary enrollment in Kodiak. Enrollment is for school year 1977-1978.

Karluk

Karluk Elementary School serves grades kindergarten through 8. There is one classroom. A teacher sometimes conducts classes in his house. The school, built in 1980, is a temporary structure. Money has already been appropriated for construction of a school at the new townsite, and site selection is almost complete. Twenty-four students are instructed by two full-time elementary school teachers, and one teacher who splits his time between special education and the Title 1 funded supplementary reading and mathematics program. There is also a part-time teacher's aide and a fulltime teacher's aide. The school has a playground.

Three high-school-age students are in the cottage home program in Kodiak, and one student remains in Karluk and takes correspondence courses.

KANA operates a preschool. One teacher instructs 9 students, 2 hours daily, Monday through Friday.

Old Harbor

Old Harbor has two schools. The elementary school, built in 1966, contains 4,905 square feet and serves grades kindergarten through 8. There are 77 students.

The Old Harbor High School, built in 1979, contains 7,621 square feet. It serves grades 9 through 12 and has 25 pupils. The new school contains a multipurpose room/gym that can be divided into spaces; a vocational education room that has space for welding, and a kitchen space, as well as one classroom. There is one administrator between the two schools, who also spends part of his time instructing elementary and secondary education, and ten fulltime teachers.

Ouzinkie

Ouzinkie School serves grades 1 through 10. The original structure, built in 1972, contained 4,200 square feet. In 1980, a 5,600-square-foot addition was built. The building has five classrooms, including a vocational education room, a home economics room, and a science room. There is also a learning resource library and a media center. In addition, there is a playground and a gymnasium. The gymnasium remains open in the evenings and on weekends for community recreational activities. Ouzinkie's 37 students are instructed by four teachers.

Eleventh and twelfth grade students are in the cottage home program in Kodiak. Kindergarten, for 4- and 5-year-olds, is conducted privately at the Baptist Mission. One teacher instructs nine students from 9 AM to noon Monday through Friday. The Kodiak Area Native Association runs a preschool for 3-year-olds. It is conducted at the Mission, and one teacher instructs four students for 2½ hours Monday through Friday.

Port Lions

Port Lions has two schools. The elementary school, built in 1964, contains 4,905 square feet and serves grades kindergarten through 8. There are three general classrooms for 34 students.

The Port Lions High School, built in 1979, contains 7,621 square feet. It serves grades 9 through 12 and has 18 pupils. The new school contains a multipurpose room/gym, which can be divided into spaces, and a vocational education room that has space for welding and a kitchen space; as well as one classroom. There is one administrator between the two schools, who also spends part of his time instructing secondary education, and six fulltime teachers. The gymnasium remains open in the evening for community recreational activities.

3.4.14 HUMAN RESOURCES - LITERATURE CITED

Alaska Dept. of Fish and Game (ADF&G). 1979. Kodiak Management Area, finfish annual report. Juneau, Alaska.

ADF&G. 1980. Westward region Tanner crab report to the Alaska Board of Fisheries, December 1980. Kodiak, Alaska.

ADF&G. 1981. Westward region shellfish report to the Alaska Board of Fisheries. Kodiak, Alaska.

Alaska Dept. of Health and Social Services, Division of Public Health. 1979. Alaska Vital Statistics. Anchorage, Alaska.

Alaska Dept. of Labor. 1979. Statistical quarterly, first quarter, 1979. 22 p.

Alaska Dept. of Natural Resources. Unpublished Document. Alaska historical resources survey site report.

Bureau of Land Management (BLM). 1980. DEIS: Proposed outer continental shelf oil and gas lease sale #46, Western Gulf of Alaska, Kodiak. Washington, D.C.: U.S. Dept. of Interior.

BLM. 1980. DEIS: Proposed outer continental shelf oil and gas lease sale No. 60, Lower Cook Inlet-Shelikof Strait, Alaska. Washington, D.C.: U.S. Dept. of Interior.

BLM. 1981. FEIS: Proposed out continental shelf oil and gas lease sale No. 60, Lower Cook Inlet-Shelikof Strait, Alaska. Washington, D.C.: U.S. Dept. of Interior.

CH2M Hill. 1981. Reconnaissance study of energy alternatives, Akhiok-King Cove-Larsen Bay-Old Harbor-Ouzinkie-Sand Point. Prepared for Alaska Power Authority. 40 p.

DMJM Forssen. 1980. Aleutian and southwestern coastal ferry study. State of Alaska, Dept. of Transportation and Public Facilities. pp. 75-78.

DOWL. 1981. Kodiak, Akhiok, Karluk, Larsen Bay, Port Lions, Ouzinkie, and Old Harbor community profiles. Prepared for the Dept. of Community and Regional Affairs.

Dept. of the Army, Alaska District Corps of Engineers. 1980. Regional inventory and reconnaissance study for small hydro-power projects. Aleutian Islands, Alaska Peninsula, Kodiak Island, Alaska. Vol. II-Community Hydro Reports.

Kodiak Area Native Association. 1980. KANA OEDP Report, 1979-1980. Kodiak Island. 119 p.

Kramer, Chin, and Mayo, Inc. (KCM). 1978. Kodiak Island Borough regional Plan and development strategy Summary Report, July 1978. 84 p.

U.S. Dept. of Commerce, NOAA, National Ocean Survey. 1975. NEIDC/ISERG. 1974.

4.0 RESOURCE ANALYSIS

4.0
RESOURCE ANALYSIS

4.1 INTRODUCTION

To implement their Coastal Management Program, the Kodiak Island Borough will make decisions on the use of coastal resources. Residents strongly support maintaining the productivity and economic growth of fisheries resources, improving transportation facilities and services, developing low-cost sources of energy, and guaranteeing resident use of subsistence resources. Development of petroleum and timber resources, uncertain land status, important fish and wildlife resources, high-quality recreation resources, and potential conflicts between resource uses indicate a need for careful management of coastal resources. By assessing the demands on coastal resources and the capability of those resources to meet these demands, the resource analysis provides a reasoned approach to making resource use decisions.

The resource analysis has the following objectives:

- o Assesses present and anticipated demands on coastal resources;
- o Evaluates resource sensitivity and capability to meet demands;
- o Projects significant anticipated changes in inventory characteristics; and
- o Classifies coastal mamagement areas based on local needs, resource sensitivity, and other factors, such as public safety.

The resource analysis is structured to consider the Kodiak Island Borough as a whole, and the seven major communities of the Borough. The regional analysis examines known and possible changes that may affect the natural, physical, and cultural environment of the Kodiak Island Borough, including fisheries and subsistence resources, geophysical hazards, land management, and development of natural resources.

The community analysis under each section addresses specific activities and potential problems and trends, including the following parameters, as appropriate:

- o Coastal habitits and biological resources
- o Air and water quality
- o Geophysical hazards
- o Land ownership, use, and management
- o Recreation
- o Transportation
- o Energy facilities
- o Coastal access
- o Housing
- o Community facilities and services
- o Economic characteristics
- o Employment and income
- o Subsistence

Areas within the Kodiak Island Borough are classified for development, development with restrictions, and conservation. As the name suggests, development areas permit development to take place according to the zoning ordinance, building code, subdivision ordinance, and applicable federal and state regulations. Development with restrictions is designated where special biological resource, geophysical hazard, and human needs constrain development. Areas classified as development with restrictions may be subject to special siting, design, and construction requirements, and will be considered by the Planning Department on a site-by-site basis.

Conservation areas are designated where overriding biological resource, geophysical hazard, and cultural resource concerns should preclude any development other than identified nonintensive resource use.

4.2 NATURAL RESOURCE ANALYSIS

The economy of Kodiak Borough is primarily based on the exploitation of its natural resources. Living (biological) resources are utilized to a variable extent in each of the eight habitats designated as coastal zone management units. Some of the resources, such as the anadromous salmon, utilize several of these habitats at different stages of their life history, are harvested in each habitat, and exert a major influence on the ecology of a particular habitat in which they occur or on organisms that feed on salmon. The complexity of salmon life history, and their importance to the economy and ecology of the Borough, constitute a difficult management problem. Management decisions that concern existing or proposed uses of one habitat and effects on its resources must also consider the ramifications of an activity on resources in other habitats.

This resource analysis is presented in two parts. First, the utilization of biological resources is discussed without specific consideration of habitat management issues (i.e., adverse environmental effects of uses or conflicting uses). Second, uses of biological resources are summarized by habitat, and sources of adverse environmental effects and conflicting uses are discussed.

4.2.1 FISHERIES RESOURCES

The fisheries resources within Kodiak Borough and from surrounding areas of continental shelf and slope support an exceptionally valuable commercial fishery as well as important subsistence and sports fisheries. The importance of commercial fishing to the Borough, State of Alaska, and nation is underscored by the statistic that commercial landings in 1978 were the second most valuable in the nation (SAI 1980). This section focuses on the identification of areas that are important to

resource use; "importance" refers to source of supply, which is discussed in this section, whereas economic considerations are discussed in Section 3.4.10. Catch statistics are of use in describing both level of resource abundance/availability and economic value. Consequently, some level of repetition of information is unavoidable in this section and that on economics.

Shellfish

Commercial harvesting of shellfish in the Kodiak area is important not only to the Borough but to Alaska as well. One measure of the magnitude of this resource is that over the period from 1969 to 1977 Kodiak produced 37 percent of the statewide harvest of shellfish. The more important species that are the object of commercial fisheries include Dungeness crab, Tanner crab, king crab, shrimp, and scallops. In addition to some of the aforementioned species, razor clams support subsistence and bait fisheries.

Dungeness Crab. The fishery for Dungeness crab operates primarily during summer in nearshore areas at depths of 7 to 50 meters. Between 1969 and 1975 the most productive area was south of the Trinity Islands (BLM 1980). Other productive areas were to the east and northeast of these islands, south of Alitak Bay, from Ayakulik to Spiridon Bay along the west coast of Kodiak Island, Ugak Bay, and south of Sitkalidak Strait. Recent trends in the Dungeness crab harvest are summarized by ADF&G management districts in Table 4.1. Considerable variation in the harvest occurs from year-to-year and among districts. Such variation reflects not only the production of the stock, but market conditions and level of fishing effort as well. The catch from 1974 to 1977 was exceptionally low. In subsequent years the catch has increased markedly, to a total of about 1.6 million pounds in 1980. The 1981 harvest is expected to duplicate that of 1980, given recruitment levels comparable to those of the last three years (ADF&G 1981a). From 1978 to 1980 the eastside, southeast, and westside districts have been most productive. In

Table 4.1. Dungeness crab commercial harvest (in pounds) by fishing section, Kodiak Management District (Kodiak Archipelago only), 1974-1980.

Fishing Section	1974	1975	1976	1977	1978	1979*	1980
Northeast	30,125	892	0	0	35,281	61,573	89,126
Eastside	331,156	259,096	250	103,265	420,742	459,120	224,203
Southeast	42,741	7,540	0	0	202,593	346,067	442,254
Southwest	0	0	0	0	42,314	34,626	71,326
Westside	200,276	208,371	66,970	6,971	277,107	148,630	800,826
TOTAL	604,298	475,899	67,220	110,236	978,037	1,050,016	1,627,735

Source: ADF&G 1981a.

*Fishing section boundary between Eastside and Southeast sections revised beginning with 1979 season.

1980 the westside district produced substantially more Dungeness crab than in previous years, possibly signifying a shift in resource abundance.

Dungeness crab are of primary importance for subsistence to the villages of Ouzinkie and Port Lions, and are of secondary importance in Karluk and Larsen Bay (BLM 1981). Dungeness crab are not a target of a subsistence fishery in Kodiak, but are used as they are incidentally taken in the king and Tanner crab catch (Bill Donaldson, personal communication, 1981).

Tanner Crab. The fishery for Tanner crab became commercially important in 1967, and by 1972-73 had become the primary shellfishery in winter and spring (ADF&G 1980). The Kodiak Management District is composed of five sections and eighteen subsections (Table 4.2). The catch from 1972 to 1980 has varied considerably among years and areas (Table 4.3). On the average, the northeast and southwest sections have produced the highest yields in the Kodiak Archipelago (4.45 and 5.31 million pounds per year, respectively). Recently (1978-80), the highest catches were produced by the following subsections: Inner Marmot Gully, Chiniak Gully, Compass Rose/West Chiniak Island, and Cape Ikolik (ADF&G 1980).

Areas of fishing concentration shift seasonally (ADF&G 1978). During winter, fishing effort is concentrated in the east and northeast, and in Shelikof Strait. After winter storms subside, more effort is directed to offshore areas and to the south.

There is evidence that the catch per unit effort (CPUE) has declined in recent years, which may reflect a general decline in abundance of Tanner crab stocks (ADF&G 1980). CPUE from 1972-73 to 1975-76 ranged from 59 to 83, and has fallen progressively to 24 in 1979-80. In addition, fewer legal-size males have been taken in recent years. To allow time for recovery, ADF&G has reduced the catch quotas in heavily exploited areas.

Table 4.2. ADF&G Tanner Crab Sections and Subsections Adjacent to the Kodiak Archipelago.

SECTION/SUBSECTION	
NORTHEAST	
	Marmott Bay
	Chiniak Bay
	Inner Marmot Gully
	Outer Marmot Gully
	Chiniak Gully
	Undefined
EASTSIDE	
	Ugak/Barnabas
	Undefined
SOUTHEAST	
	South Sitkalidak Strait/Two Headed Island
	South Trinity Island
SOUTHWEST	
	Alitak Bay
	Compass Rose/W. Chiniak Island
	Cape Ikolik
	Undefined
WESTSIDE	
	Uyak Bay
	Kupreanof Strait/Uganik Bay
	West Afognak

Source: ADF&G 1980.

Table 4.3. Tanner crab catch in pounds and metric tons by fishing sections for the Kodiak Management District, 1972-73 through 1979-80 fishing seasons.[1]

Sections		1972-73 [2]	1973-74 [3]	1974-75 [3]	1975-76 [4]	1976-77 [5]	1977-78 [6]	1978-79 [6]	1979-80 [6]
Northeast	lbs.	4,539,417	6,152,046	2,764,127	4,054,131	2,871,225	3,881,767	6,359,777	4,986,120
	m.t.	2,059.07	2,790.54	1,253.79	1,838.94	1,302.37	1,760.75	2,884.77	2,262.30
Eastside	lbs.	5,370,516	5,619,276	2,423,228	5,032,755	3,071,856	3,910,122	3,032,083	2,119,244
	m.t.	2,436.05	2,548.89	1,099.17	2,282.84	1,393.38	1,773.62	1,375.34	961.54
Southeast	lbs.	1,655,000	1,883,948	623,990	5,859,831	5,908,729	5,222,577	2,529,316	974,921
	m.t.	750.70	854.55	283.04	2,658.00	2,680.18	2,368.95	1,147.29	442.34
Southwest	lbs.	9,243,861	7,383,704	3,938,902	3,455,050	1,793,648	8,831,087	5,185,730	2,647,294
	m.t.	4,192.99	3,349.23	1,786.67	1,567.20	813.59	4,005.75	2,352.23	1,201.13
Semidi Is.	lbs.	-	-	-	-	-	-	722,600	1,292,275
	m.t.	-	-	-	-	-	-	372.77	586.33
N. Mainland	lbs.	6,876,969	7,009,117	3,536,872	4,568,804	3,433,147	6,791,254	7,111,498	4,677,742
	m.t.	3,119.37	3,179.31	1,604.31	2,072.39	1,557.26	3,080.49	3,225.75	2,122.39
S. Mainland	lbs.	120,124	50,419	191,554	23,638	20,651	59,255	277,921	500,247
	m.t.	54.48	22.86	86.88	10.72	9.36	26.87	126.06	226.97
Westside	lbs.	2,893,890	1,722,389	171,293	4,342,700	3,620,823	4,585,410	3,954,882	1,426,032
	m.t.	1,312.66	781.27	77.69	1,969.83	1,642.39	2,079.9	1,793.92	647.02
TOTAL	lbs.	30,699,777	29,820,899	13,649,966	27,336,909	20,720,079	33,281,472	29,173,807	18,623,875
	m.t.	13,925.33	13,526.67	6,191.58	12,399.94	9,398.57	15,096.38	13,233.15	8,450.03

[1] Table revised 1/79 to reflect creation of Semidi, Southeast, and Southwest sections from old "Southern" section and minor modification of Eastside section description. Semidi Island section added beginning 1978-79 fishing season.
[2] Fishing season July 1 - June 30.
[3] Fishing season November 1 - June 30.
[4] Fishing season November 1 - April 30, shortened due to price disputes and market conditions.
[5] Fishing season January 1 - April 30.
[6] Fishing season January 5 - May 15.

The subsistence fishery for Tanner crab is very limited. Karluk, Larsen Bay, and Ouzinkie villagers consider Tanner crab a secondary food resource, and Port Lions villagers rarely use it.

King Crab. The king crab fishery in the Kodiak Management Area was initiated in the 1940's, expanded greatly during the 1960's when a peak harvest occurred in 1965-66, and then dropped to a substantially reduced level sustained throughout the 1970's (Table 4.4). Six stocks have been identified as being biologically distinct, and are managed accordingly. The distribution of these stocks is shown in Figure 4.1. Stocks I, II, and III are the largest. Since the 1974-75 season, Stock III has produced the largest catch of king crab.

Between 1969 and 1979 the most productive king crab area was in the Sitkalidak district (No. 20) (Figure 4.1). Landings in 1980 suggest a shift in relative stock abundance, because the Compass Rose (No. 30) and Cape Ikolik (No. 34) districts produced the highest yields (ADF&G 1981a). In 1980 the fishing season was extended to 107 days to provide more opportunity to fill quotas. However, the extended season was not accompanied by a commensurate increase in the total catch.

Subsistence use of king crab is extensive. It is considered a primary subsistence and commercial resource for the villages of Ouzinkie and Port Lions. Ten fishermen in Port Lions and six in Ouzinkie held commercial entry permits for king crab in 1980 (BLM 1981). King crab are a secondary subsistence resource for residents of Karluk and Larsen Bay. Three fishermen in Larsen Bay held entry permits in 1980 (BLM 1981a). There is also extensive subsistence use of king crab by Kodiak residents (Bill Donaldson, personal communication, 1981).

Shrimp. The commercial shrimp fishery in the Kodiak area has a history of overfishing various stocks, with the result being frequent shifts to raw fishing grounds to allow overfished stocks time to recover. The commercial fishery began in 1958 and developed through the 1960s reaching a peak harvest of 82 million pounds in 1971. In 1972 quotas

Table 4.4. Commercial red king crab harvest by biological stock (number and pounds), 1960-61 through 1980-81, Kodiak Management Area, Alaska.[1]

Fishing Year	Stock I		Stock II		Stock III		Other Stocks		Totals	
	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.
1960-1961	269,429	2,499,909	658,120	7,405,755	837,216	7,815,131	351,610	3,344,076	2,116,375	21,064,871
1961-1962	498,344	4,580,779	869,707	8,735,268	1,148,059	9,358,636	665,444	6,288,217	3,181,554	28,962,900
1962-1963	1,037,540	10,257,992	1,267,138	12,136,629	1,393,632	11,010,718	447,833	4,221,364	4,146,143	37,626,703
1963-1964	1,666,875	16,479,593	1,362,566	12,295,969	712,034	5,605,489	417,513	3,335,172	4,158,988	37,716,223
1964-1965	1,374,436	13,570,658	2,755,000	21,763,800	449,851	3,461,206	344,022	2,800,854	4,923,309	41,596,518
1965-1966	2,339,423	22,966,614	6,995,585	57,643,489	1,504,577	12,036,222	222,124	1,784,701	11,061,709	94,431,026
1966-1967	1,541,723	15,716,564	4,645,057	39,215,389	1,919,636	15,562,870	369,883	3,322,956	8,476,299	73,817,779
1967-1968	987,324	9,540,196	1,080,565	8,387,022	2,596,691	21,121,856	482,741	4,399,418	5,147,321	43,448,492
1968-1969	546,995	4,714,838	652,627	4,730,183	807,360	6,109,150	341,968	2,657,314	2,348,950	18,211,485
1969-1970	400,245	3,246,190	430,846	3,152,575	410,620	3,157,224	364,470	2,644,582	1,606,181	12,200,571
1970-1971	374,933	3,142,881	606,948	4,216,123	284,104	1,998,344	295,333	2,370,462	1,561,318	11,727,810
1971-1972	78,698	658,749	656,082	4,579,149	736,298	5,128,154	68,079	525,086	1,539,157	10,891,138
1972-1973	128,120	1,039,847	871,238	6,600,988	906,794	6,844,092	123,518	1,005,036	2,029,670	15,489,963
1973-1974	202,178	1,648,990	1,009,625	7,896,548	543,451	4,092,729	92,425	759,020	1,847,679	14,397,287
1974-1975	567,843	4,640,274	972,086	8,069,791	1,140,450	9,084,000	168,828	1,276,307	2,849,207	23,070,372
1975-1976[2]	890,044	7,747,625	631,474	5,018,948	1,230,413	9,501,631	225,478	1,793,447	2,977,409	24,061,651
1976-1977	752,044	6,888,083	578,995	4,516,641	708,522	5,377,321	139,315	1,191,653	2,178,876	17,973,698
1977-1978	289,806	3,012,932	446,728	3,501,170	787,772	6,398,641	66,141	590,923	1,590,447	13,503,666
1978-1979	187,344	1,829,449	245,440	2,011,580	948,069	7,484,847	83,138	695,972	1,463,991	12,021,848
1979-1980[3]	282,931	2,345,934	237,778	1,679,972	1,348,491	9,740,907	110,194	842,087	1,979,394	14,608,900
1980-1981[3]	555,161	4,589,704	518,955	3,703,322	1,408,485	9,921,245	304,598	2,234,383	2,787,199	20,448,654
TOTAL	14,971,436	141,117,801	27,492,560	227,260,301	21,822,525	170,810,413	5,684,655	48,083,030	69,971,176	587,271,555

1 Fish ticket statistics.
2 In years prior to 1975-76 season the totals for "other stocks" may inadvertently omit a small catch of crab from the Kilokak Rocks and Cape Kumlik area of the Alaska Peninsula.
3 Data is subject to minor change.

Source: ADF&G 1981a.

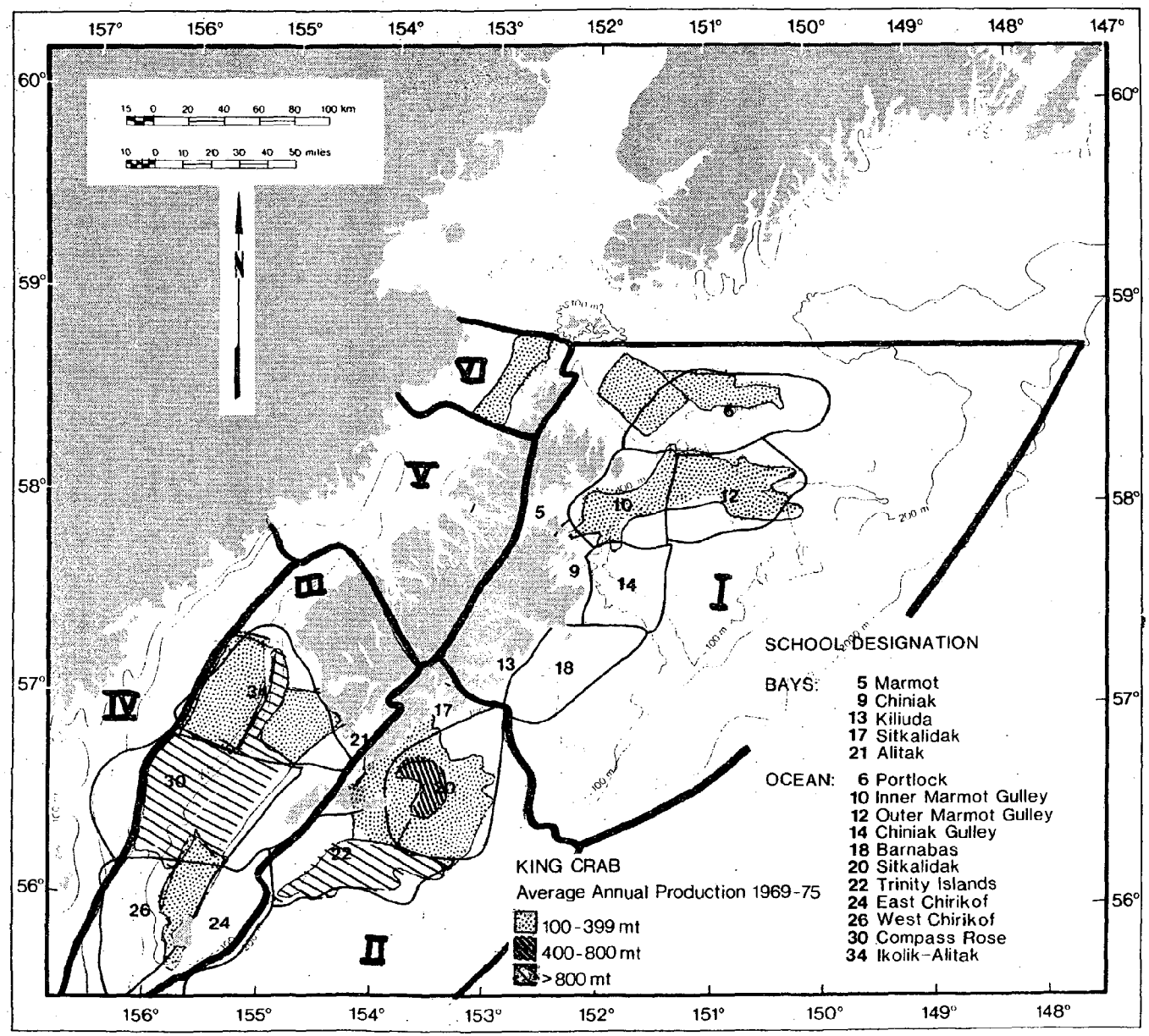


Figure 4.1. King crab reproduction areas I through VI, king crab schools most heavily exploited by the fishery in the Kodiak management district, and areas of high commercial catches of king crab by U.S. fishermen, 1969-75.

were established to limit annual harvests, and thereby minimize overfishing of stocks (ADF&G 1981a). In the early 1970s Uyak Bay was a prime shrimping area. It was closed to shrimping in 1973 and was not reopened until the 1980-81 season. Marmot Island and Twoheaded Island were the prime grounds between 1973 and 1977. Both areas were subsequently closed in 1978 and 1979, respectively. During the 1980-81 season, Alitak Bay and the adjacent offshore area was the primary ground (Table 4.5) (ADF&G 1981a).

The subsistence fishery for shrimp is limited. Residents of Ouzinkie consider shrimp a primary subsistence resource. Those in Port Lions and Larsen Bay value shrimp as a secondary subsistence resource.

Scallops. Commercial harvest of scallops began in 1967 (Table 4.6). Catch peaked in 1970 at 1.4 million pounds. Post-1973 declines in landings culminated in the absence of fishing effort in 1977 and 1978. The lack of fishing effort in those years has been atrributed to static prices for scallops, lack of experienced crew, and the use of the vessels in other, more lucrative, fisheries. Recent renewed interest in the fishery reflects declines in scallop stocks in New England and a strengthening of market conditions. Incidental catches of Tanner and king crab remain a problem for scallop fishermen. Scallops are not used in the villages or in Kodiak as a subsistence resource.

Razor Clams. Although razor clam beaches exist on Kodiak Island, they are no longer commercially harvested for human consumption. Rather, the fishery provides only bait for the Dungeness crab fishery. Economic and natural factors prompted curtailment of commercial harvest. Economic problems included a weak clam market and increased federal and state regulation of clam processing. Natural problems centered on the need for continuous monitoring of the stocks for paralytic shellfish poisoning, and changes in benthic characteristics after the 1964 earthquake.

Villagers in Karluk and Larsen Bay use clams as a primary subsistence resource. Those in Ouzinkie and Port Lions use clams as a secondary resource (BLM 1981).

Table 4.5. Comparison of Kodiak District trawl shrimp harvest by fishing section for the 1973-74 through the 1980-81 fishing seasons.

Fishing Section	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Inner Marmot	3,363,507	2,840,884	3,051,753	2,707,340	1,482,689	473,700	-0- [1]	-0- [1]
Marmot Island	15,555,319	16,440,280	15,925,966	12,197,407	3,298,643	-0-	-0-	-0-
Chinlak Bay	1,396,297	2,894,115	760,727	1,009,352	33,811	-0-	-0-	-0-
Kalsin Bay	- [2]	- [2]	1,277,202	1,506,366	1,913,233	1,163,818	925,388	135,804
Kiliuda Bay	5,934,647	8,753,689	6,608,702	6,688,416	6,059,204	-0-	-0-	-0-
Two-Headed Is.	12,737,189	12,734,937	12,812,773	11,885,465	4,038,294	1,600	-0-	2,164,645
Southern	8,991,722	4,185,268	4,248,602	4,896,996	4,416,986	3,485,531	3,537,017	4,713,808
Olga Bay	-	-	-	-	-	1,794,091	2,259,906	1,164,641
Ugak Bay	21,911	63,167	-0-	-0-	19,000	-0-	533,598	1,047,092
Uyak Bay	1,482,421	722,166	329,190	478,911	2,309,710	1,003,946	-0-	426,800
Uganik Bay	1,935,597	1,600,994	842,553	908,027	1,481,186	367,838	-0-	-0-
West Afognak	843,806	664,154	831,461	986,024	258,730	879,082	478,327	1,275,719
Northern	1,417,357	3,090,640	1,033,971	1,065,966	46,407	1,149,071	1,430,362	2,101,661
S. Mainland	69,483	-0-	121,930	214,185	274,484	-	-	-
Kukak Bay	2,150,814	480,484	1,023,566	217,998	776,989	586,496	534,187	1,160,987
Portlock	303,922	3,765,204	218,195	1,949,630	-0-	-	-	-
Wide Bay	-	-	-	-	-	-	1,181,936	977,680
Puale Bay	-	-	-	-	-	-	1,841,223	663,954
Non-Section	-0-	-0-	-0-	-0-	-0-	9,600,848	141,592	11,970,218
TOTAL	56,203,992	58,235,982	49,086,591	46,712,083	26,409,366	20,506,021	12,863,536	27,803,009

Source: ADF&G 1981.

[1] Catches of zero usually indicate that a section was not opened for harvest.

[2] Dashes indicate that no section existed that year.

Table 4.6. Historic commercial catch of weathervane scallops, Kodiak Management District, 1967-1980, excluding 1977 and 1978, when no effort occurred.

Year	Number of Vessels	Number of Landings	Commercial Catch (pounds)	Avg. Catch Per Landing (pounds)
1967	2	6	7,788[1]	1,298
1968	8	89[2]	872,803[3]	8,983[2]
1969	11	86	1,012,860	11,777
1970	7	102	1,417,612	13,898
1971	5	48	841,211	17,525
1972	5	68	1,038,793	15,276
1973	4	42	935,705	22,279
1974	3	14	147,945	10,568
1975	3	29	294,142	10,143
1976	1	6	75,245	12,541
1979	1	4	24,826	6,206.5
1980	7	33[4]	371,018[5]	11,045[4]
Total[6]		511	6,860,453	
Average[6]		46	623,678	13,558

Source: ADF&G 1981a.

[1]Unshucked scallops only.

[2]80 landings of shucked scallops, 9 landings unshucked. Average pounds/landing based on shucked weight and landings.

[3]718,671 pounds of shucked scallops; 154,132 pounds unshucked.

[4]32 landings of shucked scallops, 1 landing unshucked. Average pounds/landing based on shucked weight and landings.

[5]353,443 pounds of shucked scallops; 17,575 pounds of unshucked scallops.

[6]1968-80 total and average, shucked scallops only.

Finfish

Herring. Since 1964 the herring fishing in the Kodiak area has been directed toward sac roe and provision of bait to the crab and halibut fisheries (ADF&G 1980). A summary of salient features of this fishery is given in Table 4.7. The sac roe fishery operates during spring prior to spawning when roe is in prime condition. The bait fishery targets on herring when roe is not in prime condition. The fishery has grown rapidly from 26 vessels in 1974 to 236 vessels in 1980. In this period there was a shift from larger seine vessels to smaller seiners. At this time purse seiners (89 vessels) comprise only 38 percent of the fleet, but take about 84 percent of the catch; most of the other vessels are gill netters.

Management of the herring roe fishery is difficult because of the timing necessary to ensure that herring are taken while the roe is prime prior to spawning (ADF&G 1980). Spawning is sensitive to several environmental parameters, especially to temperature, and can occur at a number of locations at any time from late April to early June (Figure 4.2). Erratic spawning patterns in the early and mid-1970s resulted in poor timing of the fishing effort and herring quotas were not filled. Quotas were finally reached in 1979. Several bays were closed well before the end of the season, including Melina, Red Fox, Terror, Inner Uyak, Womens, Sulua, and Moser-Olga bays. Eventually all estuaries within the Uyak, Uganik, and Afognak Districts were closed. Sixteen bays produced 50 to 200-ton harvests, and 19 bays produced 1 to 49-ton harvests in 1979. Many bays were fished for the first time: Red Fox, Sulua, Moser-Olga, Shearwater, Wide, Duck, and Seal bays.

Traditional herring areas are extensive on the east coast of Afognak Island where historically only Izhut Bay was fished. Other areas subject to historical fishing efforts include estuarine areas from Cape Chiniak to Whale Pass, including outer Chiniak Bay, estuaries south of Ugak Bay to Alitak Bay, estuaries south of Shuyak Strait to Sturgeon Head, especially Zachar, Spiridon, and Uyak bays, and Raspberry and Kupreanof straits (BLM 1980, 1981; ADF&G 1980).

Table 4.7. Kodiak Area Roe Herring Harvest, 1964-1980.

Year	Harvest (tons)	Number of Companies	Number of Vessels
1964	567.8	2	No data
1965	657.2	2	No data
1966	2,769.3	5	No data
1967	1,662.4	3	5
1968	2,000.6	4	10
1969	1,130.0	9	21
1970	341.6	No data	No data
1971	284.3	No data	No data
1972	215.0	1	4
1973	831.0	4	11
1974	868.0	4	26
1975	8.0	3	2
1976	4.6	1	1
1977	338.44	3	11
1978	903.6[1]	7	42[2]
1979	1,735.7	8	173[3]
1980*	2,384.3	9	236[4]

Source: ADF&G 1979.

[1]Only 621 tons were sold as roe herring. The remaining 282 tons were sold for bait.

[2]For the first-time trawls, drift gillnets and set gillnets were used in the fishery. In 1978, 29 seiners, 2 trawlers, and 11 gillnetters participated in the fishery.

[3]58 purse seiners, 43 drift gillnetters, 71 set gillnetters, and 1 beach seiner (no trawls).

[4]89 purse seiners, 145 gillnetters, 1 trawler, and 1 beach seiner. (Includes 2 gillnetters that fished without Interim Use permits for herring roe).

*Preliminary figures.

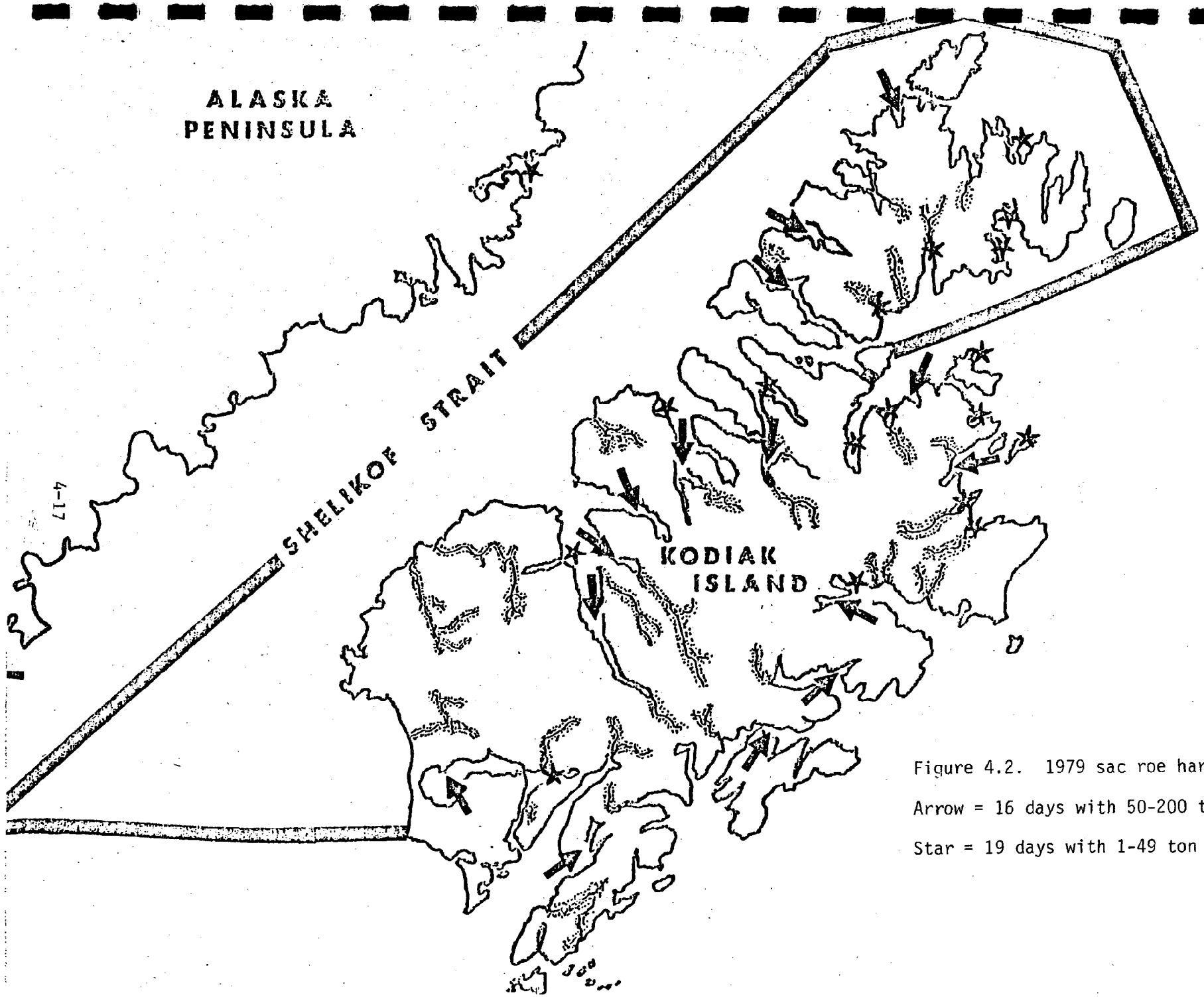


Figure 4.2. 1979 sac roe harvest.

Arrow = 16 days with 50-200 ton harvest

Star = 19 days with 1-49 ton harvest.

Herring are of only secondary importance to the villages of Karluk, Larsen Bay, and Port Lions as a subsistence resource. They are rarely used in Ouzinkie (BLM 1981).

Groundfish. The groundfish fishery has been characterized by rapid growth during the last few years, during which time the fishery was redirected from the bait market to use for human consumption. Prior to 1978 trawlers targeted on bottom fish to provide bait for the crab fisheries. In 1978 processing facilities became available to handle bottomfish for human consumption, and landings in Kodiak increased to more than two million pounds, substantially more than ever before. In 1979 the groundfish catch exceeded five million pounds (Table 4.8). Pollock comprised 60 percent of the catch, followed by cod which constituted 28 percent; no other species contributed more than 2 percent of the catch. Apparently there has been a shift in this fishery because in 1976, 91 percent of the landings were cod, 6 percent were flounder, and 2 percent were rockfish (NPFMC 1979).

The major commercial fishing areas for pollock and cod are estuaries on the west coast of Kodiak Island, the east coast of Shuyak Island, and Shelikof Strait (BLM 1981).

Halibut has tranditionally supported a commercial fishery operated by local residents. This long-line fishery primarily focuses on areas near the Barren Islands, off the southwest tip of Kodiak Island, and along the west coast of Kodiak from Uyak Bay north to Black Cape on Afognak Island (BLM 1981).

Of the two groundfish species, halibut is most frequently used for subsistence. Residents of Larsen Bay, Ouzinkie, and Port Lions consider halibut a primary subsistence resource. Larsen Bay villages also consider flounder and cod as primary resources, although residents of Ouzinkie and Port Lions rate them of secondary value. Karluk residents rely on flounder more than halibut as subsistence resources, and rarely

Table 4.8. Catch of groundfish in 1979 in the Kodiak Management Area, by species and month.

	Unspecified	Cod	Flounder	Rockfish	Bullhead	Pollock	Skates	Sablefish	Atka Mackerel	Total
Jan	1,867	142,995	12,825	-	7,730	3,889	12,997	19,018	-	201,321
Feb	2,760	110,136	8,431	-	1,201	184,929	18,712	1,512	-	327,681
Mar	115,598	148,868	26,586	2,789	-	1,307,670	9,091	9,432	-	1,620,029
Apr	195,990	397,737	8,427	3,500	1,366	891,309	10,923	47,429	-	1,556,681
May	6,601	560,465	4,409	-	-	68,879	-	-	-	640,354
June	-	8,254	-	-	-	-	-	-	-	8,254
July	14,186	50,018	315	-	-	295,234	78	-	17,500	377,331
Aug	51,375	64,811	-	64	-	447,103	-	4,763	-	568,116
Sept	-	13,910	-	-	-	-	-	-	-	13,910
Oct	-	7,335	-	-	-	-	-	-	-	7,335
Nov	1,457	11,066	-	-	-	22,895	-	-	-	35,418
Dec	910	5,114	1,820	-	-	7,094	8,545	-	-	23,483
Total	390,744	1,520,709	62,813	6,348	10,297	3,229,002	60,346	82,154	17,500	5,379,913
% of total	7	28	1	<.01	<1	60	1	2	<1	

Source: ADF&G 1979.

Note: In 1976, 113 of 124 landings in Kodiak were for cod, 8 for other flounder, and 3 for other rockfish (NPFMC 1979).

consume cod (BLM 1981). Commercial fishermen most often retain Pacific cod as an incidental subsistence catch (NPFMC 1979).

Halibut is the only groundfish heavily pursued in the recreational fishery. Recent regulations have limited the catch and possession limit for sport fishermen to two fish of any size caught with hook attached to a handline, rod, or by spear. Kodiak landed 6 percent of the 1979 Alaskan sport catch, a substantial increase over the previous year (ADF&G 1980).

Salmon. Salmon are of great importance to the Borough, supporting valuable commercial, subsistence, and recreational fisheries. Prior to the turn of the century, red salmon was the primary target of the commercial fishery; subsequently, fishing effort switched to the pink salmon. In 1980 nearly 70 million pounds of salmon were caught, comprised of 81 percent pinks, 12 percent chums, 5 percent reds, 2 percent cohos, and a trace catch of kings. The composition of the 1980 catch is reasonably close to the average for the last 15 years. In 1968 processing of salmon for their roe was initiated, and in 1979 more than one million pounds of roe were processed.

Purse seiners are the primary method of harvest, having replaced fish trapping in 1958 (ADF&G 1980). In addition to purse seining, beach seines and gill-nets are used to catch salmon commercially. About three quarters of the purse seine and gill-net fleets are registered to Kodiak residents, and nearly all of the beach seiners are residents.

The commercial salmon fishery is closely regulated. To facilitate the management of the numerous salmon stocks, the Archipelago has been divided into nine districts, each of which consists of subdistricts or fishing units. Management is achieved by selectively opening and closing fishing units to provide sufficient salmon escapement for maintenance of salmon stocks in particular stream systems.

The highest catches (all species) in 1979 were from southeast Kodiak (No. 258-00), south Kodiak (No. 257-00), and west Kodiak between Uyak Bay and Raspberry Island (Nos. 253-00 and 254-00). Escapement figures are not necessarily closely related to commercial catch statistics because of area closures. For example, the Karluk (No. 255-00) and Ayakulif (No. 256-00) systems are among the most productive red salmon areas on Kodiak Island, but because of closures the catches were among the lowest in the Archipelago in 1979.

The commercial salmon fishing season begins with red salmon that move into the estuaries to run up natal streams from late June through early July. Red salmon comprised 8 percent of the total salmon catch by weight and 10 percent of the fish taken averaged over the period from 1966 to 1980 (Table 4.9, ADF&G 1980). The highest catches in 1979 were from Uyak Bay, Spiridon Bay, Ayakulik, Alitak Bay, and the Dog Salmon-Fraser Lake system.

Pink salmon runs occur from late July to early August and sustain the fishery during this period, which is the height of the season. This species has accounted for an average of 78 percent of the total catch by weight and 83 percent of the number of fish. Even-year runs produced about 4.6 million more fish per year than odd-year runs from 1966 to 1980. In 1980 the primary fishing grounds for pinks on Kodiak Island were Viekoda Bay, Uyak Bay, Alitak Peninsula, and the east coast north to Womens Bay. On Afognak Island, Kazakof, Duck, and Izhut bays were prime fishing areas in 1979.

The chum salmon run follows that of pink salmon, and has become an increasingly important part of the Kodiak fishery in recent years. From 1966 to 1980 chums comprised an average of 14 percent of the annual catch by weight and 7 percent of the total number of fish. In 1979 the highest chum catch was from southeast Kodiak Island in Sitkalidak Strait south of Old Harbor and in Kiliuda Bay.

Table 4.9. Kodiak area salmon catch by species, 1948-1980.

YEAR	KINGS	REDS	COHOS	PINKS	CHUMS	TOTAL
1948	1,401	1,260,465	32,364	5,958,487	330,795	7,583,512
1949	851	892,336	55,737	4,927,779	699,548	6,574,251
1950	2,127	920,885	40,653	5,304,701	685,109	6,953,475
1951	2,204	470,172	47,724	2,005,947	422,179	2,948,227
1952	961	631,094	35,875	4,553,697	983,800	6,205,427
1953	2,927	391,855	38,889	4,947,481	490,012	5,871,164
1954	906	329,370	56,426	8,325,034	1,139,763	9,851,499
1955	2,468	164,482	34,582	10,794,164	482,424	11,478,121
1956	576	306,194	54,215	3,349,203	660,326	4,370,514
1957	1,023	234,127	35,028	4,690,994	1,152,416	6,113,588
1958	1,942	288,014	20,555	4,038,938	930,698	5,280,147
1959	1,837	330,087	14,512	1,799,675	733,784	2,879,895
1960	1,191	362,194	54,213	6,684,798	1,133,412	8,199,808
1961	864	407,979	28,579	3,926,023	518,935	4,882,380
1962	1,095	784,664	53,831	14,188,745	794,717	15,823,052
1963	286	407,040	57,011	5,480,158	305,061	6,249,556
1964	1,302	477,938	35,567	11,861,785	932,219	13,299,811
1965	786	346,137	26,672	2,886,831	431,340	3,691,766
1966	593	631,650	67,681	10,755,582	762,765	12,218,271
1967	962	283,588	10,083	187,813	221,149	703,595
1968	1,936	760,348	56,013	8,760,533	749,854	10,328,684
1969	2,241	603,798	35,126	12,492,576	536,808	13,670,549
1970	1,089	917,057	66,426	12,045,586	919,306	13,949,464
1971	920	478,195	22,844	4,332,994	1,541,227	6,376,180
1972	1,300	221,604	16,646	2,485,802	1,164,526	3,889,878
1973	800	167,341	3,573	511,708	317,921	1,001,343
1974	542	415,236	13,329	2,646,097	247,879	3,323,073
1975	101	135,418	23,659	2,942,801	84,431	3,187,410
1976	766	641,484	23,714	11,077,992	740,495	12,484,451
1977	585	623,468	27,920	6,252,405	1,072,313	7,976,691
1978	3,228	1,071,782	48,795	15,004,065	814,345	16,942,215
1979	1,905	631,735	140,629	11,287,591	358,400	12,420,260
1980	529	651,394	139,154	17,290,615	1,075,557	19,157,249
1949-1979 ODD-YEAR AVERAGE	1,298	410,547	37,535	4,801,151	585,497	6,190,573
1948-1980 EVEN-YEAR AVERAGE	1,257	627,727	47,968	8,487,098	827,376	9,991,426
1948-1980 AVERAGE	1,280	519,569	41,843	8,737,565	709,574	8,009,831

1/ Catches prior to 1948 were estimated from casepack production.

Source: ADF&G 1979.

Coho salmon run late in the season (mid-September) and comprise a very small percentage of the total salmon harvest. In recent years the only consistent area of production was at Karluk Lagoon.

There is no season established for king salmon, and its catch is totally incidental to that of other species (ADF&G 1980).

Red, pink, and coho salmon are the primary species in the subsistence fishery, accounting for an annual average of 93 percent of the catch (Table 4.10). Red salmon account for 48 percent of the catch, more than double that for coho and pinks (22 and 23 percent respectively). Chum salmon account for 7 percent of the catch, and king salmon account for a trace catch.

Red salmon are considered a primary subsistence resource in most areas. In 1979, a total of 10,376 fish were taken in the Borough, of which 34 percent were harvested in the Buskin area of Chiniak Bay. The second largest catch (11 percent) was from Afognak Bay. Pink salmon were also taken in good quantities in the Buskin area, as well as near Old Harbor, Barling Bay, and Uyak Bay. Nearly half of the coho harvest was from the Chiniak area; other areas on Kodiak that provided good catches were Kizhuyak Bay and the Karluk area. On Afognak Island good subsistence yields of coho came from Afognak Bay, Litnik, Selief Bay, and Danger Bay (ADF&G 1980).

Sportsmen concentrate their fishing efforts in Chiniak Bay. Saltwater harvests for sportsmen totaled three-forths that of subsistence users (Table 4.11). Species composition of the sport catch differed from that of subsistence users. Coho and pink salmon were the primary targets.

The sport catch in fresh water in 1979 more than doubled the saltwater harvest that year. Pink and coho salmon again dominated the harvest.

Table 4.10. Kodiak area subsistence fishery, 1962-1979.

Year	Permits Issued	Permits Returned	Species Catch					
			Kings	Reds	Cohos	Pinks	Chums	Total
1962	74	13	0	0	433	397	20	850
1963	74	15	0	297	576	836	195	1,904
1964	43	9	6	332	184	88	71	681
1965	67	7	2	19	318	244	12	595
1966	48	13	0	295	331	334	393	1,353
1967	84	29	2	1,306	571	894	344	3,117
1968	132	28	0	658	433	529	45	1,665
1969	242	30	1	481	338	620	30	1,470
1970	213	49	1	959	939	797	265	2,961
1971	267	131	5	3,442	1,720	1,276	472	6,915
1972	329	176	11	3,633	1,531	2,516	2,729	10,420
1973	400	149	7	4,453	2,289	1,393	1,166	9,308
1974	367	90	1	1,909	846	1,094	128	3,978
1975	508	90	1	1,141	922	947	221	3,232
1976	536	243	4	4,338	962	2,275	370	7,949
1977	739	451	54	8,119	2,508	2,849	317	13,847
1978	860	539	50	7,239	3,699	2,747	572	14,307
1979	1,085	697	111	10,376	3,840	3,300	333	17,960

Source: ADF&G 1979.

Table 4.11. Kodiak Area* sport fish harvests and effort by fisheries and species, 1979.

	Days Fished	KS	SS	RS	PS	CS	LL	HA	SH	RT	DV AC	Other
SALTWATER:												
Boat	7,750	10	1,335	63	1,345	0	0	2,887	0	0	800	2,890
Shoreline	15,374	88	2,271	267	7,508	382	0	126	9	0	4,481	12,242
SALTWATER TOTAL	23,124	98	3,606	330	8,853	382	0	3,013	9	0	5,281	15,132
Percent of Total Salmon		1	27	2	67	3						
FRESHWATER:												
Buskin River	19,336	0	2,870	424	4,036	0	0	0	0	0	15,150	0
Pasagshak River	5,785	0	2,409	236	1,173	9	0	0	0	0	982	0
Other Streams	8,017	654	2,346	1,289	1,809	109	0	0	309	136	2,172	0
Roadside Lakes	1,258	0	136	31	0	0	109	0	0	300	173	127
Other Lakes	1,525	0	155	126	0	0	264	0	0	536	1,663	0
FRESHWATER TOTAL	35,921	654	7,916	2,106	7,018	118	373	0	309	972	20,140	127
GRAND TOTAL	59,045	752	11,522	2,436	15,871	500	373	3,013	318	972	25,421	15,259
Percent of Total Salmon		2	37	8	51	2						

Source: ADF&G 1981b.

*Kodiak Area (Area Q): All waters and drainages of the Kodiak and Afognak Island groups.

KS = King Salmon
SS = Silver Salmon (Coho)
RS = Red Salmon (sockeye)
PS = Pink Salmon
LL = Land locked coho
SH = Steelhead
RT = Rainbow Trout
DV/AC = Dolly Varden/Arctic Char
CS = Chum Salmon
HA = Halibut

Sports Fisheries. Most freshwater fishing effort is directed toward Dolly Varden (Table 4.11). This occurs primarily during the spring in streams along the Kodiak road system. The Buskin and Pasagshak rivers are among the most popular. Catches from areas not easily accessible by road are usually incidental to salmon, rainbow trout, or steelhead fishing (ADF&G 1978).

Steelhead fishing is a popular sport fishery, running from late September through early November; however, catch statistics indicate that very few steelhead are harvested. In 1979 the catch totaled 318 fish. The Karluk River receives the greatest steelhead fishing effort (ADF&G 1978).

Rainbow trout, graylings, and landlocked coho are stocked regularly in lakes around the City of Kodiak. Although rainbow trout are fished year-round, the major fishing pressure occurs during the summer months. Native stocks are more remote and are usually taken incidental to other activities, such as bear hunting (ADF&G 1978).

4.2.2 WATERFOWL

Waterfowl are hunted for subsistence and sport purposes. Ducks are the primary waterfowl taken, 50 percent of which are mallards. Fewer than 50 geese per year were taken between 1977 and 1979 for the entire Archipelago. Approximately one-third of the sport harvest is taken in Kalsin Bay. American River is also a popular hunting area (Timm 1980).

4.2.3 MARINE MAMMALS

Marine mammals are used for subsistence in Karluk, Larsen Bay, and Ouzinkie. Seals are considered a primary subsistence resource in all three villages. Sea lions are considered a primary resource only in Larsen Bay. They are of secondary importance in the other two villages (BLM 1981).

4.2.4 UPLAND GAME

Ptarmigan and Rabbit. Ptarmigan and rabbit are primary subsistence game. They are also exploited by sportsmen. No harvest figures are available, however, to indicate where and how many are taken.

Bear. Bear are a recreational game animal. Harvests are closely regulated through two permit processes. All of Kodiak except for the northeast section is regulated through permit drawings (Table 4.12). Sixty percent or more of the permits must be issued to residents; eligibility is restricted to one bear every four years. Afognak, Shuyak, and Raspberry islands and northeast Kodiak have an open registration issued throughout the spring and fall hunting seasons.

Average annual harvests between 1961 and 1979 equaled 133 bear (ADF&G 1980a). The recommended maximum annual harvest is 140, divided among 5 harvest subunits (Table 4.13).

Allowable harvests are greatest on southwest Kodiak Island. There, hunters tend to focus their efforts in the Karluk River area (USF&WS 1977). Afognak Island also offers prime hunting, reflecting its proximity to Kodiak and open registration.

Mountain Goat. Limited mountain goat harvests preclude the usefulness of goats for subsistence purposes. In 1980 hunting was limited to 15 goats regulated through a permit drawing; successful applicants are limited to alternate year drawings. Four management units each have separate quotas (Table 4.14).

Harvests range from a low of 3 goats in 1976 to a high of 16 goats in 1974. Average annual harvest between 1973 and 1980 equalled 11 goats. 1980 game recommendations indicate that the goat population on Crown Mountain is thriving. As a result, the hunting area may be expanded to include the eastern slope of the mountain (ADF&G to be published).

Table 4.12. Fall 1980 drawing permits: Kodiak Brown Bear.*

Area (Game Management Unit 8)	No. of Permits to be issued Res.	No. of Permits to be issued Non-Res.	Total No. of Applications Received	Total No. of Fall Brown Bear Harvested**
South & west of Kizhuyak Bay	2	1	5	0
West of Ugak Bay	3	2	12	2
South of Ugak Bay	3	2	13	1
Kiliuda Bay	3	2	13	1
Sitkalidak Strait Sitkalikdak Island	3	2	4	1
West of Kaiugnak Bay	3	2	8	1
Aliulik Peninsula	3	2	8	2
Deadman Bay	3	2	25	2
Salmon Flats and Moser Peninsula	2	1	15	2
South of Olga Bay	3	2	10	1
North of Olga Bay	3	2	52	1
Frazer Lake	2	1	68	2
Karluk Lake	3	2	96	4
East of Halibut Bay	3	2	5	1
Sturgeon River	3	2	11	1
North Karluk River	3	2	30	0
Amook Bay, Amook Island	3	2	16	2
South of Amook Bay	2	1	3	1
South & east of Zachar Bay	2	1	4	1
South & east of Spiridon Bay	2	1	6	1
Spiridon Lake, north of Spiridon Bay	3	2	13	1
South & west of Uganik Bay	3	2	8	0
South & east of South Arm Uganik Bay	2	1	3	0
Uganik Lake	3	2	6	1
Uganik Passage, Terror Bay	3	2	15	1
Kupreanof Peninsula	2	1	5	0
TOTAL			454	30

Source: Sexton 1981.

* A person could be drawn for an alternate bear hunt.
** Fall Season: October 25-November 30.

Table 4.13. Distribution of brown bear harvest in Unit 8, 1979.

Harvest Submit Number	Total Number	Recommended Maximum Annual Harvest
1-Afognak, Raspberry and Shuyak Islands	15	20
2-NE Kodiak Island	18	15
3-SE Kodiak Island	25	20
4-SW Kodiak Island	52	55
5-NW Kodiak Island	29	30
	139	140

Source: Hinman 1980.

Table 4.14. Fall 1980 drawing permits for Kodiak mountain goats.

Area	Number of Permits Issued	Number of Applicants	Goats Harvested
Wild Creek-Center Mt.	10	23	5
Crown Mt.	5	33	1
Hidden Basin-Terror Lake	8	33	3
West Uyak Bay	13	5	2
	36	94	11

Source: ADF&G, to be published.

Elk. Restricted geographic distribution and limited permit availability on Raspberry Island limit the usefulness of elk as a subsistence resource. Most of the harvest is from northwest Afognak Island, too far from the population centers to be hunted economically. Distribution of the elk harvested in 1979 indicates that the Duck Mt.-Discovery Bay area where 12 elk were taken was best. Ten elk were taken near Tonki Bay/Peninsula area; 9 near Izhut Bay, 4 near Waterfall Lake, and 3 near Paramanof Bay.

Harvest allocations were increased in 1980 in response to increases in elk population. Permit drawings were dropped for southwest Afognak, and Raspberry Island district special draw permits were increased by 15 (Table 4.15). The 1980 harvest was almost two-thirds greater than that of 1979. Most of the increase came from northwest Afognak Island. One location was unknown.

Future management of the elk stocks may be influenced by three factors. First, winter weather can influence the elk populations. Mild winters enhance the populations by expanding forage areas; harsh winters take a toll on the population. Second, hunting pressure can change. Currently there is an increase in hunter participation, particularly in northwest Afognak Island. Permits issued for elk hunting in that area nearly doubled between 1979 and 1980, and 1979 hunter participation was the highest on record. (Some of the overall increase in permits is attributable to the change in permit status in southwest Afognak Island.) Third, timber practices may alter the availability of preferred habitat, replacing areas of mature spruce-open meadow mix with first clear cuts, followed by planted stands which eliminate the open meadows.

Deer. The proximity and abundance of deer make them a primary resource for both subsistence and recreational hunting. Productive harvest areas are Afognak and Shuyak Islands and northwest Kodiak Island. Shuyak Island is particularly popular with mainland hunters.

Table 4.15. 1979-1980 Elk harvest.

	No. of Permits		Applicants		Hunters		Harvest	
	1979	1980	1979	1980	1979	1980	1979	1980
Area 1 NW Afognak Island	524	907	-	-	268	?	39	70
Area 2 SW Afognak Island	150	389	198	-	54	?	14	22
Area 3 Raspberry Is.	50	65	?	352	35	?	15	9
	724	1361		352	375		68	101

Source: ADF&G, to be published; Hinman 1980b.

Nearly half those who participate in the deer harvest are local residents. Between 1800 and 2000 persons participated in the 1979 deer harvest. Average annual harvest of deer between 1968 and 1979 was 1434. The 1979 harvest totalled 3500, or 1400 more deer than the previous record take in 1968.

Both the number of hunters and deer harvests increased dramatically in 1979. In spite of increased hunting pressure, deer population is still increasing and currently is at the highest level since deer were introduced in 1924. As long as harvest continues to lag behind the increase in population, deer will continue to expand into new areas. Loss of habitat through logging, construction, or natural phenomena such as climate or seismic hazard could have a major detrimental effect on the expanded population.

4.2.5 NATURAL RESOURCE MANAGEMENT ISSUES

Residents of Kodiak Borough are heavily dependent upon the natural resources of the area to sustain the economy, for subsistence, and for recreation. Present uses of these resources are extensive, and use or overuse of one resource or habitat may be in conflict with other resource and habitat uses. Utilization of the majority of important resource species is managed and regulated by the Alaska Department of Fish and Game. The goal of the management policies is to allow a maximum sustainable yield of each resource, which necessitates the setting of harvest quotas to minimize overexploitation that could result in the decline or demise of a stock, or in erratic fluctuations of stock abundance.

Given the importance of the biological resources, other uses of the coastal zone are expected to hold some elements of conflict with biological resource use in Kodiak Borough. In the marine environment (tidal to offshore), the principal sources of potential conflict with the commercial and subsistence fisheries are oil and gas activities on the OCS, development of new port facilities, and the construction and operation of fish processing plants. In the terrestrial and aquatic

(freshwater) environments, potential conflicts with biological resource use could arise from use of habitat for urban development, cattle grazing, logging, and hydroelectric development.

Virtually all coastal marine habitats could be adversely affected by oil and gas exploration and development on the OCS. BLM is currently reviewing its plans for leasing tracts on the OCS to expedite oil and gas exploration. Thus, while the Kodiak Lease Sale has been dropped from the current five year plan, it could be reinstated in the near future. BLM (1981) has assessed the environmental impacts of the previously proposed Kodiak lease sale (No. 46). The fact that this sale was not held can be taken as a measure of the level of concern for the impacts that could occur in the Kodiak area attending OCS development. BLM (1981) concluded that a large oil spill could severely affect fisheries resources over an extensive area with the potential for long-term adverse impacts. Oil spills, drilling vessels and platforms, abandoned well heads, and marine traffic could adversely affect commercial and subsistence fisheries. Spilled oil, drilling fluids and solids, and produced waters discharged into the ocean could introduce toxic substances that might not kill significant numbers of organisms but could contaminate the marine food web or taint the flesh of fisheries stocks. The coastal management plan should provide for a review of all permits to drill offshore to ensure that adequate measures will be taken to minimize adverse effects on natural resources.

OCS development and the growing commercial groundfish fishery could generate increased demand for new or expanded ports. Since existing ports are located in bays and new ports would probably also be located in bays, potential conflicts could develop with herring, salmon, groundfish, and shellfish fisheries. Construction of port facilities typically necessitates dredging and filling, which disturbs or preempts habitat; once constructed the facilities could alter circulation patterns and the transport of sediments. Planning for new port facilities should provide for the location of facilities in presently disturbed areas, rather than disrupting or destroying pristine habitat. Most bays contain

a mix of habitats, including exposed high energy coasts near the bay mouth, possibly rocky islands and seacliffs, and an estuarine system with tideflats and wetlands penetrated by one or more rivers or streams. The outer portions of bays can be offshore in character. Thus, a broad spectrum of resources could be affected by development of bays. The coastal management plan should provide for review of development permits and constructions plans to ensure that proposed facilities will not significantly reduce utilization of the bay by important resource species, and that construction impacts are mitigated to the extent possible.

Similar resource use conflicts could arise from the construction and operation of fish processing plants, and in addition, water quality impacts could occur from the discharge of cannery wastes and process waters. The discharge of waste water into pristine receiving waters could have significant adverse effects if diffuser design or circulation in the receiving water body is inadequate to disperse and dilute the effluent. Given the high level of human consumption of biological resources, and the importance of the nearshore marine environment to sustaining the resources, consideration should be given to setting even more stringent discharge criteria than required under the Federal Water Pollution Control Act.

In general, construction of nearshore and onshore facilities that would have significant adverse effects on water quality should be scheduled to minimize coincident timing with salmon runs and herring spawning. Increased turbidity and generally lowered water quality could disrupt spawning, upstream migration, and fishing operations that target on these species at this time (June through August). Similarly, construction activities with attending high noise levels near waterfowl nesting areas and haulout and pupping grounds for seals could disrupt reproductive success. Scheduling of heavy construction to be out of phase with nesting and pupping would minimize this source of impact.

Significant conflicts in habitat use are unlikely to occur from urban development or from cattle grazing. Projections of population

growth and for the cattle industry indicate very little growth over the next several years (section 3.4.2). Very limited population growth is expected to result even if a major oil deposit is found on the Kodiak OCS.

Logging of timber on Afognak Island is an activity that may be in conflict with other uses of upland forests and may have serious effects upon local stream and lake systems. Logging is thought to reduce elk habitat and to contribute to increased silt loads in anadromous fish streams. Little data are currently available to assess this situation.

If Alaska Department of Fish and Game setback recommendations are followed for the twelve land classifications of the State Department of Natural Resources, adverse effects on riverine systems and associated biological resources should be minimized. Recommended setbacks include:

- 200 feet for public recreation lands and private recreation lands. A minimum buffer is considered adequate to control septic systems, pollution from fueling operations, and the need for stream bank stabilization projects.

- 400 feet for agricultural lands, grazing lands, and timberlands. The setback would mitigate problems derived from agricultural runoff and the removal of stream vegetation through grazing or timber harvesting.

- 800 feet for commercial-industrial lands, material and mineral lands, residential lands, and reserved use lands. Problems encountered by these developments include adding excessive siltation, creating fish traps or blocking fish migrations, shifting river channels, adding toxic pollutants, and disturbing animal migrations and human recreation (ADF&G 1980b).

Some changes in the classification scheme have been proposed. Among the alterations are adding greenbelts, watershed lands, and wildlife habitat land to the most restrictive setback category. The rationale supporting these setbacks reflects the need or desirability to provide utmost separation of possible infringements from the more critical uses of the riverine systems (ADF&G 1980b).

An increasing demand for inexpensive electrical power could result in the construction of a number of small hydroelectric generation facilities on rivers and streams. The Terror Lake hydroelectric project is presently proposed to meet this demand. These projects would inundate portions of drainages that presently support resident and anadromous fishes and potentially important upland habitat for deer, elk, and brown bear. The reservoir formed behind each dam would support fish populations that might sustain sport and subsistence fishing, and recreational uses. However, the loss of anadromous fish spawning areas could be significant. Provision of fish ladders would be of importance to provide salmon with a means of reaching upstream (above the dam) spawning areas.

Siting of a hydroelectric project would require making judgments on the reproductive value of candidate streams to anadromous fishes. Alaska Department of Fish and Game has developed criteria for assigning priorities to stream systems in southcentral Alaska. Any system supporting anadromous fish populations is classified a priority system. Stream systems satisfying any of three additional criteria is classified as high priority. These criteria include:

- streams with salmon escapements greater than 1,000
- streams supporting species such as coho and chinook which generally spawn in smaller numbers; and
- streams needed to preserve suitable habitat for all life cycle stages (ADF&G 1980b).

Hydroelectric projects also involve penstocks, road access, and transmission line corridors. Road access to previously inaccessable areas may subject biological resources to increased hunting and fishing pressure, as well as disturbance. Construction of roads will contribute to increased streambed siltation potentially affecting spawning success. Construction of transmission line corridors and penstocks would have some of the same effects as road construction, and all three would result in the loss of upland habitat. Coastal management policy should provide for an in-depth assessment of conflicting uses that could result from such projects.

4.3 WATER RESOURCES ANALYSIS

4.3.1 SURFACE-WATER RESOURCES

Generally speaking, surface-water resources in Kodiak Island Borough are plentiful and of good quality. For example, a mean annual precipitation of 40 inches, typical of the Shelikof Strait coastline, amounts to 700 million gallons of water per year for each square mile on which it falls. Precipitation increases to roughly double this amount on the Pacific Ocean side of the islands.

In spite of this, water supply is a constraint to development within the Borough. The primary problem is water collection and storage. Near-surface bedrock limits the existence or size of groundwater aquifers; thus, much of the precipitation runs off quickly as surface runoff or in numerous small streams that have steep gradients and small valleys. Such small streams have poor potential for the development of storage reservoirs with significant capacities. Storage tanks are being used successfully in many of the communities, but they are expensive and have a limited capacity. Commercial users, such as fish processing plants, often require large quantities of water, increasing the demand for water storage. Site-specific investigations would be needed to identify potential surface-water reservoirs in the vicinity of developing communities or in new areas of development.

Development within the drainage basin of streams used as surface-water sources can adversely affect water quality. Communities in Kodiak Island Borough have typically developed on or near the coast and thus have had a low degree of impact on surface-water quality. However, development of the timber resource in a drainage basin often has detrimental effects on the quality of the receiving waters; therefore, such development should not occur in basins being used for water supply.

City of Kodiak and Vicinity

The current water supply system for the City of Kodiak is inadequate to supply the maximum level of demand during periods of dry weather. This inadequacy is primarily related to inadequate storage. Additional storage is being planned on Monashka Creek. The surface-water resources appear to be sufficient to supply more water than is currently being used if sufficient storage is provided. Development at Cape Chiniak could use the water system of the former U.S. Air Force Station. Development should be limited in the watersheds of those streams used as water sources to prevent deterioration of the water quality.

Akhiok

The water supply for the village of Akhiok has sufficient quantity and quality to meet current domestic demands (Dworsky, personal communication 1981). Substantial growth of the community or the development of commercial water demands would likely cause the capacity of the current water supply to be exceeded. Other surface-water supplies could likely be found nearby, but this has not been investigated. Water quality is not anticipated to deteriorate as a result of further development.

Karluk

The spring-source water supply of Karluk is sufficient to meet current domestic demands of the community (Dworsky, personal communication 1981). Substantial growth of the community or the development of

commercial water demands would likely cause the capacity of the current water supply to be exceeded. Other small streams in the immediate vicinity would likely be able to provide sufficient supplies for most additional demands. The Karluk River may also be a potential surface-water supply. Further development within the community is not anticipated to cause deterioration in the quality of the current water supply.

Larsen Bay

Current domestic and cannery water needs are being met by Trout Creek. It is probable that additional domestic needs could be met using Trout Creek, but further study would be needed to verify this. Large additional commercial needs for water would probably require investigation of other water supply sources. Other small streams in the area, such as the one just to the east of the village, or ground-water sources could be investigated. Deterioration of water supply quality is not anticipated as a result of further community development.

Old Harbor

All water use in the Old Harbor area is being supplied by surface-water sources. Additional growth of the community can likely be supported by the current system. The same water supply may be sufficient to support development of major commercial water users in the area, although quantification of the needs and the system capacity would be required. Other surface-water sources in the area could also be developed to meet the needs of further commercial development. For example, two streams located 1 mile northeast and southwest of the village were found to be adequate water supply sources for limited commercial use (Weeks 1970). Surface-water quality is not anticipated to change as a result of further development in Old Harbor.

Ouzinkie

Spruce Creek provides an adequate source of water for domestic use in Ouzinkie. It may also be able to support some commercial use, such as

the shellfish processor that previously used Spruce Creek for its water supply. Substantial growth of the community water demand, or the development of major commercial water user demands, may cause the supply of Spruce Creek to be exceeded. The community desires to upgrade the old system, which has been in operation since 1965 (Kodiak Area Native Association 1980). It is likely that other surface-water supplies could be found in the general vicinity of Ouzinkie. It is unlikely that development in the Ouzinkie area will cause deterioration of the quality of the Spruce Creek water.

Port Lions

Current surface-water supply is ample to meet current demands. Domestic and commercial growth in the community can be handled by current or additional surface-water sources. The village desires to improve the water system, including a new dam, water storage tank, water treatment facilities, and water extensions to new homes (Kodiak Area Native Association 1980). Streams at the head of Settler Cove and near the airstrip could likely be used for water supply. Further development within the community is not anticipated to cause deterioration of the quality of the surface-water resources.

4.3.2 GROUND WATER RESOURCES

Ground-water resources in the Kodiak Island Borough are quite limited in distribution, extent, and yield. Thus, current and future water demands must largely be met by surface-water sources. However, this should not preclude the investigation of ground-water sources to supply new development.

Use of ground-water sources as a water source for existing or new developments can cause water quality degradation. The primary way that this can occur is if wells near the coast are pumped sufficiently to cause brackish water to flow into the aquifer.

City of Kodiak and Vicinity

Ground water is currently not being used in any significant quantity in the area. Ground-water resources can likely be used to support isolated users with low water demand. Site-specific studies would be needed to identify the potential for ground-water use to meet a certain demand.

Akhiok

Current ground-water use in the Akhiok area is negligible. Further limited development in the area may be supported by surface or ground-water sources. Further ground-water source investigation is warranted if future development occurs.

Karluk

Current ground-water withdrawal in the Karluk area appears to be negligible. Further development in the area can likely be served by surface-water sources, but ground-water sources may also provide sufficient quantities for limited development. Further studies would be required to quantify the ground-water resource potential.

Larsen Bay

Current ground-water use in the Larsen Bay area is minimal. Ground-water supplies may be able to support limited development in the area, but further study would be needed to quantify this potential.

Old Harbor

Very few data are available on the ground-water resources of the Old Harbor area. Further investigation would be necessary if ground-water sources are needed to support new development.

Ouzinkie

Very few data are available on the ground-water resources in the Ouzinkie area. It appears that the potential for developing the ground water is good for small-quantity users, and fair to poor for commercial users with high water demands.

Port Lions

No data could be located on the ground-water resources of the Port Lions area. Although there is likely a fair potential for developing a limited ground-water supply, surface-water sources are adequate for anticipated development.

4.4 GEOPHYSICAL HAZARDS ANALYSIS

4.4.1 GEOLOGIC HAZARDS

Constraints of geologic origin fall into two categories: (1) seismic, and (2) mass wasting restrictions. The restrictions generally fall into the categories of no development in or adjacent to the hazards and/or using adequate design techniques to minimize adverse affects from the hazard. Site-specific studies are needed to adequately address these constraints when planning future developments.

Seismic Constraints

Several major faults either border or cross the Kodiak Island Borough Coastal Management District and the southcentral area of Alaska, which is one of the most seismically active areas in the world. One of the strongest earthquakes in recorded history struck southcentral Alaska in March of 1964, with a magnitude of 8.4 on the Richter Scale. While the quake was centered in the Prince William Sound area, approximately 280 miles from the City of Kodiak, resulting tsunamis caused extensive damage to the east side of the Kodiak Archipelago. Several

active faults with youthful scarps occur along the southeastern shore of the Archipelago. Construction within the anticipated ground rupture zone on these or other active fault traces should consider the consequences of faulting. The width of ground rupture along a fault is a site-specific function; ruptures could range in width from a few feet to several hundred feet. See Figure 3.9 for the general location of reported active faults. Liquefaction potential is high in areas with a combination of fine-grained deposits and high water table. Specific site response to ground shaking, however, is also dependent on a number of other factors such as duration of shaking, response spectra, earthquake magnitude and intensity, depth of focus, and building design and construction.

The Kodiak shoreline, particularly Marmot, Chiniak, Ugak, and Kiliuda Bays, is exposed to tsunamis generated anywhere in the Pacific, especially along the Aleutian seismic belt. Based on historical events, the zone of greatest susceptibility to tsunami damage has been between mean sea level and elevation 16 meters. Development on the southeastern shore of the Archipelago should avoid this elevation zone or incorporate appropriate siting and design measures. Table 3.19 shows the highest level of tsunami run-up in each of the Borough communities resulting from the 1964 earthquake.

Mass Wasting Constraints

Mass wasting presents a constraint on development in the Borough. Landslides occur in abundance along many of the steep slopes. Development on or near the toe of landslide deposits may reactivate the slide and should be avoided.

Site-specific examinations should be made prior to development on or near slopes steeper than 35 degrees in the slide prone areas of the City of Kodiak and Old Harbor. Avalanche chutes are generally a phenomenon of the steep, higher mountainous areas, but if development progresses into these areas, careful planning and site-specific mapping

need to be done. Activities in the avalanche-prone areas should be restricted, particularly during times of high avalanche risk, characteristically during spring thaw.

4.4.2 OCEANIC HAZARDS

Hazards of oceanic origin that can potentially affect the Kodiak Island Borough coastline include seismicity, coastal erosion, and storms.

Seismic Constraints

Constraints associated with the seismic hazard include those to minimize damage from coastal erosion and flooding. Tsunamis and seiches can cause significant wave-induced erosion and flooding. Further study is needed to quantify this hazard for use in site-specific planning on the Kodiak Island Borough Coastal Management District coastline.

Coastal Erosion Constraints

Coastal erosion is a reported hazard in nearly all the Borough communities; however, site-specific data on the rate and extent of erosion are lacking. Areas particularly susceptible to the erosional effects of sea waves are a factor of area exposed to sea waves, wave energy, and the material composition of the shoreline. Where a sedimentary shoreline coincides with high wave energy, the potential for coastal erosion is high.

There is a need for detailed study in those communities where coastal erosion is reported to identify the cause, rate, and extent of erosion. The success of any remedial measures taken to arrest the rate of erosion is dependent on acquiring these data. With regard to new development, consideration of the potential hazards associated with the coastline should be included in any analysis of development potential of the area. Site-specific data should be collected in any such analysis, since the available data base is extremely limited.

Storm Constraints

As with other coastal hazards, erosion and flooding may result from storm-driven waves. This hazard has been significant in the City of Kodiak, Karluk, Ouzinkie, and Port Lions. Some of the solutions discussed by local residents include placement of breakwaters to protect shorelines from storm-induced waves. Further study is required to determine the extent of storm-induced erosion and proper remedial measures. New development planned adjacent to the coast or offshore should consider the impacts of this hazard.

Summary of Geophysical Hazards

The constraints to development associated with geophysical hazards can be classified into two general categories: avoidance of the hazard area, and designing to minimize damage associated with the hazard (Table 4.16). In most cases, avoidance of the hazard is the best approach. When the hazard is so widespread that it cannot be avoided, or when the proposed development cannot be relocated, projects should be designed to minimize the impacts of the hazard.

4.4.3 RIVERINE FLOODING

Riverine flooding in Kodiak Island Borough is generally limited to relatively narrow zones along the streams. However, flooding in some areas may be widespread; detailed stream floodplains should be delineated in areas of potential development to ensure that significant development does not occur in the floodplains. Floodplain lands are best suited for open-space uses.

Construction of water supply reservoirs on a stream may slightly decrease the flood hazards associated with snowmelt or rainfall events, but a dam break could cause substantially greater flooding downstream. An analysis of the flood potential related to a dam break should be considered if development is to occur downstream.

Table 4.16. Summary of basic development constraints associated with geophysical hazards in the Kodiak Island Borough Coastal Management District.

	Avoid Hazard Area	Design for Hazard
GEOLOGIC - SEISMIC		
Fault traces	X	X
Liquefaction	X	X
Ground shaking		X
GEOLOGIC - MASS WASTING		
Landslides	X	X
Avalanches	X	X
HYDROLOGIC - FLOODING		
Within floodway	X	
In floodway fringe	X	X
HYDROLOGIC - ICINGS		
All locations	X	X
HYDROLOGIC - BANK EROSION		
All locations	X	X
OCEANIC - SEISMIC		
Coastal erosion	X	X
Coastal flooding	X	X
OCEANIC - STORMS		
Coastal erosion	X	X
Coastal flooding	X	X

] When both avoidance and design options are identified, avoidance is preferred.

City of Kodiak and Vicinity

Development of certain areas in and near the City of Kodiak should be restricted due to a moderate riverine flood hazard potential. Specific areas that have been delineated as having a flood hazard potential are the presently developed area downstream of the Lake Bettinger Reservoir Dam and the undeveloped land downstream of the proposed enlargement of the Monashka Creek Reservoir. Other riverine flood hazard areas have not been analyzed for detailed floodplain delineation. Areas of potential flood hazard would be a relatively narrow zone along both sides of the streams in the area; the width of these zones would depend on the topography adjacent to the streams. Further study is warranted to delineate these areas.

Akhiok

Development in the Akhiok area is not anticipated to be significantly restricted by riverine flood hazards. The small streams in the area are likely to have relatively narrow floodplains. These floodplains could be delineated in detail with detailed on-site studies.

Karluk

Development in the Karluk area is not anticipated to be significantly restricted by riverine flood hazards. Floodplains bordering the small streams in the area are likely to be narrow, and the terrain is such that Karluk River flooding is not anticipated to be widespread. Flooding potential downstream from the water storage dam should be investigated. Floodplain boundaries could be delineated in detail with further study.

Larsen Bay

Riverine flood hazards are not anticipated to restrict development in the Larsen Bay area. Detailed floodplain boundaries could be delineated with further study.

Old Harbor

Riverine flood hazards are not anticipated to restrict development in the Old Harbor area. Detailed floodplain boundaries could be delineated with further study.

Ouzinkie

Development in the Ouzinkie area is not anticipated to be restricted by riverine flood hazards. The floodplain boundaries for the streams in the area are anticipated to be relatively narrow; this could be verified by further study.

Port Lions

Channel icings cause annual flooding in some areas of Port Lions. Further study is warranted to delineate the area of flooding or to investigate the potential for reducing the icing problem. New development should not be located in areas that are flooded frequently.

4.4.4 STREAM BANK EROSION

Stream bank erosion is not a major hazard in the developed areas of the Kodiak Island Borough. Future development should not be located in areas of obvious stream bank erosion; this should not be a very restrictive guideline in the vicinity of the City of Kodiak, Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions. Akhiok and Karluk have small areas of concern over stream bank erosion problems endangering existing structures.

4.4.5 ICINGS

Icings are not a major hazard in the developed areas of the Kodiak Island Borough. Small icings may occur, but such icings need not preclude development. Proper site selection and development should eliminate any adverse effects of icings.

4.5 CULTURAL RESOURCE ANALYSIS

4.5.1 POPULATION

All of the population forecast figures and some of the discussion in this analysis were obtained from the population discussion in the Final Environmental Impact Statement for Lease Sale No. 60 Lower Cook Inlet-Shelikof Strait, prepared by the Alaska BLM-OCS office, 1981.

The following population forecast for the Borough is based on a non-OCS petroleum development scenario.

1980	1985	1990	1995	2000
10,856	13,851	15,558	17,967	19,556

The forecasts for 1985 to 2000 should probably be reduced by about 8 percent due to the overestimate of the 1980 population by 8 percent. The major portion of the projected growth can be attributed to expectations of expansion in the fishing and fish processing industry. These expectations are based on assumptions regarding the relaxing of present constraints on the industry, such as housing, energy, and land; and on the continuing trend toward longer operating seasons. Expansion into the bottomfishery is also assumed. If bottomfish are harvested by large catcher/processors, or if the primary in-state processing requirement is relaxed, these population forecasts may prove to be too high. Even delays in dealing with some of the industry constraints may reduce the rate of population growth.

Due to the existing locational pattern of harbor and processing facilities, most of the Borough's population growth will occur in the Kodiak urban area. About two-thirds of this growth will occur within the City of Kodiak. The city has been forecast to grow to 10,299 persons by the year 2000.

The growth trend forecast for the Kodiak urban area is steadily upward without big population swings. The 112 percent increase in the City's population by the year 2000 will create a significant impact on the community's infrastructure. A more urban physical development pattern and lifestyle than now exists will be likely to develop. Demands on coastal resources will be an extension of the current pattern - demands for more residential land, water, liquid and solid waste disposal, and energy.

With OCS development in the lower Shelikof Straits area, the annual population growth rate would increase slightly from 5.6 percent to 6.1 percent. By the year 2000 this would mean an additional 445 residents. This forecast for the Kodiak urban area assumes the construction and operation of offshore support service base facilities somewhere in the road-connected area of Kodiak Island. Other than a slight increase in pressure on coastal resources already discussed, the population impacts of OCS petroleum development in the Kodiak road-connected area are minimal.

The populations of the villages in the Borough are expected to grow more slowly than the area around Kodiak. Port Lions is expected to grow at an annual rate of 3 percent under a non-OCS scenario. This growth rate is slightly higher than for the other villages, and stems primarily from Port Lion's expressed desire to attract new industry and the expanded housing availability. This will encourage a larger proportion of the younger populace to remain in the community rather than emigrating as has been the case in the past in several of the villages. The population of Port Lions has been forecast to grow from an estimated 266 people in 1980 to 481 people in 2000. The actual 1980 population of Port Lions was 215 people. The overestimate of the 1980 population by 24 percent means that the forecast for the year 2000 should probably also be reduced by about 24 percent.

Even this moderate 3 percent rate of population growth is substantial in a community the size of Port Lions. The most significant problem the community faces during this period (1980 to 2000) is an anticipated continuing housing shortage despite the planned additions to the current housing stock. By the early 1990s the community will experience the same housing shortage it has experienced in the recent past. Thus, demands on coastal resources generated by population growth in Port Lions will consist of demands on land, water, waste disposal, energy, and fish and wildlife resources, and in short-term environmental degradation.

With OCS development Port Lions is expected to be significantly affected due to the construction of a terminal facility in the village. In this case, the annual population growth rate would increase to 7.2 percent over the 1980 to 2000 period, yielding a population of 648 by the end of the century. This estimate should again be reduced by some percentage to account for the overestimate of the 1980 population.

In addition to larger demands on the resources already mentioned, impacts on Port Lions include expansion of the local economy and competition for jobs by the secondary population accompanying the petroleum workers.

Without OCS development the future of the other Kodiak villages is likely to bring little, or at least relatively modest, change within the foreseeable future. The populations of the villages are expected to grow at an annual rate of about 2 percent per year, but rates of growth are of little significance given the small populations. The demands on coastal resources generated by growth of the populations in the villages are nonetheless expected to be significant. Many community infrastructure requirements, such as those for housing, waste disposal, transportation, and energy, are not now being met in the villages. Population growth, even at low rates, will exacerbate the problems caused by these deficiencies. Demands on fish and wildlife resources are expected to grow, and a potential problem exists with competition for these resources by non-village residents.

Population growth in the Borough is expected to significantly increase demands on coastal resources. Economic growth and development is the driving force behind population growth. Therefore decisions on economic growth and development strategies and plans should take into account the resulting population changes and hence the demands on coastal resources. Coastal resources present both choices and constraints. Development can occur at a rate determined by the constraints; or it can occur at a rate determined by public choices regarding coastal resource management, usually at a rate less than that determined by constraints.

4.5.2 LAND OWNERSHIP, USE, AND MANAGEMENT

Land Ownership

Because of topfiling land selections among state, local, and Native entities, overfiling by some Native corporations, and the uncertain legal status of others, it will be several years before land ownership is finalized. And, even when land ownership has changed hands, many use restrictions remain.

After the final transactions associated with the Alaska Native Claims Settlement Act and the Alaska National Interest Lands Conservation Act, the status of federal lands depends on actions taken by the Department of Interior. The opening of certain federal lands in the Borough to oil and gas exploration and other proposed programs could result in new lease arrangements or land disposals. Should Native corporations show interest in selling lands within the Natinal Wildlife Refuge, and the federal government exercise its option at first right of purchase, federal land ownership could actually increase.

The status of state-owned lands depends on rulings on tentatively approved and selected lands. Of the lands likely to be patented, much may be included in the State Game Refuge and Parks systems.

The Borough is still in the process of patenting its 56,000-acre entitlement from the State of Alaska. The largest and most imminent area to be patented is the center of Shuyak Island; potential use for that selection is being negotiated with the state of Alaska, which has patented the shorefront portion of the Island. The Borough is likely to continue its current practice of disposing patented land to private ownership through land sales.

Native Corporation land ownership is still in the process of adjudication. In many parts of the Borough, Native Corporation lands are subject to several sets of restrictions. Privately-owned lands are subject to the provisions of the Kodiak Island Borough Zoning Ordinances, Subdivision Regulations, and Building Codes. On the National Wildlife Refuge, corporation lands must be managed in accordance with Refuge management guidelines, which can significantly restrict uses to those compatible with wildlife habitat. Subsurface estate of corporation lands remains in the possession of the refuge, which also has right of first refusal on any lands offered for sale. This latter clause has the potential to limit sale value of corporation lands.

Other private lands will remain a small percentage of total land ownership, although land disposals may slightly increase total private acreage.

Land Use

Land use patterns in the Borough depend in large part on federal policy. Opening federal offshore and onshore lands to petroleum exploration has direct and indirect land use implications. An economic find will increase industrial use directly, and possibly generate population-induced increases in commercial and residential uses, primarily in Kodiak. Use patterns and distribution for timber and agriculture should remain the same. Without petroleum development, residential use should increase slightly in communities due to high housing demand, and possibly in remote areas with Borough land disposals.

4.5.3 RECREATION

Activities

Recreation resource use in the Kodiak Island Borough will continue to increase, with hunting, fishing, and boating experiencing the highest resident and nonresident use participation. Distribution of activities is currently constrained and concentrated in certain areas by limited access and facilities, particularly outside of the Kodiak road system. New facilities, such as marine and state parks and recreation cabins, could broaden the distribution of recreation use, and generally increase use level. Increased access and cheaper access costs (such as the ferry) should also increase recreation activity use levels. The Department of Fish and Game received 2000 easement requests for sport fishing access in the Borough (Troll 1980). However, increased access to rural communities will only aggravate existing conflicts with other resource uses.

Management Facilities and Responsibilities

Future recreation facilities and management are very much tied to land ownership status. With the passage of the Alaska National Interest Lands Conservation Act, U. S. Forest Service recreation cabins were transferred to both the U. S. Fish and Wildlife Service and Koniag Inc. Whether either of these entities will provide additional facilities remains to be seen. State park facilities at proposed marine parks and on Shuyak Island are likely, but may not be constructed for several years, depending on land conveyence and facility fund appropriation. The facilities would consist of developed campsites and day use facilities. Several potential state marine parks have been investigated in the Kodiak Archipelago.

Conflicts. Recreation use conflicts with village subsistence use and lifestyle are due to several factors. Ferry and airstrip access to Port Lions and Karluk coincide with prime recreation attractions, hunting, and fishing. The lack of publicized and posted easements contri-

butes to conflict when trespass and littering of private property results. Developing facilities and providing ferry access to prime hunting or fishing areas remote from villages is a potential solution; posting and publicizing recreation easements on private lands is another. Another more complicated solution would be for Borough communities to site and develop recreation facilities to minimize conflicts in town yet capture game revenue from recreation visitors. However, this solution could attract more nonresident use.

The recreation analysis for the seven Borough communities in presented below.

Akhiok

Projected recreation use in Akhiok by nonresidents is unlikely, with the exception of occasional bear hunters at existing camps on bays north of the community. Areas of concern near Akhoik identified by the Alaska Division of Parks include Russian Harbor, Tugidak Island, Drake Head, and South Olga Lakes.

Kodiak

The City of Kodiak will continue to experience increasing resident and nonresident recreation use of the road system area. Several current recreation-related problems could become more severe: lack of campground facilities for visitors and transient work force, limited boat launch and harbor facilities for recreational boating, reduced access to recreation areas on Native corporation lands, and increased hunting and fishing pressure on fish and game resources.

The Borough Parks and Recreation Comprehensive Plan element forecasts priority needs for parks, boat launch facilities, a pistol-rifle range, trails, bike trails, and campgrounds over the next five years. More detailed information can be obtained in the plan report.

Areas of concern in the Kodiak road system area identified by the Alaska Division of Parks include Monashka Creek, Pillar Creek, Fort Abercrombie, Spruce Cape, Holy Resurrection Church, Erskine House, Gibson Cove, Baskin Lake-River-Beach, Woody Island, Long Island, Cape Chiniak Road, Womens Bay, Cliff Point, Middle Bay, Kalson Bay, Isthmus Bay, Cape Chiniak, Narrow Cape, Pasagshak Bay, and Saltery Cove.

Karluk

Recreation fishing and floating make the Karluk River the most popular recreation area outside the road system. Recreation activity levels will probably increase, but no new federal or state facilities are planned. Posting easements through Native corporation lands is needed to reduce trespass and property damage. Provision and maintenance of recreation facilities on public easements are also needed to eliminate camping on private lands and reduce littering.

Local residents are concerned that if recreation fishing on the Karluk increases, fishery resources will be allocated between subsistence and recreation use.

Areas of concern near Karluk identified by the Division of Parks include the Ayakulik River, Halibut Bay, and the Karluk Lake and River.

Larsen Bay

Larsen Bay will continue to be a jump-off point for fishermen and hunters flying out to more remote areas. The probability of developing any attractions in the immediate area of town are low at this time.

Areas of concern near Larsen Bay identified by the Alaska Division of Parks are the head of Uyak Bay, Carlsen Point, Chief Point and Cove, and Little River Lake.

Old Harbor

Like Akhiok, nonresident recration use of the immediate Old Harbor area will remain at low levels, probably limited to bear hunters utilizing local guides, and occasional tourists. Bear hunting will continue to occur in the major bays north and south of the community.

Areas of concern near Old Harbor identified by the Alaska Division of Parks include Midway Bay, Barling Bay, Three Saints Bay, and Ocean Bay-Rolling Bay.

Ouzinkie

As Kodiak metropolitan area residents pursue recreation activities, they are likely to increase hunting and fishing pressure around the community and Native corporation lands at Icon Bay, Anton Larsen Bay, and southwestern shore of Narrow Strait. Ouzinkie residents are concerned about the impact on subsistence resources. Posting of easements through Native corporation lands is needed to reduce trespass and property damage. In places like Icon Bay and Anton Larsen Bay, provision and maintenance of recreation facilities on public easements are also needed to eliminate camping on private lands and reduce littering.

Areas of concern in the Ouzinkie area identified by the Alaska Division of Parks include Anton Larsen Bay, The Triplets, and Icon Bay.

Port Lions

Recreation activity levels and demands in Port Lions have community resident and nonresident components. To meet resident needs the Port Lions Comprehensive Parks and Recreation Plan identifed a need for three proposed facilities; a ball field-ice rink at Andersen Field, a swimming beach at Gunderson Beach, and a ski area at Hansen Hill. Five recreation-related capital improvement recommendations were also made for 1980-85 at the city hall, playground, library, boat harbor, and ski hill.

The recent influx of tourists and nonresident hunters and fishermen have presented several problems for Port Lions residents, including trespass, property damage, competition for subsistence resources, and disruption of lifestyle. As public transportation, ferry access for nonresidents can't be prevented, and local residents feel that improving recreation facilities for local needs may only encourage more nonresident recreation use. Two solutions have been recommended: reducing the deer bag limit from four to one in the immediate town area, and providing a new lodge/campground for tourists stranded by the ferry. The Parks and Recreation Plan states that the problem needs further planning.

Areas of concern in the Port Lions area identified by the Alaska Divison of Parks include Kizhuyak Bay, Anton Larsen Bay, and Barbara Lake and Cove.

4.5.4 TRANSPORTATION

Transportation is of paramount importance in the Kodiak Island Borough due to the relative isolation of the Borough and the even greater isolation of the villages. Therefore, demands on coastal resources generated by transportation needs will be likely to receive high priority. The major demand is for additional land on which to expand or to build new transportation facilities. Increased accessibility of the Borough will enlarge demands on several coastal resources such as fish and wildlife. While transportation is vital to the economic well-being of the Borough, transportation-generated demands on coastal resources will have to be reconciled with other needs.

The importance to the Kodiak Island Borough of marine transportation is expected to become even more crucial in the future. New or improved deep water docking, cargo and passenger handling, and cargo storage facilities are needed to expand the Borough's role as a transshipment point and to provide better marine services to the Borough residents. Expanded ferry service for both passengers and commodities is being considered by the state. A potential conflict exists because while villagers want expanded and improved ferry service, they are also concerned about the accessibility of their villages and local resources to

outsiders. The expansion of the fishing and recreation industries is creating needs for new and improved small boat harbors.

Air carrier operations are expected to continue to expand, along with population and economic activity, while general aviation operations are expected to expand even faster. These expanding operations are creating needs for new and improved runways, and passenger and cargo facilities and equipment, such as navigation aids. Except in the case of seaplanes, land is the only coastal resource demanded to meet the needs of expanded air transportation.

The demands on coastal resources generated by land transportation needs are significant. Even though the villages contain relatively few miles of roads, their needs are as critical as the needs of the road-connected area around the City of Kodiak. Demands on coastal resources include land for new or enlarged rights-of-way, and material sites for road construction and maintenance.

The transportation needs for each of the villages and the City of Kodiak area are discussed under each individual community.

Akhiok

Transportation facilities and service in Akhoik are limited, and suffer from weather contraints, lack of maintenance, and erosion. The community badly needs a protected moorage area for local fishing boats. Boats are currently tied up on the beach and hauled out of the water during storms. Funding for such a facility has been appropriated, and preliminary investigation of sites near Akhiok has begun by the Alaska District Corps of Engineers. Weather conditions, especially during the fall and winter months, interrupt air access to the community for several days at a time. However, little can be done to alleviate this situation.

As elsewhere in the Borough, lack of maintenance of transportation facilities jeopardizes their continued use. Without maintenance, the road connecting Akhiok and its airstrip will continue to erode and eventually become impassable.

Karluk

Like Akhiok, transportation facilities and service in Karluk are limited, and suffer from weather constraints, lack of maintenance, and erosion. The community needs protected boat moorage facilities in Karluk Lagoon; boats are currently tied up on the beach and can be damaged during bad weather. Weather, particularly winds from the southwest, west, and northwest, interrupts air service into Karluk. Air service is further constrained by topography and orientation of the airstrip. In both cases, little can be done to alleviate the situation.

Gravel mining operations and the lack of maintenance have resulted in erosion of the road connecting the airstrip with the old village site. Without a solution to the erosion problem the road could become impassable within a few years.

Kodiak

The City of Kodiak is faced with several major transportation problems and needs. The Sealand port facility has limited nearby space to serve as marshalling yards, and has sustained periodic damage from severe storms and coastal erosion. The small boat harbor has been extremely overcrowded for many years; during peak fishing seasons boats can be rafted seven deep. Construction of the Dog Bay small boat harbor in 1982 should help alleviate small boat overcrowding. The instability of Pillar Mountain makes construction or expansion of facilities in the St. Paul Harbor area questionable, particularly in terms of receiving state or federal financing.

Larsen Bay

Larsen Bay has limited transportation facilities and services. Relatively well-protected, weather is not as significant a problem for air service as in other communities, and the community has protected moorage for fishing vessels available. Road erosion and maintenance are the principal transportation problems in Larsen Bay. Local roads, not built to state standards by the Bureau of Indian Affairs, were in poor shape. The State of Alaska takes no maintenance responsibility for them, and the community cannot afford to maintain them. Road reconstruction is the best long-term solution.

Old Harbor

Old Harbor has good docking facilities and a small boat harbor, and proximity to the City of Kodiak results in good air service. Transportation needs are associated with the maintenance of facilities and preferred relocation of the airport. As in Larsen Bay, BIA roads are not up to standard and are poorly maintained. The road connecting the townsite with the new housing area is eroding, and without proper attention will continue to deteriorate. Some local residents feel that the boat harbor is slowly filling with sediment and in need of dredging (Old Harbor 1981, community meeting). The community's airstrip is located immediately adjacent to the northeast edge of town, and an airplane accident could result in substantial loss of life and property damage. An alternative site just past the lagoon and landfill has been suggested.

Ouzinkie

Transportation facility and service needs in Ouzinkie vary. Close proximity to the City of Kodiak means relatively good floatplane service and lower transportation costs than other villages. However, the community badly needs an airstrip; one has been planned, but has in the past been deleted from state transportation improvement priorities. The community also lacks a formal boat harbor. There is limted tie-up space at

the village corporation dock, and most boats are moored in the open water of Ouzinkie Harbor. Some sort of protection from the southeastern storms is desirable to local residents (Ouzinkie 1981, community meeting). As in other villages, local roads were built by BIA, below state standards, and are deteriorating. The state has not taken maintenance responsibility, and the community does not have sufficient funds to do so.

Port Lions

Transportation facilities and service for Port Lions are the best of the Borough's six rural communities. The community's need for a small boat harbor will be met upon completion of a new harbor facility north of town. Port Lions major transportation problem is related to ferry service, and is often cited when other Borough communities discuss extension of ferry service. As state-funded public transportation, the ferry provides access to and from Port Lions, allowing an unwanted influx of recreation hunters and fisherman. This influx has resulting in competition for subsistence resources, trespass on private property, and general disruption of community lifestyle. Port Lions has sought to mitigate this impact by reducing local fish and game limits.

4.5.5 ENERGY FACILITIES

Energy costs in the Borough will continue to be a critical factor in the determination of the rate of economic growth and the viability of village life. The shift towards more energy intensive methods in the fish processing industry will make energy costs a crucial factor in the growth of this industry. Energy costs will also affect the cost of living of all Borough residents, thereby affecting wage levels and possibly the rate of economic growth.

The remoteness of the villages forces the utilization of high-cost small-scale, less efficient fuel oil energy systems. Energy costs are

using up larger and larger shares of the small cash incomes earned in association with a predominantly subsistence lifestyle. This will make life difficult for a number of village people.

Transportation improvements will help stem the rising costs of fuel oil deliveries, but there is no relief foreseeable in the rapidly rising costs of petroleum products. Even if oil were to be discovered in the Shelikof Straits, this would have little if any effect on oil prices in the Borough.

For this reason, strong interest has developed in hydropower and other alternative energy sources such as windpower. The largest proposed hydropower project is the Terror Lake Project. A smaller project has been proposed for near Port Lions, and the Corps of Engineers has identified several potential sites near the various villages.

Hydropower has the promise of clean and, over the long term, low-cost power. Hydropower projects have high front-end costs, but it appears that the state will be willing to help finance these costs.

Hydropower projects have the potential for significant impacts on coastal resources. The biological resource section of this report, section 4.1, discusses the impacts of dams and power lines on biological habitats. Recent experience with the Terror Lake Project has revealed a regulatory conflict, which has been temporarily resolved. The U.S. Fish and Wildlife Service found the Terror Lake Project incompatible with its resource management goals. While this issue is resolved for Terror Lake and possibly for some of the other projects, hydropower development could be delayed if found incompatible with refuge management guidelines.

Petroleum development in the Kodiak Island Borough region has the potential for very significant demands on coastal resources. The potential impacts on biological resources are discussed in section 4.1, and the potential impacts on socioeconomic resources are discussed earlier in this section.

A major unresolved concern is the siting of a marine terminal if commercial reserves are found in Shelikof Strait. The only oil terminal site in the Borough is hypothesized to be located at Talnik Point near Port Lions. The residents of Port Lions are quite concerned about this selection. Several studies have identified potential sites, and it is now up to the Borough and other concerned groups to identify their choices for sites among the alternatives.

If a commercial discovery is made, the Secretary of the Interior has the authority to require a developmental EIS in a frontier area such as lower Cook Inlet-Shelikof Strait. If major issues remain unresolved, Borough residents may request such an EIS, which would take into account an approved Coastal Management Plan for the Borough.

4.5.6 COMMUNITY FACILITIES AND SERVICES

Community facilities and services (water, sewer, and solid waste) are constantly changed, replaced, and improved as equipment and structures become outdated or reach capacity as demands generated by economic development and population growth increase.

The resource inventory detailed the existing and anticipated deficiencies. These deficiencies are presently and will continue to generate significant demands on coastal resources. Impacts on biological resources are detailed in Section 4.2. The constraints imposed on economic growth due to utility system deficiencies are detailed later in this section.

The Community Facility and Service inventory also presents Borough and community capital improvement to upgrade facilities and services.

4.5.7 ECONOMIC ANALYSIS

The foundation of the Kodiak economy, the fishing and fish processing industries, will continue to grow and diversify. Growth is expected in both the traditional fisheries and the emerging bottom fishery.

Most of the traditional fisheries are being fully utilized, but better scientific understanding and improved resource management will enhance and stabilize yields, allowing more efficient use of gear, plant, and labor force. The catch in the traditional fisheries is expected to grow 33 percent in weight and 75 percent in real value by the year 2000. (BLM 1980). Little growth is expected in either fishing employment or the number of fishing vessels because the effort of the present fisherman will be intensified rather than new people or gear being used.

The demands of the fishing industry on biological resources are discussed in Section 3.1. The potential exists for conflicts with sport and subsistence use of the resource. Even though the small boat harbor in Kodiak is used well beyond its design capacity, the projected increase in the traditional fisheries harvesting activity can occur without a significant increase in the number of boats using the facility (BLM 1980).

Moderate growth is expected in the traditional fish processing industry but the industry may be negatively affected by a change in primary processing requirements. Underutilization of present processing facilities or the capability to expand capacity implies that little change should be expected in the number of plants. The output mix of the processing industry will continue recent trends toward more fresh and frozen products. Without any increases in efficiency, processing employment is projected to grow by 33 percent. With increased efficiency, processing employment is expected to drop by 11 percent (BLM 1980).

Recent challenges to the constitutionality of the instate primary processing requirement could lead to a significant drop in both employment and the number of processing plants.

The expected growth in the processing of traditional fish catches will create additional demand for water, land, housing, transportation, and energy, but none of these demands will be of a critical nature. While improved supplies of these resources will aid the growth of the industry,

the existing shortages are not of a magnitude that affects the viability of the industry.

Predictions about expansion into the harvesting and processing of bottomfish remain speculative at best. The resource potential exists - the Alaska Sea Grant Program has projected a catch of 100,000 metric tons in the Kodiak region by the year 2000 - but harvesting and processing methods are still being investigated. The two main scenarios that have been proposed imply different demands on coastal resources.

The harvest by smaller vessels and on-shore processing scenario adds to the demands created by growth in the traditional fisheries industry, namely water, energy, land, housing, and transportation. Shortages of these resources could significantly affect the growth potential of the industry in the Kodiak Island Borough.

The other scenario involves the utilization of large catcher/processors. If this scenario were realized, marine service and supply and transportation demands would be generated, primarily in and around the City of Kodiak.

The timber industry in the Kodiak Island Borough is not expected to grow significantly. Operations on Afognak Island are expected to continue at the present level for at least the next 7 to 10 years. Logging on Afognak at about present levels could continue indefinitely if the native corporation owners decide to utilize Afognak's entire timber resource potential on a sustained yield basis. The fluctuations in the Japanese export market will continue to influence the year to year level of logging activity. The potential for conflicts exists between logging activity and other uses of Afognak such as fish habitat, elk hunting, and other recreational uses, and will require continued sound management practices. The only potential for growth in the timber industry over current levels would be to make Shuyak Island available for timber operations. Land ownership agreements between the Department of Natural Resources and the Kodiak Island Borough make this prospect unlikely.

Agricultural production, primarily range-fed livestock, is not expected to grow significantly in the foreseeable future. While the rangeland potential is great, Kodiak's distance from larger markets such as that in southcentral Alaska is a major handicap. If large-scale feed lot meat processing facilities were ever built in the railbelt area of the state, the demand for feeder cattle would possibly extend to the Kodiak Island Borough, but only on a marginal basis. Due to transportation costs the level of demand would probably be small, but could conceivably be large in some years, depending on production conditions and costs along the railbelt. The impacts of expanded production on coastal resources would be minimal due to the virtual lack of competing uses for the grazing areas. Bear predation of livestock will continue to be a problem, and growth of the industry may stimulate the search for longer-range solutions to the problem.

The potential for metallic mineral mining is unknown at this time, but continued explorations are expected. Renewed interest in the gold deposits in the Borough are not likely to lead to any major developments.

The limited supply of gravel deposits near Kodiak has created conflict in the past. The lack of designated gravel borrow sites and uncertain land ownership are the prime causes of conflict. The only formally designated site in the Borough is located at Bells Flats, adjacent to a developing rural residential area, where residents are organizing to limit or close down gravel mining and processing in the area. Gravel removal from a site in Anton Larsen Bay for breakwater construction at Port Lions did not have approval from Koniag, Inc., which owns the property. In Karluk, gravel removal from a beach to provide material for a new airstrip is a possible cause of erosion to the road connecting the airstrip and the old village site. All of these problems point to a need for a cooperative effort by federal, state, Borough and Koniag representatives to identify appropriate areas and mining techniques for gravel mining throughout the Archipelago.

The future of petroleum resource development in the Kodiak region is hard to predict at this time. Petroleum potential exists in both the Gulf of Alaska and the Shelikof Straits offshore areas. The Western Gulf of Alaska OCS lease sale number 61 was cancelled in 1980, and it is not now known whether this will be reactivated. OCS lease sale number 60, for tracts in the Cook Inlet-Shelikof Strait area, will take place in September of 1981. Strong interest is being shown in this sale. There is also an OCS lease sale number 100 scheduled for 1986, which includes the western Gulf of Alaska. This lease sale area has not yet been precisely delineated.

There is a 2 to 5 percent probability of discovering commercial resources in the lease sale number 60 area. The potential economic impacts of a commmercial find are discussed below (paraphrased from leased sale No. 60, BLM 1981).

The employment impacts of a mean level find are mild. Direct employment would peak in the late 1980s with 276 jobs and then level out with around 200 permanent jobs (BLM 1981).

Secondary employment would also peak in the late 1980s with 132 jobs created, with minor fluctuations thereafter at a slightly lower level. The location of these jobs would primarily be in the City of Kodiak and to a lesser extent at an oil terminal if located near other Borough communities.

The size of the impact expected in the City of Kodiak area is small relative to total Borough employment. The employment impacts of an oil terminal in an outlying area or village may be considerable.

Petroleum industry purchases of specialty supplies, equipment, and services would not be large enough to support Borough-based industry suppliers and subcontractors. Only mild increases in trade and transport services would be likely to occur. If an oil terminal were located within the Borough, this would represent a very substantial source of property tax revenue.

Unless chosen as the site of the oil terminal, the villages in the Borough are not likely to be significantly affected.

The tourism and recreation industry is expected to show modest growth. Promotion of Kodiak's historical and recreational assets and improved visitor facilities should attract increased numbers of tourists, conventioneers, and vacationers to the Kodiak area.

The Kodiak Coast Guard Station, currently a major military installation with about 980 military personnel and an on-base population of about 2,500, is forecast to remain at about its current strength. However, a modest increase is foreseen in civilian employment at the base.

Kodiak already has an unusually well-balanced trade and services sector for a town of its size, and it is anticipated that expansion of tourist and bottom-fishing industries will reinforce these sectors.

4.5.8 SUBSISTENCE

Subsistence harvesting of resources will continue to be important to Kodiak Island Borough residents; degree of utilization will be influenced by economic factors, competition among resource users, and legal questions. In the Borough's village communities, significant new employment opportunities or increased income levels are highly unlikely, as are reduced transportation costs for food and other goods. Therefore, the economic and social reliance on subsistence resources will remain high. Although Kodiak metropolitan residents are not as economically dependent on subsistence, there are no indications that their subsistence needs will decrease. Both areas face increasing competition for subsistence resources, whether from commercial fishing, recreation hunting and fishing, or other subsistence users.

Subsistence harvesting activities are affected by the human demand for these resources, and by resource population dynamics or the ability to sustain certain levels of harvest. When combined use demand exceeds

the ability to sustain harvest levels, there is little choice but to allocate resources among users and/or limit harvest levels in specific areas. The legal status of resource allocation has been repeatedly challenged throughout the state; harvest quotas, and closing fish and game areas to some or all users have been more acceptable. The Kodiak road system is already experiencing forms of resource allocation, closings or quotas; pressures on road system resources, including subsistence, will remain constant or increase. In village areas such measures have not been necessary, although Port Lions has voluntarily requested game limit reductions to protect subsistence resources.

Perceived conflicts between subsistence and other resource uses in village areas will remain when traditional harvest levels are threatened and resource allocation appears possible. Nonresident recreation use conflicts with subsistence are the most likely, although impacts of oil and gas development on subsistence are also a concern. Avoidance of conflicts over subsistence, and conflict resolution, need cooperative solutions from the parties affected.

Access and the vicinity of subsistence resources are important to village residents. Since most subsistence harvesting is done by boat or on foot, subsistence resource areas in the immediate vicinity of villages are the most important. In these areas subsistence resource use should be maintained when faced with competing uses (recreation) or potential impacts (oil and gas development). Areas of secondary subsistence importance remote from village sites are not as critical to subsistence harvests, although they should still be maintained for subsistence use to the extent feasible.

4.6 RESOURCE MANAGEMENT AREA CLASSIFICATION

Based on the resource analysis, portions of the Kodiak Island Borough Coastal Management District have been classified as Development, Development with Restrictions, and Conservation. This classification

system is intended to guide resource use and activities in the coastal management area.

It should be emphasized that this classification system in no way eliminates the requirement of complying with existing federal, state, and Borough regulations. Nor does it influence additional restrictions that public and private land owners place on resource use and activities. In many cases, such compliance will meet use constraints identified under this classification system.

4.6.1 DEVELOPMENT AREAS

Development areas within the Kodiak Island Borough Coastal Management District are those areas where economic and coastal development are overriding objectives and are not subject to constraints created by geophysical hazards, biological resources, coastal habitat, recreation, land ownership, coastal access, and air/water quality concerns. Economic and coastal developments are preferential uses for these areas, within the bounds of appropriate federal, state, and local regulations.

4.6.2 DEVELOPMENT WITH RESTRICTIONS

Development with Restriction areas in the Kodiak Island Borough Coastal Management District are identified where coastal development may be subject to constraints created by biological resource needs, geophysical hazards, coastal habitat, subsistence, recreation, land ownership, coastal access, and air/water quality. No activities and development should necessarily receive preferential status in Conditional Development areas (for example, petroleum development always preferred to recreation). Activities and development within Conditional Development areas are subject to coordination with the Planning Department and appropriate state and federal agencies. The Coastal Management Program will identify potential constraints on activities and development within Development with Restrictions areas.

4.6.3 CONSERVATION AREAS

Conservation areas in the Kodiak Island Borough Coastal Management District have been identified based on overriding geophysical hazards, biological resource, subsistence, recreation, and air/water quality concerns. Activities and development within Conservation areas should be limited to nonconsumptive, nonintensive human use activities such as subsistence, recreation, and grazing (where permitted).

Tables 4.17 and 4.18 show resource areas and volumes classified as Development with Restrictions and Conservation, and the resource maps and figures where they appear. Areas not classified as either are considered Development areas.

Table 4.17. Development with Restrictions areas.

Resource Map No.	Resource Area/Value	Use Contraints
Map 2	o Estuaries o Lagoons	o Coastal development must minimize dredge and fill activities, discharge of effluents, obstruction of circulation, fish passage, and shoreline alteration.
Map 3	o Wetlands o Tideflats	o Coastal development must minimize dredge and fill activities and adverse impacts on habitat, water quality, and flood-water retention values when siting and constructing facilities.
Map 6	o Anadromous fish streams	o Restricted use with 300 feet on either bank to minimize stream erosion, siltation, and obstruction of fish passage.
Map 7	o Waterfowl concentrations	o Coastal development must minimize destruction of waterfowl habitat from dredge and fill activities and facility construction.
Map 8	o Winter habitat - deer, elk, goats	o Logging, industrial, and residential development should minimize habitat loss to the extent feasible. Major construction should be scheduled to avoid wintering concentrations of game.
Map 9	o Suspected bear denning o Spring full intensive use areas	o Structures and facilities should not locate with one mile of suspected denning sites; activities and facility siting should minimize human-bear conflicts in intensive use areas.

Table 4.17. (Concluded).

Resource Map No.	Resource Area/Value	Use Contraints
Map 10 for Figures 3.19-27	o Coastal erosion areas o High wave energy coastline	o Site, design, and construct facilities high wave energy conditions and to minimize coastal erosion impacts on facilities and adjacent shorelines.
Figures 3.11-17	o Landslide areas	o Development within potential landslide/ mass mass wasting areas should exhibit appropriate site investigation and mitigation measures.
Figures 3.11-17	o Faults	o Development over known or potential faults should exhibit appropriate site investigation and siting-design-construction mitigation measures.
Map 11	o Cultural sites with insufficient the information	o Coastal development should consult with state archaeologist before siting and constructing development to utilize proper mitigation measures.
Map 12	o All lands selected but not conveyed, patented, or tentatively approved the State of Alaska, Kodiak Island Borough, and pertinent Native corporations	o Because of uncertain land ownership no development or resource use, including extraction, shall take place without agreement between parties selecting land.
Map 15	o Primary and secondary subsistence areas	o Coastal development must minimize impacts on subsistence resources and habitats through facility siting, design, and construction measures.
Map 16	o Areas Meriting Special Attention nominated for recreation values	o Proposed development must exhibit measures to minimize impacts to recreation values and use such as noise levels, emission of noxious odors, and degradation of scenic vistas.

Table 4.18. Conservation areas.

Resource Map No.	Resource Area/Value	Use Contraints
Map 4	o Seal pupping areas	o No facility siting, material borrow, or any activities that destroy this habitat area should be approved.
Map 6	o Anadromous fish streams	o No development should take place within 25 feet of anadromous fish streams. Road or utility crossings of such streams shall comply with Alaska Dept. of Fish and Game regulations.
Map 7	o Seabird colonies	o No facility siting, material borrow, or any activities that destroy this habitat areas should be approved.
Map 9	o Known bear denning sites	o No new development should be located within one mile of known bear denning areas.
Map 11	o Sites eligible for inclusion in the National Register of Historic Places	o No development should take place within these sites.
	o ANCSA 14(h) Sites	
Map 13	o Designated and proposed take state parks	o Nonpark-related development should not place bordering these areas. Development in the vicinity should minimize impacts to recreation values and use, such as high noise levels, emission of noxious odors, and degradation of scenic vistas.
Map 12	o Proposed Marine Wildlife Refuges	o No coastal development should take place within these areas.

4.7 LITERATURE CITED - RESOURCE ANALYSIS

Alaska Department of Fish and Game (ADF&G). 1978. Alaska's fisheries atlas, Vols. I & II.; Juneau, Alaska.

ADF&G. 1979. Kodiak management area, 1979 finfish annual report. Juneau, Alaska.

ADF&G. 1980. Westward region Tanner crab report to the Alaska Board of Fisheries, Dec. 1980. Kodiak, Alaska.

ADF&G. 1980b. A synthesis and evaluation of ADF&G fish and wildlife resources information for the Willow and Talkeetna sub-basins. Prepared for U.S. Department of Agriculture, Soil Conservation Service.

ADF&G. 1981a. Westward region shellfish report to the Alaska Board of Fisheries, March 1981. Kodiak, Alaska.

ADF&G. 1981b. Draft natural resource inventory maps of Kodiak Archipelago. Prepared for Kodiak Island Borough.

ADF&G. No date. Present and potential ADF&G rehabilitation and enhancement projects in the Kodiak Island Borough.

ADF&G. To be published. Annual report of survey - inventory activities, mountain goat and elk.

Alaska Department of Natural Resources (ADNR). Division of Research and Development, Land and Resource Planning Section. 1980. Public interest lands in Alaska's municipalities.

Arctic Environmental Information and Data Center, (AEIDC). 1975. Kadyak: A background for living. Anchorage, Alaska.

AEIDC. 1979. An Assessment of environmental effects of constructiton and operation of the proposed Terror Lake hydroelectric facility. Prepared for Kodiak Electric Association, Inc. Kodiak, Alaska.

AEIDC. 1980. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility. Brown bear studies and mountain goat studies. Prepared for the Kodiak Electric Association, Inc. Kodiak, Alaska.

AEIDC. 1981. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility, Final report. Prepared for Kodiak Electric Association, Inc. Kodiak, Alaska.

Bureau of Land Management (BLM). 1980. DEIS: Proposed outer continental shelf oil and gas lease sale 46, Western Gulf of Alaska, Kodiak. Washington, D.C.: U.S. Dept. of the Interior.

BLM. 1981. FEIS: Proposed outer continental shelf oil and gas lease sale 60, Lower Cook Inlet-Shelikof Strait.

Hinman, R. 1980a. Annual report of survey - inventory activities. Part I. Black bear and brown bear. ADF&G, Juneau, Alaska.

Hinman, R. 1980b. Annual report of survey - inventory activities. Part II. Deer, elk, and moose. ADF&G, Juneau, Alaska.

Manthey, K. 1980. Salmon report to the Alaska Board of Fisheries, Dec. 1980. ADF&G, Kodiak Alaska.

Mills, M. 1981. Statewide harvest study, vol. 22. ADF&G, Juneau, Alaska.

North Pacific Fisheries Management Council (NPFMC). 1979. Fishery management plan for the Gulf of Alaska groundfish fishery. Anchorage, Alaska.

R.W. Retherford Associates and International Engineerng Co., Inc. (RRA/IEC). 1978. Application for License, Project No. 2743, Volume 2, Exhibit W. Terror Lake hydroelectric project, Kodiak Island, Alaska. Prepared for Kodiak Electric Association, Inc.

Ronholt et al. 1978. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass, 1948 to 1976 (a historical review). Vols. 1-4. Seattle, Washington, U.S. Dept. of Commerce, National Marine Fisheries Service.

Science Applications, Inc. (SAI). 1980. Environmental assessment of the Alaskan continental shelf, Kodiak interim synthesis report. Prepared for the U.S. Dept. of Commerce NOAA, Boulder, Colorado.

Selkregg, L. (ed). 1974. Alaska regional profiles, southcentral region. AEIDC, Anchorage, Alaska.

Sexton, J. 1981. Memorandum to Lee Glenn re. permit results, Fall 1980.

Smith, R. 1978. Report submitted for annual survey - inventory activities. ADF&G, Juneau, Alaska.

Smith, R. 1980. Goat winter range surveys and brown bear sightings, Terror Lake project area. ADF&G, Kodiak, Alaska.

Sowls, A., S. Hatch, and C. J. Lensink. 1978. Catalog of Alaskan seabird colonies. Washington, D. C.: U. S. Dept. of Interior, Fish and Wildlife Service.

Timm, D. 1980. Report of survey-inventory activities. Waterfowl. Juneau, Alaska.

Troyer, W. and R.J. Hensel. 1977. The brown bear of Kodiak Island. USDOI, BSFW.

U.S. Dept. of the Interior (USDI), Fish and Wildlife Service (FWS), National Wildlife Refuge System (NWRS). 1978. Kodiak national wildlife refuge, Kodiak, Alaska. Annual Narrative Report, Calendar Year 1977.

USDI. 1980. FWS, NWRS. Kodiak national wildlife refuge, Kodiak, Alaska. Annual Narrative Report, Calendar Year 1979.

Vivion, M. 1978. Reindeer survey, file memo. U.S. Dept. of the Interior, Fish and Wildlife Service, Kodiak National Wildlife Refuge.

5.0 SUBJECT USE, POLICIES, PROPER AND IMPROPER USES

5.1 SUBJECT USES

The following activities and uses of coastal land and water resources are subject to the Kodiak Island Borough District Coastal Management Program:

- o Coastal Development - industrial, commercial, and residential development.
- o Recreation - designation of areas and facilities.
- o Energy Facilities - petroleum and petrochemical product refining, storage, transportation, and transfer; electric, hydroelectric, and wind generation facilities and transmission lines
- o Transportation - highway, air, and marine facilities.
- o Utilities - water and sewer lines and facilities, solid waste disposal, utility lines.
- o Fisheries - seafood processing, fishery enhancement and rehabilitation.
- o Timber Harvesting and Processing - timber sales and harvesting, log storage and transfer.
- o Mining and Mineral Processing - hard rock minerals, gravel, sand, and other construction materials.

- o Subsistence - subsistence areas and activities.

5.1.1 USES OF STATE CONCERN

The policies of the Kodiak Island Borough District Coastal Management Program reflect the five categories of Uses of State Concern, which are defined as those land and water uses that would significantly affect the long-term public interest. The five categories are listed below:

- o Uses of national interest, including the resources for the siting of ports and major facilities which contribute to meeting national energy needs, construction and maintenance of navigational facilities and systems, resource development of federal land, and national defense and related security facilities that are dependent upon coastal locations;

- o Uses of more than local concern, including those land and water uses that confer significant environmental, social, cultural, or economic benefits or burdens beyond a single coastal resource district;

- o The siting of major energy facilities or large-scale industrial or commercial development activities that are dependent on a coastal location and which, because of their magnitude or the magnitude of their effect on the economy of the state or the surrounding areas, are reasonably likely to present issues of more than local significance;

- o Facilities serving statewide or interregional transportation and communication needs; and

- o Uses in areas established as state parks or recreational areas under AS 41.20 or as state game refuges, game sanctuaries, or critical habitat areas under AS 16.20.

5.2 PROPER AND IMPROPER USES

In accordance with the policy of multiple use of resources, the determination of proper and improper uses of coastal land and water resources within the Kodiak Island Borough Coastal Management District is not an exclusionary process. Proposed uses are measured by performance with regard to policies, resource concerns identified under conditional development areas found in the Resource Analysis, and Areas Meriting Special Attention (AMSA) management guidelines.

Specific proposals for land and water uses or activities shall be submitted to the Community Development Department for review and determination of both proper/improper use and consistency with the District Coastal Management Program. Decisions made by the Community Development Department can be appealed to the planning and Zoning Commission and Kodiak Island Borough Assembly. This process in no way precludes the need for compliance with the Borough's Zoning Ordinance, subdivision regulations, building codes, and other pertinent Kodiak Island Borough land and water use controls.

In addition to the specific policies, conditional development resource concerns, and AMSA guidelines, the following points should be emphasized in the evaluation of resource use/activities proposals:

1. Zoning Ordinance. Acceptable uses under the Kodiak Island Borough Zoning Ordinance must address applicable conditional development concerns.

2. Water Dependency. Water-dependent or water-related uses have priority use of the shoreline. Non-water-dependent or related uses should be located inland when feasible and prudent inland locations are available. Feasibility reflects zoning constraints, population distribution, and economic hardship to private individuals.

5.3 DRAFT POLICIES

The Kodiak Island Borough Coastal Management Program is centered on recognition that local government is developing the tools necessary to implement the goals and objectives of the district program. To accomplish this, a set of principles or policies is needed to guide decisions concerning activities and uses in the coastal zone. The following policies are presented in three categories: 1) general policies on land and water activities, and consistency and coordination; 2) policies for specific coastal activities and resources and 3) policies regarding development areas.

Where applicable, the policies incorporate the standards and guidelines of the Alaska Coastal Management Act. These policies actively promote: sensible and efficient use of coastal lands; consolidation of activities; concurrent or multiple use of lands; use of sound engineering practices; protection of environmental quality; enhancement of fish and wildlife resources; regional cooperation; and coordination between state and federal agencies and the Kodiak Island Borough.

Achieving balance is also important, particularly where there are potentially competing goals, such as industrial development and resource enhancement; where local preferences differ from state and federal interests; where planning for activities in the coastal area can lead to unnecessary restrictions; or where short-run gains result in the forfeiture of long-run benefits.

Finally, the policies are action-oriented. With its planning and regulatory powers, the Kodiak Island Borough intends to implement this program through its municipal authority, the allocation of fiscal and human resources, and cooperation with private developers and other levels of government.

5.3.1 GENERAL POLICIES

Land and Water Activities

1. Water-Dependent/Water-Related Uses.

   Water-dependent and water-related activities or uses as defined in this plan will receive priority for waterfront areas. Uses that are neither water-dependent nor water-related will be considered in shoreline areas only when inland sites are not available.

2. Concurrent and Multiple Uses.

   - Recreational use of undeveloped shoreline areas not needed for other activities is encouraged provided that recreation activities are compatible with the maintenance and use of resources in the area.

   - Cooperative use of piers, cargo handling, storage, parking, and other facilities is strongly encouraged or may be required.

   - The navigable waters around the Kodiak Island Borough shall continue to be available for many users.

3. Compatibility.

   Activities on and uses of coastal lands shall be compatible with adjacent land use to the greatest extent feasible.

Consistency and Coordination

Uses and activities in the coastal zone, including public activities by all levels of government, shall be consistent with the district plan.

Federal or State agencies shall not issue any permit for dredging/filling or any other activity without first contacting the Community Development Department and without first complying with all applicable provisions of the Coastal Management Plan.

Implementation

1. To the extent feasible, the Kodiak Island Borough shall minimize new regulations by using existing ordinances and codes, and by drafting Memoranda of Understanding, to implement the Coastal Management Program.

2. To the extent feasible, regulations should be performance-oriented to allow flexibility in the techniques used to achieve desired goals of local government.

5.3.2 SPECIFIC USE POLICIES

Coastal Development

Industrial Development.

1. Optimum Location
The Kodiak Island Borough shall assist with the identification of suitable sites for industrial development that satisfy industrial requirements, meet safety standards, protect fish and wildlife resources, and maintain environmental quality.

2. Natural Features
Excavation, shoreline alteration, and disturbance of anadromous streams, tideflats, and wetlands shall be minimized when constructing and operating port, harbor, dock, and industrial facilities.

3. Views and Natural Setting

Ports and industry shall be encouraged to minimize impacts that detract from the natural setting of the Kodiak Archipelago, and to enhance and maintain positive visual aspects of their development and to provide opportunities for public viewing of such positive aspects whenever practical and safe.

4. Dredge and Excavation Material

Dredge and site excavation material shall be disposed of in upland sites identified by the Community Development Department; dredge spoil may be utilized in shoreside landfills if permitted under applicable regulations for the purpose of creating usable waterfront land.

5. Facility Design

Developments in or over the water, such as piers, docks, and protective structures shall be located, designed, and maintained in a manner that prevents adverse impacts upon water quality, fish, wildlife, and vegetative resources, and minimizes interruption of water circulation patterns and coastal processes.

6. Buffer Zones

To the extent feasible, buffer zones shall be established between industrial areas and major public transportation routes and between industrial development and adjacent, nonindustrial properties.

7. Accessory Development

Accessory development that does not require a shoreline location in order to carry out its support functions shall be sited away from the shoreline. This category includes parking, warehousing, open air storage, waste storage, and treatment or storm runoff control facilities, utilities and land transport development.

Commercial Development

1. The following industrial policies shall also apply to commercial development:

   - o Natural features
   - o Views and natural setting
   - o Dredge and excavation material
   - o Facility design
   - o Accessory development

2. Filling or drainage of water bodies, floodways, backshores, or natural wetlands for expansion of upland areas for commercial development is subject to review by the Community Development Department.

Residential Development

1. Location

   In areas with poorly-draining soils, development shall not be allowed unless connected to a sewer line. Where this is not feasible, on-site facilities shall be designed so as not to cause conditions that will pollute rivers, lakes, and other water bodies, including the ground-water supply.

2. Open Space

   Maximum retention of green areas and open space shall be encouraged.

3. Access

   New subdivisions or other residential developments on the shoreline shall provide a community recreation and public access area along the shoreline, extending the length of the development. Such areas shall be of a minimum width of 50 feet measured land-ward from ordinary high water mark (OHWM).

4. Hazardous Lands

Development shall not occur in hazardous areas such as avalanche runout zone, active floodplains and high water channels, and unstable slopes and shorelines. Siting, design, and construction measures to minimize exposure to these hazards may be required for conditional hazardous areas.

Energy Facilities

The siting and approval of major energy facilities shall be based on the standards and guidelines set forth in the Alaska Coastal Management Act (6 AAC 80.070).

1. Energy facilities must be compatible with nearby land and water uses.

2. Energy facilities will be located in areas set aside by Kodiak Island Borough for industrial use.

3. Sites must have enough space for reasonable expansion of facilities without preempting lands suitable for other development.

4. Preference will be given to sites where existing roads, docks, and services can satisfy industrial requirements, or where an enclave development may be deemed feasible.

5. Companies must strive to consolidate their activities and, wherever feasible, share their facilities with other companies or the community.

6. Sites will be approved that call for a minimum of dredging, clearing, and construction in productive habitats.

7. Priority will be given to sites that are free from navigational hazards and where new vessels will not cause overcrowding.

8. Sites must be selected where water discharges and oil spills can be contained and damage to the environment minimized.

9. Energy facilities with airborne emissions must be located where winds and air currents can disperse emissions and where the cumulative impact does not violate state and federal air quality standards.

10. Effluent discharge of energy facilities must be located where currents can disperse effluents and where the cumulative impact does not violate state and federal water quality standards.

11. Energy facilities will be sited to protect scenic, recreational, environmental and cultural values in the immediate vicinity.

Recreation, Tourism, and Natural Setting

1. Recreational developments shall provide the local population with a balanced choice of recreation experiences in appropriate locations. Public agencies and private developers shall coordinate their plans and activities with the Community Development Department to provide a wide variety of recreational opportunities without needless duplication of facilities.

2. Facilities for water-dependent recreation such as fishing, tour operators, and boating, and water-oriented recreation such as picnicking, hiking, skiing, and walking shall be located near the shoreline, while non-water-related recreation facilities should be located inland.

3. Recreational facilities shall be located and designed to minimize conflicts with other uses, activities, and user groups not compatible with recreational uses.

4. Recreational and access developments shall, wherever appropriate, preserve or enhance scenic views and vistas as well as improve the aesthetic value of the area.

5. Industrial/energy facility development in Kodiak Island Borough has proven compatible with or has enhanced recreation/tourism. New development shall incorporate where applicable recreation facilities such as trails and educational aids and tours and displays.

6. The Kodiak Island Borough shall support state and federal efforts to develop marine parks, roadside pullouts, and other recreation facilities on public lands within and adjacent to coastal management district boundaries when identified in conjunction with the Kodiak Island Borough.

Transportation and Utility Routes

1. State Highway Construction and Maintenance
The Kodiak Island Borough shall support state highway construction and maintenance efforts to improve transportation corridors.

2. Location
Wherever there is an inland alternative, transportation and utility routes shall be located away from the shorelines. Shoreline routes shall incorporate pullouts and other means of public access.

3. Facility Design, Construction, and Maintenance
Highway, airport, port, and utility design, construction, and maintenance shall minimize alteration of water courses, wetlands, and intertidal marshes, and visual degradation.

4. Stream Crossings
Roads and trails shall cross anadromous streams only when necessary to provide access as deemed necessary by the Kodiak Island Borough. Bridge or culvert construction and design must minimize

habitat disturbance and allow fish passage. Phasing of construction scheduling shall be done to avoid critical migration periods for salmon and other anadromous species.

5. Underground Utilities

To the extent feasible, underground installation of utilities is recommended in areas of high recreational or scenic value or intensive public use.

6. Utility Service

New development shall locate in areas where water and sewer service are already developed or suitable on-site systems are feasible.

7. Sanitary Landfills

To avoid leachate pollution, landfills shall be located well above the ground-water table. The soils shall be of proper permeability and texture to restrict the passage of polluted waters into the ground-water system. Landfills shall be located above any floodplains and away from water bodies or wetlands so as to avoid pollution of these aquatic environments. Landfill sites shall be screened from transportation routes and neighboring properties, and located in areas protected from high winds.

Geophysical Hazards

1. Utilization

The Kodiak Island Borough shall support safe and sensible utilization of potentially hazardous lands.

2. Coordination

The Kodiak Island Borough, state and federal government, and private interests shall coordinate to develop information defining the extent of geophysical hazards, and proper siting/design and construction measures to maximize safe utilization of potentially hazardous lands.

3. Avalanche Hazards

Coastal development shall be prohibited in areas identified as avalanche chute and runout zones. These areas shall remain in open space.

4. Landslides and Mass Wasting Hazards

Commercial and residential development shall be prohibited in areas identified as subject to landslide and mass wasting hazards. Industrial development shall be subject to approval of siting/design/construction measures to mitigate the hazard.

5. Riverine Flooding

Development shall not take place with the 10-year recurrence (or 10 percent probability) floodplain in order to protect life and property and to avoid construction of unnecessary flood control structures at public expense. Development considered necessary within the 100-year (1 percent probability) floodplain shall be subject to proper siting/design/construction measures to minimize the potential flooding hazard.

6. Coastal/Seiche Flooding

Development shall be limited to water-dependent uses within _____ feet elevation above mean sea level (100-year recurrence or 1 percent probability event). Water-dependent development within _____ feet above sea level shall be subject to siting/design/construction measures to mitigate the potential hazard.

7. Seismic Events

The Kodiak Island Borough shall institute programs to identify and further delineate areas of known and potential hazard, and to identify proper and improper use of seismic hazard areas. Proposals for development within known and potential seismic areas shall be required to prepare a geotechnical investigation prior to development to determine an area's physical capability to accommodate various uses. It shall also address siting/design/construction measures to minimize the hazard.

Coastal Access

1. Public Access

   New development shall be encouraged to provide physical or visual access to shorelines when such access does not cause interference with operations or hazard to life and property.

2. Recreation Facilities

   The Kodiak Island Borough, through the Community Development Department, shall continue to provide access to the shoreline through trails, bikepaths, and development of State Public Interest Lands under its management.

3. Access to State and Federal Lands

   The Kodiak Island Borough shall continue to support state and federal efforts to provide marine access to their lands in the Kodiak Island Borough.

Fisheries and Seafood Processing

1. Fisheries Enhancement

   The Kodiak Island Borough shall continue to actively promote the development of hatcheries and aquaculture programs.

   Fisheries enhancement programs will strive to maintain or restore the biological productivity of anadromous streams and lakes in the coastal zone.

2. Optimum Resource Use

   Maintenance and enhancement of fisheries should be given priority consideration in reviewing shoreline use proposals that might adversely impact fisheries habitat, migratory routes, and harvest of significant fish.

3. Industrial Development

Development of industrial and energy-related facilities shall include programs to replace fishery stock affected by water supply or other applicable aspects of construction and operations.

Mining and Mineral Processing

1. Material Sources

The Kodiak Island Borough shall identify preferred locations for extracting gravel and other material sources within the Coastal Management District.

2. Gravel Mining

Plans for mining gravel in floodplains shall be reviewed by the Community Development Department prior to initiating gravel mining.

Timber and Timber Processing

1. Timber harvesting activities shall be managed to ensure a sustained yield, except when harvesting insect-infested and blowdown timber.

2. Timber harvesting activities shall be conducted in a manner that most minimizes damage to or loss of anadromous fish streams, and elk winter habitat.

Archaeological/Historical Resources

1. Resource Identification

Because prehistoric and archaeological sites are important assets to both local municipalities and the state, local and state governments should institute conscientious programs designed to identify and preserve all significant sites not already protected by federal and state programs.

2. Resource Distribution Forecast Map

The cultural resource distribution forecast map presented in the Coastal Management Program shall be used as a guide to development, but does not satisfy the requirements of the Alaska Historic Preservation Act or Procedures for the Protection of Historic and Cultural Properties.

Air and Water Quality

1. Cumulative Impact

New industrial developments shall be required to evaluate and provide information on their cumulative impact on district air and water quality prior to siting facilities.

2. State-of-the-Art Technology

Equipment and procedures utilizing the best available technology for limiting emissions and effluents, and for handling, cleanup, and disposal of oil and hazardous materials shall be required of all facilities.

3. Wastewater Discharge

The discharge of wastewater and toxic wastes into Kodiak Island Borough waters shall be limited to areas with adequate flushing action and in accordance with State of Alaska regulations. Discharge shall not be in amounts to render such water unsuitable for fish survival, industrial cooling, and industrial process watering supply purposes.

4. Harbors

Harbor, small boat harbor, and marina designs shall incorporate facilities for proper handling of sewage and refuse. Discharge of untreated sewage and surface waters from boats shall be prohibited. Water channels should be interconnected to aid in maintaining water flushing action.

5. Siting

The Kodiak Island Borough shall work with proposals for industrial facilities for evaluating emission and effluent dispersion, and assist in siting industrial facilities.

Resource Enhancement and Protection

1. Enhancement

The maintenance and enhancement of fish, wildlife, and vegetative resources shall be given high priority through a hatcheries/ aquaculture development program, and other programs as appropriate.

2. Habitat Protection

Management of sensitive areas such as estuaries, wetlands, tide-flats, beaches, rivers, streams and lake systems, and high energy coasts shall be done in accordance with the standards of the Alaska Coastal Management Program.

3. Siting and Design

Development shall be designed, located, and built to preserve or use wisely the natural features that are valuable or scarce.

4. Natural Processes

Estuaries, tideflats, and wetlands shall be managed so as to assure water flow, natural circulation patterns, and nutrient and oxygen levels. Dredging shall not be permitted in these areas, unless approved by the Community Development Department, U.S. Army Corps of Engineers, and other appropriate state and federal agencies.

Upland habitats shall be managed to retain natural drainage patterns, prevent excessive runoff and erosion, surface water quality, and natural ground-water recharge areas.

Subsistence

1. Subsistence use of resources by Kodiak Island Borough residents is recognized as a primary resource use, and shall be a protected use when coastal development occurs.

5.4 DEVELOPMENT CLASSIFICATION POLICIES

The following policies are meant to guide activities and development in areas classified by the resource analysis.

5.4.1 CONSERVATION AREAS

1. Conservation areas within the Kodiak Island Borough Coastal Management District shall be established based on overriding geophysical hazards, biological resource, coastal habitat, recreation, and air/water quality concerns.

2. Activities and development within conservation areas shall be limited to those identified as proper uses for these areas.

5.4.2 DEVELOPMENT WITH RESTRICTIONS

1. Conditional development areas with the Kodiak Island Borough Coastal Management District shall be established where coastal development may be subject to constraints created by biological resource needs, geophysical hazards, coastal habitat, recreation, land ownership, coastal access, and air/water quality.

2. No activities or development shall necessarily receive preferential status in conditional development areas.

3. Activities and development within conditional development areas shall be subject to coordination with the Community Development Department and with appropriate state and federal agencies.

4. Potential constraints on activities and development within conditional development areas shall be identified in the Kodiak Island Borough District Coastal Management Program.

5.4.3 DEVELOPMENT AREAS

1. Development areas shall be established within the Kodiak Island Borough Coastal Management District where economic and coastal development objectives are not subject to constraints created by geophysical hazards, biological resources, coastal habitat, recreation, land ownership, coastal access, and air/water quality concerns.

2. Economic and coastal development are preferential uses for these areas.

6.0 AREAS MERITING SPECIAL ATTENTION

6.0

AREAS MERITING SPECIAL ATTENTION

Areas meriting special attention (AMSAs) are areas singled out during coastal management program development for detailed planning. AMSAs fulfill the national objective of identifying and designating coastal areas of particular concern (USC Sec 305 b 3) and the state recognition that in certain areas specific management objectives are necessary to resolve problems associated with conflicting uses. As defined in the Alaska Coastal Managment act [AS46.210(1)], AMSAs are:

> A delineated geographic area within the coastal area which is sensitive to change or alteration and which, because of plans or commitments or because a claim on the resources within the area delineated would preclude subsequent use of the resources to a conflicting or incompatible use, warrants special management attention, or which, because of its value to the general public, should be indentified for current or future planning, protection, or acquisition.

Acceptable rationales for designating AMSAs are identified in the Alaska Coastal Management Act (CMA) and the Alaska Coastal Management Program standards. All proposals for AMSAs must be related to one or more of the following:

1. Areas of unique, scarce, fragile, or vulnerable natural habitat, cultural value, historical significance, or scenic importance;

2. Areas of high natural productivity or essential habitat for living resources;
3. Areas of substantial recreational value or opportunity;
4. Areas where development of facilities is dependent upon the utilization of, or access to, coastal waters;
5. Areas of unique geological or topographic significance that are susceptible to industrial or commercial development;
6. Areas of significant hazard due to storms, slides, floods, erosion, or settlement; and
7. Areas needed to protect, maintain, or replenish coastal land or resources, including coastal floodplains, aquifer recharge areas, beaches, and offshore sand deposits.
8. Areas important for subsistence hunting, fishing, food gathering, and foraging;
9. Areas with special scientific values or opportunities, including those where ongoing research projects could be jeopardized by development or conflicting uses and activities; and
10. Potential estuarine or marine sanctuaries. [AS 46.40.210 (1) and ACMP Standards 6AAC 80.160 (b)]

Any person, federal or state agency, or local government may recommend AMSAs if the requisite information is included with the application. Applicants must include the following information:

1. The rationale for identifying the area as an AMSA based on the reasons listed above;
2. A map showing the geographical location, surface area, and, where appropriate, bathymetry of the area;
3. A description of the area, including dominant physical and biological features;
4. The existing ownership, jurisdiction, and management status of the area, including existing uses and activities;
5. The existing ownership, jurisdiction, and management status of adjacent shoreland and sea areas, including existing uses and activities;

6. Current and anticipated conflicts among uses and activities within or adjacent to the area, if any; and
7. A proposed management scheme.

The management scheme which "must preserve, protect, enhance, or restore the value or values for which the area was designated," as specified in 6AAC 80.160(c). The management scheme must include:

(a) A description of the uses and activities that will be considered proper and the uses and activities that will be considered improper with respect to land and water within the area;

(b) A summary or statement of the policies that will be applied in managing the area; and

(c) An identification of the authority that will be used to implement the proposed management scheme.

Coastal Management Districts must consider recommended AMSAs, but are not bound to accept an AMSA as nominated. Final decisions on AMSA designations are made during program review by the Coastal Policy Council, which considers state and federal agency comments at that time. This minimizes speculation and diverse interpretations about how the area is to be maintained.

The use of AMSAs to manage resource use and activities can be easily abused; ideally AMSAs should be used to resolve conflicts between uses or to protect single-purpose values of public importance only when other coastal management tools are not adequate. In the case of many potential AMSAs, policies, development conditions, and implementation (including incorporation of state and federal regulations) are adequate to resolve use conflicts or protect uses. A large number of individual

AMSAs can result in piecemeal planning and additional layers of requirements for potential resource users.

Approval of an AMSA as part of a Coastal Management Program includes both the approval of the AMSA boundaries and of the specific management plan adopted for it.

Many recommendations for areas of concern in Kodiak have been made, primarily by state agencies. Some are as site-specific as a particular historic building; others are as general as Afognak Island, the entire west coast of Kodiak Island, or the 1.5 meter isobath. The purposes for designating sites are diverse, reflecting most of the ten catagories listed earlier and other values as reasonable bases for designation. Purposes range from preservation of existing resources to development of energy facilities (Table 6.1).

Special ares of concern identified by Alaska Department of Natural Resources (ADNR), Division of Geological and Geophysical Surveys, Alaska Department of Fish and Game (ADF&G), and Alaska Department of Community and Regional Affairs (ADCRA) were published recently by the State OCM. Recommendations have also been identified by the Kodiak Island Borough and local residents.

Each of the areas nominated for special attention is listed in Table 6.1. Also included in the table are the nominating agency as village and the purpose(s) for the nomination. Proposed AMSAs are also identified on Map 16. Areas delineated AMSAs proposed by the Department of Natural Resources, Division of Parks, were derived from ADNR maps indicating the watershed area associated with each AMSA. The boundaries of sites nominated by others were derived only from textual material, and may not exactly depict the area of concern. Moreover, several areas identified were so extensive that they were not included on the map. These areas include all of Afognak Island and the Kodiak Marine Sanctuary,

which follows the 20 meter isobath around the shores of the National Wildlife Refuge. Other sites (such as the entire west coast of Kodiak Island) were not included because the nomination was contingent upon the development of offshore oil in lower Cook Inlet and Shelikof Strait.

Final selection of AMSAs for the coastal manangement program will be made by the Borough during the Phase II Program based upon a thorough examination of nominated sites and comments received from the public, local governments, and state and federal agencies.

6.1 AMSA LITERATURE CITED

Alaska Dept. of Natural Resources, Division of Parks. 1980. Recreation, scenic, and heritage areas of concern: Kodiak Archipelago.

Alaska Office of Coastal Management. 1980. Special areas in the Alaska coastal zone: abstracts of proposals. Juneau, Alaska.

Marshall, W. and A. Croswell. 1981. Preliminary report: KANA Coastal management village public participation program.

Table 6.1. Nominated areas meriting special attention.

NAME OF NOMINATING BODY	1. Vulnerable Natural Habitat	Cultural Resource	Historic Resource	Scenic Resource	2. Critical Habitat	3. Recreational Area	4. Water dependent Facility	5. Unique Geologic Area	6. Hazard Area	7. Areas Needed to Maintain Coastal Processes	8. Subsistence Area	9. Scientifically Important Area	10. Potential Estuarine or Marine Sanctuaries	11. Lifestyle Impacts	12. Energy Facilities	13. Timber Harvesting	14. Residential Development	15. Land Ownership Requires Joint Planning	16. Transportation Facilities
Alaska Dept. of Natural Resources (ADNR), Division of Geologic and Geophysical Services																			
1. Kodiak and Vicinity									X										
Alaska Dept. of Fish and Game & ADNR Division of Parks																			
2. Barren Islands				X	X	X		X					X						
Alaska Dept. of Fish and Game																			
3. Kodiak Coastal Marine Sanc.													X						
Dept. of Community and Regional Affairs and ADNR Div. of Parks																			
4. Kalsin Bay		X		X	X	X		X											
Alaska Dept. of Commerce and Economic Development																			
5. Terror Lake							X								X				
ADNR Div. of Parks																			
6. Afognak Lake and River			X	X	X	X						X				X		X	
7. Devil Inlet				X	X	X													
8. Duck Bay		X	X	X	X	X						X				X		X	
9. Kazakof Bay		X		X	X	X										X			
10. Kitoi Bay		X	X	X	X	X													
11. Little Waterfall Bay				X	X	X										X			
12. Melina Lakes		X	X	X	X	X												X	
13. Onion Bay				X	X	X													
14. Paramanof Bay	X	X		X	X	X		X				X				X		X	
15. Pauls and Laura lakes			X	X	X	X												X	
16. Seal Bay		X		X	X	X													
17. Shuyak Island			X	X	X	X		X								X	X	X	
18. The Slough				X	X	X												X	
19. Tonki Bay and Pillar Cape	X	X		X	X	X													
20. Tonki Cape	X			X	X			X										X	
21. Anton Larsen Bay		X	X	X	X	X													
22. Barabara Lake and Cove				X	X	X					X								
23. Boulder Bay			X	X	X	X													
24. Buskin Lake, River & Beach			X	X	X	X					X								
25. Cape Chiniak			X	X	X	X		X							X	X		X	
26. Cliff Point			X	X	X	X													
27. Dry Spruce Bay & Islands				X	X	X		X											
28. Eagle Harbor		X	X	X	X	X					X								
29. Erskine House			X	X															
30. Gibson Cove				X		X													
31. Hidden Basin				X	X	X													
32. Holy Resurrection Church			X	X															
33. Icon Bay			X	X	X	X					X			X		X			
34. Isthmus Bay				X	X	X		X										X	
35. Kizhuyak Bay				X	X	X					X				X			X	

Table 6.1. (Continued).

NAME OF NOMINATING BODY	1. Vulnerable Natural Habitat	Cultural Resource	Historic Resource	Scenic Resource	2. Critical Habitat	3. Recreational Area	4. Water dependent Facility	5. Unique Geologic Area	6. Hazard Area	7. Areas Needed to Maintain Coastal Processes	8. Subsistence Area	9. Scientifically Important Area	10. Potential Estuarine or Marine Sanctuaries	11. Lifestyle Impacts	12. Energy Facilities	13. Timber Harvesting	14. Residential Development	15. Land Ownership Requires Joint Planning	16. Transportation Facilities
36. Long Island			X	X	X	X												X	
37. Middle Bay				X	X	X												X	
38. Monaska Creek & Bay	X	X		X	X	X	X										X	X	
39. Narrow Cape					X	X		X											
40. Pasagshak Bay		X	X	X	X	X												X	
41. Pillar Creek & Monashka Bay	X	X		X	X	X													
42. Road to Cape Chiniak		X	X	X	X	X													
43. Saltery Cove		X	X	X	X	X												X	
44. Shearwater Bay*				X	X	X					X							X	
45. Spruce Cape			X	X		X													
46. The Triplets				X	X	X													
47. Ugak Island			X	X	X	X													
48. Womens Bay		X		X	X	X									X		X	X	
49. Woody Island			X	X	X	X													
50. Akalura Lake		X	X		X	X	X												
51. Ayakulik River		X	X	X	X	X		X			X							X	
52. Barling Bay*			X	X	X	X					X			X					
53. Carlson Point				X	X	X												X	
54. Chief Point & Chief Cove		X		X	X	X													
55. Drake Head				X	X	X													
56. Frazer Lake			X	X	X	X												X	
57. Halibut Bay				X	X	X		X										X	
58. Karluk Lake & River*	X		X	X	X	X					X				X			X	
59. Kiavak Bay		X	X	X	X	X													
60. Little River Lake				X	X	X													
61. Midway Bay*				X	X	X					X								
62. Ocean Bay & Rolling Bay		X	X	X	X	X													
63. Russian Harbor			X	X	X	X													
64. South Olga Lakes			X	X	X	X					X								
65. Three Saints Bay		X	X	X	X	X					X			X					
66. Tugidak Island	X			X	X	X		X				X							
67. Uganik Island				X	X	X		X											
68. Uganik Lake				X	X	X													
69. Uyak Bay*				X	X	X						X							
70. Fort Abercrombie			X	X	X	X													
Villages																			
Akliok																			
71. Deadman Bay					X														
72. Portage Bay					X														
73. Olga Bay					X														
74. Humpy Cove					X														
75. Seven Rivers					X														
76. Kaguyak Bay					X														
77. Sulua Bay					X														
78. Moser Bay					X														
79. Cape Alitak					X														
80. Aygalulik Peninsula																			
81. Seququia Bay					X														

Table 6.1. (Concluded).

NAME OF NOMINATING BODY	1. Vulnerable Natural Habitat	Cultural Resource	Historic Resource	Scenic Resource	2. Critical Habitat	3. Recreational Area	4. Water dependent Facility	5. Unique Geologic Area	6. Hazard Area	7. Areas Needed to Maintain Coastal Processes	8. Subsistence Area	9. Scientifically Important Area	10. Potential Estuarine or Marine Sanctuaries	11. Lifestyle Impacts	12. Energy Facilities	13. Timber Harvesting	14. Residential Development	15. Land Ownership Requires Joint Planning	16. Transportation Facilities
Old Harbor																			
82. Kiliuda Bay					X						X								
83. Big Creek					X						X								
Ouzinkie																			
84. Monks Lagoon			X																
85. Marmot Bay*					X							X							
86. Kuprenoff Strait*					X							X							
87. Camels Rock					X							X							
88. Doctors River					X							X							
Port Lions																			
89. Talnik Point					X							X							
90. Sheratin Bay*					X							X							
91. Whale Island					X							X							
92. Whitney Bay					X							X							
93. Litnik					X							X							
94. Raspberry Island					X							X							
95. Afognak Island					X							X							

Legend
X prime concerns
X additional concerns
* nominated by a village plus another source, including other villages

7.0 PUBLIC INVOLVEMENT

7.0 PUBLIC INVOLVEMENT

7.1 INTRODUCTION

The purpose of public involvement in the Kodiak Island Borough coastal management program has been two-fold:

1. to provide information and to educate the public about the purpose and impact of the program; and
2. to provide opportunities for public input throughout the planning and decision-making process.

During the coastal management program, public involvement activities have been integrated into the overall planning process. It was recognized early in the process that a variety of "publics" exists. For that reason, a variety of techniques was used to obtain public involvement. In an effort to involve as many people as possible, for as long as possible in the program, four interrelated techniques were used:

1. select committees (CZM Technical Committee, and KANA OEDP Committee);
2. public meetings and workshops;
3. surveys; and
4. media contacts.

With all of the techniques a "reiterative" approach was used. That is, the Kodiak Island Borough staff took the responsibility of proposing "something" as a basis of discussion and debate, as well as for review and comment. Based on public input, draft documents were refined several times prior to distribution to the Assembly. Two important sections of the report

were developed in this manner: issues, goals and objectives; and resource inventory. To a lesser degree, the policies section also underwent this process of review and refinement.

Public involvement in the Kodiak Island Borough's coastal management program will not end with this Phase I progress report. Continuing efforts will be made to inform the public about the work accomplished through the program and to provide opportunities for public input in the development of the Kodiak Island Borough coastal management plan.

The rest of this section will highlight each of the four techniques used to obtain public input in Phase I of the Kodiak Island Borough coastal management program.

7.2 SELECT COMMITTEES

Select committees known by a variety of names (e.g. Technical Committee, Advisory Committee, Steering Committee, Working Groups) are generally designed to represent interests and values that occur in a community. As such, they usually provide a broad range of attitudes in one group of individuals. Select committees are most often used as advisory bodies to guide the direction of technical work throughout the planning process.

The advantages of the select committee approach are the continuity of the committee throughout the planning process, the potential diversity available in one "working" group, and greater intensity of interaction with the process and its products. One of the disadvantages of this method of public involvement is that it tends to limit public input to those on the committee. This can be a problem if the committee members are not representative of broader community attitudes. In order to overcome the possible disadvantage of the select committee method of public involvement, the Kodiak Island Borough complemented its use of two select committees with three other public involvment techniques. These techniques are described later in this section.

In early October (1980), the Kodiak Island Borough established a CZM Technical Committee. The purpose of the Committee was to "advise the CZM Coordinator on matters pertaining to the coastal zone management program. Specifically, the Committee would:

1. Provide input for the development of the detailed coastal zone management work program, within the framework of the general work program approved by the Borough Assembly; and

2. Review and comment on the documents prepared for the coastal zone management program, prior to consideration by the Assembly".

The Kodiak Island Borough CZM Technical Committee is composed primarily of individuals who represent major community groups or interests. The individuals and the organization they represent are listed below:

KODIAK ISLAND BOROUGH CZM TECHNICAL COMMITTEE

Robert Amesbury/Darwin Rennewanz	Sea-Land Service, Inc.
Leslie Anderson/Gary Haines	KONCOR Forest Resource Management
William Anderson	United States Coast Guard
Tom Azumbrado	Kodiak Island Housing Authority
Forrest Blau	Private Citizen
Tim Blott	Kodiak Seafood Processors' Assoc.
Mike Brechan	Brechan Enterprises, Inc.
Tim Hill	KIB Planning & Zoning Commission
Wayne Marshall	Kodiak Area Native Association
Dave Nease/Laurel Peterson	Kodiak Electric Association
Hank Pennington	KIB OCS Advisory Council
James Peotter	Kodiak Island Borough Assembly
Thomas Peterson	Kodiak Economic Development Comm.
Gordan Ryan/Bill Bivin	City of Kodiak
Mary Jo Simmons	Private Citizen
Richard Sims	Kodiak Area Chamber of Commerce
Jeffrey Stephan	United Fishermens' Marketing Assoc.
Gene Sundberg	Koniag, Inc.
Noreen Thompson/Bob Thomas	KIB School District
Nell Waage	Kodiak Halibut Fishermens' Assoc.

The Kodiak Island Borough CZM Technical Committee met approximately every one to two months, during Phase I of the coastal management program (October, December, 1980 - January, February, March, May, 1981). At all of their meetings, the CZM Technical Committee reviewed the status and direction of the Borough's coastal management program; while commenting on specific topics, such as the CZM draft goals and objectives and agendas for public meetings and work shops.

In addition to the CZM Technical Committee, the Kodiak Island Borough used one other select committee, the Kodiak Area Native Association Overall Economic Development and Planning Committee. The Committee consists of one representative from each of the six villages in the Borough (Larsen Bay's position has been vacant since mid-February). The following people serve on the KANA OEDP Committee:

KANA OEDP COMMITTEE

Duke Delgado	Ouzinkie
David Eluska	Akhiok
Ron Lind	Karluk
Patricia Lukin	Port Lions
Arthur Panamaroff	Larsen Bay
Dorothy Pestrikoff	Old Harbor

The KANA OEDP Committee was initially involved in the Kodiak Island Borough coastal management program in a review capacity. The Committee played an integral role in the CZM village participation program, subcontracted through KANA. The KANA OEDP Committee performed the same function as the CZM Technical Committee in the Kodiak Island Borough's coastal management program's public involvement efforts and met the same months as the CZM Technical Committee. The February 1981 meeting was a joint working meeting between the two Committees and the Kodiak Island Borough Assembly. Further information on the role of the Committees in the Borough's coastal management program can be obtained from the Kodiak Island Borough.

7.3 PUBLIC MEETINGS AND WORKSHOPS

One of the techniques used to supplement the select committee method of obtaining public input was public meetings and workshops.

Two workshops/meetings were held in each of the villages in the Kodiak Island Borough, as well as in the City of Kodiak. The first set of village workshops occurred from February 9-16, 1981. A workshop/public meeting for the City of Kodiak was held on February 24, 1981. The main purpose of the first set of workshops was educational; to provide Borough residents with basic information about coastal management. In addition, the following topics were discussed at the workshops: the role of the Kodiak Island Borough in preparing a coastal management plan, and the work program for plan preparation; the role of KANA as a sub-contractor for the village public participation program; the role of Woodward-Clyde Consultants as a sub-contractor for the inventory analysis portion of the program; and an introduction to the concept of Areas Meriting Special Attention (AMSA). Additional intents of the first set of workshops were: to explain the possible impacts of the coastal managment program; and to obtain some initial reactions to Kodiak Island Borough coastal management issues. The first set of workshops in Kodiak Island Borough villages was well attended. A total of 56 village residents participated in the workshops. The workshop/meeting in the City of Kodiak had low attendence by comparison, six CZM Technical Committee members and one interested citizen attended the city workshop/meeting.

A second set of village workshops occurred from April 13-23, 1981, with a second workshop/meeting held in the City of Kodiak on May 20, 1981. The second set of workshops dealt with coastal management issues in more depth than the first set. The four major topics that were discussed at each of these workshops were: review of the general status and direction of the Kodiak Island Borough coastal managment program; review of the resource inventory and analysis portion of the program; identification of fish and game resource use patterns by Borough residents; and review of CZM draft goals and objectives. As with the first set of workshops, those held in the villages had higher participation

than the one held in the City of Kodiak. Approximately 35 village residents were involved in the second set of workshops. In the City of Kodiak, only two CZM Technical Committee members attended the meeting.

In addition to the two sets of workshops/meetings held in each of the villages and the City of Kodiak, two "CZM Intervillage Conferences" were also sponsored. The two conferences were held February 23-25, 1981 and May 19-20, 1981, both in the City of Kodiak. The main purpose of the CZM Intervillage Conferences was to enable village residents to discuss and identify common coastal management issues. The first conference was attended by 19 village residents, the second by 22 village residents, representing all six villages in the Kodiak Island Borough. Representatives from the City of Kodiak were invited to attend portions of both conferences.

Overall, the workshops/meetings appear more successful in obtaining public input from Borough residents in villages, than from Borough residents in the City of Kodiak. Further information on the workshops/meetings held by the Kodiak Island Borough as part of the coastal management program can be obtained from the Borough.

7.4 SURVEYS

The Kodiak Island Borough used two similar public opinion surveys to supplement the other public involvement techniques used in the coastal management program.

The Kodiak Area Native Association, through their sub-contract with the Borough, surveyed householders in the six Borough villages. The surveys were conducted on a door-to-door basis in each village. Approximately 65% of the village households were surveyed, representing about 35% of the adult population in the villages.

In the Kodiak urban area, the survey was distributed to all boxholders at the U. S. Post Office in the City of Kodiak and at the U. S.

Coast Guard Base. Additional surveys were also located in sites around the City of Kodiak and were available at several public meetings. Approximately 3,855 surveys were distributed in the Kodiak urban area, 139 surveys were completed and returned, representing a 3.6% response rate. A copy of the survey distributed in the Kodiak urban area is included in this section of the Phase I progress report.

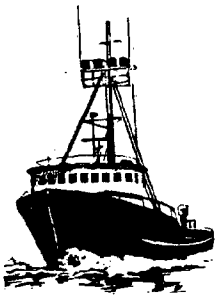
This section will primarily summarize data obtained from the Kodiak Island Borough coastal management surveys. In most cases, the data has been summarized on a composite basis for 1) the six villages in the Borough, and 2) the Kodiak urban area. As previously stated, more detailed information can be obtained from the Kodiak Island Borough.

The first four questions of the survey were intended to determine Borough residents' basic understanding of coastal management. Forty-one percent (41%) of the village respondents had some knowledge of coastal management, but only thirty percent (30%) were aware that the Borough was undertaking the development of a coastal managment plan. Sixteen percent (16%) of the village respondents felt that the Borough could represent their interests in a coastal management plan, but another sixty-three percent (63%) were unsure of the Borough's ability to do so.

In the Kodiak urban area, there was more awareness about coastal management from survey respondents. Sixty-seven percent (67%) of urban area respondents had some knowledge of coastal management, and fifty-eight percent (58%) were aware that the Borough was undertaking the development of a coastal management plan. Only twenty-six percent (26%) of urban area respondents felt that the Borough could represent their interests in a coastal management plan, and fifty-nine percent (59%) were unsure of the Borough's ability to do so.

Village respondents felt that 1) village workshops, 2) village representatives on the CZM Technical Committee, and 3) periodic newsletters were the best ways to involve them in the coastal management pregram. Urban area respondents felt that 1) surveys, 2) public meetings, and

KODIAK ISLAND BOROUGH
COASTAL MANAGEMENT PROGRAM
P.O. BOX 1246
KODIAK, ALASKA 99615
486 - 5736



BOXHOLDER

COASTAL MANAGEMENT

? ? ? COASTAL MANAGEMENT ? ? ?

COASTAL MANAGEMENT IS A JOINT EFFORT BY LOCAL, STATE, AND FEDERAL GOVERNMENTS AND THE PRIVATE SECTOR TO MANAGE COASTAL RESOURCES AND PROMOTE THEIR WISE AND BALANCED USE. YOU CAN HELP ! THE KODIAK ISLAND BOROUGH IS PREPARING A "COASTAL MANAGEMENT PLAN." THE COASTAL MANAGEMENT PLAN, WHEN ADOPTED, WILL BE A LEGAL DOCUMENT THAT GUIDES THE FUTURE USE OF LAND AND WATER IN THE BOROUGH. WE NEED YOUR COMMENTS TO PREPARE A GOOD PLAN. PLEASE HELP BY FILLING OUT THE ENCLOSED SURVEY AND COMING TO OUR PUBLIC MEETING:

KODIAK COMMUNITY COLLEGE
WEDNESDAY, MAY 20, 1981
7:00 P.M.

FOR MORE INFORMATION, CONTACT LINDA FREED—CINDY BOWSER AT 486 - 5736

COMMUNITY SURVEY

COASTAL MANAGEMENT PROGRAM
KODIAK ISLAND BOROUGH
MAY 1981

The Kodiak Island Borough is developing a coastal management plan for all lands located within the Borough; from the Barren Islands to the Trinity Islands and everything in between. The purpose is to enable local, state and federal governments and private interests to plan for the balanced use of the coastal resources in the Kodiak Archipelago. This survey is being conducted by the Kodiak Island Borough to help assess the understanding and concerns of residents about coastal management. The survey is being conducted in the Kodiak City area and has been conducted in each of the Borough's six villages. The answers you provide will be used to guide the Borough in the development of the coastal management plan. We would like to emphasize that this survey is only one way that you can provide direction in the development of the coastal management plan. We encourage you to express your views at our public meetings or by phone, letter or in person. You can contact Linda Freed or Cindy Bowser at the Kodiak Island Borough for more information. Thank you for your interest.

PLEASE ANSWER THE FOLLOWING QUESTIONS AS BEST YOU CAN. YOU MAY WRITE ADDITIONAL COMMENTS ANYWHERE ON THE SURVEY. WHEN YOU ARE DONE, PLEASE PLACE THE COMPLETED SURVEYS IN THE BOXES LOCATED AT:

- CITY POST OFFICE
- C. G. BASE POST OFFICE
- BOROUGH OFFICES
- HOLMES-JOHNSON LIBRARY
- COMMUNITY COLLEGE LIBRARY
- SHIRE BOOKSTORE

PLEASE COMPLETE THE SURVEY BY MAY 29, 1981. THANK YOU!

1. At the present time, how much do you know about coastal management in general?

   ( ) Good knowledge of coastal management.
   ( ) Some knowledge of coastal management.
   ( ) No knowledge of coastal management.

2. Prior to this survey, were you aware that the Kodiak Island Borough was in the process of developing a coastal management plan for the Borough?

   ( ) Yes ( ) No

3. Do you feel that the Kodiak Island Borough has the ability to develop a coastal management plan that will reflect your interests in the management of coastal resources?

   ( ) Yes ( ) No ( ) Don't know

   If yes or no, what are the main reasons for your answer?

4. After it is adopted, the Kodiak Island Borough's Coastal Management Plan may have an effect on the manner in which coastal resources in the Borough are used.
How do you feel that residents' interests can best be identified?

( ) Surveys
( ) Public meetings
( ) Radio shows
( ) Newsletters
( ) Newspaper articles
( ) Other (please list)

5. Overall, how do you feel the land around your neighborhood should be managed?

	Within ½ Mile	½ - 5 Miles	Beyond 5 Miles
Development	( )	( )	( )
Development with restrictions	( )	( )	( )
Conservation	( )	( )	( )

What "neighborhood" do you live in?

If you have chosen "development with restrictions", what restrictions would you like to see?

6. A purpose of the coastal management program is to identify the types and locations of development that may occur in the Borough. The following types of development could occur in the Borough. What do you think about their location?

	Near the City of Kodiak	In the Borough Outside City	Should not occur in the Borough
Fish processing	( )	( )	( )
Tourism & recreation	( )	( )	( )
Oil or gas on-shore facilities	( )	( )	( )
Port/transportation industry expansion	( )	( )	( )
Timber	( )	( )	( )
Mining & mineral processing	( )	( )	( )

6. (Continued)	Near the City of Kodiak	In the Borough Outside City	Should not occur in the Borough
Shipyards/marine repair facilities	( )	( )	( )
Agriculture/ranching	( )	( )	( )
Other (list)	( )	( )	( )

Of these possible types of development, which types would you like to see for this area?

7. The developments in question #6 could have an impact on the Borough's environment and its resources. In considering possible developments, please indicate your general level of concern about the following resource protection interests:

	None	Minimal	Some	Very
Natural setting	( )	( )	( )	( )
Fish/wildlife habitat	( )	( )	( )	( )
Water quality	( )	( )	( )	( )
Air quality	( )	( )	( )	( )
Other (please list):	( )	( )	( )	( )

8. The people living in the Borough are an integral part of the island's environment. The coastal management program must also consider peoples' lifestyles. Of the following lifestyles, which do you view as being of the most importance?

	None	Minimal	Some	Very
Subsistence hunting & fishing	( )	( )	( )	( )
Commercial fishing or trapping	( )	( )	( )	( )
Sport fishing & hunting	( )	( )	( )	( )
Year-around employment opportunities	( )	( )	( )	( )
Other (please list):	( )	( )	( )	( )

9. The coastal management program will also indentify specific areas that merit special attention. These areas may merit special attention because of unusual social, economic, or environmental value, or because they are very sensitive to change. Do you feel any areas in the Borough should be indentified as areas meriting special attention? Please list area (location), reason it is special, and how you would like to see it managed.

10. The coastal management program must also consider natural hazards that could create problems for developmental activities in the Borough. Of the following hazards, which do you feel are of concern to development in your area?

	LEVEL OF IMPORTANCE			
	None	Minimal	Some	Very
River flooding	( )	( )	( )	( )
Coastal storm flooding	( )	( )	( )	( )
Landslide & avalanches	( )	( )	( )	( )
Earthquakes	( )	( )	( )	( )
Tidal waves	( )	( )	( )	( )
Erosion	( )	( )	( )	( )
Winds	( )	( )	( )	( )
Other (please list):	( )	( )	( )	( )

This last set of questions relates to the goals of the Kodiak Island Borough Coastal Management Program. These goals will provide the framework for the coastal management plan. What do you think of these goals?

1. To provide for cultural/social strength, public safety, and the economic welfare of Borough residents when siting future land use activities.

   Good goal ( ) Fair goal ( ) Poor goal ( )

2. To recognize that residents of the Borough utilize local fish, game, and plant resources to meet dietary and traditional/ cultural needs.

   Good goal ( ) Fair goal ( ) Poor goal ( )

3. To protect coastal habitats and air and water quality in conjunction with development activities.

   Good goal ( ) Fair goal ( ) Poor goal ( )

4. To preserve the scenic beauty and the cultural, ethnic, & historical values of the Kodiak Island Borough.

   Good goal ( ) Fair goal ( ) Poor goal ( )

5. To strive for compatible use of coastal lands and waters between diverse development activities.

Good goal ( ) Fair goal ( ) Poor goal ( )

6. To encourage economic productivity and diversity in the Borough, while minimizing any conflict with fisheries resources and the fishing industry.

Good goal ( ) Fair goal ( ) Poor goal ( )

7. To encourage the provision of land for desired development activities.

Good goal ( ) Fair goal ( ) Poor goal ( )

8. To simplify and expedite permit procedures and governmental agency review in the implementation of the Kodiak Island Borough Coastal Management Plan.

Good goal ( ) Fair goal ( ) Poor goal ( )

PLEASE TELL US SOMETHING ABOUT YOURSELF:

1. Male ( )
   Female ( )

2. Age: _____

3. "Neighborhood" that you live in:

4. How long have you been a resident of Kodiak:

THANK YOU AND PLEASE DEPOSIT THE COMPLETED SURVEY IN THE BOXES LOCATED AT:

- CITY POST OFFICE
- C. G. BASE POST OFFICE
- BOROUGH OFFICES
- HOLMES-JOHNSON LIBRARY
- COMMUNITY COLLEGE LIBRARY
- SHIRE BOOKSTORE

3) radio shows were the best ways to involve them in the coastal management program.

Thirty-six percent (36%) of the village respondents stated that they felt there were areas near their village that deserved consideration as Areas Meriting Special Attention (AMSA). Approximately sixty-one percent (61%) of urban area respondents identified areas in the Borough as AMSA's.

Question 11, in both surveys, related to possible goals and objectives of the Kodiak Island Borough. The goals and objectives presented in the village survey were general goals and objectives taken from a draft goals and objectives statement adopted by the Borough in 1977. Overall, these goals and objectives received support from village respondents, as being good goals and objectives.

The goals identified in the Kodiak urban area survey were specifically related to the coastal management program. In all cases, a majority of the respondents felt that the goals were good goals for the Kodiak Island Borough coastal management program. The responses from remaining survey questions (5,6,7,8, and 10) follow in tabular form.

7.5 MEDIA CONTACTS

The fourth technique used to obtain public involvement in the Kodiak Island Borough coastal management program was contact with local media. There are two radio stations (KVOK-AM and KMXT-FM) and two newspapers (Kodiak Daily Mirror and Kadiak Times) based in the City of Kodiak. KVOK-AM is received throughout the Borough. KMXT-FM is heard primarily in the City of Kodiak, with fair reception in the villages of Port Lions and Ouzinkie. The Kodiak Daily Mirror is published daily Monday through Friday, while the Kadiak Times is published weekly on Thursdays.

Notices of all the workshops and public meetings were published in both papers and were broadcast as public service announcements on both radio stations. In most cases, the purpose of contact with local

media was to make the public aware of meetings related to coastal management.

In addition, a few stories and editorials about the Kodiak Island Borough coastal management program were published in both papers during the Phase I program. As well, KMXT-FM produces a local public affairs talk show called "Public Forum". This program was used approximately bi-monthly to inform Borough residents about the status and direction of the coastal management program.

KANA, through their sub-contract with the Borough, also provided information to village residents on coastal management, through articles in KANA's newsletter. These articles appeared in the November, December and January newsletters. In late June 1981, a newsletter devoted exclusively to coastal management will be distributed through KANA.

7.6 SUMMARY

The Kodiak Island Borough conducted an extensive public involvement effort during Phase I of the coastal management program. Additional details of any of the techniques used, or the input obtained, are available from the Borough. Technical Appendix 1 provides specific information on the public participation program in Borough villages, performed by KANA, through a sub-contract with the Borough.

The distribution of this Phase I progress report continues the public involvement efforts of the Kodiak Island Borough coastal management program. This document will be widely distributed for review and comment. At a minimum, an additional set of workshops/meetings will be held in Borough villages and the City of Kodiak. At least two public hearings are anticipated on the "public hearing draft" of the Kodiak Island Borough coastal management plan; one before the Kodiak Island Borough Planning and Zoning Commission and one before the Kodiak Island Borough Assembly. Some consideration is also being given to holding public hearings, on the public hearing draft of the Kodiak Island Borough coastal management plan, in each of the six villages in the Borough.

QUESTION	AKHIOK			KARLUK			LARSEN BAY			OLD HARBOR			PORT LIONS			OUZINKIE			KODIAK*		
5. Overall, how do you feel the land around your neighborhood should be managed?	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles
Development	12	10	-	4	11	-	12	2	-	21	71	-	7	15	-	1	0	-	18	23	30
Development w. restrictions	12	10	-	4	11	-	3	13	-	42	58	-	8	22	-	10	8	-	39	60	27
Conservation	11	12	-	1	12	-	4	11	-	17	78	-	10	31	-	4	7	-	35	29	45
6. A purpose of the Coastal Management Program is to identify the types and locations of development that may occur in the Borough. The following types of development could occur in the Borough. What do you think of their location?	Near Village	Around Island	Not at All	Near Village	Around Island	Not at All	Near Village	Around Island	Not at All	Near Village	Around Island	Not at All	Near Village	Around Island	Not at All	Near Village	Around Island	Not at All	Near City	In Borough	Not in Borough
Fish Processing	5	18	0	14	6	-	15	12	0	97	3	0	30	15	0	14	10	0	106	56	4
Tourism & Recreation	1	5	17	8	10	-	7	11	3	22	76	2	4	19	17	1	3	13	109	85	9
Oil/Gas On-shore Facilities	0	8	15	2	11	-	3	12	3	26	65	6	7	5	32	0	3	13	22	61	65
Port/Transportation Industry	4	15	4	5	11	-	10	13	1	87	12	2	23	12	8	5	5	8	99	55	9
Timber	0	7	16	3	13	-	1	14	1	2	91	4	7	11	26	4	6	7	10	85	46
Mining/Mineral Processing	0	6	17	2	11	-	4	12	3	29	63	6	1	5	36	0	2	14	8	72	56
Shipyards/Marine Repair	7	16	0	2	14	-	5	15	0	88	10	1	26	18	1	9	10	4	108	57	6
Agriculture/Ranching																			13	127	10
Other:																					
Gear Storage																				2	
Hydro-Electric Power																			2		
Fish Hatchery																			1	1	
Small Business																			1	2	
Roads																			3		
Manufacturing																			1		

* - Composite of Kodiak surveys.

QUESTION	U.S.C.G. BASE			BELLS FLATS			CHINIAK			BUSH AREAS			IN CITY LIMITS			NORTH OF CITY			INDETERMINATE		
5. Overall, how do you feel the land around your neighborhood should be managed?	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles	Within ½ Mile	½-5 Mi.	Beyond 5 Miles
Development	1	3	3	1	2	11	1	1	2	0	0	0	9	9	6	1	3	5	5	5	3
Development with Restrictions	4	8	3	12	16	3	1	2	1	0	0	0	14	23	12	8	9	6	0	2	2
Conservation	4	5	9	8	9	10	2	2	3	2	2	2	13	6	15	5	4	5	1	1	1
6. A purpose of the Coastal Management Program is to identify the types and locations of development that may occur in the Borough. The following types of development could occur in the Borough. What do you think about their location?	Near City	In the Borough	Not in Borough	Near City	In the Borough	Not in Borough	Near City	In the Borough	Not in Borough	Near City	In the Borough	Not in Borough	Near City	In the Borough	Not in Borough	Near City	In the Borough	Not in Borough	Near City	In the Borough	Not in Borough
Fish Processing	13	13	0	22	11	1	5	2	0	1	0	1	38	20	0	21	5	2	6	5	0
Tourism & Recreation	17	19	3	20	19	1	4	2	1	1	0	1	39	23	1	23	17	1	5	5	1
Oil/Gas On-shore Facilities	2	14	10	3	8	16	1	1	4	0	0	2	7	23	20	6	11	10	3	4	3
Port/Transportation Industry	16	10	2	21	7	2	5	3	0	0	1	1	34	19	1	18	10	2	5	5	1
Timber	0	12	10	2	12	10	2	3	1	0	0	2	3	37	13	1	16	9	2	5	1
Mining/Mineral Processing	2	10	13	1	11	12	1	3	1	0	0	2	1	29	15	0	15	10	3	4	3
Shipyard/Marine Repair	17	9	2	23	8	1	4	2	0	1	0	1	35	22	0	21	12	2	7	4	0
Agriculture & Ranching	2	22	2	3	23	3	1	5	0	1	1	0	3	44	3	0	27	1	3	5	1
Other:																					
Gear Storage														2							
Hydro-Electric Power													2								
Fish Hatchery													1				1				
Small Business					2														1		
Roads	1												2								
Manufacturing																1					

QUESTION	AKHIOK				KARLUK				LARSEN BAY				OLD HARBOR				PORT LIONS				OUZINKIE				KODIAK**			
7. The developments in question #6 could have an impact on the Boroughs environment and its resources. In considering possible developments, please indicate your general level of concern about the following resource protection interests.	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None
Natural Setting	18	5	0	0	5	8	2	0	7	5	1	1	70	13	8	5	33	7	1	0	7	7	0	2	93	30	9	7
Fish/Wildlife Habitat	16	7	0	0	7	9	0	0	5	8	0	1	77	18	0	1	20	12	7	0	12	3	0	1	110	21	2	5
Water Quality	22	1	0	0	16	0	0	0	13	0	0	1	48	28	13	7	23	12	5	0	9	2	4	1	116	17	1	4
Air Quality	22	1	0	0	14	0	1	1	11	2	0	1	27	17	15	36	22	11	5	0	7	3	4	2	114	16	5	4
Other:																												
Population Control																									2			
Quality of Life																									4			
Pollution																									5			
Community Development Aesthetics																									2			
Road System																									3			
Trash Control																									2			
8. The people living in the Borough are an integral part of the Island's environment. The Coastal Management Program must also consider people's lifestyles. Of the following lifestyles, which do you view as being of most importance?	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None
Subsistence Hunting & Fishing	22	1	0	0	15	0	0	0	9	6	0	0	93	3	2	0	31	2	4	0	13	2	0	1	67	41	19	4
*Commercial Fishing & Trapping	22	1	0	0	13	1	0	0	14	1	0	0	92	2	4	1	13	21	1	1	15	0	0	1	91	27	6	5
Sport Fishing & Hunting	0	0	4	19	10	2	3	1	5	7	1	2	48	24	15	8	7	16	6	3	9	2	3	2	55	53	17	7
Village Lifestyle	20	3	0	0	11	5	0	0	12	2	0	0	83	13	1	2	26	3	3	4	14	0	0	2	-	-	-	-
Year-around Employment	2	0	6	15	8	6	1	1	8	5	1	1	85	10	0	4	30	6	2	0	14	0	0	2	84	35	8	9
Other:																												
Energy Alternative Lifestyle																									2			
Farming																									1			
Recreation on Road System																									1			
Cultural Development																									1			
Affordable Land																									1			

** - Composite of Kodiak surveys.

* - No trapping

QUESTION	U.S.C.G. BASE				BELLS FLATS				CHINIAK				BUSH AREAS				IN CITY LIMITS				NORTH OF CITY				INDETERMINATE			
7. The developments in question #6 could have an impact on the Borough's environment and its resources. In considering possible developments, please indicate your general level of concern about the following resource protection interests:	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very
Natural Setting	0	2	7	16	1	0	4	20	0	0	1	4	0	0	0	2	4	2	12	29	0	4	6	18	2	1	0	4
Fish/Wildlife Habitat	0	1	3	21	1	0	2	22	0	0	0	5	0	0	0	2	2	1	10	33	0	0	5	23	2	0	1	4
Water Quality	0	1	4	20	1	0	2	22	0	0	0	5	0	0	0	2	1	0	6	39	0	0	5	23	2	0	0	5
Air Quality	0	1	3	21	1	1	1	22	0	0	0	5	0	0	0	2	1	0	8	37	0	3	4	22	2	0	0	5
Other:																												
Population Control												1				1												
Quality of Life								2																1				1
Pollution				1				1												3				1				
Community Development Aesthetics																				2								
Road System																				1				2				
Trash Control																								2				

8. The people living in the Borough are an integral part of the island's environment. The Coastal Management Program must also consider people's lifestyles. Of the following lifestyles, which do you view as being of most importance?	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very
Subsistence Hunting & Fishing	0	7	7	11	1	2	8	13	0	0	0	4	0	0	0	2	3	6	13	21	0	2	10	15	0	2	3	2
*Commercial Fishing & Trapping	0	3	10	12	1	1	4	12	0	0	1	3	0	0	0	2	2	1	6	37	1	1	4	21	1	0	2	4
Sport Fishing & Hunting	0	5	10	10	1	1	9	13	0	0	1	3	0	0	2	0	3	4	18	18	2	5	11	9	1	2	2	2
Year-around Employment	1	2	7	15	0	0	10	14	0	0	1	3	1	1	0	0	3	3	7	33	1	2	9	16	3	0	1	3
Other: Affordable Land																				1								
Energy Alternative Lifestyle								2																				
Farming																				1								
Recreation on Road System																								1				
Cultural Development																								1				
* - No trapping	* (1)																*(1)				* (3)							

QUESTION	AKHIOK				KARLUK				LARSEN BAY				OLD HARBOR				PORT LIONS				OUZINKIE				KODIAK*			
10. The Coastal Management Program must also consider natural hazards that could create problems for developmental activities in the Borough. Of the following hazards, which do you feel are of concern to development in your area?	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None	Very	Some	Minimal	None
River Flooding	1	1	1	20	0	8	6	2	2	1	6	6	1	4	16	79	1	4	12	17	1	1	7	7	11	25	45	48
Coastal Storm Flooding	1	1	9	12	6	7	3	0	0	6	5	2	32	36	21	11	0	13	16	6	1	4	5	6	22	36	42	33
Landslides & Avalanches	1	2	12	8	5	5	2	3	2	2	3	6	11	33	36	17	0	0	17	17	3	8	3	2	28	37	47	19
Earthquakes	1	16	6	0	1	8	4	2	2	4	6	2	55	28	6	5	2	6	26	2	7	4	3	2	38	58	29	8
Tidal Waves	0	5	12	6	0	5	7	5	2	3	8	2	55	28	7	4	3	8	23	0	8	4	3	1	42	57	21	11
Erosion	16	7	0	0	10	4	1	0	8	5	1	0	17	44	25	9	10	28	1	1	7	6	2	1	44	46	32	9
Winds	22	1	0	0	13	2	0	0	7	5	2	1	24	26	25	18	29	10	0	0	5	8	1	2	46	47	27	6
Other:																												
Pollution																									1			
Fresh Water Shortage																									1			
Rain Damage																									1			
Ocean Storms/Currents																									1			
Dusty Roads																									3			
Rats																									1			
Fire																									2			

* - Composite of Kodiak surveys.

QUESTION	U.S.C.G. BASE				BELLS FLATS				CHINIAK				BUSH AREAS				IN CITY LIMITS				NORTH OF CITY				INDETERMINATE			
10. The Coastal Management Program must also consider natural hazards that could create problems for developmental activities in the Borough. Of the following hazards, which do you feel are of concern to development in your area?	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very	None	Minimal	Some	Very
River Flooding	9	11	3	1	1	6	13	4	0	1	3	1	0	1	0	1	21	14	4	3	13	10	2	0	4	2	0	1
Coastal Storm Flooding	6	10	5	4	4	4	14	5	0	0	4	1	0	1	0	1	15	14	6	7	6	10	6	3	2	3	1	1
Landslides & Avalanches	1	12	6	6	1	8	10	5	0	2	2	0	0	1	0	1	7	13	11	14	8	9	6	1	2	2	2	1
Earthquakes	1	2	16	5	0	8	10	5	0	1	4	1	0	1	0	1	3	9	15	18	2	7	10	7	2	1	3	1
Tidal Waves	1	2	15	6	0	5	13	6	0	0	4	1	0	1	0	1	7	6	14	17	1	6	8	10	2	1	3	1
Erosion	1	9	10	4	0	5	8	11	0	0	1	4	0	1	0	1	5	7	17	15	1	9	9	6	2	1	1	3
Winds	0	9	7	8	0	3	13	8	0	0	0	4	0	1	0	1	3	7	15	15	1	7	9	8	2	0	3	2
Other:																												
Fresh Water Shortage																				1								
Pollution				1																								
Rain Damage				1																								
Ocean Storms/Currents																												1
Dusty Roads																				1				2				
Rats																				1								
Fire								2																				

APPENDIX A — PROJECT TEAM

PROJECT TEAM

- Woodward-Clyde Consultants

  Project Management

  Dr. Richard Firth, Project Manager
  M. Jonathan Isaacs, Deputy Project Manager

  Natural Resources

  Mr. Michael Joyce
  Dr. Maureen McCrae
  Dr. Kenneth Critchlow

  Geophysical Hazards

  Dr. Jack Colonell
  Dr. Lawrence Rundquist
  Ms. Lorrain Ferrel
  Ms. Pamela Leuthold

  Human Resources

  Mr. Jonathan Isaacs
  Mr. Jon Lockert
  Ms. Pamela Leuthold

  Report Production

  Ms. Beverley DeWitt
  Ms. Jessie Wood
  Ms. Jean Borstad
  Ms. Jayne Vorhiis

- Mr. Dale Tubbs, Land Management Consultant

- Kodiak Island Borough

  Ms. Linda Freed, CZM Coordinator
  Ms. Cindy Bowser

- Kodiak Area Native Association

  Public Participation Program

  Mr. Wayne Marshall

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