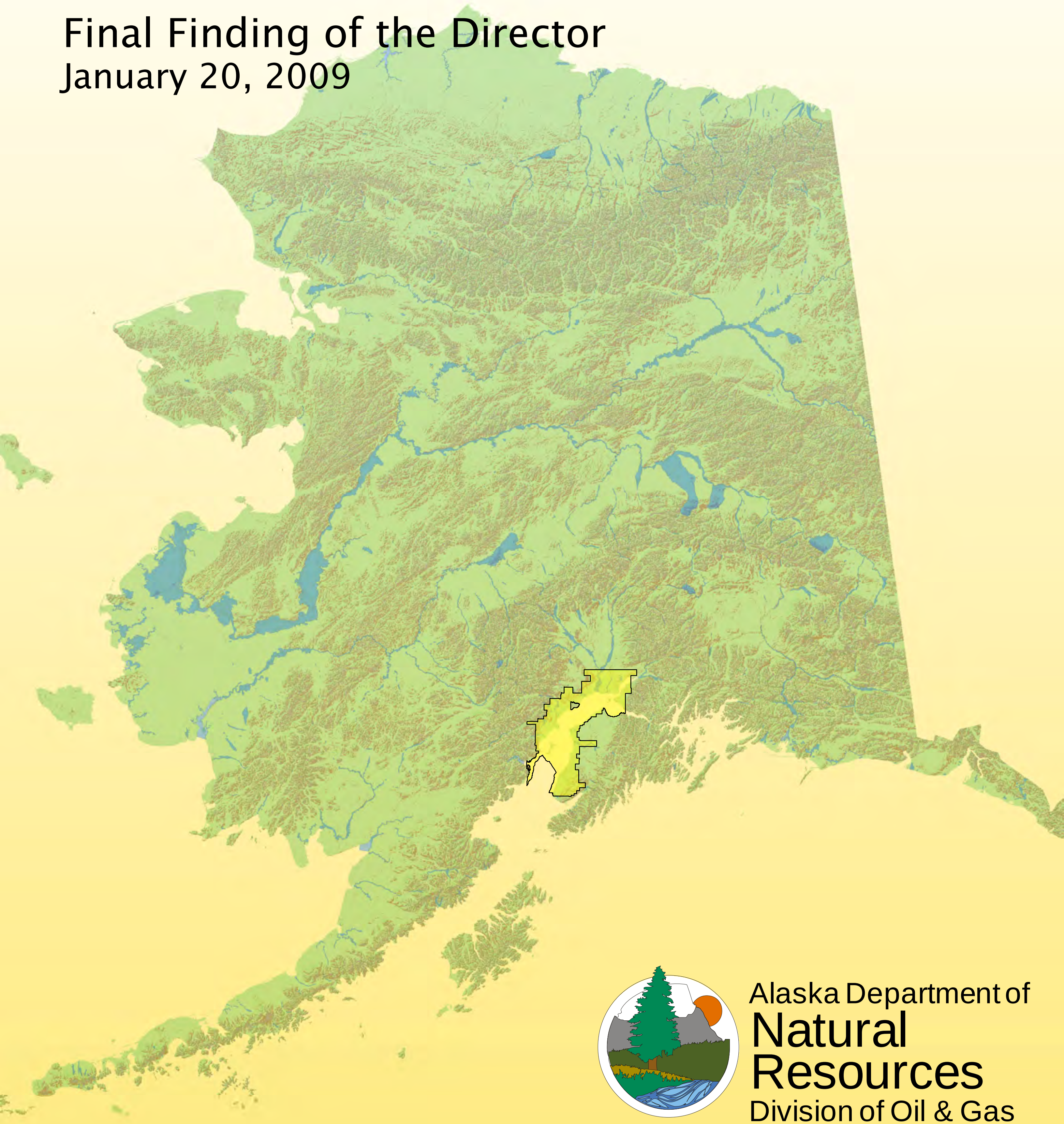
COOK INLET AREAWIDE OIL AND GAS LEASE SALE

Final Finding of the Director

January 20, 2009



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Final Finding of the Director

Prepared by:
Alaska Department of Natural Resources
Division of Oil and Gas

January 20, 2009

List of Abbreviations

AAC	Alaska Administrative Code
ACMP	Alaska Coastal Management Plan
ADCED	Alaska Department of Community and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOR	Alaska Department of Revenue
AEIDC	Arctic Environmental Information and Data Center
AHRS	Alaska Heritage Resources Survey
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
AOGCC	Alaska Oil and Gas Conservation Commission
AS	Alaska Statute
Bbl(s)	Barrel(s) (42 gallons)
Bcf	Billion cubic feet
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
Bpd	Barrels per day
DF	Division of Forestry
DMLW	Division of Mining Land and Water
DO&G	Division of Oil and Gas
DPOR	Division of Parks and Outdoor Recreation
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
gal	Gallon(s)
km	Kilometer
LNG	Liquefied Natural Gas
MESA	Most Environmentally Sensitive Area
m	Meter
MMS	Minerals Management Service
MSB	Matanuska-Susitna Borough
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NPR-A	National Petroleum Reserve-Alaska
NPS	National Park Service
OHMP	Office of Habitat Management and Permitting
OPMP	Office of Project Management & Permitting
Penin.	Peninsula
RCRA	Resource Conservation and Recovery Act
SHPO	State Historic Preservation Officer
SPCC	Spill Prevention Control and Countermeasure
sq. ft.	Square feet
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDOI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service

Metric and Standard Conversion Tables

To Metric		From Metric	
Feet	Meters	Meters	Feet
1	0.3	1	3.2
2	0.6	2	6.6
3	0.9	3	9.8
4	1.2	4	13.1
5	1.5	5	16.4
6	1.8	6	19.6
7	2.1	7	23
8	2.4	8	26.2
9	2.7	9	29.5
10	3	10	32.8
20	6	20	66
30	9	30	98
40	12	40	131
50	15	50	164
60	18	60	197
70	21	70	230
80	24	80	262
90	27	90	295
100	30	100	328
200	61	200	656
300	91	300	984
400	122	400	1312
500	152	500	1640
1000	305	1000	3281
1500	457	1500	4921

To Metric		From Metric	
Miles	Kilometers	Kilometers	Miles
1	1.6	1	0.6
2	3.2	2	1.2
3	4.8	3	1.9
4	6.4	4	2.5
5	8	5	3.1
6	9.7	6	3.7
7	11.3	7	4.3
8	12.9	8	5
9	14.5	9	5.6
10	16	10	6.2
20	32	20	12
30	48	30	19
40	64	40	25
50	80	50	31
60	97	60	37
70	113	70	43
80	129	80	50
90	145	90	56
100	161	100	62

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Chapter One: Executive Summary

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Chapter One: Executive Summary

The State of Alaska is offering for lease all available state-owned acreage in Cook Inlet Areawide oil and gas lease sales from 2009-2018. The director of the Department of Natural Resources, Division of Oil and Gas, has made a final finding that holding these lease sales is in the best interest of the state. The director reviewed all facts and issues known or made known to him, and limited the scope of the finding to the lease phase of oil and gas activities and the reasonably foreseeable significant effects of issuing leases (AS 38.05.035(e)(1)(A)). Conditions for phasing have been met under AS 38.05.035(e)(1)(C). The content of best interest findings is specified in AS 38.05.035(e), and topics that must be considered and discussed are prescribed in AS 38.05.035(g).

After weighing the facts and issues known to him at this time, considering applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the director has concluded that the potential benefits of lease sales outweigh the possible negative effects, and that Cook Inlet Areawide oil and gas lease sales will be in the best interests of the state of Alaska.

A. Description of the Lease Sale Area

The Cook Inlet area falls within the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough. The area's 30 cities, towns, villages, and communities range in population from a few hundred to almost 300,000. Many of the industries and businesses of the area are supported directly or indirectly by natural resources. Industries include fishing, timber, mining, tourism, construction, and petroleum. Local, state and federal governments, non-governmental organizations, health care, and education are also large employers.

Cultural and historic resources include a wide range of sites, deposits, structures, ruins, buildings, graves, artifacts, fossils, and other objects of antiquity. Sites in the area date to prehistoric periods of Dena'ina and Eskimo occupations, and to historic periods of Russian and Euroamerican occupations.

The area is characterized by three climate zones: the maritime zone, continental zone, and transition zone. Cook Inlet itself is a 350 km long estuary and includes 11 watersheds draining major mountain ranges. Snowmelt and glaciers, which cover 11 percent of the land area of the Cook Inlet basin and store massive amounts of water as ice, provide a large portion of the input to area watersheds.

Several geologic hazards exist in the area, including earthquakes, volcanoes, tsunamis, flooding, ice, current, sediment, tides, and coastal erosion. Located in one of the most seismically active regions in the world, the area has several active volcanoes nearby. Despite these conditions, the petroleum industry has functioned in Cook Inlet without significant environmental damage since its beginnings in 1957.

B. Habitat, Fish, and Wildlife

The Cook Inlet area includes a wide variety of habitats and a broad diversity of fish and wildlife that support a host of economic, recreational, and subsistence activities for residents and visitors. Most of the area's habitats and populations of fish and wildlife are healthy because of careful management and regulatory mechanisms in place for development. A few populations have been identified as threatened or endangered under the federal Endangered Species Act or as species of special concern by the Alaska Department of Fish and Game. Cook Inlet includes many areas established by state or federal law to protect and preserve natural habitat and wildlife populations and to maintain public use of these resources. Many of the special areas have legislatively defined restrictions on development activities.

C. Current and Projected Uses

The Cook Inlet area's abundant moose, black and brown bear, caribou, waterfowl, and many fish species form the resource base for subsistence, sport, commercial, personal use, and educational harvest activities, which are integral to the history and culture of the area, as well as contributing significantly to the economy. Residents and visitors use the area extensively for recreation and tourism. Other abundant natural resources support timber, agriculture, mining, and oil and gas industries.

D. Oil and Gas in Cook Inlet

The Cook Inlet lease sale area has low to moderate petroleum potential, based on factors including geology, seismic data, exploration history of the area, and proximity to known hydrocarbon accumulations. Cook Inlet is a mature, producing petroleum basin, which has had extensive exploration and development over the past 40 years. The area continues to be of interest to the petroleum industry, with annual oil production of 6 million bbls (barrels) and annual gas production of 196 Bcf (billion cubic feet) in 2006.

Oil and gas activities proceed in phases; each subsequent phase's activities depend on the completion or initiation of the preceding phase. During the lease phase, the first step in the process of developing the state's oil and gas resources after the best interest finding process, the state conducts competitive areawide sales of oil and gas leases, offering for lease all available state acreage within the sale area. An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances; however, a plan of operations, subject to a myriad of regulatory authorities and permits, must be approved before any operations may be undertaken on or in the leased area. In the exploration phase, information is gathered about the area's petroleum potential by examining surface geology, researching data from existing wells, performing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. During the development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery.

Over 5.9 million acres of state land have been leased in 52 state oil and gas lease sales in the Cook Inlet area since 1959, generating up to $67.7 million in bonuses received by the state. As of December 30, 2008, over 1 million acres were under lease; 510,705 acres offshore and 675,626 acres onshore.

The location and nature of oil or gas deposits determine the type and extent of facilities necessary to develop and transport the resource. However, modern oil and gas transportation systems usually include the following major components: 1) pipelines; 2) marine terminals; and 3) tank vessels. Oil and gas produced in the lease sale area would most likely be transported by a combination of these depending on the type, size, and location of the discovery. Because the Cook Inlet Basin has produced oil and natural gas since the 1960s, it has a well-developed infrastructure for transporting petroleum, especially in upper Cook Inlet.

The risk of a spill exists any time crude oil or petroleum products are handled. Oil spills associated with the exploration, development, production, storage, and transportation of crude oil may occur from well blowouts, or pipeline or tanker accidents. Since 1999, there have been 18 crude oil spills in the Cook Inlet area of 100 gallons or more from pipelines, platforms, onshore production facilities, storage facilities, and marine tankers. Six of these were more than 500 gallons.

E. Governmental Powers to Regulate Oil and Gas

All exploration lease activities are subject to numerous federal, state, and local laws and regulations with which the lessee is obligated to comply. These government agencies have a broad spectrum of authorities to regulate and condition activities related to oil and gas, and their role in the oversight and regulation of oil and gas activities differ, although some agencies may have overlapping authorities. These agencies include the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game; the Alaska Oil and Gas Conservation Commission; the U.S. Environmental Protection Agency; the U.S. Army Corp of Engineers; the U.S. Fish and Wildlife Service; and the National Marine Fisheries Service.

F. Reasonably Foreseeable Cumulative Effects of Leasing and Subsequent Activity

Potential post-lease activities that could have cumulative effects on the area's habitats and fish and wildlife populations include seismic surveys, construction of support facilities, and drilling and production activities. Some potential cumulative effects of these activities include physical disturbances that could alter the landscape, lakes, rivers, and wetlands; habitat change; behavior changes of fish, wildlife and birds; drawdowns and contamination of groundwater; and contamination of terrestrial or freshwater habitats from discharges from well drilling and production, gas blowouts, or oil spills.

Oil and gas exploration, development, and production activities may produce emissions that have the potential to affect air quality, including carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter-10 (PM_{10}), $PM_{2.5}$, volatile organic compounds (VOC), ozone, and greenhouse gases including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

Oil and gas related activities could result in increased access to hunting and fishing areas due to construction of new roads, but this could also increase competition between user groups for fish and wildlife resources. Interference with commercial fishing operations is a potential effect. A major oil spill could harm fisheries through direct lethal or sub-lethal effects to fish stocks, and could decrease resource availability and accessibility for users.

Although oil and gas activities subsequent to leasing could potentially affect habitats, fish and wildlife and their uses, subsistence, air quality, and commercial fishing, measures included in this best interest finding, along with regulations imposed by other state, federal, and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

G. Fiscal Effects and Effects on Municipalities and Communities

Alaska's economy depends heavily on revenues related to petroleum development, which totaled $4.57 billion in fiscal year 2007. The petroleum industry is Alaska's largest industry, annually spending $2.1 billion, including $422 million on payroll and $1.7 billion on goods and services. Overall, this spending generates 33,600 jobs, $1.4 billion in payroll, and value added to the Alaska economy of $1.8 billion for total output of $3.1 billion. Oil and gas accounts for 12 percent of private sector jobs and 20 percent of private sector payroll. The oil and gas industry has the highest monthly wage in Alaska, averaging $7,754, 2.8 times higher than the statewide average of $2,798.

Demand for natural gas in the Cook Inlet area is projected to exceed supply by 2015 unless new reserves are discovered and developed, natural gas is transported to the area by a spur line from the proposed North Slope pipeline, or LNG is imported. Decreasing supplies of Cook Inlet natural gas led to the closure of the Agrium plant in 2007, resulting in the loss of 250 jobs in the Kenai

Peninsula Borough. The LNG (liquid natural gas) export license and supply contracts were extended to 2011, but continued operation of the LNG plant may be jeopardized without long-term proven supplies of natural gas. Without increased Cook Inlet natural gas supplies, prices for residential and commercial natural gas and for electricity will continue to increase. Between 2000 and 2006, the price of natural gas increased 91 percent for Anchorage households, the cost of electricity increased 28 percent, and rates for home heating are expected to rise at least another 22 percent in January 2009.

H. Mitigation Measures and Other Regulatory Protections

Mitigation measures address habitat loss avoidance and protection; prohibitions and restrictions on surface entry into legislatively designated and other important habitat areas; disturbance avoidance; and free passage of fish and wildlife. Mitigation measures protect trumpeter swan nesting areas, bald eagles, and Steller's eiders. Sets of comprehensive measures protect the Kenai Lowlands caribou herd, brown bears and their habitat, and beluga whales. Measures to protect fish and wildlife uses address harvest interference avoidance, public access, and road construction. Other measures and regulations protect drinking water and clean air, and address seismic activities, design and construction of pipelines, discharges and waste from drilling and production, oil spill prevention and control, and site rehabilitation.

I. Director's Final Finding

The director of the Division of Oil and Gas has made a final finding that holding annual Cook Inlet Areawide oil and gas lease sales from 2009-2018 is in the best interests of the state (Chapter 11). State law AS 38.05.035(e) and (g) requires that before an oil and gas lease sale, the director determine whether the lease sale is in the best interests of the state; state law also specifies what must be considered in making that determination. Annually, the Division of Oil and Gas (DO&G) issues a call for substantial new information that has become available since the most recent finding, and based on information received, the commissioner determines whether it is necessary to supplement the finding.

This final determination is based upon a review of all facts and issues known, or made known, to the director. The director limited the scope of the finding to the lease sale phase of oil and gas activities and the reasonably foreseeable significant effects of a lease sale (AS 38.05.035(e)(1)(A)). Conditions for phasing were met under AS 38.05.035(e)(1)(C).

In making this final finding, the director considered the petroleum potential of the lease sale area; the fish and wildlife and their habitats; current and projected uses in the area, including uses and value of fish and wildlife; the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the lease sale area, including effects on subsistence uses, fish and wildlife habitats, populations, and their uses, and historic and cultural resources; the methods most likely to be used to transport oil or gas from the lease sale area and the advantages, disadvantages, and relative risks of each; the reasonably foreseeable fiscal effects of the lease sale and subsequent activity on the state and affected municipalities and communities; and the reasonably foreseeable effects of exploration, development, production, and transportation involving oil and gas on municipalities and communities in the lease sale area (AS 38.05.035(g)).

After weighing the facts and issues known to him at this time, considering applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the director concludes that the potential benefits of the lease sale outweigh the possible negative effects, and that Cook Inlet Areawide oil and gas lease sales will best serve the interests of the state of Alaska.

A person affected by this decision who provided timely written comments or oral testimony may request reconsideration, in accordance with 11 AAC 02. Any reconsideration request must be received by February 9, 2009, and may be mailed or delivered to:

Thomas E. Irwin, Commissioner
Department of Natural Resources
550 W. 7th Avenue, Suite 1400
Anchorage, Alaska 99501

Fax: 1-907-269-8918
Email: dnr.appeals@alaska.gov.

If reconsideration is not requested by that date or if the commissioner does not order reconsideration on his own motion, this decision goes into effect as a final order and decision on February 20, 2009. Failure of the commissioner to act on a request for reconsideration within 30 days after issuance of this decision is a denial of reconsideration and is a final administrative order and decision for purposes of an appeal to Superior Court. The decision may then be appealed to Superior Court within a further 30 days in accordance with the rules of the court, and to the extent permitted by applicable law. An eligible person must first request reconsideration of this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. A copy of 11 AAC 02 may be obtained from any regional information office of the Department of Natural Resources.

Chapter Two: Introduction

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Chapter Two: Introduction

The Alaska Department of Natural Resources (ADNR) is offering for lease all available state-owned acreage in Cook Inlet Areawide oil and gas lease sales from 2009-2018 (Figure 2.1). The lease sale area consists of all state-owned uplands located in the Matanuska and Susitna river valleys generally south and west of Houston and Wasilla, the Anchorage Bowl, the western and southern Kenai Peninsula from Point Possession to Anchor Point, and the western shore of Cook Inlet from the Beluga River to Harriet Point. The lease sale area also includes all state owned tide and submerged lands in upper Cook Inlet from Knik Arm and Turnagain Arm south to Anchor Point and Tuxedni Bay. The area is bounded on the east by the Chugach and Kenai mountains and on the west by the Aleutian Range. The gross area is about 4.2 million acres and is divided into 815 tracts ranging from 640 to 5,760 acres.

The Cook Inlet Areawide lease sale contains tracts in which the state owns both the land estate and the mineral estate; and tracts where the state owns just the mineral estate, while the land estate might be either privately owned or owned by a municipality. Only those free and unencumbered state-owned oil and gas mineral estates within the tracts will be included in any lease issued.

A. Authorities

The Alaska Constitution provides that the state’s policy is “to encourage … the development of its resources by making them available for maximum use consistent with the public interest” and that the “legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State … for the maximum benefit of its people” (Alaska Constitution, article VIII, §1 and 2; AS 44.37.020(a)). To comply with this provision, the Alaska State Legislature enacted Title 38 of the Alaska Statutes (AS 38) and directed ADNR to implement the statutes.

The legislature found that the people of Alaska have an interest in the development of the state’s oil and gas resources to maximize the economic and physical recovery of the resources; maximize competition among parties seeking to explore and develop the resources; and maximize use of Alaska’s human resources in the development of the resources (AS 38.05.180(a)(1)). The legislature also found that it is in the best interests of the state to encourage an assessment of its oil and gas resources and to allow the maximum flexibility in the methods of issuing leases and to offer acreage for oil and gas leases or for gas only leases (AS 38.05.180(a)(2)).

B. Issues Addressed in Best Interest Findings (“g-list”)

Alaska statutes govern the disposal of state-owned mineral interests. AS 38.05.035(e) says that upon a written finding that the interests of the state will be best served, the director may, with the consent of the ADNR commissioner (commissioner), approve contracts for the sale, lease, or disposal of available land, resources, property, or interests in them. The written finding is known as a best interest finding and it describes the lease sale area, analyzes the potential effects of the lease sale, describes measures to mitigate those effects, and constitutes the director’s determination that the interests of the state will be best served by the disposal. ADNR, DO&G makes available both a preliminary and a final written finding and provides opportunity for public comment. The final written finding also discusses material issues that were raised during the period allowed for receipt of public comment.

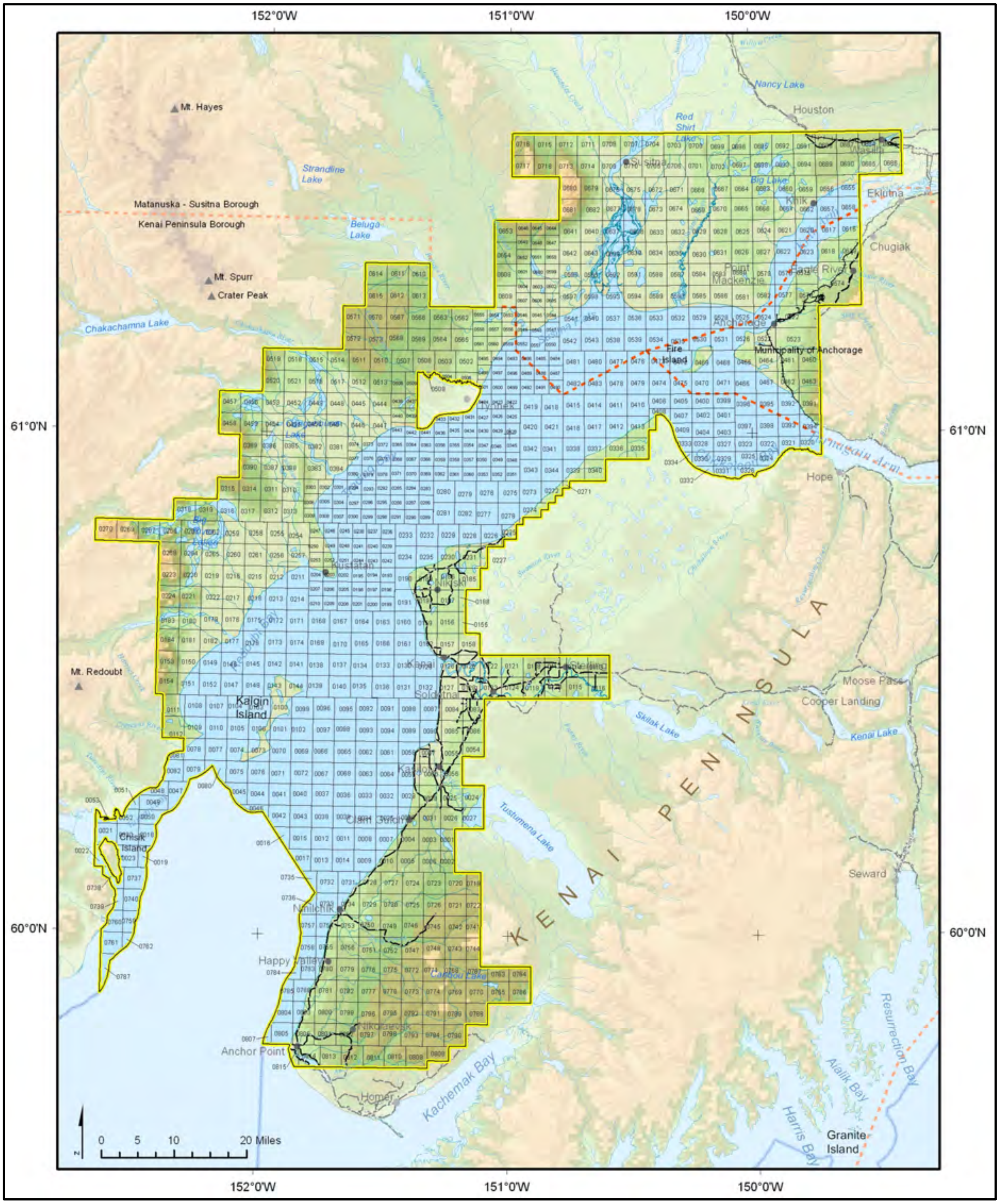

Figure 2.1. Map of the Cook Inlet lease sale area.

AS 38.05.035(e) prescribes what, at minimum, must be in these findings. AS 38.05.035(g)(1)(B) lists the following matters that DO&G must consider and discuss in its written finding:

i. property descriptions and locations;
ii. the petroleum potential of the sale area, in general terms;
iii. fish and wildlife species and their habitats in the area;
iv. the current and projected uses in the area, including uses and value of fish and wildlife;
v. the governmental powers to regulate the exploration, development, production, and transportation for oil and gas or for gas only;
vi. the reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas or for gas only on the sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources;
vii. lease stipulations and mitigation measures, including any measures to prevent and mitigate releases of oil and hazardous substances, to be included in the leases, and a discussion of the protections offered by these measures;
viii. the method or methods most likely to be used to transport oil or gas from the lease sale area and the advantages, disadvantages, and relative risks of each;
ix. the reasonably foreseeable fiscal effects of the lease sale and the subsequent activity on the state and affected municipalities and communities, including the explicit and implicit subsidies associated with the lease sale, if any;
x. the reasonably foreseeable effects of exploration, development, production, and transportation involving oil and gas or gas only on municipalities and communities within or adjacent to the lease sale area; and
xi. the bidding method or methods adopted by the commissioner under AS 38.05.180.

This document is organized for ease of reading and reviewing, and therefore does not necessarily follow the order of the "g-list". Location of "g-list" items are listed in Table 2.1.

Table 2.1. Location of topics required by AS 38.05.035(g)(1)(B) – "g-list" – in the best interest finding.

"g-list" Number	"g-list" Description	Location in the Best Interest Finding
i	Property description	Chapter 3
ii	Petroleum potential	Chapter 6B
iii	Habitat, fish, and wildlife	Chapter 4
iv	Current and projected uses in the Cook Inlet area; fish and wildlife uses and value	Chapter 5
v	Governmental powers to regulate oil and gas	Chapter 7
vi	Reasonably foreseeable cumulative effects; habitats; subsistence uses; fish and wildlife populations and their uses; historic and cultural resources	Chapter 8A-F
vii	Mitigation measures	Chapter 9
viii	Likely methods of oil and gas transportation	Chapter 6E
ix	Reasonably foreseeable effects; fiscal effects	Chapter 8G
x	Reasonably foreseeable effects; effects of oil and gas on municipalities and communities	Chapter 8H
xi	Bidding method	Chapter 10

A compilation of other laws and regulations applicable to oil and gas activities in Alaska can be found in Appendix B. If a proposed activity occurs in the coastal zone, AS 46.40 requires that the activity be consistent with the Alaska Coastal Management Program (ACMP), which includes approved local district coastal zone management plans. An ACMP consistency analysis was released concurrently with the preliminary best interest finding, and will be followed by a proposed consistency determination and a final consistency determination.

C. Areawide Lease Sales

Before 1996, ADNR evaluated noncontiguous, patchwork portions of a region and then offered them for lease. For each subsequent lease sale, ADNR repeated this exercise for other patchwork portions of the region often directly adjacent to those just evaluated. The public faced repeated requests to comment on areas with similar resources and issues or concerns. The state faced repeating costly analyses of resources and issues identical to those just analyzed.

As a result of 1996 amendments, AS 38.05.180(d) allows the commissioner to annually offer leases for oil and gas or leases for gas only of the acreage described in AS 38.05.035(e)(6)(F). Further, a written finding under AS 38.05.035(e)(6)(F) that the interests of the state will be best served is not required before the approval of an exempt oil and gas lease sale or gas only lease sale under AS 38.05.180(d) of acreage subject to a best interest finding issued within the previous 10 years or a reoffered oil and gas lease sale or gas only lease sale under AS 38.05.180(w) of acreage subject to a best interest finding issued within the previous 10 years, unless the commissioner determines that substantial new information has become available that justifies a supplement to the most recent best interest finding.

Areawide leasing allows a thorough, region-wide analysis, eliminates repeated requests to the public, increases government efficiency, and allows ADNR to focus once a year on substantial new information that has become available. It also provides an established time each year that ADNR will offer for lease all available acreage within five geographical regions: the North Slope, Beaufort Sea, Cook Inlet, North Slope Foothills, and Alaska Peninsula. By conducting lease sales at a set time each year, ADNR provides industry with a stable, predictable leasing program, which allows companies to plan and develop their exploration strategies and budgets years in advance. The result is more efficient exploration and earlier development, which, in turn, benefits the State of Alaska and its residents. Areawide sales are also more efficient for the public and ADNR.

The last best interest finding for Cook Inlet was issued January 20, 1999. Supplements to the finding were issued on May 20, 2000, February 18, 2004, February 21, 2007, and February 4, 2008. The 1999 finding was valid for lease sales held through 2008.

D. Process

The process of developing a best interest finding includes many opportunities for input from a broad range of participants, including the public, government agencies, Native organizations, resource user groups, environmental organizations, and others (Figure 2.2).

1. Request For Agency Information

The process of developing a best interest finding begins with a request for information from agencies, local governments, and Native Corporations. DO&G requests information and data about the region’s property ownership status, peoples, economy, current uses, subsistence, historic and cultural resources, fish and wildlife, and other natural resource values. Using this information, as well as other relevant information that becomes available, DO&G develops a preliminary best interest finding to be released for public comment.

On February 16, 2007, DO&G issued a *Request for Agency Information* to begin the process of gathering information on the proposed lease sale area. The ADNR, Office of Habitat Management and

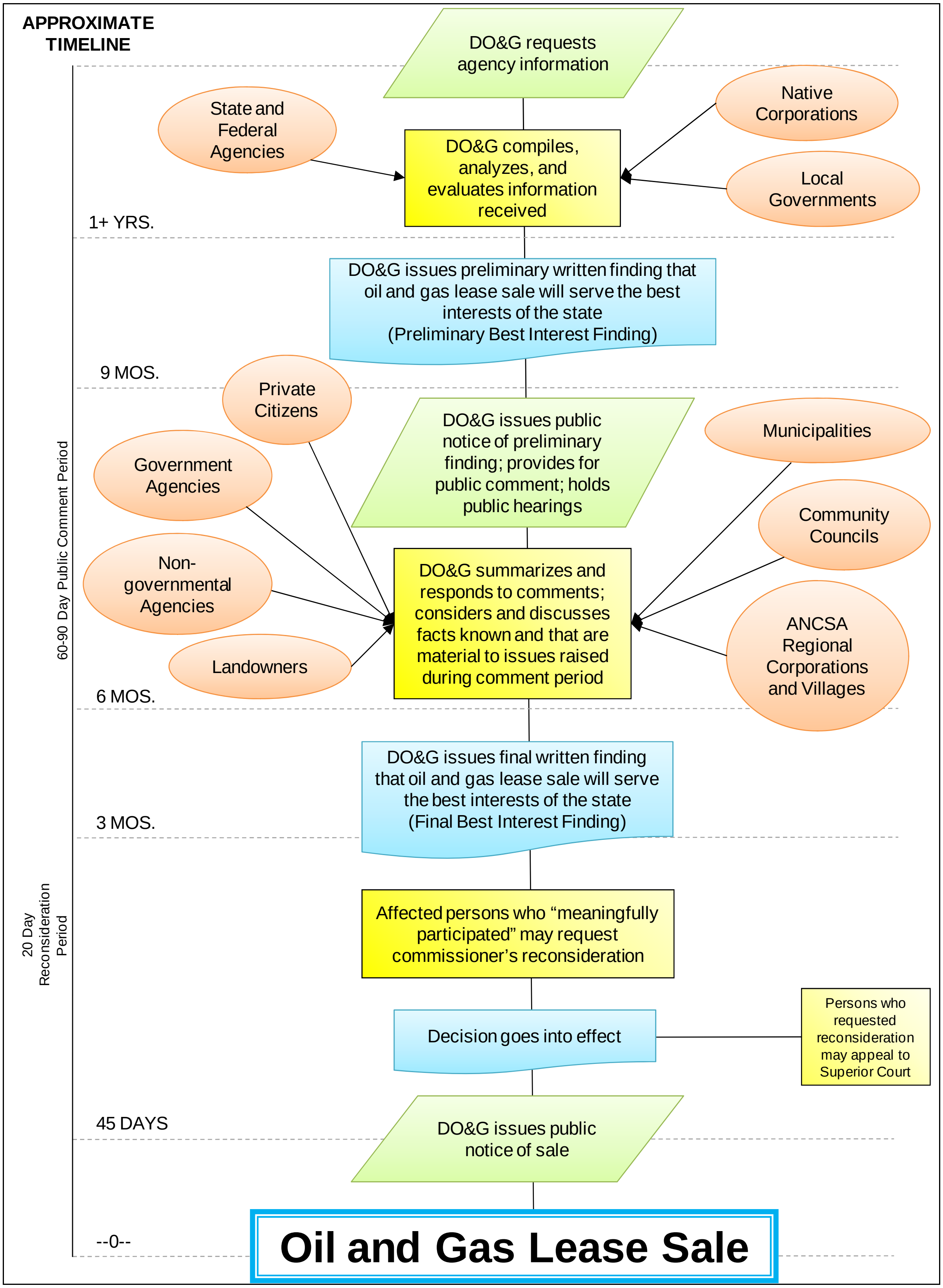

Figure 2.2. Public process for developing best interest findings for areawide oil and gas lease sales. Note that timeline is not to scale.

Permitting (OHMP)[1] provided some updated harvest estimates for commercial, sport, and subsistence fisheries, noted that the Kenai Peninsula Brown Bear Conservation Strategy had been completed, and recommended including lessee advisories from the U.S. Coast Guard and Federal Aviation Administration concerning boat and aircraft traffic in the vicinity of species protected under the Migratory Bird Treaty Act, the Marine Mammal Protection Act, and the Endangered Species Act. The Alaska Department of Fish and Game (ADF&G) subsequently provided additional updated information on several species of birds, fish, marine mammals, and terrestrial mammals. ADNR, Office of History and Archaeology stated that the study area is extensive and requested that the final lease sale boundary area be forwarded for review under the Alaska Historic Preservation Act. The Bureau of Land Management provided a copy of its 2006 Ring of Fire Proposed Resource Management Plan and Final Environmental Impact Statement.

Information provided by these agencies, as well as other relevant information, was incorporated into this best interest finding.

2. Preliminary Best Interest Finding and Request for Public Comments

To obtain public comments on a preliminary best interest finding, DO&G follows the public notice statute, AS 38.05.945. This statute includes specific requirements for notice given by ADNR for a written finding under AS 38.05.035(e). These include: publication of both a legal notice and a notice in display advertising in newspapers of statewide circulation and in newspapers of general circulation in the vicinity of the proposed action; public service announcements on the electronic media serving the area to be affected by the proposed action; and one or more of the following methods: posting in a conspicuous location in the vicinity of the proposed action; notification of parties known or likely to be affected by the action; or another method calculated to reach affected parties. Notice must also be given to a municipality if the land is within the boundaries of the municipality; to a coordinating body or a community council if requested in writing; to a regional corporation if the boundaries of the corporation established by the Alaska Native Claims Settlement Act (ANCSA) encompass the land and the land is outside a municipality; to a village corporation organized under ANCSA if the land is within 25 miles of the village for which the corporation was established and the land is located outside of a municipality; to the postmaster of a permanent settlement of more than 25 persons located within 25 miles of the land if the land is located outside a municipality, with a request that the notice be posted in a conspicuous location; and to a nonprofit community organization or a governing body that has requested notification in writing and provided a map of its boundaries, if the land is within the boundaries.

In addition, AS 38.05.946 provides that a municipality, an ANCSA corporation, or nonprofit community organization may hold a hearing within 30 days after receipt of the notice. The commissioner has discretion to hold a public hearing.

Public comment assists in providing a body of information for the best interest finding review and analysis that is as complete as possible. Information provided by agencies and the public assists the director in reviewing all of the facts and issues; determining which facts and issues are material to the decision of whether the lease sale is in the best interests of the state; and determining the reasonably foreseeable, significant effects of the proposed lease sale.

A preliminary best interest finding for Cook Inlet oil and gas lease sales was issued on September 29, 2009. DO&G gave notice by publication in *The Frontiersman*, *The Anchorage Daily News*, *The Peninsula Clarion*, and *The Homer Tribune*; posting on the division's web

[1] The Office of Habitat Management and Permitting (OHMP) of the Alaska Department of Natural Resources became the Division of Habitat, a part of the Alaska Department of Fish and Game (ADF&G), effective July 1, 2008, as a result of Executive Order 114.

page: http://www.dog.dnr.state.ak.us/oil/; posting on the State of Alaska Online Public Notice page: http://notes5.state.ak.us/pn; and through a media release that went to all media outlets listed in the Alaska Media Directory. Notice that the preliminary finding had been issued was mailed directly to approximately 700 individuals, businesses, and governmental and non-governmental agencies; and to postmasters at 42 post offices in the Cook Inlet area with a request that the notice be posted in the post office. Copies of the preliminary finding were also distributed to libraries in the Cook Inlet area.

The public comment period was September 30, 2008 through December 1, 2008. During the comment period, public hearings were held in Anchorage on October 27, 2008; in Wasilla on October 29, 2008; in Kenai on November 3, 2008; and in Homer on November 6, 2008. Notice of the public hearings included display ads in *The Anchorage Daily News*, *The Frontiersman*, *The Peninsula Clarion*, and *The Homer Tribune*; posting on the division's web page: http://www.dog.dnr.state.ak.us/oil/; posting on the State of Alaska Online Public Notice page: http://notes5.state.ak.us/pn; and through a media release that included a public service announcement that went to all media outlets listed in the Alaska Media Directory. Notice of the public hearings was also mailed directly to approximately 700 individuals, businesses, and governmental and non-governmental agencies.

The public hearings were formatted with an hour of informal question-answer with poster displays of information and issues from the preliminary best interest finding. DO&G staff with expertise in geology and geophysics, oil spill risk and prevention, oil and gas leasing and administration, and fish and wildlife were available to answer questions and discuss issues with the public. Following the informal time, a formal public hearing was commenced in which formal oral testimony was received. A court reporter recorded all oral testimony. Forms were provided so that people could submit written comments during the hearings as well. Attendance at the Anchorage hearing was five people, with one written comment submitted and no oral testimony; at the Wasilla hearing six people attended, with no written or oral testimony; at the Kenai hearing three people attended, with no written or oral testimony; and at the Homer hearing, five people attended with no written testimony submitted and four people giving oral testimony.

A total of 19 written and oral comments were received during the public comment period. These are summarized in Appendix A.

3. Final Best Interest Finding

After receiving public comments on the preliminary best interest finding, DO&G reviews all comments, revises the best interest finding as needed, and incorporates additional relevant information and issues brought up during the public comment period. The director strikes a balance of interests, determines if the proposed oil and gas lease sale is in the best interest of the state, and makes a final finding.

After the Cook Inlet public comment period ended on December 1, 2008, DO&G reviewed all written comments and oral testimony received. A response to each comment is provided in Appendix A. Common issues and concerns raised among commenters included oil spills; information, data, and studies used in the finding; need for additional studies; use of federal environmental impact statements; effects are insufficiently proven or disproven; effectiveness of mitigation measures is not proven; beluga whales; economic data; renewable energy; greenhouse gases, climate change, and global warming; and costs to the state and other regulatory agencies.

After weighing the facts and issues known to him at this time, comments received during the public comment period, applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the director has concluded that the potential benefits of the lease sale outweigh the possible negative effects, and that Cook Inlet Areawide oil and gas lease sales will best serve the interests of the state of Alaska.

4. Request for Reconsideration and Appeal to Superior Court

A person who is eligible to file a request for reconsideration and who is aggrieved by the final written finding may, within 20 days after issuance of the final written finding, file a request for reconsideration of the decision by the commissioner. A person is eligible to file a request for reconsideration if the person “meaningfully participated” in the process set out for receipt of public comment and is affected by the final written finding. “Meaningfully participated” means submitting written comment during the period for receipt of public comment or presenting oral testimony at a public hearing, if a public hearing was held (AS 38.05.035(i)).

A person may appeal a final written finding to the superior court, but only if the person was eligible to request, and did request, reconsideration of that finding. The points on appeal are limited to those presented to the commissioner in the person’s request for reconsideration (AS 38.05.035(l)). By requiring a party to exhaust the administrative review and reconsideration process before appealing to the superior court, the agency is given full opportunity to review, analyze, and respond to concerns before litigation. For purposes of appeal, the burden is on the party seeking review to establish the invalidity of the finding (AS 38.05.035(m)).

E. Annual Lease Sales

After a final best interest finding has been issued and any challenges to it resolved, DO&G may proceed with conducing oil and gas lease sales in the area. However, annually the commissioner must determine if substantial new information has become available that justifies a supplement to the finding.

Approximately nine months before a lease sale, DO&G calls for comments from the public requesting new information that has become available since the most recent best interest finding for that lease sale area was issued (Figure 2.3). This request is sent to agencies and individuals on the division's mailing list and posted on the DO&G web page. The call for public comments provides opportunity for public comment for a period of not less than 30 days. Based on information received, the commissioner determines whether it is necessary to supplement the finding. Based on that determination, the commissioner either issues a supplement to the finding or a “Decision of No New Substantial Information” 90 days before the lease sale. The supplement has the status of a final written best interest finding for purposes of filing an administrative appeal or a request for reconsideration. Any person who “meaningfully participated” by submitting written comments during the period for receipt of public comment and is affected by the final written finding of substantial new information is eligible to file a request for reconsideration.

On September 13, 2007, DO&G issued a Call for New Information regarding its proposal to offer all available state acreage in the Cook Inlet Areawide 2008 Oil and Gas Lease Sale. In response to the call, DO&G received five comments. DO&G reviewed the information submitted and the commissioner determined that substantial new information had become available that justified a supplement to the most recent best interest finding for Cook Inlet. As a result, a supplement was issued that added six new lessee advisories, modified two existing mitigation measures, and added one new mitigation measure to the finding. The Cook Inlet Areawide 2008 Oil and Gas Lease Sale was held on May 21, 2008. Eighteen tracts totaling 47,933.06 acres were sold.

F. Scope of Review

The director, in the written finding, shall establish the scope of the administrative review on which the director’s determination that the disposal will best serve the interest of the state is based, and the scope of the written finding supporting that determination. The scope of the administrative review and finding may address only reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(e)(1)(A)). For an effect to be “reasonably foreseeable”:

(1) there must be some cause/result connection between the proposed disposal and the effect to be evaluated; (2) there is a reasonable probability that the effect will occur as a result of the disposal; and (3) the effect will occur within a predictable time after the disposal. Therefore this finding does not speculate about potential but improbable future effects, but instead reviews only reasonably foreseeable effects of the proposed disposal.

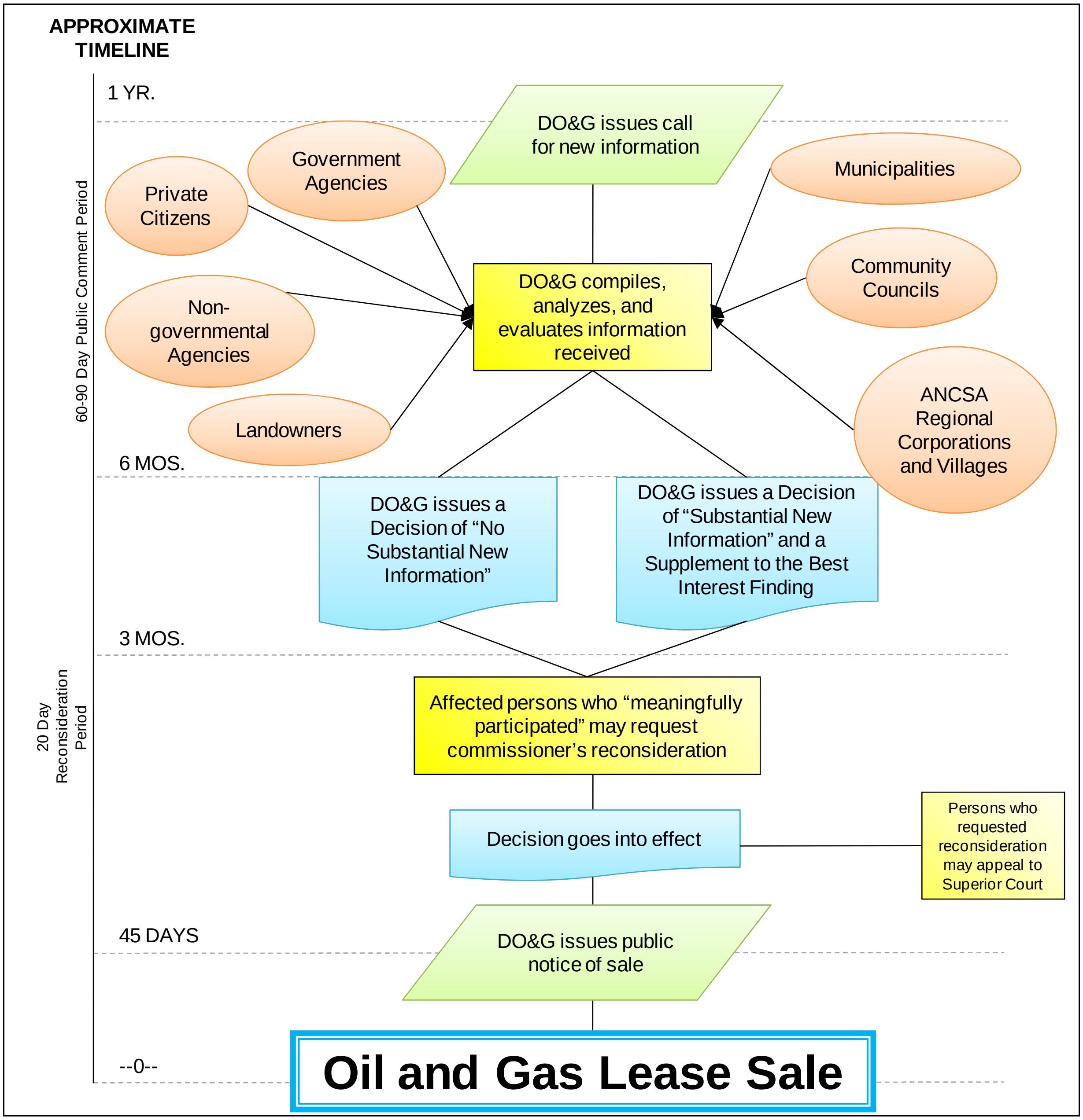

Figure 2.3. Annual public process for determining if a supplement to a best interest finding is necessary. Note that timeline is not to scale.

A reasonably foreseeable effect must also be "significant." Significant means a known and noticeable impact on or within a reasonable proximity to the area involved in the disposal.

Further, the director may limit the scope of an administrative review and finding for a proposed disposal to:

- applicable statutes and regulations;
- the facts pertaining to the land, resources, or property, or interest in them, that the director finds are material to the determination and that are known to the director or knowledge of which is made available to the director during the administrative review; and
- issues that, based on the statutes and regulations, on the facts as described, and on the nature of the uses sought to be authorized by the disposal, the director finds are material to the determination of whether the proposed disposal will best serve the interests of the state (AS 38.05.035(e)(1)(B).)

Therefore, the scope of review in this final finding addresses the reasonably foreseeable, significant effects of the uses to be authorized by the lease sale and is limited to the applicable statutes and regulations, the material facts and issues known to the director that pertain to the lease sale phase, and issues that the director finds are material to the determination of whether the lease sale will best serve the interests of the state. This includes consideration and discussion of facts that are material to issues raised during the period allowed for public comments, facts that are material to the matters listed in AS 38.05.035(g)(B)(i)-(xi), and the basis for the director's final finding, that, on balance, holding oil and gas lease sales in the area would be in the state's best interest.

G. Phased Review

Phased review recognizes that a disposal of oil and gas, or of gas only may result in future development that cannot be predicted or planned with any certainty or specificity at the initial lease sale phase, and that any future development will be subject to detailed review before it takes place. In the case of oil and gas, DO&G cannot determine with any specificity or definition at the lease sale phase if, when, where, how, or what kind of exploration, development or production might ultimately occur as the result of a lease sale. Although advances in technology, unpredictable markets changes, and specific infrastructure requirements for possible production cannot be foreseen, new developments or improvements in any or all of these areas may yield answers to some of these questions in the future.

Phasing allows the analysis of leasing to focus only on the issues pertaining to the lease sale phase and reasonably foreseeable, significant effects of a lease sale. Additional authorizations are required for exploration, development, and production phases. When a project is multiphased, review of issues that would require speculation about future factors may be deferred until permit authorization is sought at the exploration, development, and production phases. A discussion of governmental and public involvement at these later phases can be found in Chapter 7.

Under AS 38.05.035(e)(1)(C), the director may, if the project for which the proposed disposal is sought is a multiphased development, limit the scope of an administrative review and finding for the proposed disposal to the applicable statutes and regulations, facts, and issues that pertain solely to the disposal phase of the project when:

(i) the only uses to be authorized by the proposed disposal are part of that phase;
(ii) the disposal is a disposal of oil and gas, or of gas only, and, before the next phase of the project may proceed, public notice and the opportunity to comment are provided unless the project is subject to a consistency review under AS 46.40 and public notice and the opportunity to comment are provided under AS 46.40.096(c);
(iii) the department's approval is required before the next phase may proceed; and

(iv) the department describes its reasons for a decision to phase.

The conditions under which phasing may occur have been met for Cook Inlet Areawide oil and gas lease sales addressed in this best interest finding. Accordingly, the review of activities in the lease sale area is of a multiphased development. The director, in making this finding, has limited the scope of the finding to the applicable statutes and regulations, facts, and issues that pertain solely to the lease sale phase of oil and gas activities and the reasonably foreseeable significant effects of a lease sale.

Condition (i) is met because the only uses authorized by the lease sale are part of the lease sale phase. The lease gives the lessee, subject to the provisions of the lease, the right to conduct geological and geophysical exploration for oil, gas, and associated substances within the leased area and the right to drill for, extract, remove, clean, process, and dispose of any oil, gas, or associated substances that may underlie the lands described by the lease. While the lease gives the lessee the right to conduct these activities, the lease sale itself does not authorize any exploration or development activities by the lessee on leased tracts.

Condition (ii) is met because the lease sale is of oil and gas or gas only, and before the next phase of the project may proceed, ADNR will provide public notice and the opportunity to comment for any proposed plan of operations in the lease sale area. Additionally, any plan of operations in the lease sale area that is within the coastal zone is subject to consistency with the ACMP standards, including public notice and opportunity to comment under AS 46.40.

Condition (iii) is met because ADNR's approval is required before the next phase (in this case exploration) may proceed. See Chapter 6 on post leasing phases. Before exploration activities can occur on leased lands, the lessee must secure all applicable authorizations. Additional authorizations must also be secured for any subsequent development or production on the lease.

The plan of operations must identify the specific measures, design criteria, construction methods, and standards that will be employed to meet the provisions of the lease. A plan of operations is subject to extensive technical review by a number of local, state, and federal agencies. Oil and gas exploration, development, or production-related activities will be permitted only if proposed operations comply with all local, state, and federal laws and the provisions of the lease.

Condition (iv) is met because ADNR describes the reasons for its decision to phase above.

The effects of future exploration, development, and production will be considered at each subsequent phase, when various government agencies and the public review applications for specific proposed activities at specific locations. However, this finding does discuss, in general terms, the potential effects that may occur with oil and gas exploration, development, production, and transportation within the proposed lease sale area as well as measures to be imposed as terms of the lease, subsequent permit, and plan of operations to mitigate possible adverse effects.

H. Post-Sale Title Search

The Cook Inlet lease sale area has been divided into tracts that will remain fixed for future lease sales. The extent of the state's ownership interest in these tracts will not be determined before the lease sale. Instead, following the lease sale, ADNR will verify title only for tracts receiving bids. Therefore, should a potential bidder require title or land status information for a particular tract before the lease sale, it will be the bidder's responsibility to obtain that information from ADNR's public records. It is possible that a tract included in the lease sale may contain land that the state cannot legally lease because it is subject to an existing oil and gas lease or because the mineral estate is not state owned. Depending on the number of tracts leased and the complexity of the ownership, it could take weeks or months following the lease sale to complete the title work and issue all of the leases.

Chapter Three: Description of the Cook Inlet Lease Sale Area

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Chapter Three: Description of the Cook Inlet Lease Sale Area

A. Property Description

1. Area Included in the Lease Sale


L. Silliphant, DO&G

West side of Cook Inlet, Beluga River area.

The Cook Inlet Areawide oil and gas lease sale area (Figure 2.1) consists of state-owned uplands located in the Matanuska and Susitna river valleys generally south and west of Houston and Wasilla, the Anchorage Bowl, the western and southern Kenai Peninsula from Point Possession to Anchor Point, and the western shore of Cook Inlet from the Beluga River to Harriet Point. The lease sale area also includes the tide and submerged lands in upper Cook Inlet from Knik Arm and Turnagain Arm south to Anchor Point and Tuxedni Bay. The area is bounded on the east by the Chugach and Kenai mountains and on the west by the Aleutian Range. The area is about 4.2 million acres and is divided into 815 tracts ranging from 640 to 5,760 acres.

The Cook Inlet area is used extensively for recreation, for subsistence and sport fishing, hunting and gathering, and for commercial and personal use fishing. Five species of Pacific salmon are fished throughout Cook Inlet, and numerous important anadromous fish streams are found within the lease sale area. The area provides important habitats for moose, black and brown bear, caribou, and waterfowl. Marine mammals found near or within the area include beluga whales, Steller sea lions, sea otters, and harbor seals. Species listed as threatened or endangered under the Endangered Species Act that inhabit the lease sale area include the Steller sea lion (threatened east of 144° longitude and endangered west of 144° longitude), the Steller's eider (Alaska breeding population, threatened), and Cook Inlet beluga whale (endangered). Steller sea lions and Steller's eiders are also listed as species of special concern by the state, as are olive-sided flycatcher, Gray-cheeked thrush, Townsend's warbler, Blackpoll warbler, Kenai Peninsula brown bear, harbor seal, beluga whale, and sea otter.

A number of state and federal wildlife refuges, critical habitat areas, recreation areas, and parks exist within or near the lease sale area. These areas encompass important fish and wildlife habitat, and have significant scenic and recreational value.

The Cook Inlet Areawide lease sale area is located within the boundaries of the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough. The boroughs and municipality have the powers of taxation, land management and zoning and are responsible for providing their communities with public works, utilities, education, health, and other public services. Over half of the population of the state resides in the area, and the region is the industrial and business center for Alaska. All have approved coastal management plans, which are incorporated in the Alaska Coastal Management Program.

2. Land and Mineral Ownership

The Alaska Statehood Act allowed the State of Alaska to select 102.5 million acres of land from the federal public domain as an economic base for the new state. The Act also granted to Alaska the right to all minerals underlying these selections and specifically required the state to retain this mineral interest when conveying the land (AS 38.05.125). Consequently, when state land is conveyed to an individual citizen, local government, or other entity, state law requires that the deed reserve the mineral rights to the state. There are a few exceptions. ANCSA, passed by Congress in 1971, allowed newly created regional Native corporations to select and obtain from the federal domain both the land and the mineral rights within Native corporation boundaries as an economic base. It also allowed for Native village corporations and individual Native Alaskans to receive land for their economic benefit.

The uplands in the lease sale area are a complex mosaic of ownership. The predominant landowners are the federal and state governments. Other institutional land owners include the Matanuska-Susitna Borough, Municipality of Anchorage, Kenai Peninsula Borough, Cook Inlet Region Incorporated, village corporations, Mental Health Trust, and the University of Alaska. Private land holdings include subdivisions, homesites, Native allotments, and homesteads.

The Cook Inlet Areawide lease sale contains tracts in which the state owns both the land estate and the mineral estate; and tracts where the state owns just the mineral estate, while the land estate might be either privately owned or owned by a municipality. Only those free and unencumbered state-owned oil and gas mineral estates within the tracts will be included in any lease issued.

B. Historical Background

At the time of first European contact, Tanaina Indians occupied the Cook Inlet area. Evidence from the Yukon Island site in Kachemak Bay shows that lower Cook Inlet was occupied by Eskimos from about 1500 BC to 1000 AD and then by Athabaskan Indians, probably the ancestors of the Tanaina who moved into the coastal area from the Interior (Selkregg 1975).

Freshwater and Marine Image Bank

Example of Alaska Native fish traps, 1902.

Tanaina Indian groups entered the Cook Inlet subregion through the Alaska Range from the west, primarily through Rainy, Merrill, and Lake Clark passes, and continued this southeastward migration until most of their villages were located on or near the major salmon producing streams of Cook Inlet (Selkregg 1975). Tanaina villages consisted of four or five large semi-subterranean log structures; each occupied by several nuclear families belonging to the same clan. Clan dwellings were occupied throughout the winter and early spring. During the summer, families relocated to fish camps. In late summer and early fall, hunting groups traveled to the mountains, and occupied traditional, temporary campsites along established travel routes (ADF&G 1985).

Captain Cook’s 1778 expedition into Cook Inlet made contact with the Tanaina, but Russian fur traders and missionaries of the Russian Orthodox Church were the first to establish non-Native outposts in the region in the late eighteenth and early nineteenth centuries. These religious and cultural ties continue today. The Russian foothold in Cook Inlet survived early Tanaina resistance and hostilities, and eventually gained some acceptance. Epidemics devastated the Tanaina population during the 1830s. Survivors commonly abandoned traditional villages and concentrated in settlements at places such as Knik, Susitna Station and Tyonek (ADF&G 1985). The Russian period lasted until 1867 when Alaska was purchased by the United Sates.

The introduction of the tin can dramatically changed salmon processing and shipping, providing the impetus for large commercial salmon fisheries. A cannery was established at Kasilof in 1882, and a saltery built near Tyonek serviced the emerging Cook Inlet commercial fishing industry (ADF&G 1985). In the first 20 years of the 20th century, canneries were established throughout coastal Alaska (Selkregg 1975).

The gold rush brought prospectors to mining districts in Alaska, but most of the Cook Inlet area was inaccessible and settlement of the area was sparse. Construction of the Alaska Railroad brought large numbers of construction workers into the Cook Inlet area. Anchorage at Ship Creek was founded as a railroad construction camp in 1914. Fish camps in the Anchorage area were also in use by local residents. By the time the railroad was completed in 1923 many more settlers had arrived from Europe and the United States. However, many of these newly arrived residents left Alaska in 1917 to fight in World War I and did not return (Selkregg 1975).

Anchorage Museum, AMRC-b75-134-9.

Anchorage Harbor and mouth of Ship Creek, 1921.

Population growth in the Cook Inlet area remained slow until World War II. A major influx of settlers colonized the Matanuska Valley in 1935 to create a farming community. Although the early settlers experienced many hardships, several thriving dairy farms were eventually founded to meet local residents' needs. The community of Palmer rapidly emerged as the center of the colony (Selkregg 1975).

The establishment of military bases at Anchorage in 1940 brought the first significant wave of migration to Alaska since the building of the railroad (Selkregg 1975). Base construction activities and newly stationed troops caused Anchorage's population to triple between 1940 and 1945. Because Anchorage was the state's transportation and financial hub, it benefited from economic activity anywhere in the state (ADF&G 1985).

The completion of the Glenn Highway in 1942, the Sterling and Seward highways in 1950 and 1951, and the George Parks Highway in 1971 opened central Alaska to fishing, hunting and tourism. A lucrative king crab fishery emerged in Kodiak in the 1950s, providing the necessary economic base for the development of other fisheries in shrimp and tanner crab, in addition to salmon. Oil was found on the Kenai Peninsula in 1957. The city of Kenai and the surrounding area immediately began a period of rapid growth. In 1958, convinced that the territory of Alaska had the resources to sustain its people, Congress passed the Statehood Act, making Alaska the 49th state admitted to the Union. Oil development in Cook Inlet increased with the building of offshore platforms north of the Forelands between 1966 and 1968 (Selkregg 1975).

On March 27 (Good Friday), 1964, a magnitude 9.2 earthquake devastated coastal Alaska. Communities reconstructed and relocated with federal assistance. The discovery of oil at Prudhoe Bay in 1968 initiated another wave of settlement. Construction of the Trans-Alaska Pipeline in the 1970s fueled the growth of service-related industries, financial institutions, government, and in more recent years, tourism, by providing funding for government services and the construction of roads, docks, and airports (Selkregg 1975).

To expedite construction of the Trans-Alaska Pipeline which would be used to carry oil from Prudhoe Bay to Valdez, Congress passed ANCSA in 1971, granting title to more than 40 million acres of land and providing more than $900 million to Alaska Natives. The Act also set up corporate ownership of assets with Native residents as shareholders.

In 1980, the state legislature amended the state constitution, requiring that one quarter of all mineral lease rentals, royalties, royalty sales proceeds, federal mineral revenue sharing payments, and bonuses received by the state be placed in the Alaska Permanent Fund, the principal of which may only be used for income-producing investments (APFC 2005). Realized income from the fund's investments may be appropriated by the legislature for dividends, inflation proofing, and other purposes the legislature designates. With the passing of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, Congress set aside more than 100 million acres of Alaska for national wildlife refuges, national wild and scenic rivers, national forests and national parks (ADF&G 1985). The population of Alaska has grown from 103,000 in 1946 to more than 670,000 in 2006 (USCB 2007; ADF&G 1985).

C. Boroughs and Communities Within the Lease Sale Area

The Cook Inlet Areawide lease sale area falls within the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough (Figure 2.1). The area includes about thirty cities, towns, villages and communities, ranging in population from a few hundred to almost 300,000 (Table 3.1).

The population of Alaska has been increasing steadily since 1990, and the total population was about 670,000 in 2006 (Figure 3.1). Over 60 percent of the population, or over 400,000 people, lives in the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough combined (Figure 3.2; USCB 2007). Demographically, almost 70 percent of Alaska's population is white, and 15.6 percent is American Indian or Alaska Native, but characteristics of the Cook Inlet area boroughs and municipality are somewhat different (Table 3.2; USCB 2001).

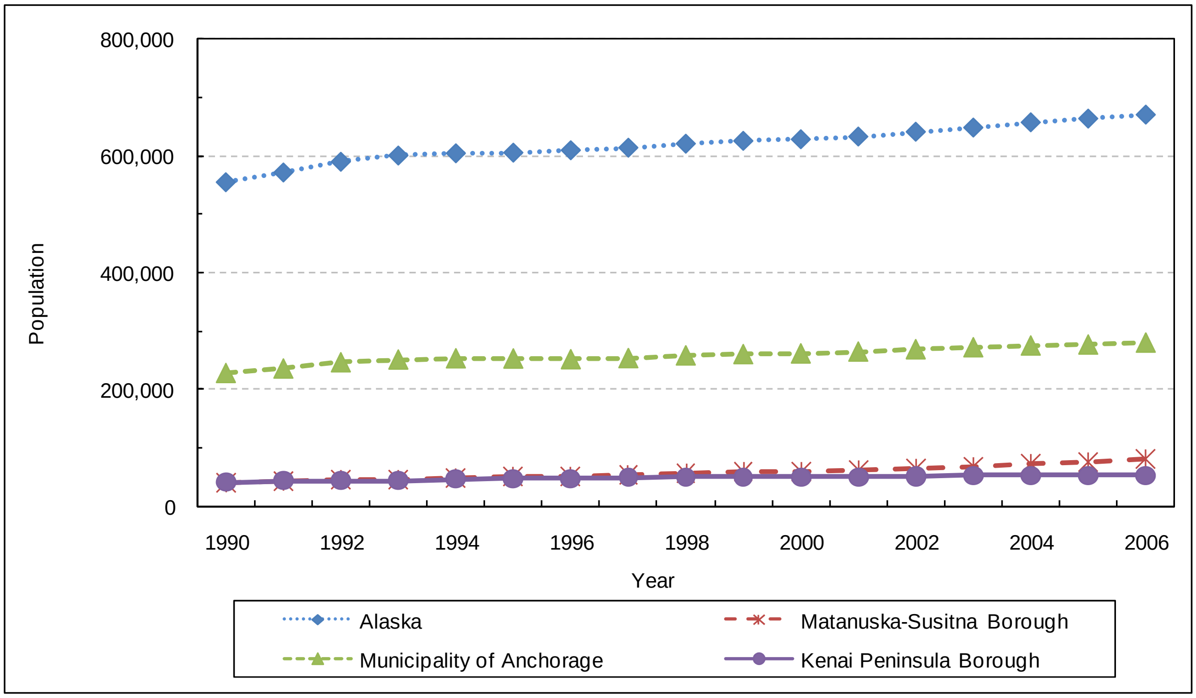
Many of the industries and businesses of the Cook Inlet area are supported directly or indirectly by natural resources of the area. Industries include fishing and fish processing, fishing and hunting guide and taxi services, timber harvesting and restoration, mining and reclamation, agriculture, mariculture, tourism by residents and non-residents, transportation, public works construction, trade, private commercial and residential development, and petroleum exploration, development, production, transportation, and support services. Additionally, local, state and federal governments, non-governmental organizations, health care, and education are large employers. In 2006, total annual earnings and average monthly employment were highest in the government and trade sectors (ADOL 2007; Figure 3.3; Figure 3.4). Statewide unemployment rates increased from 2001-2003, and then decreased through 2006 (Figure 3.5; USDOL 2008).

Government spending is an integral part of Alaska's economy. Public works spending varies from year to year. The state's operating budget was $6.5 billion in fiscal year 2008, and the capital budget was $1.3 billion (Legislative Finance Division 2007). Federal spending in Alaska accounted for 33 percent of the state's economy in 2003, and federal spending totaled $7.6 billion in Alaska in 2002 (DCCED 2008d). Aside from state and federal sources, municipalities and other incorporated communities derive revenues from sales taxes; property taxes; enterprise sources such as garbage collection, water, and sewer; and other revenues.

Table 3.1. Boroughs, municipalities, towns, and other communities in the Cook Inlet lease sale area.

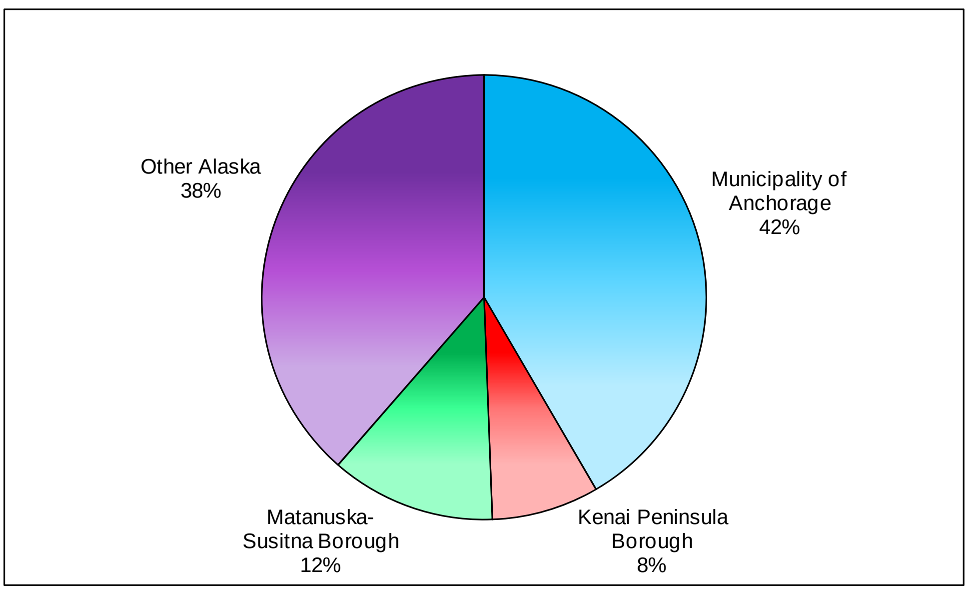
Community	Municipal Classification	Population
Municipality of Anchorage	Unified home rule municipality	282,813
Kenai Peninsula Borough	Second class borough	51,350
Matanuska-Susitna Borough	Second class borough	77,174
Kenai	Home rule city	6864
Palmer	Home rule city	5,574
Homer	First class city	5454
Seldovia	First class city & Unincorporated	287
Soldotna	First class city	3,807
Wasilla	First class city	6,775
Houston	Second class city	1537
Anchor Point	Unincorporated	1,803
Big Lake	Unincorporated	3,082
Clam Gulch	Unincorporated	165
Cohoe	Unincorporated	1,260
Eklutna	Unincorporated	368
Happy Valley	Unincorporated	472
Hope	Unincorporated	143
Kalifornsky	Unincorporated	6,914
Kasilof	Unincorporated	547
Knik-Fairview	Unincorporated	11,238
Nanwalek (English Bay)	Unincorporated	228
Ninilchik	Unincorporated	784
Nikiski	Unincorporated	4,179
Nikolaevsk	Unincorporated	297
Port Graham	Unincorporated	136
Ridgeway	Unincorporated	1,961
Salamatof	Unincorporated	906
Sterling	Unincorporated	5,036
Tyonek	Unincorporated	199

Source: DCCED 2008c, query of current population, June 5, 2008.



Source: USCB 2002, 2007.

Figure 3.1. Population estimates for Alaska, the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough, 1990-2006.



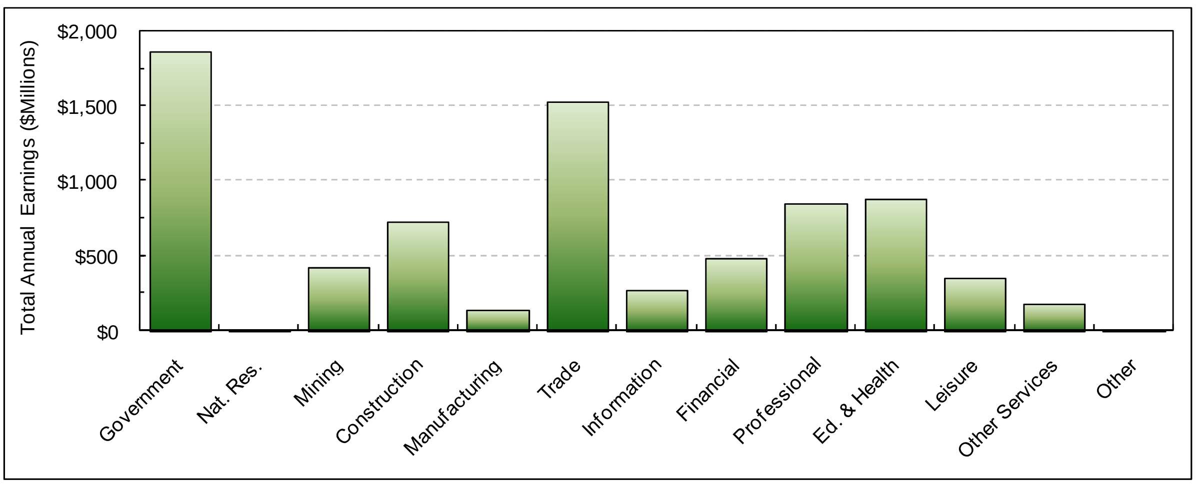
Source: USCB 2002, 2007.

Figure 3.2. Percentage of the population of Alaska in the Matanuska-Susitna Borough, the Municipality of Anchorage, the Kenai Peninsula Borough, and other Alaska locations, 2006.

Table 3.2. Ethnic diversity of Alaska's population in 2000.

Race	Alaska	Mat-Su	Anchorage	Kenai Peninsula
White	69.3	87.6	72.2	86.2
Black/African American	3.5	0.7	5.8	0.5
American Indian/Alaska Native	15.6	5.5	7.3	7.5
Asian	4.0	0.7	5.5	1.0
Native Hawaiian/Other Pacific Islander	0.5	0.1	0.9	0.2
Other	1.6	0.9	2.2	0.8
2 or more races	5.4	4.6	6.0	3.9

Source: USCB 2001.



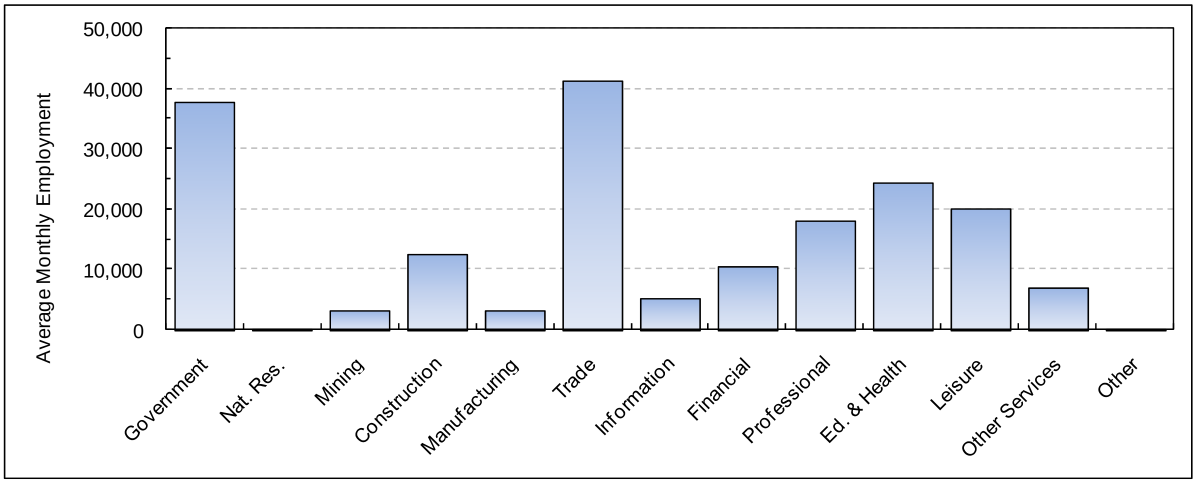
See footnote for source and notes.[1]

Figure 3.3. Total annual earnings in 2006, by industry, for the Matanuska-Susitna Borough, Municipality of Anchorage and Kenai Peninsula combined.

[1] Source: USDOL 2008.

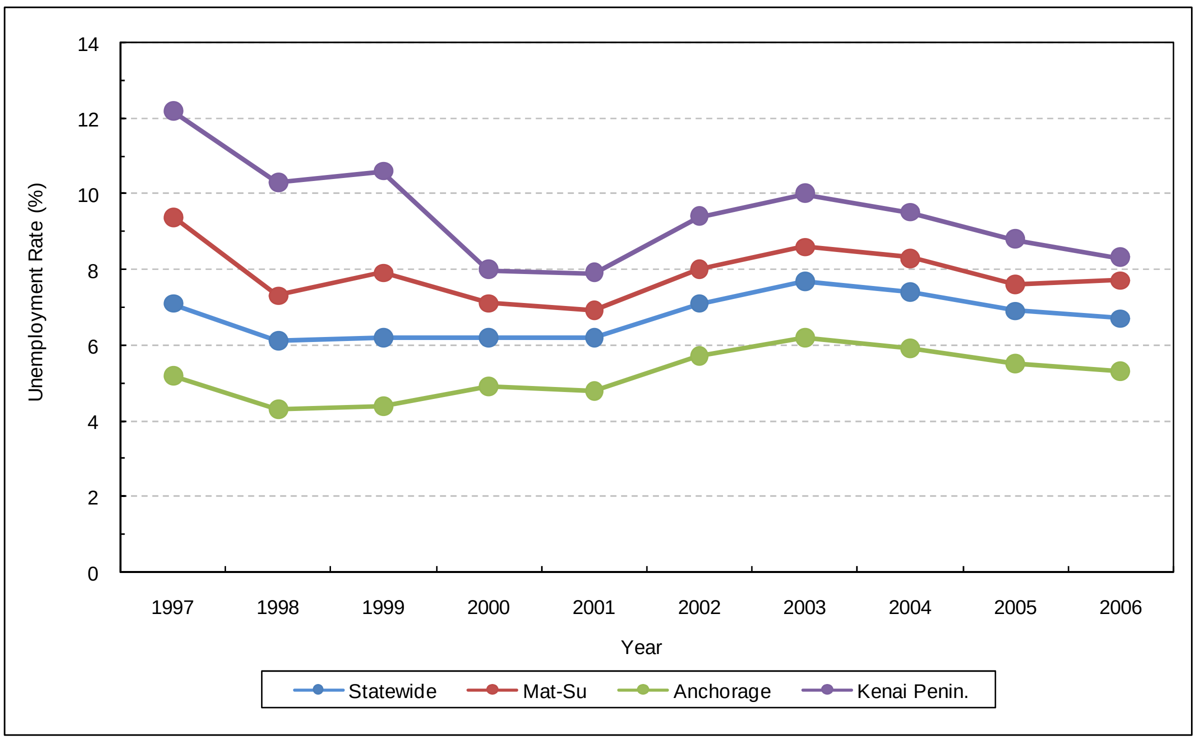
Notes: Government = "total government"; Nat. Res. = natural resources (agriculture, forestry, fishing, hunting); Mining = mining, oil and gas, and support; Trade = trade, transportation, and utilities; Financial = finance, insurance, real estate; Professional = professional and business services; Ed. & Health = education and health services; Leisure = leisure and hospitality services.

Excludes the following: self-employed individuals, fishers, unpaid family help, domestics, and most individuals engaged in agriculture.



See footnote on page 3-7 for source and notes.[1]

Figure 3.4 Average monthly employment by industry, for the Matanuska-Susitna Borough, Municipality of Anchorage, and Kenai Peninsula combined, 2006.



Source: USDOL 2008.

Figure 3.5. Unemployment rates for Alaska, the Matanuska-Susitna Borough, Municipality of Anchorage, and Kenai Peninsula Borough, 1997-2006.

1. Matanuska-Susitna Borough

a. Population

The population of the Matanuska-Susitna Borough (MSB) has doubled, from about 40,000 in 1990 to about 80,000 in 2006 (USCB 2002, 2007). Larger communities include Palmer, Wasilla, Knik-Fairview, Butte, Meadow Lake, and Big Lake (Table 3.3). Palmer, Houston, and Wasilla are the only incorporated communities in the MSB.

Table 3.3. Matanuska-Susitna Borough community profiles.

Community	Incorporation Type	Land Area (sq. mi)	Population Current	2000	1990
Mat-Su Borough	2nd Class Borough	24,682	77,174	59,322	39,683
Big Lake	Unincorporated	132	3,082	2,635	1,477
Butte	Unincorporated	40	3,166	2,561	2,039
Chase	Unincorporated	93	30	41	38
Chickaloon	Unincorporated	79	282	213	145
Houston	2nd Class City	22	1,537	1,202	697
Knik-Fairview	Unincorporated	70	11,238	7,049	n/a
Knik River	Unincorporated	90	652	582	n/a
Lazy Mountain	Unincorporated	36	1,347	1,158	838
Meadow Lakes	Unincorporated	67	6,492	4,819	2,374
Palmer	Home Rule City	4	5,574	4,533	2,866
Skwentna	Unincorporated	443	71	111	85
Sutton-Alpine	Unincorporated	151	1,278	1,080	n/a
Talkeetna	Unincorporated	42	840	772	250
Trapper Creek	Unincorporated	365	415	423	296
Wasilla	1st Class City	12	6,775	5,469	4,028
Willow	Unincorporated	685	1,973	1,658	285

Source: DCCED 2008c, query of current population, June 5, 2008.

b. Economy

The MSB is the fastest-growing community in the state, primarily because it is close to Anchorage. Because housing costs are lower than Anchorage, it is an attractive community for commuters. Nearly 40 percent of borough residents work in Anchorage (ADOL 2008c). The fastest growing industries are community care facilities for the elderly, financial investment, engineering and construction, nursing and residential care facilities, and vocational rehabilitation services (ADOL 2008c). In 2006, the largest employers were government, trade, education and health, and leisure industries (Figure 3.6; ADOL 2007). Wages totaled about $579 million, about 26 percent from government, 20 percent from trade, 16 percent from education and health, and 13 percent from construction (ADOL 2007; Figure 3.7). Median family income was $69,100 in 2004, and per capita income was about $29,400 (ADOL 2008c). The unemployment rate was 6.4 percent in March 2008.

c. Transportation

The MSB is linked to other Alaskan communities and the lower 48 states by road, rail, water, and air transportation systems. The Glenn Highway connects the borough to Anchorage to the south, providing highway access to the Kenai Peninsula; and Glennallen to the east, providing highway access to the Richardson and Alaska highways, which lead to Valdez, Fairbanks, Canada, and the lower 48 states. The Parks Highway also connects the borough to Fairbanks. There are about 600 miles of borough-maintained roads (DCCED 2008f). The Knik Arm crossing project has been in the planning phase for several years. This 2-mile toll bridge, spanning Knik Arm from Point MacKenzie, would connect the MSB with Anchorage as an alternative to the Glenn Highway (KABATA 2007).

The borough is also linked by rail to Fairbanks, and the ports of Anchorage, Seward, and Whittier. In addition to passenger service, the railroad is important for commercial freight shipping, especially sand and gravel (DCCED 2008f). Other cargo shipped by rail includes construction steel, chemicals, coal, and concrete.


Port MacKenzie

Port MacKenzie, 2007.

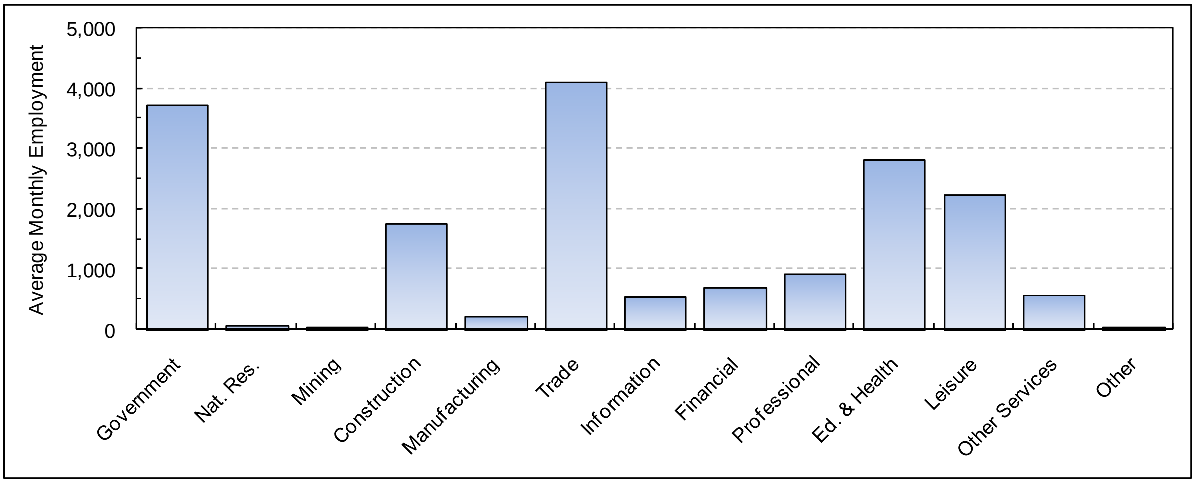
Port MacKenzie, completed in 2000 with additional improvements in 2004, is the northernmost deep-draft dock in North America (MSB 2008). It includes a 500 ft bulkhead barge dock, a 1,200 ft long deep-draft dock, and 14 sq. miles of adjacent uplands which are available for commercial development. In addition to the toll bridge described above, a ferry operating between Port MacKenzie and Anchorage, and a railroad spur are also planned for the port (MSB 2008).

The Ted Stevens Anchorage International Airport is the nearest facility providing jet service. However, there are an additional 10 publicly owned airports and several private airports in the borough. These are located at Big Lake, Goose Bay, Lake Louise, Palmer, Sheep Mountain, Skwentna, Summit, Talkeetna, Wasilla, and Willow (DOWL Engineers 2007). The Palmer and Wasilla airports are owned and operated by the cities of Palmer and Wasilla; the other airports are owned and operated by the Alaska Department of Transportation and Public Utilities.

d. Government and Education

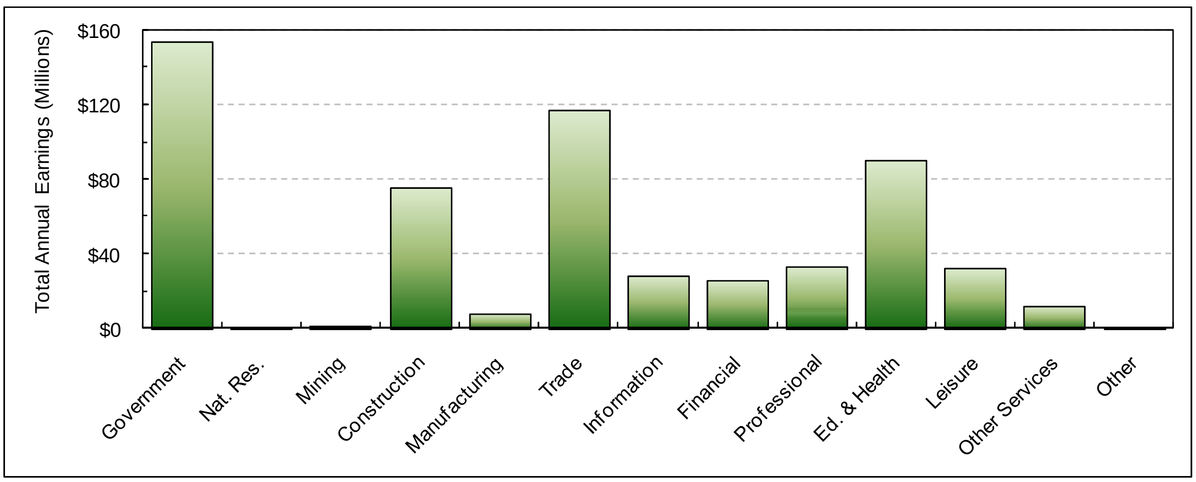
The MSB is a second class borough incorporated in 1964. The borough has no sales tax, although it does have real and personal property, bed, tobacco, and oil and gas property taxes. The 2007 assessed value of real and personal property was $7.1 billion (ADOL 2008c). Total tax revenue was about $90 million in 2007.

About 15,800 students were enrolled in MSB’s 38 public schools during the 2006-2007 school year, and the borough expended almost $9,000 per student (Table 3.4; MSB 2007). In 2000, about 88 percent of borough residents age 25 or older had a high school diploma, and about 18 percent had a college degree (USCB 2001).



See footnote on page 3-7 for source and notes.[1]

Figure 3.6. Average monthly employment in 2006, by industry, in the Matanuska-Susitna Borough.



See footnote on page 3-7 for source and notes.[1]

Figure 3.7. Total annual earnings in 2006, by industry, in the Matanuska-Susitna Borough.

Table 3.4. Educational statistics for the Mat-Su Borough School District.

Educational Attainment[a]		School Information	
High school graduate or higher (%)	88.1	Number of Schools[b]	38
Bachelor's degree or higher (%)	18.3	Number of Students[c]	15,846
		Expenditure/student (FY2007)[c]	$8,973

[a] USCB 2001.
[b] DCCED 2008b.
[c] 2006-2007 school year; MSB 2007.

2. Municipality of Anchorage

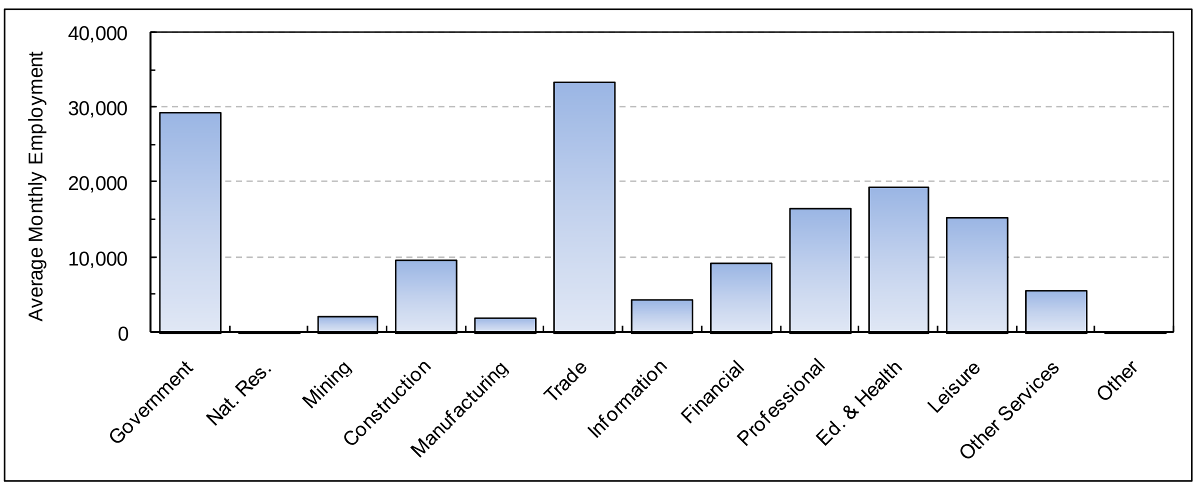
a. Population

With a population of about 280,000, about 42 percent of Alaska's population lives in the Municipality of Anchorage (USCB 2007). The population of Anchorage is culturally diverse, with a minority population of about 30 percent (Table 3.2). Communities within the Municipality of Anchorage include Girdwood, Bird, Indian, Eagle River, Birchwood, and Chugiak.

b. Economy

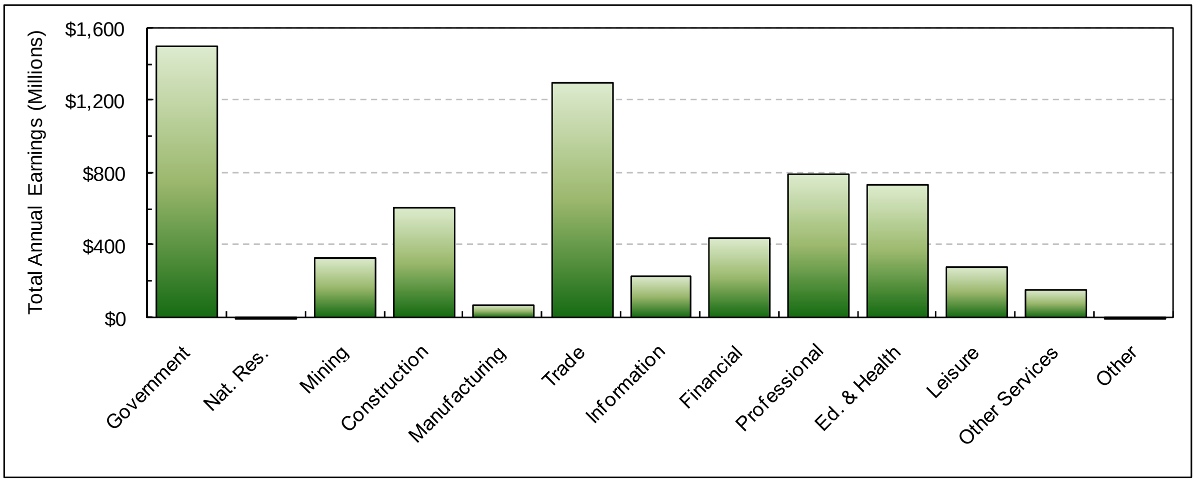
Anchorage is the center of trade, finance and transportation in Alaska. It is the primary transportation hub for the state, with the Port of Anchorage, the Ted Stevens International Airport, and the Alaska Railroad. Many Alaska industries have headquarters in Anchorage including oil and gas, construction and industrial services, communications, and government. Over 8,500 military personnel are stationed at Fort Richardson and Elmendorf Air Force Base.

In 2006, the largest employers were government, trade, professional, education and health, leisure, and construction industries (Figure 3.8; ADOL 2007). The fastest growing industries are community care facilities for the elderly, financial investment, engineering and construction, nursing and residential care facilities, and vocational rehabilitation services (ADOL 2008a). Wages totaled about $6,473 million, about 23 percent from government, 20 percent from trade, 12 percent from professional, 11 percent from education and health, and 9 percent from construction (ADOL 2007; Figure 3.9). Median family income was $78,700 in 2004, and per capita income was about $38,800 (ADOL 2008a). The unemployment rate was 6.4 percent in March 2008.



See footnote on page 3-7 for source and notes.[1]

Figure 3.8. Average monthly employment in 2006, by industry, in the Municipality of Anchorage.



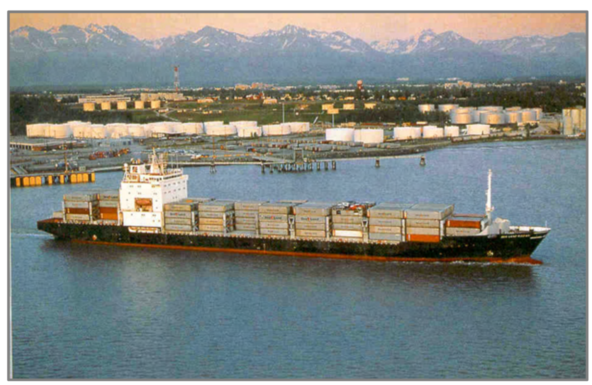
See footnote on page 3-7 for source and notes.[1]

Figure 3.9. Total annual earnings in 2006, by industry, in the Municipality of Anchorage.

c. Transportation

The Municipality of Anchorage has major highway, rail, water, and air transportation systems. Anchorage is the hub for vehicles and freight entering and leaving Southcentral, and is connected to all the major highway systems in Alaska (DCCED 2008a). These include the Glenn, Parks, Alaska, Seward, and Sterling highways. Truck freight ranges from small trucks with light loads to tractor and semi-trailer trucks transporting line haul and full container loads.

The Alaska Railroad is headquartered at the Port of Anchorage, which also serves as the Southcentral hub (DCCED 2008a). Rail transportation is available to the ports of Seward and Whittier, and as far north as Fairbanks. Commercial passenger demand has been increasing, but the railroad's mainstay continues to be commercial freight shipping, especially sand and gravel from the Matanuska-Susitna Borough (DCCED 2008a).



Port of Anchorage Administration

A Horizon Lines ship departing the Port of Anchorage.

The Port of Anchorage is critical to the supply of goods throughout the state, serving 80 percent of the state's population and 90 percent of communities along the railbelt (APET 2008). The port provides facilities for moving containerized freight, bulk petroleum, cement, and other products, totaling four million tons of goods and generating a $750 million economic impact annually. Two major carriers provide containerized service from Tacoma, WA twice weekly. Most of Alaska's refined petroleum products, such as jet fuel, are handled through the port, and Asian ships frequently transport construction materials and bulk cement to the port (APET 2008).

The Ted Stevens Anchorage International Airport provides passenger and cargo service to the Southcentral area, as well as being the primary air link for most of the state to connecting flights within and outside Alaska. Because it is within 9.5 hours by air from most of the industrialized world, the Anchorage Airport has become a leading crossroads for global air cargo activity (AEDC 2006). It ranks first in the U.S. for landed cargo weight, and third in the world for cargo throughput.

The two major terminals total more than 1.2 million sq. ft (AEDC 2006). In fiscal year 2007, over 5 million passengers passed through the airport (ADOT 2008). Other airports, airstrips, and water landing areas in the Municipality of Anchorage include Merrill Field, Lake Hood Seaplane Base and Lake Hood Airstrip, Campbell Lake/Sand Lake, Campbell Airstrip, Birchwood Airstrip, and Elmendorf Air Force Base.

d. Government and Education

The Municipality of Anchorage has no sales tax, although it does have real and personal property, bed, tobacco, oil and gas property, and vehicle rental taxes. The 2007 assessed value of real and personal property was $29 billion (ADOL 2008a). Total tax revenue was about $443 million in 2007.

Almost 50,000 students were enrolled in the Anchorage School District’s 95 public schools during the 2006-2007 school year, and expenditures per student were over $9,000 (Table 3.5; ASD 2007). In 2000, about 90 percent of the municipality’s residents age 25 or older had a high school diploma, and about 29 percent had a college degree (USCB 2001).

Table 3.5. Educational statistics for the Anchorage School District.

Educational Attainment[a]		School Information	
High school graduate or higher (%)	90.3	Number of Schools[b]	95
Bachelor's degree or higher (%)	28.9	Number of Students[c]	49,116
		Expenditure/student (FY2007)[c]	$9,158

[a] USCB 2001.
[b] DCCED 2008b.
[c] 2006-2007 school year; ASD 2007.

3. Kenai Peninsula Borough

a. Population

Over 50,000 people live in the Kenai Peninsula Borough (USCB 2007). Larger communities in the borough include Homer, Kalifornsky, Kenai, Nikiski, and Soldotna (Table 3.6). Some of the communities are outside the lease sale area, particularly those on the east side of the Kenai Peninsula and on Kachemak Bay.

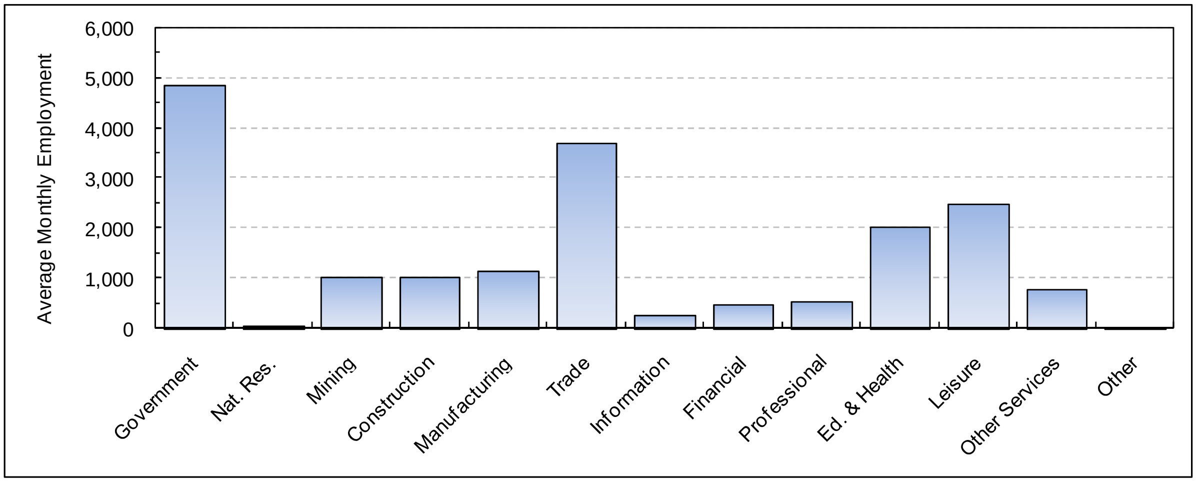
b. Economy

The economy of the Kenai Peninsula Borough is well diversified (ADOL 2008b). In 2006, the largest employers were government, trade, leisure, and education and health (Figure 3.10; ADOL 2007). The fastest growing industries are community care facilities for the elderly, financial investment, engineering and construction, nursing and residential care facilities, and vocational rehabilitation services (ADOL 2008b). Wages totaled about $660 million, about 31 percent from government, 18 percent from trade, and 13 percent mining (including oil and gas) (Figure 3.11; ADOL 2007). Median family income was $67,300 in 2004, and per capita income was about $29,400 (ADOL 2008b). The unemployment rate was 9.6 percent in March 2008.

Table 3.6. Kenai Peninsula Borough community profiles.

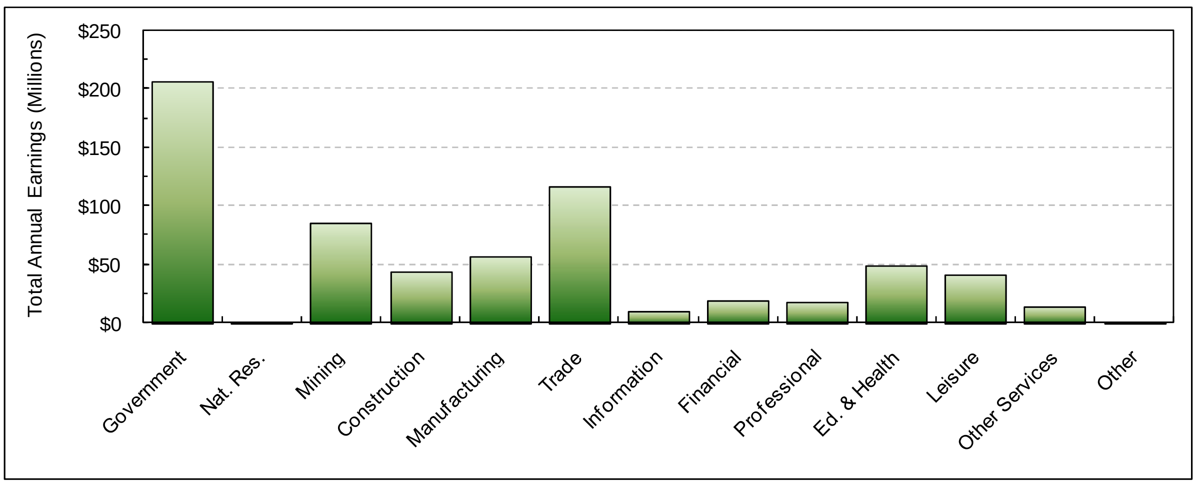
Community	Incorporation Type	Land Area (sq. mi)	Population Current	Population 2000	Population 1990
Kenai Penin. Borough	2nd Class Borough	16,013	51,350	49,691	40,802
Anchor Point	Unincorporated	91	1,803	1,845	866
Clam Gulch	Unincorporated	14	165	173	79
Cohoe	Unincorporated	70	1,260	1,168	508
Cooper Landing	Unincorporated	66	357	369	243
Crown Point	Unincorporated	4	81	75	62
Fox River	Unincorporated	127	639	616	382
Fritz Creek	Unincorporated	54	1,723	1,603	1,426
Halibut Cove	Unincorporated	8	24	35	78
Happy Valley	Unincorporated	89	472	489	309
Homer	1st Class City	11	5,454	3,946	3,660
Hope	Unincorporated	52	143	137	161
Kachemak	2nd Class City	2	458	431	365
Kalifornsky	Unincorporated	69	6,914	5,846	n/a
Kasilof	Unincorporated	10	547	471	383
Kenai	Home Rule City	30	6,864	6,942	6,327
Moose Pass	Unincorporated	18	204	206	81
Nanwalek	Unincorporated	9	228	177	158
Nikiski	Unincorporated	70	4,179	4,327	2,743
Nikolaevsk	Unincorporated	36	297	345	371
Ninilchik	Unincorporated	208	784	772	456
Port Graham	Unincorporated	6	136	171	166
Primrose	Unincorporated	37	79	93	63
Ridgeway	Unincorporated	17	1,961	1,932	2,018
Salamatof	Unincorporated	8	906	954	999
Seldovia	1st Class City	0.4	287	286	316
Seward	Home Rule City	14	2,627	2,830	2,699
Soldotna	1st Class City	7	3,807	3,759	3,482
Tyonek	Unincorporated	68	199	193	154

Source: DCCED 2008c, query of current population, June 5, 2008.



See footnote on page 3-7 for source and notes.[1]

Figure 3.10. Average monthly employment in 2006, by industry, in the Kenai Peninsula Borough.



See footnote on page 3-7 for source and notes.[1]

Figure 3.11. Total annual earnings in 2006, by industry, in the Kenai Peninsula Borough.

c. Transportation

The Kenai Peninsula Borough is connected to the rest of Alaska and the lower 48 states by regional highway, rail, water, and air transportation systems. The Seward and Sterling highways are the primary highways on the Kenai Peninsula. Other major roads include the Kenai Spur and North Kenai roads. In addition, the borough maintains about 630 miles of local roads (DCCED 2008e). A system of gravel roads in the Beluga and Tyonek area on the west side of Cook Inlet provide local service but are unconnected to the main road system.

The Alaska Railroad provides rail service to the Port of Seward, which is on the Kenai Peninsula but outside the lease sale area. Commercial freight is shipped through Seward by rail, including coal, construction steel, chemicals, sand and gravel, concrete, timber, and other large building materials (DCCED 2008e).

Although most freight such as construction materials, petroleum products, automobiles, and other bulk materials arrive through the Port of Anchorage and are subsequently trucked to borough communities, the ports of Seward and Homer also handle these items (DCCED 2008e). The Port of Homer, located on Homer Spit, includes a deep-water cargo dock, an ocean pier, and a small boat harbor. The Port of Seward includes a deep-draft dock, three medium-draft docks, four shallow-draft docks, and a small boat harbor. Other docks in Seward include the Fourth Avenue City Dock, the Alaska Institute of Marine Science Dock, and the Seward Marine Services Dock. In addition, the Port of Kenai has a shallow-draft public dock and boat ramp. The Port of Nikiski is a private dock located north of Kenai that is owned by petroleum and freight shipping companies (DCCED 2008e).

Facilities providing air service in the Kenai Peninsula Borough include the Kenai Municipal Airport and the Homer Airport (DCCED 2008e).

d. Government and Education

The Kenai Peninsula Borough has a 3 percent sales tax, and real and personal property, and oil and gas property taxes. The 2007 assessed value of real and personal property was $46 million (ADOL 2008b). Total tax revenue was about $71 million in 2007.

Over 9,000 students were enrolled in the Kenai Peninsula District’s 44 public schools during the 2006-2007 school year, and expenditures per student were about $10,000 (Table 3.7; KPB 2007b). In 2000, about 89 percent of the borough’s residents age 25 or older had a high school diploma, and about 20 percent had a college degree (USCB 2001).

Table 3.7. Educational statistics for the Kenai Peninsula School District.

Educational Attainment[a]		School Information	
High school graduate or higher (%)	88.5	Number of Schools[b]	44
Bachelor's degree or higher (%)	20.3	Number of Students[c]	9,368
		Expenditure/student (FY2007)[c]	$10,073

[a] USCB 2001.
[b] DCCED 2008b.
[c] 2006-2007 school year; KPB 2007b.

D. Historic and Cultural Resources

Historic and cultural resources in the Cook Inlet area include a wide range of sites, deposits, structures, ruins, buildings, graves, artifacts, fossils, and other objects of antiquity. The Alaska Heritage Resources Survey (AHRS) is an inventory of all reported historic and prehistoric sites within the state of Alaska. Sites may be listed as historic if they are at least 50 years old (AHRS 2008). More than 530 historic or prehistoric sites are reported within the Cook Inlet lease sale area (AHRS 2008).

Sites in the Cook Inlet area date as early as 8,000 years B.P. Later prehistoric occupations include Dena’ina, Chugach, and Eskimo populations, as well as Russian and Euroamerican occupations during the historic period (AHRS 2008). Sites are often clustered near natural features, such as river mouths, bluffs, and natural transportation routes. Few archaeological surveys have been conducted on the west side of Cook Inlet, and the actual number of historic sites is unknown. Numerous sites are scattered along the east bank of the Susitna River and along the Iditarod trail route, although data are sparse to the west of the Susitna River. Few data are available for other drainages such as the Yentna, Theodore, Lewis, Beluga, Chuitna, Chakachatna, and Kustatan rivers and Nikolai Creek (AHRS 2008).


Div. of Community & Business Development

Alaska Native baskets.

The more populated areas and federal park units have been surveyed more intensively. Many sites have been discovered in the Houston and Big Lake region, and in the Wasilla and Palmer area. Over 250 buildings and farm sites at Palmer are from the Matanuska Valley agricultural colony period of the 1930s. Sites are clustered around existing communities of Tyonek, Knik, Eklutna, and Eagle River (AHRS 2008). Several sites exist at Fort Richardson and Elmendorf Air Force Base. There are more than 100 sites (historic buildings and structures) within the city of Anchorage. Many sites are scattered along Turnagain Arm (AHRS 2008).

On the Kenai Peninsula, more than 150 sites have been identified within the Cook Inlet lease sale area (AHRS 2008). The area south of the Kenai River is well known historically and archaeologically, although the townships north of Kenai are only sporadically surveyed (AHRS 2008). The Anchor River drainage is largely unexplored. Clusters of sites are reported around Anchor Point, Kasilof River, and the Kenai River. There are more than 50 sites in the area of the City of Kenai, the majority of which are historic (AHRS 2008).

E. Climate

The Cook Inlet area is characterized by three climate zones: the maritime zone, continental zone, and transition zone (Alaskool 2004). In the maritime zone areas, which encompass the coast and islands, annual precipitation averages about 60 inches. Mean maximum temperatures in the summer are in the upper 50s, and low means during winter are in the low 20s. Offshore winds average 12-18 knots, with winter extremes of 50-75 knots (Alaskool 2004). Areas further from the coast may have continental zone characteristics, with annual precipitation from 10-15 inches, mean maximum summer temperatures in the mid- to upper 60s, and mean lows in the winter ranging from -10 to -30 degrees. Surface winds tend to be lighter compared to coastal maritime areas. Other locations in the Cook Inlet area, such as interior portion of the Kenai Peninsula and the area around Talkeetna, have transition zone characteristics, with temperatures similar to continental zone areas, precipitation similar to maritime zone areas, and winds intermediate (BLM 2006; Alaskool 2004).

In the Matanuska-Susitna Borough, average January temperatures range from 6° - 14°, and July temperatures range from 47° - 67° (DCCED 2008b). Average precipitation is 16.5 inches. In the Municipality of Anchorage, January temperatures average 8° - 21°, and July temperatures average 51° - 65°. Anchorage has an average of 15.9 inches of rain and 69 inches of snow (DCCED 2008b). Average temperatures on the Kenai Peninsula, range from 4° - 22° in January, and from 46° - 65° in July. Annual precipitation averages 20 inches (DCCED 2008b). However, temperature and precipitation can vary greatly between years and among locations (Brabets and Whitman 2004).

Since the late 19th century, average global temperatures have increased 0.5°F to 1.0°F (BLM 2005). Temperature increase in Alaska over the last 50 years averages 3.4°F, although the temperature changes vary greatly across the state and most of the change has occurred in winter and spring months (ACRC 2008). Little additional warming has occurred since 1977, with the exception of a few locations (ACRC 2008). Regional climatic change is difficult to quantify and much less reliable than global estimations (BLM 2005; ACRC 2008).

Changes that could accompany warming trends include melting glaciers, reduction in seasonal sea ice cover resulting in increased storm effects and higher coastal erosion rates, increased permafrost melting, shifting vegetation zones, increased fires, insect outbreaks, changing animal migration paths, and changing subsistence patterns (DGGS 2008). In 2006, the Alaska Climate Impact Assessment Commission was formed to assess the effects of climate change on citizens, resources, economy, and assets of the State of Alaska (ACIAC 2008). In September 14, 2007, Administrative Order 238 was signed, creating the Climate Sub-Cabinet to develop an Alaska Climate Change Strategy. The strategy will serve as a guide for responding to climate change and will identify immediate priorities as well as long-term strategies, including recommendations for saving energy and reducing greenhouse gas emissions (SOA 2008b). On March 17, 2008, the Alaska Climate Impact Assessment Commission released a report to the legislature outlining recommendations, including a coordinated process for village relocation efforts; capital project planning to take into account potential future impacts resulting from climate change; assessing public infrastructure needs to protect against erosion and loss of permafrost; and researching needs (ACIAC 2008). As of May 2008, more than 100 Alaskans had been selected to serve on advisory groups and technical work groups under the Climate Change Sub-Cabinet (SOA 2008a), and development of the Alaska Climate Change Strategy is underway.

F. Waters of the Cook Inlet Area

1. Marine Waters

Cook Inlet is a 350 km long estuary that is semi-enclosed and has a free connection to the open ocean (MMS 2003; MMS 2000). Cook Inlet, and its channels, coves, flats, and marshes, are a mixture of terrestrial sources from numerous river drainages and marine waters of Shelikof Strait and the Gulf of Alaska (MMS 2003). Cook Inlet varies in width from about 100 m near the entrance to less than 20 m at its head (MMS 2000). Beach substrate may be sand, hard or soft mud, gravel or cobble (Pentec Environmental 2005).

Public domain

Cook Inlet, as viewed from downtown Anchorage.

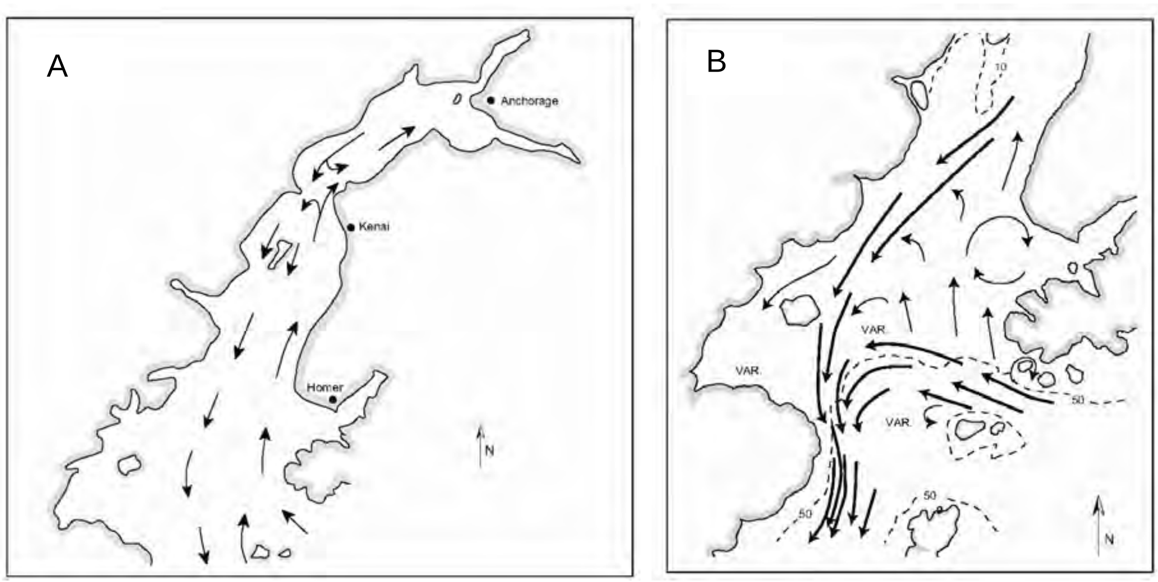
a. Bathymetry

The bottom of Cook Inlet is extremely rugged with deep pockets and shallow shoals (KPB 2007a). Upper Cook Inlet north of the Forelands is generally less than 120 ft deep; the deepest portion is in Trading Bay, east of the mouth of the McArthur River. Two channels extend southward on either side of Kalgin Island, joining west of Cape Ninilchik. This channel gradually deepens to the south, to about 480 ft, then widening to extend across the mouth of Cook Inlet from Cape Douglas to Cape Elizabeth (KPB 2007a). The 60 ft depth contour is generally located 2.5 to 3 miles offshore along lower Cook Inlet, but falls within 0.7 miles of shore for a length of about 3 miles near Cape Starichkof (KPB 2007a). The southeast coast of the Kenai Peninsula consists of a series of deep, glacially carved fjords (KPB 2007a).

b. Tides and Currents

Tides in Cook Inlet are semidiurnal, with two unequal high tides and two unequal low tides per tidal day (24 hours, 50 minutes). The mean diurnal tidal range varies from 13.7 ft at the mouth of Cook

Inlet to 29 ft in upper Cook Inlet (KPB 2007a). Strong tidal currents and inlet geometry produce considerable cross currents and turbulence within the water column. Tidal bores of up to 10 ft have occurred in Turnagain Arm (KPB 2007a). Current velocities are influenced by local shore configuration, bottom contour and possibly wind effects in some shallow areas (MMS 2003). Maximum surface current speeds average about 3 knots in most of Cook Inlet; however, currents may exceed 6.5 knots in the Forelands area, and have been reported at up to 12 knots in the vicinity of Kalgin Island and Drift River (KPB 2007a). The mixing of incoming and outgoing tidewater, combined with freshwater inputs, are the main forces driving surface circulation (Figure 3.12; MMS 2003).



Source: (Mulherin et al. 2001).

Figure 3.12. Surface currents of upper (A) and lower (B) Cook Inlet.

c. Sediment and Salinity

Cook Inlet receives large quantities of glacial sediment from the Knik, Matanuska, Susitna, Kenai, Beluga, McArthur, Drift, and other rivers. This sediment is redistributed by intense tidal currents. Most of this sediment is deposited on the extensive tidal flats or is carried offshore through Shelikof Strait and eventually deposited in the Aleutian trench beyond Kodiak (KPB 2007a; MMS 2003). Powered by the Alaska Coastal Current, sediments of the Copper River drainage drift into lower Cook Inlet and Shelikof Strait where they eventually settle to the bottom. MMS survey results indicate that about 10-20 percent of the bottom sediments in the Cook Inlet area are from the Copper River (MMS 2000).

Sediment in Cook Inlet is generally transported along the Kenai Peninsula into lower Cook Inlet, Kachemak, and Shelikof Strait (MMS 2000). Sediments transported down the west side of Cook Inlet are eventually deposited in the shallows of Kamishak Bay, while sediment is also deposited in Kachemak Bay, deeper portions of outermost Cook Inlet and Shelikof Strait (MMS 2000). Homer Spit is maintained by sediment transported from the north (KPB 2007a).

Salinity of Cook Inlet waters increases steeply and evenly along the inlet, from Point Possession to East and West Foreland. Slightly higher salinities are found on the east side. This rapid increase in salinity is due to high concentrations of glacial silt in runoff from the Matanuska, Susitna and Knik rivers and subsequent settling of sediment in upper Cook Inlet. Local areas of with less salinity occur near the mouths of large glacially fed streams such as the Tuxedni, Kenai, and Kasilof rivers (KPB 2007a).

d. <u>Water Temperature and Ice Conditions</u>

The water temperature in upper Cook Inlet varies with season from 32° to 60° F. Water temperatures of lower Cook Inlet, which are influenced by warmer waters entering from the Gulf of Alaska, range from 48° to 50°F (KPB 2007a).

The ice in Cook Inlet comes from four different sources: pack ice, shorefast ice, stamukhi, and estuary and river ice (Mulherin et al. 2001). Pack ice forms in seawater and is formed by the direct freezing of seawater. Shorefast ice is formed from freezing of surrounding water, from ice being piled and refrozen. Mud exposed to the air by the ebbing tide can freeze, and when seawater contacts the frozen mud, beach ice forms. Stamukhi are massive ice blocks created by repeated wetting and accretion of seawater, crushing and piling of ice blocks, and stranding of successive layers of ice which freeze together. Estuary ice forms from freshwater in estuaries and rivers. River ice is much stronger than sea ice and is generally unaffected by tidal action until spring breakup (Mulherin et al. 2001).

The primary factor for ice formation in upper Cook Inlet is air temperature, and the major influences in lower Cook Inlet are the Alaska Coastal Current temperature and inflow rate (MMS 2003). Cook Inlet ice generally begins forming in October, covers a large area by November, and melts completely in the spring (Mulherin et al. 2001). On the east side of Cook Inlet, ice may extend to Anchor Point, and on the west side, to Cape Douglas (Mulherin et al. 2001). Ice concentrations or cover are sometimes found in Kamishak Bay extending outward to Augustine Island, and Chinitna, Tuxedni and other western Cook Inlet bays (KPB 2007a).

2. Freshwaters

The Cook Inlet area includes many watersheds (Figure 3.13), including 11 that drain major mountain ranges (BLM 2006). These include the Kenai Mountains on the Kenai Peninsula, the Chugach Mountains adjoining the Municipality of Anchorage, the Talkeetna Mountains in the Matanuska-Susitna area, the Alaska Range in the northwest, and the Chigmit, Neacola, and Tordillo mountains in the west (BLM 2006). Freshwater sources include glaciers and icefields; glacial, runoff, and spring-fed streams; rivers; lakes; and wetlands. Glaciers and snowmelt provide a large portion of the input to watersheds in the Cook Inlet area (BLM 2006). In fact, glaciers cover 11 percent of the land area of the Cook Inlet basin, storing massive amounts of water as ice (Brabets and Whitman 2004).


USFWS

Kenai River

Major rivers in the Matanuska-Susitna area include the Matanuska, Knik, Little Susitna, and Susitna rivers and their tributaries such as the Talkeetna and Yentna rivers; important lakes include Big, Nancy, Alexander, and Eklutna lakes (BLM 2006). In the Anchorage area, the primary rivers are Ship, Campbell, and Bird creeks, and Eagle and Twentymile rivers. Larger rivers on the Kenai Peninsula include the Kenai, Ninilchik, and Anchor rivers; and among the larger lakes are Tustumena, Kenai, and Skilak lakes. Important rivers on the west side of Cook Inlet include the Drift, McArthur, Theodore, McNeil, and Kamishak rivers (BLM 2006).

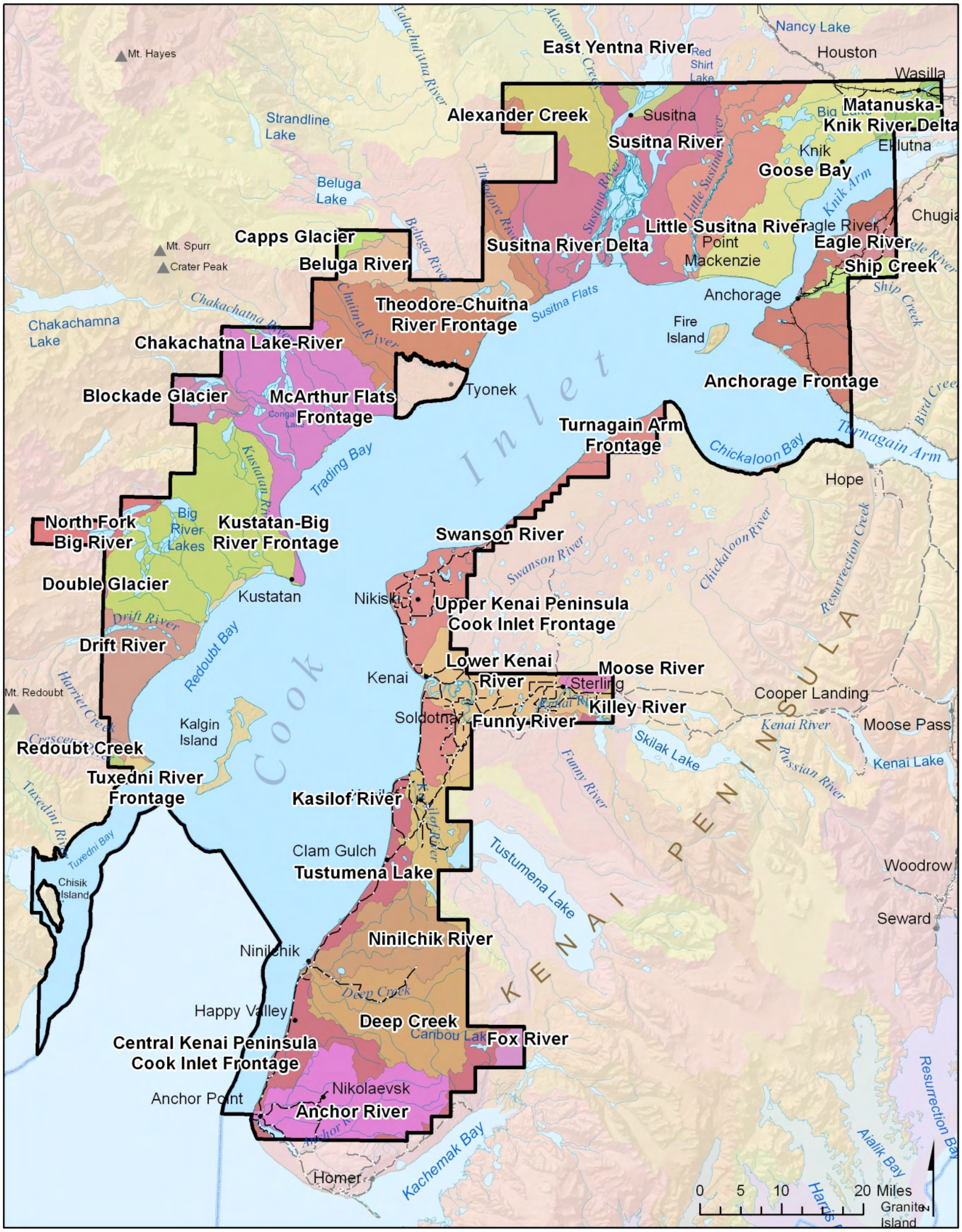


Figure 3.13. Watersheds of the Cook Inlet area.

A large aquifer system is found beneath much of Cook Inlet area lowlands, composed of unconsolidated glacial-outwash and alluvial deposits (Glass 1999). In upland areas, groundwater is also found in saturated fractures in bedrock. Groundwater provides most of the water in streams of the area during the winter. Groundwater yields range from 1.34-133.68 cfm on the Kenai Peninsula and up to 133.68 in the Susitna River Valley (BLM 2006).

G. Geologic Hazards

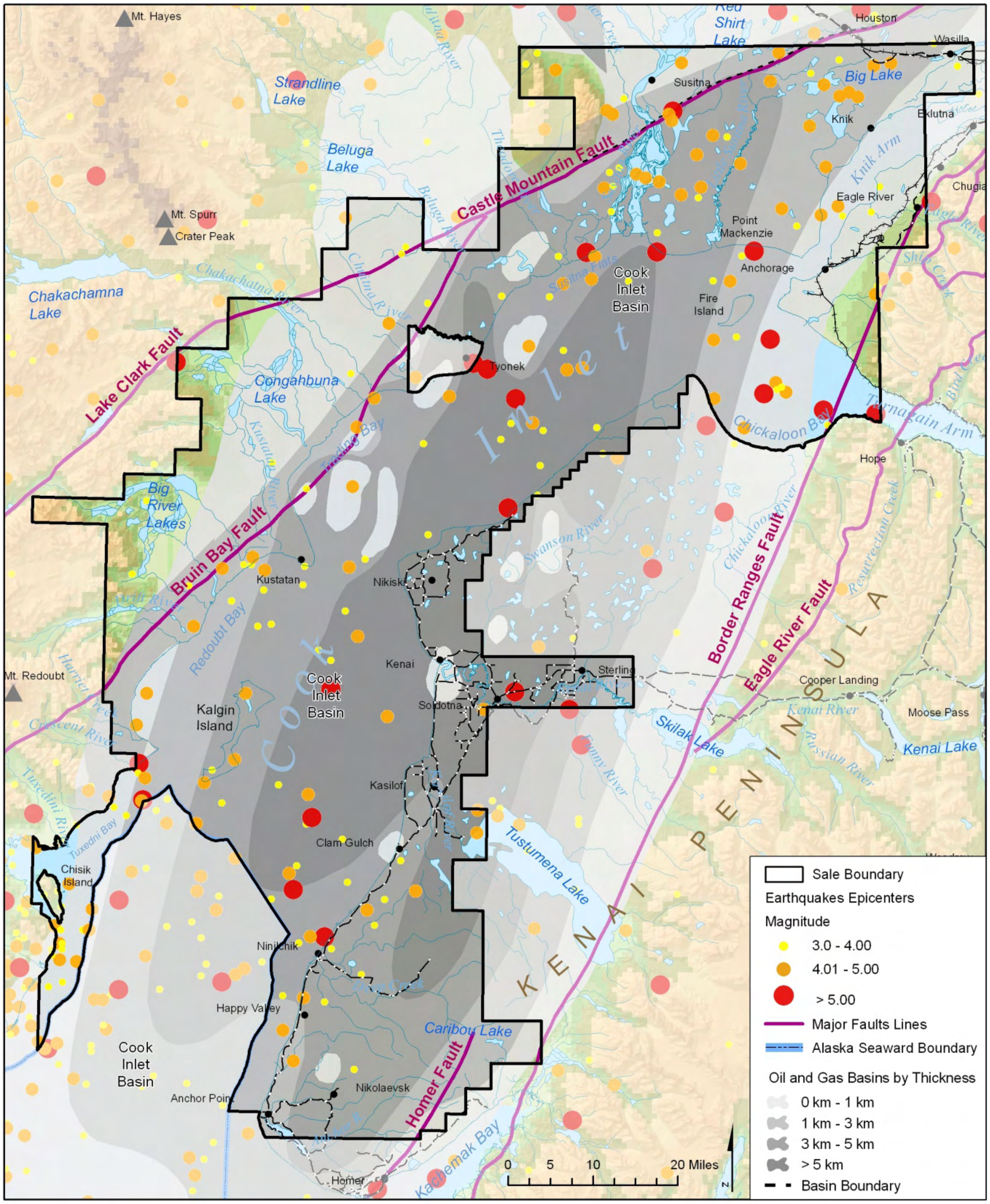
Several geologic hazards that could pose potential problems to oil and gas installations both onshore and offshore exist in the Cook Inlet area. These include earthquakes, volcanoes, tsunamis, flooding, ice, current and sediment hazards, and coastal erosion. The Cook Inlet area is located in one of the most seismically active regions in the world, is in close proximity to several active volcanoes, and has some of the highest tides in the world. “In spite of these environmental constraints, petroleum extraction and processing facilities have functioned, both onshore and offshore, without significant environmental damage since the Swanson River field was discovered in 1957” (Combellick et al. 1995, citing to Magoon and others 1976).

1. Faults and Earthquakes

The Cook Inlet trough is a forearc basin between the Aleutian Arc to the west and the Kenai Mountains to the east (Combellick et al. 1995, citing to Kelley 1985). Subduction of the Pacific crustal plate beneath the Kenai Mountains and Aleutian Arc (North American plate) accumulates crustal stresses that are periodically relieved by deep-focused earthquakes (Figure 3.14). The Castle Mountain fault is the only surface fault in the Cook Inlet region with unequivocal evidence of Holocene offset. Geologic evidence of four events in the past 2,700 years indicates an average recurrence interval of about 700 years for significant (magnitude 6-7) earthquakes on the fault. Considering it has been 600-700 years since the last event, an event of this magnitude may be likely on the Castle Mountain fault in the near future (Haeussler et al. 2002). In 1984, a magnitude 5.7 earthquake with an epicenter in the Matanuska Valley, near the town of Sutton was attributed to subsurface movement along the Castle Mountain fault (Combellick et al. 1995, citing to Lahr and others 1986).

The Bruin Bay fault system consists of a family of four or five echelon faults[2] in a zone as much as 5 miles wide. The fault zone crosses the lease sale area through the northwestern quadrant of T12N, R11W, Seward Meridian and extends more than 250 miles southwest from the Castle Mountain fault west of Anchorage to Becharof Lake on the Alaska Peninsula. The fault plane dips between 45 degrees and vertical, although most of the fault system dips between 60-70 degrees as measured in the Kamishak Bay area. Evidence seems to suggest at least two major movements along this fault system, the first occurring in late Jurassic time (approximately 160 million years ago) and the second more than 25 million years ago during the mid-Cenozoic. The major activity on the main part of the fault system probably ceased during the Oligocene time (approximately 30 million years ago). Offset across the Bruin Bay fault system appears to be dip-slip with a possible strike-slip component. The amount of throw along this system could be as much as 10,000 feet with the southeast block relatively downthrown and a possible left-lateral offset of 12 miles (DO&G 1993, citing to Detterman and Hartsock 1966) to 40 miles (DO&G 1993, citing to Detterman and Reed 1980). During the 1964 earthquake, the west side of Cook Inlet rose as part of a broad uplift, but no differential uplift took place across the Bruin Bay fault system (DO&G 1993, citing to Detterman and Reed 1980).

[2] A grouping of faults that are arranged in a step-like manner.



Source: Alaska Earthquake Information Center.

Figure 3.14. Earthquakes, faults, and volcanoes in the Cook Inlet area.

The inferred trend of the Bruin Bay fault crosses several townships of the lease sale area from the vicinity of Tyonek to near Harriet Point on the west side of Cook Inlet (Combellick et al. 1995, citing to Magoon and others 1976). Several northeast-trending faults have been identified or inferred in the western Kenai Lowlands. "Several of these structural breaks are known to cut Tertiary age rocks of the Kenai Group, but they are not known to offset younger deposits and their activities and subsurface extents remain speculative." (Combellick et al. 1995, citing to Barnes and Cobb 1959, Kirschner and Lyon 1973, Tysdal 1976). There is no evidence of movement on the Bruin Bay fault in Holocene or historic time.

The Border Ranges fault is considered a former boundary between the subducted oceanic plate and the continental plate and is considered the eastern boundary of the Cook Inlet basin. The Border Ranges fault forms an arc from Kodiak Island, across the Kenai Peninsula, to the eastern Chugach Mountains, a distance of more than 320 miles. The Border Ranges fault is not exposed along much of the Kenai Peninsula, but it outcrops northeast and east of Anchorage (referred to as the Knik fault) and along Kachemak Bay in the southwestern Kenai Peninsula (DO&G 1993, citing to MacKevett and Plafker 1974). The fault plane generally dips between 70 degrees and vertical with the most recent movement along this fault occurring approximately 70 million years ago in the late Mesozoic or early Tertiary time. There is indirect evidence in the Twin Peaks area of the western Chugach Mountains that the Border Ranges fault may have had minor displacement since the Holocene time (10,000 years ago; Reger and Petrik 1993, citing to Reger and Updike 1983).

Geologic studies indicate that seven great (1964-style) subduction earthquakes have occurred in the Cook Inlet region during approximately the past 4,000 years, indicating an average recurrence interval of about 600 years (Shennan et al. *In press*). Smaller but potentially damaging earthquakes (magnitude greater than 5.5) have occurred more frequently. There have been 119 earthquakes with magnitudes of 5.0 or greater in the Cook Inlet region since 1899. Most of these earthquakes had magnitudes of 5.0 to 6.0; four had magnitudes of greater than 7.0 (AEIC 2008).

Diffuse seismicity shallower than 35 km in the Cook Inlet area results from transpressional deformation. A 1933 magnitude 6.9 event near Anchorage which caused intensity VII effects on the Mercalli scale[3] may have been related to this shallow deformation. Some buried folds in the upper Cook Inlet area, such as at the Middle Ground Shoal oil field, are cored with blind reverse faults that may be capable of generating magnitude 6-7+ earthquakes (Haeussler et al. 2000).

The epicenter of the 1964 earthquake (moment magnitude 9.2) was in Prince William Sound. However, geologic effects were widespread in the Cook Inlet area and included seismic shaking, ground breakage, landslides and other surface displacements, liquefaction, falling objects, and structural failures (Combellick et al. 1995, citing to Waller 1966, Stanley 1968, Foster and Karlstrom 1967, Tysdal 1976). Future strong earthquakes can be expected to produce similar effects.

Anchorage Museum, AMRC-b76-118-16

Damage to the J.C. Penney store and other buildings in downtown Anchorage, from the March 27, 1964 earthquake.

Other types of ground failure include liquefaction and sliding of water saturated soils, rockfalls, translatory block sliding such as occurred at Anchorage in 1964, horizontal movement of vibration-mobilized soil which was the cause of extensive damage to Alaskan railways and highways in 1964, and ground fissuring and

[3] The Mercalli scale measures damage done by an earthquake on a scale from I (not felt) to XII (damage total).

associated sand extrusions typical of areas where the ground surface is frozen. Extensive occurrence of all these phenomena has been documented for large earthquakes. No producing oil and gas wells or pipelines in the Cook Inlet region were damaged by the 1964 earthquake. In Nikiski, a fuel storage tank was buckled at its base and several floating roofs on storage tanks were damaged by earthquake-generated waves inside the containers (Plafker et al. 1969).

The northern half of the Kenai Peninsula coastline is underlain by till, outwash, and gravely glaciomarine deposits. The southern half is underlain by the Tertiary Beluga formation, which is composed of thinly interbedded layers of sand, shale, and coal. Both of these areas are relatively stable under earthquake loading and should not be compared to the highly unstable sensitive-clay deposits under Anchorage or extensive liquefaction-susceptible sands. Liquefaction of coarse glacial deposits under earthquake loading is probably low, particularly if they remain overconsolidated due to ice loading. However, recent evidence of gravel liquefaction in the Portage area during the 1964 great earthquake indicates that gravel may be more susceptible to liquefaction than previously thought. Site specific testing of liquefaction susceptibility is advisable (Combellick et al. 1995).

The USGS has a series of seismic hazard maps for Alaska, which are available on the USGS Website at http://earthquake.usgs.gov/research/hazmaps/ . These maps depict earthquake hazard by showing, with contour values, the earthquake ground motions that have a given probability of being exceeded in 50 years. The ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned a probability based on the annual probability of occurrence of the causative magnitude and distance from the source. The method is based on historical earthquake occurrences and geological information on the recurrence rate of fault ruptures. To prepare these maps, the USGS analyzed all known seismic sources (surface faults, subduction zone and volcanic sources). Included in the computations are all historical and instrumental recordings of ground motions, gathered using a grid of 1-sq. km polygons. It is therefore possible to see the probabilistic ground motion for any location. The USGS seismic hazard maps are incorporated into the International Building Code for establishing the seismic design values for a selected location.

2. Volcanic Hazards

Alaska contains about 80 percent of all the active volcanoes in the United States and about 8 percent of the active volcanoes in the world. The western shore of Cook Inlet contains seven volcanoes that have erupted in Holocene time (10,000 years ago). These are, from north to south, Mt. Hayes, Mt. Spurr, Mt. Redoubt, Mt. Iliamna, Mt. Saint Augustine, Mt. Douglas, and Fourpeaked Mountain (about 8 miles southwest of Mt. Douglas). Three of these (Mt. Spurr, Mt. Redoubt, and Mt. Saint Augustine) have erupted more than once this century and could well erupt again in the next few years or decades (Combellick et al. 1995). Augustine erupted recently with a series of explosive eruptions January 11-28, 2006, continuing with an effusive phase through late March. Fourpeaked had its first historic eruption on September 17, 2007, with an ash plume to 20,000 feet asl (Alaska Volcano Observatory 2008).


USFWS

Augustine Volcano.

Study of tephras (volcanic ash layers) in the Cook Inlet region indicates that eruptions have occurred every 1 to 200 years (Combellick et al. 1995, citing to Riehle 1985). In the 20th century, these events have occurred every 10 to 35 years, and, for the last 500 years, tephras were deposited at least every 50 to 100 years, with Mt. Redoubt, Mt. Spurr, and Mt. Saint Augustine being the most active (Combellick et al. 1995, citing to Stihler 1991, Stihler and others 1992, Beget and Nye 1994, Beget and others 1994). Mt. Saint Augustine is one of the most active volcanoes in Alaska, with major eruptions in 1883, 1935, 1964, 1976, and 1986. Mt. Redoubt erupted in 1968 and 1989-90, and Mt. Spurr erupted in 1953 and 1992 (Combellick et al. 1995, citing to Wood and Kienle 1990). No historic eruptions are known for Mt. Douglas or Mt. Iliamna, although geologic evidence shows that each has erupted during the past 10,000 years (Combellick et al. 1995).

During their periodic violent eruptions, the active glacier-clad stratovolcanoes produce abundant ash and voluminous mudflows that have threatened air traffic and onshore petroleum facilities (Combellick et al. 1995, citing to Riehle and others 1981, Brantley 1990). These are examples of the two major categories of volcanic hazards that will continue to threaten activities in the region. Proximal hazards are those close to volcanoes and consist of a wide variety of flow phenomena on the flanks of volcanoes or in drainages which head on the volcanoes (Combellick et al. 1995). Distal hazards are those farther from volcanoes, such as ashfall and tsunamis (Combellick et al. 1995).

A proximal hazard of particular concern to the lease sale area are floods generated by the rapid emplacement of large volumes of hot volcanic ejecta onto snow and ice on the upper flanks of volcanoes. All the volcanoes in Cook Inlet except Mt. Saint Augustine have permanent snow and ice stored in snowfields and glaciers on their upper flanks (Combellick et al. 1995).

The largest volcanically generated flood this century was caused by the January 2, 1990, eruption of Redoubt Volcano. The flood impacted the operation of the Drift River Oil Terminal (Combellick et al. 1995, citing to Brantley 1990). The state allowed normal loading operations to resume once a protective dike was installed around the tank farm and support facilities to provide protection from flooding. This work was accomplished by August 1990 and the facility was fully operational. Another, and probably much smaller, flood came down the Chakachatna River in response to the 1953 eruption of Mt. Spurr. Floods caused by eruptions can impact any drainage on a volcano (Combellick et al. 1995).

In the area of the lease sale, drainages that could be impacted by volcanigenic floods are the Chakachatna River drainage (from Trading Bay to the McArthur River), Drift River drainage (from Montana Bill Creek to Little Jack Slough), Redoubt Creek, and the Crescent River. This is approximately half of the lease sale lands on the western shore of Cook Inlet. Drift River and Chakachatna River are the most likely to host floods.

A very large debris avalanche came down Redoubt Creek and formed the land that now underlies Harriet Point in latest Pleistocene time (1 million years ago), but that drainage does not appear to have had a large flow since that time (Combellick et al. 1995, citing to Beget and Nye 1994). Large flows, some of which reached the present shoreline, came down Crescent River between about 3,600 and 1,800 years ago (Combellick et al. 1995, citing to Beget and Nye 1994). The most probable volcanically induced floods are small, water-rich floods, which depending on the local hydrographic conditions, could impact roads, pipelines, and other infrastructure (Combellick et al. 1995).

Other proximal volcanic hazards on the western shore of Cook Inlet are lava flows, block-and-ash flows, pyroclastic[4] flows, and hot gas surges. The lands included in the lease area are far enough from the volcanoes that they are out of range of all but the very largest eruptions (eruptions on the scale of the 1980 Mount St. Helens or 1991 Mt. Pinatubo eruption). Eruptions this large are rare, although they are certainly possible and have happened at several of the Cook Inlet volcanoes, the most recent being the eruption of Mt. Katmai in 1912.

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[4] Volcanic material that has been explosively ejected from a vent.

The most common distal hazard is ashfall, where volcanic ash (finely ground volcanic rock) is lofted into the atmosphere and stratosphere by explosive eruptions, drifts downwind, and falls to the ground. There have been dozens of such events from Cook Inlet volcanoes since 1900. In most cases, volcano ashfalls have been a few millimeters or less in thickness. The primary hazard of such ashfalls is damage to mechanical and electronic equipment such as engines, which ingest ash past the air filter, computers, and transformers, possibly causing electrical shorts. Ashfalls of a few millimeters should be expected throughout the Cook Inlet and Susitna basins with a long-term average frequency of a few every decade or two. Ashfalls thick enough to collapse buildings are possible but rare (Combellick et al. 1995).

The Alaska Volcano Observatory has recently produced volcano-hazard assessment reports for Augustine, Iliamna, Redoubt, and Spurr volcanoes, published by the U.S. Geological Survey.

3. Tsunamis

Tsunamis (large water waves induced by earthquakes, subsea landslides, or volcanic activity) are a potential hazard for lower Cook Inlet (south of the Forelands). The most likely cause of a tsunami in Cook Inlet is either a large magnitude earthquake similar to the 1964 quake or a violent eruption of Mt. Saint Augustine. Tsunamis are generated when large volumes of sea water are displaced, either by tectonic displacement of the sea floor or by large rockfalls or landslides. The narrow, elongate geometry of Cook Inlet should reduce the chances that a tsunami generated outside the inlet will propagate significant destructive energy into it. For example, the tsunami generated by the 1964 earthquake produced damage in the lower Cook Inlet at Rocky Bay and Seldovia, and hit much of the west coast of the lower inlet, but caused no damage in upper Cook Inlet. Conversely, if a tsunami were caused by a displacement of the sea floor in Cook Inlet, it probably would have little effect in open waters but could produce significant damage along the coastline (DO&G 1993, citing to Hampton).

Anchorage Museum, AMRC-b70-15-35

View of damage from the March 27, 1964 earthquake and tsunami, Seward.

Marine portions of the lease sale area are relatively shallow and protected from open ocean; therefore the hazard from distant tsunamis is low. The hazard from local earthquake generated tsunamis is also low because there are no known active surface faults in the inlet, no adjacent steep slopes to serve as sources of massive slides into the inlet, and no evidence of thick, unstable seafloor deposits that would fail in massive underwater slides. There is no known geologic evidence of prehistoric tsunamis in the lease sale area (Combellick et al. 1995).

A major current concern in Cook Inlet today is the possibility of tsunamis being generated by volcanic activity on Mt. Saint Augustine. A volcanic eruption can produce debris avalanches with velocities of up to 328 feet per second. When the avalanche reaches the sea, the displaced water mass can become a tsunami. These waves would hit both the east and west shores of Cook Inlet. While the west shore is largely unpopulated, populated areas on the east shore within lower Cook Inlet could be subject to extensive damage. These include Port Graham, Anchor Point, Nanwalek, Seldovia, Homer and several small communities (DO&G 1993, citing to Kienle et al. 1987). Mt. Saint Augustine volcano presents the greatest threat to shoreline and offshore structures because of its island location in southwestern Cook Inlet. Mt. Saint Augustine experiences frequent violent eruptions, and has a propensity for producing unstable summit domes that periodically collapse into large, rapidly moving debris avalanches. These enter Cook Inlet and generate rapidly spreading tsunamis (Reger and Petrik 1993, citing to Begét and Kienle 1992). Other major volcanoes in the Cook Inlet region, including Mt. Iliamna, Mt. Redoubt and Mt. Spurr, are located farther inland, and are not considered likely to produce similar submarine debris flows and corresponding tsunamis.

The volcanogenic tsunami hazard in Cook Inlet is presently poorly understood, although the potential for the generation of large waves is real. There is some anecdotal evidence in historic records that the 1883 eruption of Augustine generated a wave that was several meters high when it impacted Nanwalek, on the east side of Cook Inlet (Combellick et al. 1995, citing to Beget and Kienle 1992). There are also historical documents that discount the existence of this. In any event, geologic evidence of repeated anomalous waves has not been found (Combellick et al. 1995, citing to Waythomas 1995). The explosive eruptions of Augustine Volcano in early 2006 did not produce a tsunami.

4. Marine and Seafloor Hazards

Cook Inlet has a maximum tidal range of 4 to 11 m, depending on location, which produces rapid tidal flows and strong riptides (Combellick et al. 1995, citing to Evans and others 1972, Hayes and others 1976, National Oceanic and Atmospheric Administration 1977). High tidal-current velocities in upper Cook Inlet prevent deposition of clay and silt-size sediments, which largely remain in suspension. Bottom sediments in the lease sale area are mainly gravel and sandy gravel with gravel content of 50-100 percent (Combellick et al. 1995, citing to Sharma and Burrell 1970). Similar deposits in lower Cook Inlet are thought to be reworked and redistributed coarse-grained glacial material (Combellick et al. 1995, citing to Rappeport 1981). These deposits show no evidence of gravitationally unstable slopes or soft, unconsolidated sediment (Combellick et al. 1995, citing to MMS 1995).

Several pipeline failures in upper Cook Inlet have been directly attributed to the current-sediment interaction. (See Chapter 6 for additional information on pipelines and oil spills.) As the bottom sediments shift under the influence of bottom currents, sections of the pipeline are undermined and become unsupported. The pipeline may then flutter, which causes fatigue and failure. Actions taken in Cook Inlet to prevent this situation include conducting annual side-scan sonar surveys, attaching pipelines to piles driven into the seafloor, placing large bags of a sand-cement mixture around the pipelines to anchor them, and using heavy walled pipe (DO&G 1993, citing to Whitney and others 1979).

During the winter months, ice forms up to three feet thick on upper Cook Inlet. This ice, propelled by the swift tidal currents, creates very large load stresses on the offshore platforms. Since the platforms are designed to withstand the ice loads, this should not present a problem. Ice is not as severe a problem in the southern part of the inlet due to a higher salinity, less fresh water inflow, and a greater proportion of warm ocean waters.

Winter ice conditions combined with tidal action may occasionally hinder offshore operations in the upper inlet from December through April (Combellick et al. 1995, citing to Sharma and Burrell 1970). During the winter of 1970-1971, inlet ice extended as far south as Anchor Point and Cape Douglas. Although blocks of floe ice generally reach a thickness of 1.2 m in Cook Inlet, grounding of these blocks forms large piles of ice blocks (stamukhi) that exceed 12 m in thickness and, where floated, stamukhi have damaged ships in the inlet (Combellick et al. 1995, citing to Evans and others 1972). Numerous large erratic blocks in shallow, nearshore waters are hazards to ship navigation.

5. Flood Hazards

In addition to volcanigenic flooding on the west side of Cook Inlet, flood hazards in the Cook Inlet area may result from glacial outburst (jökulhlaups), ice jams, and high rainfall.

Glacial outburst occurs when glacial movement opens a pathway for water trapped behind a glacier to escape. Rivers are subject to large magnitude outburst floods as a result of the sudden drainage of large, glacier-dammed lakes, particularly on the west side of Cook Inlet. Major rivers affected by outburst floods include Beluga, Chakachatna, Middle, McArthur, Big, and Drift rivers (Combellick et al. 1995, citing to Post and Mayo 1971). For example, in September 1982, over 95 percent of Strandline Lake drained, releasing about 700 million cubic meters (185 billion gallons) of water. Strandline Lake has drained catastrophically into Beluga River every 1 to 5 years since about 1954 (Combellick et al. 1995, citing to Sturm and Benson 1988). The most reliable predictor of outburst floods from Strandline Lake is the development of a calving embayment in the lobe of Triumvirate Glacier, which dams the lake (Combellick et al. 1995).

G. Litchfield, ADF&G

Ice and flood damage, Kenai River.

Ice jam flooding occurs during breakup when ice blocks a river or stream, in effect becoming a dam. This causes water to back up and flood the adjacent land. Ice jam flooding is localized, but affects the greatest number of residents over time because of the high population concentration along rivers (Combellick et al. 1995, citing to J. M. Dorava, U.S. Geological Survey, personal communication, 1995).

On the east side of Cook Inlet, in the Kenai Lowlands, high water levels in the Kenai River frequently occur due to the sudden drainage of glacier-impounded lakes at the head of the Snow River tributary east of Kenai Lake, and lakes held in by Skilak Glacier located in the Harding Ice Field above the Skilak River. Several small lakes impounded by Tustumena Glacier are potential sources of unexpected floods in Kasilof River. Outbursts from a Skilak Glacier dammed lake can result in extensive lowland flooding, as occurred in 1969 when severe damage resulted in Soldotna (Combellick et al. 1995, citing to Post and Mayo 1971). In October 1995, Skilak Glacier released an outburst flood that resulted in water levels cresting about 0.5 m below flood stage at Kenai Keys and Soldotna (Combellick et al. 1995, citing to unpublished data, National Weather Service, October 1995). This outburst flood had a total volume considerably less than previous events in 1985 and 1990; no damage was reported from the 1995 event. In January and February 2007, an ice jam flood occurred on the Kenai River, triggered by the release of the Skilak Glacier dammed lake (Kenai River Center 2007). The Kenai River at Skilak Lake rose about 3.8 feet, causing the ice cover to break up and form ice jams and localized flooding in the Soldotna area. The rapid increases in water level and moving ice caused significant property damage.

Signs of impending outburst releases are high lake water levels, abundant calving into the lake, and water present on northern margins of the glacier, including small marginal lakes (Combellick et al. 1995, citing to unpublished data, National Weather Service, October 1995).

The flooding in the Cook Inlet area may also be caused by heavy rainfall. For example, heavy flooding of the Kenai River in September 1995 resulted from interaction of tropical moisture and a deep low pressure center in the north Pacific Ocean; blockage of the eastward movement of this low by a high-pressure ridge in eastern Alaska and western Canada; saturated soil conditions; and greater than normal glacial melt due to preceding storms. Excess sediment deposition in channels due to rapid runoff decreased the carrying capacity of the streams. As a result, the lower Kenai River remained above flood stage for over 10 days. Crest water levels were 1.1 m above flood stage at Kenai Keys and 0.76 m above flood stage at Soldotna (Combellick et al. 1995, citing to unpublished data, National Weather Service, October 1995). An analysis of this flood indicates that it represents a 100-year event at Soldotna (USGS 1998).

In August 2006, days of heavy rain caused major flooding of the Little Susitna River, Willow Creek, Montana Creek, the Talkeetna River, and Moose Creek in the Matanuska-Susitna Borough. These rivers crested well above the flood stage, resulting in the evacuation of about 150 people, 46 borough roads and 6 major state roads flooded or damaged, 8 bridges damaged, closures and damage to the Parks Highway and Alaska Railroad, and over 150 homes flooded or damaged (MSB 2006).

The primary hazards to facilities from river flooding are high water levels, bank erosion, deposition at the river mouth, high bedload transport, and channel modification (Combellick et al. 1995).

Seasonal flooding of lowlands and river channels is extensive along major rivers that drain into Cook Inlet. Thus, measures must be taken prior to facility construction and field development to prevent losses and environmental damage. Pre-development planning should include hydrologic and hydraulic surveys of spring break-up activity as well as flood frequency analyses. Data should be collected on water levels, ice floe direction and thickness, discharge volume and velocity, and suspended and bedload sediment measurements for analysis. Also, historical flooding observations should be incorporated into a geologic hazard risk assessment. All inactive channels of a river must be analyzed for their potential for reflooding. Containment dikes and berms may be necessary to reduce the risk of flood waters that may undermine facility integrity.

6. Coastal Erosion

Coastal erosion and deposition is another potential threat to development located on or near the coastline. Frequent storms accompanied by strong winds result in strong wave action that erodes shorelines composed of unconsolidated sediments and weakly cemented Tertiary sedimentary rocks (Combellick et al. 1995, citing to Hayes and Michel 1982). The coastal bluffs around the inlet range from 20 to 200 feet in height, and are currently receding in response to natural processes such as wave action, precipitation, and wind (DO&G 1993, citing to KPB 1990). Development, such as roads and gravel excavation in the coastal areas, also has a destabilizing effect on the coastal bluffs and further contributes to erosion as well as subsidence and ground failure related to earthquakes.

L. Silliphant, DO&G

Bluffs along eastern shore of Cook Inlet, near Clam Gulch.

Erosion rates, sediment grain size and cohesiveness, riverbank stability, and nearshore bathymetry must all be considered in determining facility siting, design, construction, and operation. They must also be considered in determining the optimum oil and gas transportation mode. Structural failure can be avoided by proper facility setbacks from coasts and river banks. Mitigation Measure A1c (Chapter 9) prohibits the siting of permanent facilities, other than roads, docks, utility or pipeline corridors, or terminal facilities, within one-half mile of the banks of many major rivers, except where land use plans classify an area for development, or established usage and use history show development. Docks and road or pipeline crossings can be fortified with concrete armor, and the placing of retainer blocks and concrete-filled bags in areas subject to high erosion rates.

7. Shallow Gas Deposits

Shallow gas deposits have been encountered in the Cook Inlet area and pose risks similar to overpressured sediments. The Steelhead and Grayling platforms have experienced blowouts due to shallow gas. The same mechanisms for blow-out prevention and well control are employed to reduce the danger of loss of life or damage to the environment.

8. Mitigation Measures and Other Regulatory Protections

Several geologic hazards exist in the Cook Inlet area that could pose potential risks to oil and gas installations both onshore and offshore. As discussed above, these potential hazards include earthquakes, volcanoes, tsunamis, flooding, ice, current and sediments, and coastal erosion. Although the Cook Inlet area is seismically active, is in close proximity to several active volcanoes, and has extremely high tides, the onshore and offshore oil and gas industry has operated in the area for about 50 years without significant environmental damage.

The risks from earthquake damage can be minimized by siting onshore facilities away from potentially active faults and unstable areas, and by designing them to meet or exceed national standards and International Building Code seismic specifications specific for Alaska. National industry standards help assure the safe design, construction, operation, maintenance, and repair of pipelines and other oil and gas facilities. Sometimes referred to as "technical standards" they establish standard practices, methods, or procedures that have been evaluated, tested, and proven by analysis and/or application. These standards are intended to assure the safe design, construction, operation, maintenance, and repair of infrastructure. National consensus standards, such as the American Petroleum Institute (API), American Society of Mechanical Engineers (ASME), National Fire Protection Association (NFPA), and National Association of Corrosion Engineers (NACE), can carry the equivalent weight of law. In fact, many of them are codified by incorporation of all or parts of them into regulations by reference. They are constantly reviewed and upgraded by select committees of engineers and other technical experts (PHMSA 2008).

Design for offshore drilling and production platforms should consider all environmental events which influence the design of an arctic structure (API Recommended Practice 2N). Design conditions are those environmental conditions to which the structure is designed. Additional precautions should be taken to identify and accommodate site-specific conditions or events that can act on a structure such as unstable ground, flooding, and other localized hazards. Proper siting and engineering will minimize the detrimental effects of these natural processes (Combellick et al. 1995).

Safe design of offshore drilling and production platforms use design codes and recommended practices that assist the engineer by setting out procedures for achieving acceptable levels of safety. Recommended practices provide guidance for the design of arctic structures and pipelines considering the environment, sea ice, and permafrost. Once the design conditions have been established for each process, they become the basis for that system's design. The primary goal of codes is safety, which is accomplished by providing a minimum set of rules which must be incorporated into a sound engineering design concerning materials, fabrication, testing, and examination practices used in the construction of these systems. All of these are intended to achieve a set of engineering requirements deemed necessary for safe design and construction of these structures and their associated piping systems.

Although geologic hazards could damage oil and gas infrastructure, measures in this best interest finding, along with regulations imposed by state, federal, and local agencies, in addition to design and construction standards discussed above, are expected to avoid, minimize, or mitigate those hazards. Mitigation measures address siting of facilities, design and construction of pipelines, and oil discharge prevention and contingency plans. A complete listing of mitigation measures is found in Chapter 9.

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Chapter Four: Habitat, Fish, and Wildlife

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Chapter Four: Habitat, Fish, and Wildlife

AS 38.05.035(g) directs that best interest findings consider and discuss the fish and wildlife species and their habitats in the lease sale area. The Cook Inlet area includes a wide variety of habitats and a broad diversity of fish and wildlife species that support a host of economic, recreational, and subsistence activities for residents and visitors to the area. Most habitats and populations of fish and wildlife in the area are healthy because of careful management, conservative laws governing importation and introduction of exotic animals, regulatory mechanisms in place for development, and relatively recent population growth (ADF&G 2008a).

A. Major Habitats of the Cook Inlet Area

1. Terrestrial Habitats

Terrestrial vegetation in the Cook Inlet area is composed of several overlapping systems that provide important habitat for fish, wildlife, and humans. These habitats vary greatly depending on local conditions. The Cook Inlet lease sale area falls primarily within the marine west coast forests ecoregion (EPA level 1, ecoregion 7; EPA 2008). Habitats of this area range from forests to alpine tundra with vegetation including trees, shrubs, herbs, lichens, and mosses (EPA 2008).

a. Forest

Forests occurring in the Cook Inlet area are considered transition forests between the coastal temperate rain forests of Southeast Alaska, Kodiak, and Prince William Sound, and the boreal forests of interior Alaska (ADF&G 2006). The forests of the Cook Inlet area are divided into several forest habitat types, including coastal western hemlock-Sitka spruce forest, bottomland spruce-poplar forest, upland spruce-hardwood forest, and lowland spruce-hardwood forest (UAA-ISER 2008).


E. Schneider, Alaska Div. of Tourism

Forest habitat on the Kenai Peninsula.

Coastal western hemlock-Sitka spruce forests are composed of Sitka spruce, western hemlock, and mountain hemlock. Other tree species include cedar, poplar, and cottonwood (UAA-ISER 2008). Shrubs of this area include species such as alder, devil's club, salmonberry, willow, and blueberry.

Bottomland spruce-poplar forests are dense forests found at elevations lower than 1,000 ft, such as level floodplains, low river terraces, and some south-facing slopes (UAA-ISER 2008). These forests are composed primarily of white spruce, although poplar, cottonwood, Alaska paper birch, quaking aspen, and black spruce are also found in these forests. Some shrub species include alder, willow, raspberry, blueberry, and high bush cranberry, and plants such as fireweed, horsetail, and ferns are found there as well.

Dense upland spruce-hardwood forests are generally found at lower to mid-elevations on deeply thawed, south-facing slopes that are well drained (UAA-ISER 2008). These forests include a mixture of species such as white spruce, Alaska paper birch, quaking aspen, black cottonwood, and balsam poplar. Black spruce tends to be found in poorly drained areas; stands of white spruce, or stands of black cottonwood and balsam poplar, may be found along streams; and stands of all these species combined are found along well-drained, south-facing slopes. Shrubs characteristic of this forest type include willow, alder, rose, high bush cranberry, and currant.

Lowland spruce-hardwood forests range from dense to open, and include both evergreen and deciduous trees (UAA-ISER 2008). This type of forest is usually found on shallow peat, glacial deposits, outwash plains, and north-facing slopes. Tree species include black and white spruce, Alaska paper birch, quaking aspen, balsam poplar, and black cottonwood; shrubs include willow, dwarf arctic birch, lingonberry, blueberry, and crowberry.

b. High Brush

High brush habitats are found throughout the Cook Inlet area, including along streams, above timberline, in avalanche paths, on floodplains, in old forest burns, between beaches and forests, and between treeline and alpine tundra (UAA-ISER 2008). Trees such as quaking aspen, Alaska paper birch, and white spruce may be scattered thinly throughout the habitat. Shrubs composing this habitat include alder, devil's club, willow, currant, blueberry, raspberry, lingonberry, salmonberry, and dogwood. Other plant species include grasses, lupine, horsetail, fireweed, and several species of fern. Three subsystems of high brush habitats have been identified: coastal alder thickets, floodplain thickets, and birch-alder-willow thickets.

c. Tundra

Three types of tundra are found in Southcentral Alaska: moist tundra, wet tundra, and alpine tundra (UAA-ISER 2008). Moist and wet tundras are found mostly along the Denali Highway (outside the lease sale area) and along the eastern foothills of the Talkeenta Mountains (on the edge of the lease sale area). Alpine tundra usually occurs above forests and brush habitats at elevations above 2,500 ft. Shrubs of this habitat include resin and dwarf arctic birch, arctic willow, crowberry, labrador tea, mountain heather, rhododendron, and dwarf and alpine blueberry. Other grass and herb species include mountain avens, moss campion, arctic sandwort, alpine azalea, sedges, and lichens.

d. Wetlands

Karen Laubenstein, USFWS

Potter Marsh near Anchorage.

Wetlands are transitional zones between aquatic and terrestrial habitats that are characterized by poor soil drainage, and are primarily of four types in Alaska: bogs, grass wetlands, sedge wetlands, and marshes (ADF&G 2006). The water contained in bogs comes primarily from rainfall rather than from runoff, streams, or groundwater. Bogs are characterized by nearly complete plant cover, including up to 100 percent moss (ADF&G 2006). Grass wetlands are found throughout the Cook Inlet area. Over 50 percent of the plant species are water-tolerant grasses (ADF&G 2006). This habitat is important for recharging ground water, and for maintaining baseflows for aquatic resources downstream by storing storm and floodwaters. Sedge wetlands are found in many areas of Southcentral, such as very wet areas of floodplains, slow-flowing margins of ponds, lakes, streams, and sloughs, and in depressions of upland areas (ADF&G 2006). Salt marshes are intertidal wetlands composed of salt-tolerant plants, usually located at river mouths; behind barrier islands, coves, and spits; and on tide flats (ADF&G 2006).

Other similar habitats include low brush bogs and muskeg, habitats characteristic of wet, flat basins with ponds and standing water where trees cannot grow (UAA-ISER 2008). Dwarf shrubs are prolific, growing over a mat of sedges, mosses, and lichens. The coastal muskeg form of this habitat, which tends to be drier, includes western hemlock and Alaska cedar, while the interior bog form does not usually include trees because of the wetter conditions. Other tree species include black spruce, and shrubs include Labrador tea, bog cranberry, willow, crowberry, blueberry, dwarf arctic birch, and bog rosemary. Cottongrass, sedges, rushes, lichens, and mosses are also found in this habitat.


M. LaCroiix, ADF&G

Wetlands of O'Brien Creek, Matanuska-Susitna Valley.

The U.S. Army Corps of Engineers has developed criteria for defining wetlands. Those criteria do not constitute a classification system but only provide a basis for determining whether a given area is a wetland for purposes of Section 404, without attempting to classify it by wetland type. The U.S. Army Corps of Engineers defines wetlands as (Environmental Laboratory 1987):

> a. **Definition**. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
>
> b. **Diagnostic environmental characteristics**. Wetlands have the following general diagnostic environmental characteristics:
>
> > (1) ***Vegetation***. The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in “a” above. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions[1]. Indicators of vegetation associated with wetlands are listed [elsewhere in Environmental Laboratory 1987].
> >
> > (2) ***Soil***. Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. Indicators of soils developed under reducing conditions are listed [elsewhere in Environmental Laboratory 1987].
> >
> > (3) ***Hydrology***. The area is inundated either permanently or periodically at mean water depths ≤6.6 ft, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation[2]. Indicators of hydrologic conditions that occur in wetlands are listed [elsewhere in Environmental Laboratory 1987].
>
> c. **Technical approach for the identification and delineation of wetlands**. Except in certain situations defined in [Environmental Laboratory 1987], evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination.

Delineation of wetlands is further refined for Alaska in USACOE (2007), addressing regional wetland characteristics and differences such as climate, geology, soils, hydrology, plant and animal communities, and other factors important to the identification and functioning of wetlands.

---

[1] Species (e.g., *Acer rubrum*) having broad ecological tolerances occur in both wetlands and non-wetlands.

[2] The period of inundation or soil saturation varies according to the hydrologic/soil moisture regime and occurs in both tidal and nontidal situations.

2. Freshwater Habitats

The streams, rivers, and lakes of Southcentral Alaska provide a wide variety of freshwater habitats for fish and wildlife of the area. They serve as migratory corridors, provide habitat for spawning, rearing and overwintering, vegetative cover, are a significant source of detritus, and are frequently migrations corridors for wildlife (ADF&G 2006). Freshwater habitats range from small, intermittent streams to large rivers, and from ponds to large lakes. Water sources for these habitats include glacial melt, snowmelt, precipitation, and groundwater such as springs and upwelling areas. Lake and pond habitats are influenced by substrate, bathymetry, and shoreline contour (ADF&G 2006).

The type of habitat provided by streams and rivers is defined by the substrate, which includes large boulders, cobble, gravel, glacial silt, clay, and mud. Stream and river morphology also contributes to defining the habitat, including such characteristics as straight, meandering, or braided; and morphologic complexity is an important contributor to habitat quantity and quality (ADF&G 2006). Large woody debris in rivers and streams is important for stabilizing banks and substrates, provides cover, creates pool habitats, and increases stream productivity (ADF&G 2006).

Many of the freshwaters of Southcentral Alaska provide important spawning, rearing, or migration habitats for anadromous fishes such as salmon, trout, and char. Waters that have been identified as important for anadromous species (Table 4.1) receive special protection under AS 16.05.871. The Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes, the official listing of these waters, is updated annually (Johnson and Daigneault 2008).

3. Marine Habitats

Marine waters of Cook Inlet provide a wide variety of habitats for fish, wildlife and other aquatic organisms. Habitat types include rocky intertidal areas, mudflats and beaches, eelgrass beds, and nearshore, and benthic environments (ADF&G 2006).

E. Schneider, Alaska Div. of Tourism

Turnagain Arm.

Rocky intertidal areas are exposed to moderate to strong wave actions, and provide a rocky substrate for communities of invertebrates algae, rockweed, mussels, and barnacles. Cracks, crevices, overhangs, and rock bottoms provide microhabitats. Macroalgal species are prolific, especially during the spring and summer (ADF&G 2006). Mudflats and beaches are characterized by five habitat types: fine-grained sand, coarse-grained sand, mixed sand and gravel, exposed tidal flats, and sheltered tidal flats (ADF&G 2006). Each type supports specific communities of marine plants, fish, birds, and other animals. Eelgrass beds are found in low intertidal and shallow subtidal sandy mudflats. They provide substrate and cover for a wide diversity of marine life. Eelgrass beds are affected by season, with the blades dying off in the fall. The roots and rhizomes, which are dormant during the winter, stabilize the soft substrate, and provide a buffer from tides and storms (ADF&G 2006).

The National Marine Fisheries Service has defined areas of Essential Fish Habitat (EFH) for federally managed fish species in Alaska as required by 1996 revisions to the Magnuson-Stevens Act. EFH is defined as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Federal agencies must consult with NMFS regarding any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect EFH. Text descriptions and maps are available that identify EFHs for each life stage of fish under federal management (NMFS 2008c; NMFS 2008d).

Table 4.1. Catalogued anadromous streams within the Cook Inlet Areawide lease sale area.

Stream Number	Name	Stream Number	Name
241-14-10660	Fox Creek (upper and Caribou Lake)	247-41-10200	Susitna River
244-10-10010	Anchor River (and tributaries)	247-41-10200-2015	Alexander Creek
244-10-10050	Stariski Creek	247-41-10200-2020	Fish Creek
244-20-10090	Ninilchik River	247-41-10200-2030	unnamed
244-20-10100	Deep Creek (and tributaries)	247-41-10200-2043	Anderson Creek
244-30-10010	Kenai River (and lower tributaries)	247-41-10200-2050	unnamed
244-30-10010-2025	Beaver Creek	247-41-10200-2053	Yentna River
244-30-10010-2030	Slikok Creek	247-41-10200-2060	unnamed
244-30-10010-2039	Soldotna Creek	247-41-10200-2081	Deshka River/Kroto Creek
244-30-10010-2050	Funny River	247-41-10200-2120	Willow Creek
244-30-10010-2063	Moose River	247-41-10200-2130	Little Willow Creek
244-30-10010-2076	Killey River	247-41-10200-2180	Kashwitna River
244-30-10010-2082	Upper Killey River	247-41-10200-2190	Caswell Creek
244-30-10050	Kasilof River (and tributaries)	247-41-10200-2200	Sheep Creek
245-20-10170	Johnson River	247-41-10200-2230	Goose Creek
245-30-10010	Crescent River	247-41-10200-2250	Montana Creek
245-40-10010	Harriet Creek	247-41-10210	unnamed
245-40-10020	Redoubt Creek	247-50-10046	Fish Creek
245-40-10030	unnamed	247-50-10050	Chester Creek
245-40-10040	unnamed	247-50-10060	Ship Creek
245-40-10050	Polly Creek	247-50-10090	Sixmile Creek
245-40-10050-2002	Little Polly Creek	247-50-10095	unnamed
245-40-10065	unnamed	247-50-10110	Eagle River
245-50-10010	Kustatan River	247-50-10150	Fire Creek
245-50-10020	Bachatna Creek/Johnson Slough	247-50-10160	Peters Creek
245-50-10040	unnamed	247-50-10175	Eklutna River
245-50-10050	Big River (and tributaries)	247-50-10180	unnamed
245-50-10060	Seal River	247-50-10200	Knik River
245-50-10070	Montana Bill Creek	247-50-10220	Matanuska River (and tributaries)
245-50-10085	Drift River	247-50-10260	Rabbit Slough (and tributaries)
245-50-10090	Cannery Creek/Rust Slough	247-50-10270	Wasilla Creek
245-50-10110	Little Jack Slough	247-50-10300	Cottonwood Creek
245-50-10120	unnamed	247-50-10305	Crocker Creek
245-50-10140	unnamed	247-50-10320	O'Brien Creek
246-10-10010	unnamed (Kalgin Is.)	247-50-10330	Fish Creek
246-10-10020	Packers Creek (Kalgin Is.)	247-50-10360	Goose Creek
246-10-10030	unnamed (Kalgin Is.)	247-50-10500	Mule Creek
247-10-10070	Middle River (and tributaries)	247-60-10090	Bedlam Creek
247-10-10080	McArthur River (and tributaries)	247-60-10100	Pincher Creek
247-10-10200	Nikolai Creek	247-60-10110	Chickaloon River
247-20-10002	Three-mile Creek (and tributaries)	247-60-10120	Big Indian Creek
247-20-10008	unnamed	247-60-10130	Little Indian Creek
247-20-10010	Chuitna River (and tributaries)	247-60-10310	Potter Creek
247-20-10020	Indian Creek	247-60-10316	unnamed
247-20-10030	unnamed	247-60-10318	Little Rabbit Creek
247-20-10040	Tyonek Creek	247-60-10320	Rabbit Creek
247-20-10050	Old Tyonek Creek (and tributaries)	247-60-10320-2012	Little Survival Creek
247-30-10010	Ivan River	247-60-10340	Campbell Creek

-Continued-

Table 4.1. Page 2 of 2.

247-30-10070	Lewis River	247-80-10005	Miller Creek
247-30-10080	Theodore River	247-80-10010	Seven Egg Creek
247-30-10090	Beluga River	247-80-10015	Otter Creek
247-30-10120	unnamed	247-80-10018	unnamed
247-41-10080	unnamed	247-90-10020	Swanson River
247-41-10100	Little Susitna River	247-90-10030	Bishop Creek (and tributaries)
247-41-10180	unnamed		

Source: Johnson and Daigneault 2008.

Nearshore and benthic marine habitats are highly affected by the seasons, including extreme variations in light and ice cover, as well as temperature. Phytoplankton, with tens of thousands of species, is the main factor in productivity in these habitats, and because of seasonal light conditions, ideal growing conditions for any given species may be only a few weeks (ADF&G 2006). Upwelling and wind mixing of nutrients may also be an important factor in the abundance and distribution of phytoplankton. Nearshore habitats tend to have variable salinity, temperature, suspended sediment concentrations, and ice scouring, as well as high wave energy (ADF&G 2006). Seasonal cycles of mixing and turnover are affected by winds, freshwater input, ice currents, and tides. Factors such as salinity and turbidity are also important. Benthic, or seafloor, habitats can be soft-bottom, composed of mud, sand, shell, or gravel, or they can be rocky; the composition determines the type of community that develops there (ADF&G 2006).

J. Palardy, Kachemak Bay Research Reserve

Bull kelp, Kachemak Bay.

Kelp forests in nearshore habitats are important for providing structure, living substrate, cover, microhabitats, and primary production (ADF&G 2006). Bull kelp is the predominant kelp species in the Cook Inlet area, and is also one of the largest fastest-growing marine algae, attaining lengths of 40 m during the growing season (Schoch 2001). Kelp beds are characterized by tight trophic relationships, including rockfish, sea urchins, octopuses, sea otters, diving seabirds, herbivorous snails, diatoms, and understory algae. A complex array of physical, chemical, and biological factors affect dynamics of kelp beds and their annual fluctuations. These include water motion, temperature, salinity, nutrients, light intensity, available habitat, and invertebrate predation (Schoch 2001). In Kachemak Bay, located outside the Cook Inlet lease sale area, a total of 30.6 km^2 of kelp canopy was measured; an additional 17 km^2 were measured from Anchor Point to point Pogibshi (Schoch 2001).

4. Designated Habitat Areas

The area encompassed by the Cook Inlet lease sale includes many areas established by state or federal law to protect and preserve natural habitat and wildlife populations and to maintain public use of these resources (Figure 4.1). The lease sale area includes all or portions of several legislatively designated special areas, and is adjacent to or near others. About 1 million acres are included in these legislatively designated areas, many of which have legislatively defined restrictions. Additional restrictions to oil and gas exploration, development, and production activities in designated habitat areas are included in mitigation measures in Chapter 9.

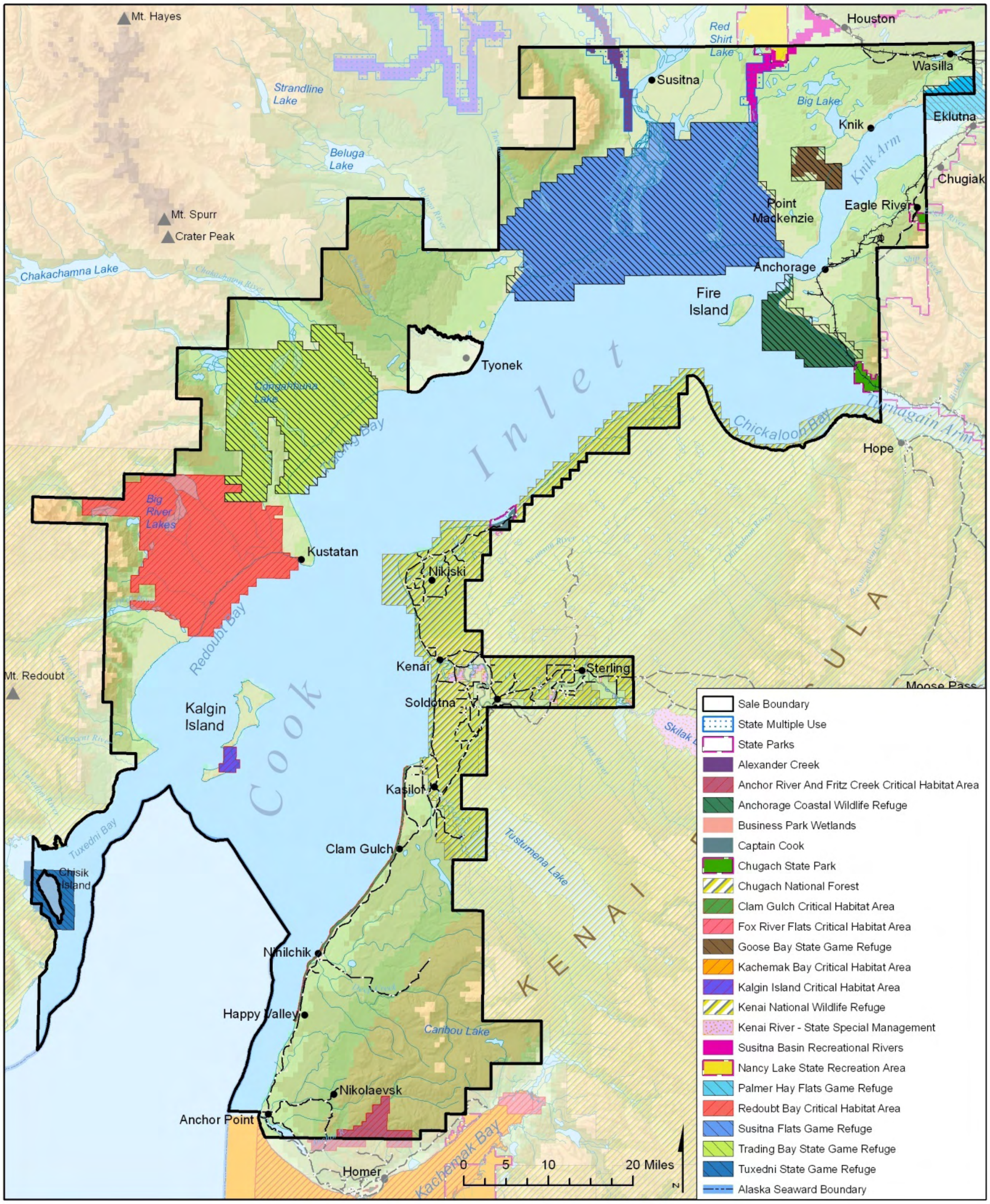


Figure 4.1. Legislatively designated areas in or near the Cook Inlet lease sale area.

a. State-Designated Areas

i. Susitna Basin Recreational Rivers

The Recreation Rivers Act of 1988 established mile-wide river corridors along the Little Susitna, Deshka, Talkeetna, and Talchulitna rivers and Lake, Moose, Kroto, and Alexander creeks, totaling about 243,000 acres of state-owned land along 460 river miles (ADNR 1991). The Act specifies that these rivers remain in public ownership, identifies purposes and management intent of the designation, and provides a management plan and advisory board that guide access, commercial uses, and development within the recreational rivers area.

One of the main purposes of the plan is "to manage, protect, and maintain fish and wildlife populations and habitat on a sustained yield basis. Areas that are important for fish and wildlife are identified and specific guidelines are designed to protect these important areas. The plan sets guidelines for reducing bear conflicts, protecting eagle and swan nesting sites, and enhancing habitat" (ADNR 1991). The plan includes riparian management areas, including guidelines to mitigate potential negative effects from overuse and development. To limit degradation of the water, recreational experience, and fish and wildlife habitats, the plan also includes guidelines for shoreline development, such as erosion control, diversion channels, docks, bridges, culverts, river crossings; and guidelines for upland development such as powerlines, pipelines, and airstrips. Motorized boat access is limited on some portions of some rivers to provide for a range of recreational experiences, especially during the summer fishing season.

ii. Nancy Lake State Recreation Area

Nancy Lake State Recreation Area was established in 1966 and includes 22,600 acres of prime recreational habitat. This recreation area is dotted with lakes and supports fishing, wildlife viewing, canoeing, and camping in summer, and skiing and snow machining in winter. There are some private land inholdings, and cabins on several lakes. Some residents live year-round on Nancy Lake. The northern boundary of the lease sale area overlaps the southern tip (1,720 acres) of the recreation area at Skeetna Lake.

iii. Susitna Flats State Game Refuge

The Susitna Flats State Game Refuge was created in 1976 to "ensure the protection of fish and wildlife populations, particularly waterfowl nesting, feeding, and migration; moose calving areas; spring and fall bear feeding areas; and salmon spawning and rearing habitats. It was also established for public use of fish and wildlife and their habitat, particularly waterfowl, moose, and bear hunting; viewing; photography; and general public recreation in a high quality environment" (ADF&G 1988). The refuge covers about 300,800 acres.

D. Rosenberg, ADF&G

Susitna Flats State Game Refuge.

The refuge is particularly important for waterfowl nesting, feeding and migration. Large numbers of mallards, pintails, Canada geese, and Tule geese are found on the refuge by mid-April, and in May, as many as 100,000 waterfowl are present feeding, resting, conducting courtship, and preparing for nesting (ADF&G 2008f). The refuge also supports several thousand sandhill cranes and more than 8,000 swans. An abundance of shorebirds uses the refuge, including northern phalaropes, dowitchers, godwits, whimbrels, snipe, yellowlegs, sandpipers, plovers, and dunlin. About 10,000 mallards, pintails, and green-winged teal ducks, as well as Tule geese, nest in the ponds and meadows. In the fall, the refuge's sedge meadows, marshes, and intertidal mud flats are used heavily by migrating waterfowl and shorebirds for resting and feeding (ADF&G 2008f).

The refuge also provides habitat for calving moose, feeding bears, and spawning salmon. In the spring, the area is used by moose for calving; in the winter, moose move into the refuge to find food and respite from deep snow at higher elevations. Brown and black bears, beaver, mink, otter, muskrat, coyote, and wolf are also found on the refuge. Beluga whales congregate near the mouth of the Susitna River to calve, breed, and feed on hooligan in late May and June (ADF&G 2008f).

iv. Palmer Hay Flats State Game Refuge

Located at the head of Knik Arm in the Matanuska-Susitna Valley and just 30 miles north of Anchorage, the Palmer Hay Flats State Game Refuge was established by the legislature in 1975 and expanded in 1985 for the purpose of protecting and preserving the natural habitat and game populations (ADF&G 2002a). About 17 percent of the refuge's 28,000 acres are included in the lease sale area north of Palmer Slough. Habitat of this refuge includes marsh and bog communities, forests, lakes, wetlands, and tidal sloughs and flats (ADF&G 2008f). The refuge is an important resting area for tens of thousands of migrating ducks in the spring in late April through May, and in the fall. Species include dabbling ducks such as pintails, mallards, green-winged teal, and diving ducks such as canvasback, lesser scaup, and common goldeneye. Some ducks remain to nest during the summer. Other species that use the refuge include lesser Canada geese, greater white-fronted geese, snow geese, trumpeter and tundra swans, and sandhill cranes (ADF&G 2008f).

The refuge provides important habitat for moose calving and wintering. Muskrats are also abundant because of the feeding and denning habitat supplied by plentiful sloughs and marshes (ADF&G 2008f). Sockeye, Chinook, coho and pink salmon spawn and rear in the creeks and rivers of the refuge, along with rainbow trout, Dolly Varden and whitefish (ADF&G 2002a).

v. Goose Bay State Game Refuge

In 1975, the legislature established this game refuge which encompasses 11,000 acres of tidelands and salt marsh habitat important to waterfowl and fish. Located across from Eagle River Flats on Knik Arm, the refuge is surrounded by residential development. From mid-April to mid-May, this refuge is an important resting and feeding area for migrating waterfowl. Over 20,000 geese, including Canada, snow, and white-fronted geese, rest and feed here during their northward migration (ADF&G 2008f). Other species such as trumpeter and tundra swans, mallards, green-winged teal, pintails, northern shovelers, snipe, yellowlegs, and sandhill cranes also use the area. Canada geese stop to rest in the refuge's wetlands in the fall during their return migration. The refuge provides important habitat for moose calving. Beavers, muskrat, mink, black and brown bears, coyote, red fox, and lynx are found in the refuge also (ADF&G 2008f). Coho salmon, rainbow trout, long-nosed sucker, and stickleback inhabit Goose Creek.

vi. Anchorage Coastal Wildlife Refuge

The Anchorage Coastal Wildlife Refuge, established in 1988, encompasses over 32,400 acres along Turnagain Arm from Potter Creek to Point Woronzof. The purpose of the refuge is "to protect waterfowl, shorebirds, salmon, and other fish and wildlife species and their habitat, and for the use and enjoyment of the people of the state" (ADF&G 1991).

Habitat of the refuge consists of extensive tidal flats, marshes, and alder-bog forests (ADF&G 2008f). Ducks, geese, and shorebirds are the most visible species on the refuge. Species include lesser Canada geese, mallards, northern pintails, northern shovelers, American wigeons, canvasbacks, red-necked grebes, horned grebes, yellowlegs, northern phalaropes, Arctic terns, mew gulls, trumpeter and tundra swans, snow geese, short-eared owls, Pacific loons, northern harriers, and bald eagles. Several species of anadromous and freshwater fish are found in the refuge (ADF&G

2008f). Moose are encountered frequently, and lynx, river otter, red fox, and black and brown bears infrequently. Other mammals inhabiting the area include least weasels, mink, snowshoe hare, red squirrels, voles, and shrews.

vii. Trading Bay State Game Refuge

The Trading Bay State Game Refuge, encompassing 160,960 acres, is located along the northwest shore of Cook Inlet. It was created in 1976 “to protect fish and wildlife populations; waterfowl nesting, feeding, and migration; moose calving areas; spring and fall bear feeding areas; salmon spawning and rearing habitats; public use of fish and wildlife (waterfowl, moose, and bear hunting); viewing; photography; and general recreation in a high quality environment” (ADF&G 1994b).

The refuge’s low-relief coastal wetlands and tide flats provide habitat for many migrating bird species, including lesser, cackling, and Taverner's Canada geese, lesser snow geese, Pacific white-fronted geese, Tule white-fronted geese, trumpeter and tundra swans, and Pacific brant (ADF&G 2008f). High concentrations of trumpeter swans nest along the Kustatan River. Other nesting birds include ducks such as mallard, pintail, green-winged teal, wigeon, shoveler, common eider, mergansers, scoters, scaup, and goldeneye; and loons, shorebirds, Tule geese and bald eagles also nest on the refuge (ADF&G 2008f). The refuge is also used in the fall by waterfowl as they prepare to migrate southward.

The refuge provides important habitat for moose calving, as well as wintering habitat. Brown and black bears, coyote, mink, land otter, weasels, and wolves also inhabit the refuge. Coho, Chinook, sockeye, rainbow trout, Dolly Varden and smelt are found in the rivers and creeks of the refuge (ADF&G 2008f).

viii. Redoubt Bay Critical Habitat Area

The Redoubt Bay Critical Habitat Area was created in 1989. It lies on the west side of Cook Inlet immediately to the south of the Trading Bay State Game Refuge and covers 171,500 acres. The purpose of the designation is “to ensure the protection and enhancement of fish and wildlife habitat and populations, especially Tule geese; the continuation of fish and wildlife harvest; and public use and enjoyment of the area in a high quality environment (ADF&G 1994b).

D. Rosenberg, ADF&G

Redoubt Bay Critical Habitat Area.

The Redoubt Bay area provides critical habitat for hundreds of thousands of migrating waterfowl in the spring and fall, supporting the world’s largest concentration of Tule white-fronted geese (ADF&G 2008f). Other birds that use the area during migrations include cackling Canada geese, Taverner's Canada geese, lesser Canada geese, snow geese, and tundra and trumpeter swans. During the summer, tens of thousands of breeding ducks also use the area; species include pintail, mallard, green-winged teal, wigeon, shoveler, scaup, canvasback, and common eider. Other species found in the Redoubt Bay area include yellowlegs, snipe, godwits, whimbrels, several species of sandpipers, plovers, dunlin, phalaropes, sandhill cranes, bald eagles, ravens, gulls, and passerines (ADF&G 2008f).

Moose use the Redoubt Bay wetlands for winter habitat. Other mammals inhabiting the area include black bears, coyote, fox wolf, mink, river otter, marten, muskrat, wolverine, weasel, lynx, and beaver (ADF&G 2008f). Beluga whales can be found feeding at the river mouths, and harbor seals haul out at stream mouths. All five species of Pacific salmon spawn and rear in the rivers and lakes of

Redoubt Bay, and rainbow trout and Dolly Varden also inhabit the streams, rivers and lakes (ADF&G 2008f).

ix. Kalgin Island Critical Habitat Area

Located 20 miles southwest of Kenai on Kalgin Island in lower Cook Inlet, Kalgin Island Critical Habitat Area was established in 1972. It is a small expanse of wetlands encompassing about 3,520 acres surrounding Swamp Creek. This area provides habitat in the spring and fall for migrating swans, geese, ducks, and shorebirds and is an important alternative habitat for nearby Redoubt Bay wetlands (ADF&G 2008f). Other birds found in the Kalgin Island Critical Habitat Area include greater yellowlegs, common snipe, northern harriers, bald eagles, and Arctic terns. Kalgin Island provides haul out habitat for harbor seals, and other small mammals inhabit the island as well, including river otter, beaver, red-backed and tundra voles, and red squirrels. Moose and fox were introduced to the island. The mouth of Swamp Creek provides an estuarine staging area for coho salmon (ADF&G 2008f).

x. Clam Gulch Critical Habitat Area

Clam Gulch Critical Habitat Area was created in 1976 and includes 3,820 acres of tide and submerged lands from Cape Kasilof south to Happy Valley. The purpose of this area is "to ensure the public continues to have the opportunity to enjoy its prolific razor clam beds" by providing a healthy, unpolluted beach (ADF&G 2008f). Birds found in the area include migrating Canada geese, snow geese, sandhill cranes, mallards, pintails, green-winged teal, goldeneyes, mergansers, buffleheads, and white-fronted goose; shorebirds inhabit the area, as well as eiders, oldsquaws, scoters, loons, Arctic terns, glaucous-winged, mew gulls, and bald eagles. All five species of salmon occur in nearshore waters during summer (ADF&G 2008f).

xi. Anchor River and Fritz Creek Critical Habitat Area

The Anchor River and Fritz Creek Critical Habitat Area was established in 1985, and encompasses 19,000 acres of Anchor River and Fritz Creek drainages, located on the southern Kenai Peninsula north of Homer. This area was established for the purpose of "protecting natural habitat critical to the perpetuation of fish and wildlife, especially moose" (ADF&G 1989). Portions of two of the most important moose ranges on the southern Kenai Peninsula are included in this area, providing one of the only major overwintering areas for moose (ADF&G 2008f). Habitat of the Anchor River/Fritz Creek area includes river bottoms, muskegs, upland spruce forests, and subalpine meadows. The riparian habitat of the area provides willow browse for moose during the winter, as well as good cover and moderate snow levels. The area also provides habitat for spring calving. Other mammals found in the area include brown and black bear, beaver, river otter, coyote, and wolf (ADF&G 2008f).

J. Giefer, ADF&G

Anchor River Critical Habitat Area.

The Anchor River/Fritz Creek area provides important habitat for birds such as willow ptarmigan, goshawks, snowy owls, sandhill cranes, trumpeter swans, snipe, yellowlegs, long-billed dowitchers, bald eagles, spruce grouse, chickadees, thrushes, sparrows, kinglets, grosbeaks, redpolls, crossbills, and woodpeckers (ADF&G 2008f). Chinook, coho, and pink salmon spawn and rear in the Anchor River, and steelhead and rainbow trout and Dolly Varden inhabit both the Anchor River and Fritz Creek.

b. Other Designated Areas Near the Lease Sale Area

i. Matanuska Valley Moose Range

This state moose range lies to the east of the lease sale area in the southern foothills of the Talkeetna mountains, north of the Matanuska River. Established in 1984, the 132,500 acre range provides a wide variety of important habitats, including river floodplains; riparian areas; deciduous, coniferous, and mixed forests and woodlands; shrublands; grasslands; forb communities; muskegs; rivers; streams; lakes; wetlands; and a variety of tundra plan communities (ADNR and ADF&G 1986). The area provides critical habitat for moose particularly, but also many other mammals, birds and fish.

ii. Chugach State Park

Chugach State Park, created in 1970, lies adjacent to the eastern boundary of the lease sale area in the Chugach Mountains near Anchorage. The park's 495,000 acres of wilderness provide important habitat for moose, sheep, mountain goat, brown and black bear, wolves, porcupines, and other furbearers and riparian animals (ADNR 1980).

iii. Kenai National Wildlife Refuge

Originally established in 1941 as the Kenai National Moose Range, this area was expanded from 1.73 million acres to 1.92 million acres through the Alaska National Interest Lands Conservation Act in 1980, and renamed the Kenai National Wildlife Refuge (USFWS 2008c). The refuge, which lies east of the lease sale area throughout the Kenai Peninsula, consists of relatively undisturbed wilderness and supports habitat for Kenai wildlife, including caribou, moose, brown and black bear, mountain goat, Dall sheep, wolves, lynx, wolverines, bald eagles, trumpeter swans, and thousands of shorebirds and waterfowl (USFWS 2008b). The headwaters of several important salmon streams are located in the refuge, including the Kenai, Russian, Kasilof, Anchor and Fox rivers.

iv. Kachemak Bay and Fox River Flats Critical Habitat Areas

The Kachemak Bay Critical Habitat Area was established in 1974 and includes approximately 222,000 acres of tide and submerged lands; Fox River Flats was established in 1972 and covers 7,100 acres of wetlands and tide flats at the head of Kachemak Bay (ADF&G 1993). These two areas are components of the International Reserve of the Western Hemisphere Shorebird Reserve and the Kachemak Bay National Estuarine Research Reserve (ADF&G 2008f). Both lie outside the lease sale area. They were designated critical habitat areas because of their diverse and productive habitats that support a wide variety of fish, shellfish, waterfowl, shorebird, seabirds, and marine mammals.

v. Tuxedni Refuge

Tuxedni Refuge, part of the Alaska Maritime National Wildlife Refuge, encompasses 5,566 acres and includes Chisik, Egg, and Duck islands (USFWS 2008a, d). The southern extension of the lease sale area surrounds Chisik Island in Tuxedni Bay. This marine region provides important habitat for shorebirds, marine birds, seals, sea otter, Steller sea lion, and beluga and killer whales.

B. Fish and Wildlife Populations

The Cook Inlet area is home to a wide diversity of fish and wildlife species representing a broad spectrum of life histories and habitat requirements. Abundance of these various populations depends on many factors, including ecological parameters such as food and predator abundance, reproductive success and survival, habitat availability, and ocean dynamics, as well as on human factors such as harvest rates. A few species, such as salmon and some large game species, have been studied extensively, but lack of essential information such as distribution, abundance, and habitat requirements has been identified as an issue for many other species, especially those that are not targeted by fisheries or sport hunting (ADF&G 2006).

Most populations of fish and game in Alaska are healthy but a few have been identified as threatened or endangered under the federal Endangered Species Act or as species of special concern by ADF&G (Table 4.2).

Table 4.2. Wildlife populations of Cook Inlet identified as threatened or endangered under the federal Endangered Species Act, or as species of special concern by ADF&G.

Species	Status
Fin whale	Endangered
Steller sea lion (western stock)	Endangered, ASSC
Beluga whale (Cook Inlet stock)	Endangered, ASSC
Humpback whale	Endangered
Steller's eider (Alaska breeding population)	Threatened, ASSC
Olive-sided flycatcher	ASSC[a]
Gray-cheeked thrush	ASSC[a]
Townsend's warbler	ASSC[a]
Blackpoll warbler	ASSC[a]
Brown bear (Kenai Peninsula population)	ASSC[a]
Harbor seal	ASSC[a]
Sea otter	ASSC[a]

[a] ASSC = Alaska species of special concern.

1. Fish and Shellfish

The waters of the Cook Inlet area abound with a wide variety of fresh and saltwater fishes. Species that have important recreational, commercial, or subsistence value are described below.

a. Freshwater Species

Rainbow and steelhead trout (*O. mykiss*) are actually the same species, and they are in the same genus as Pacific salmon. Steelhead trout migrate to the ocean; rainbow trout remain in freshwater for their entire life, either in streams or lakes. Rainbow trout spawn in the spring, and many spawn yearly, up to five times (Morrow 1980). The migratory patterns of rainbow trout vary and appear to be related to whether the population is stream or lake resident. Stream resident rainbow trout tend to remain in the same generally short sections of stream, while lake resident populations migrate to streams to spawn in the spring and then return to the lake within a few weeks (Morrow 1980).

Rainbow trout.

After hatching, steelhead spend one to four years, but usually about two, in freshwater before migrating to the ocean where they are found throughout the North Pacific (Morrow 1980). The length of time they remain in marine waters ranges from a few months to as much as four years, after which they return to their home streams to spawn.

Dolly Varden (*Salvelinus malma*) are found in many rivers and streams throughout the Cook Inlet area. They are closely related to **Arctic char** (*S. alpinus*), and in fact, distinguishing the two species requires counting gill rakers and pyloric caeca (Morrow 1980). Although Dolly Varden generally spawn in the fall, their life history is notoriously variable. For example, Dolly Varden populations can be sea-run (spending time in freshwater and nearshore marine waters) or resident (spending their entire life in freshwater), and within the same population some individuals may be sea-run while others are resident. Among freshwater residents, there are lake, stream, and dwarf forms (ADF&G 1994a). Many sea-run Dolly Varden populations in the Cook Inlet area have a life history pattern as follows: in the fall, 600-6,000 eggs are laid in redds (ADF&G 1994a), or nests, in streams and covered with gravel; they hatch in the spring and rear in the stream for 2-5 years before migrating to the ocean for the first time (Armstrong 1996).

Dolly Varden.

After their first migration to the ocean, Dolly Varden may spend the remainder of their lives overwintering in lakes and migrating between the ocean and fresh water (ADF&G 1994a). Dolly Varden that are hatched and reared in a lake system migrate to the ocean to feed and return annually to a lake or river to overwinter. Dolly Varden that hatch in non-lake systems seek out a lake for overwintering. They search for a lake randomly, migrating from system to system until they find a system with a lake. After overwintering in the lake, Dolly Varden may also migrate annually to sea in the spring, and may search for food in other stream systems. When Dolly Varden reach sexual maturity, usually between age 5-9 (or younger for stream resident populations), they migrate directly from their overwintering areas to their home stream to spawn (ADF&G 1994a; Armstrong 1996). All forms of Dolly Varden may spawn more than once, although there is generally a high mortality rate after spawning (ADF&G 1994a). Their life span can be up to 18 years, but usually it is less than 10 years (Armstrong 1996). In freshwater, Dolly Varden eat unburied salmon eggs and young, insects and crustaceans (Armstrong 1996). While in the ocean, their diet includes a wide variety of small fishes and invertebrates (Morrow 1980).

A few populations of Dolly Varden in the Cook Inlet area have been studied. A long-term study was conducted by ADF&G on Dolly Varden of the Anchor River (Larson 1997). From 1987-1990, Dolly Varden were counted as they migrated upstream through a weir on the Anchor River. Counts ranged from about 8,000-18,000 Dolly Varden, with the migration peaking in mid- to late July. Most fish were age 4, 5 or 6 although there were a few fish over age 10. Dolly Varden spawning in the Anchor River probably spend the winter there, then migrate to the ocean the next spring. Subadults probably also leave the river in the spring, spend the summer feeding in Cook Inlet, and then migrate back to freshwater for the winter, perhaps to systems other than the Anchor River such as English Bay Lakes, Packers Lake, the Kenai River, the Kasilof River, and others. When these fish reach sexual maturity, they migrate back to the Anchor River to spawn. The study found that mature Dolly Varden that had already spawned in another system that year also migrated into the Anchor River in the fall, probably to overwinter; these fish were likely from other nearby streams such as Sariski Creek. At any given time, Dolly Varden in the Anchor River are likely composed of a variety of stocks, ages, and maturities (Larson 1997).

Burbot.

Burbot (*Lota lota*) are found in deep rivers and lakes throughout the Cook Inlet area. They spawn in moderately shallow waters of rivers or lakes under the ice in the winter, February through March (Armstrong 1996). Burbot do not build nests for their eggs, but are broadcast spawners averaging about 1 million eggs per female (Sisinyak 2005; Armstrong 1996). Eggs settle to the bottom and hatch in about 30 days (Morrow 1980). Young burbot feed on invertebrates;

as they grow, their diet also includes fish such as slimy sculpin, lampreys, and young salmon; by age 5 their diet is primarily fish (Armstrong 1996). Burbot become sexually mature at about age 6 or 7 (Armstrong 1996), and can spawn multiple times. They grow slowly, but have a long life span, up to 24 years (Armstrong 1996). Burbot have been studied extensively in northern Alaska (Bernard et al. 1993), but few studies are available specific to the Cook Inlet area.

Three species of **sculpin** are found in freshwaters of the Cook Inlet area: slimy sculpin (*Cottus cognatus*), prickly sculpin (*C. aster*) and coastrange sculpin (*C. aleuticus*). They are generally found on the bottom of lakes and streams. Sculpin mature at 2 to 4 years, and spawn in the spring, laying their eggs in nests guarded by the male (Armstrong 1996). Their lifespan is about 7 years. They feed mostly on insects, although occaisionally they eat fish and fish eggs

Three-spine stickleback (*Gasterosteus aculeatus*) are abundant in lakes, ponds, and slow-moving streams. They spawn in June and July, with the female laying eggs in a nest built by the male (Armstrong 1996). Their life span is only 2 years. Stickleback feed on zooplankton, insects, and occasionally on their own eggs and young.

b. Pacific Salmon

Five species of Pacific salmon are found in the Cook Inlet area: Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), coho (*O. kisutch*), pink (*O. gorbuscha*), and chum (*O. keta*). Although salmon life histories can vary widely depending on species and population, most salmon spawn in freshwater streams between June and September. Some pink salmon also spawn in intertidal areas. Eggs are laid in the gravel where they remain through the winter. Growth and development of eggs and alevins in the gravel depends on water temperature, and requires good flow of clean water through the subsurface gravel (Armstrong 1996). Young salmon emerge from the gravel in the spring, and most species spend one or more subsequent years in freshwater. Juvenile salmon undergo significant physiological changes in preparation for migrating to the ocean, which usually occurs from mid-April through mid-July. Young salmon spend varying time in nearshore waters and then most move further offshore.

During their ocean residence, salmon grow quickly as they feed on abundant marine food supplies. Some salmon species make long migrations on the high seas that span thousands of miles and up to seven years. When they reach maturity, salmon migrate back to their natal stream. Navigation mechanisms for salmon while at sea are poorly understood but may involve the earth’s magnetic field (ADF&G 1994a). As they near freshwater, salmon use olfactory cues to find their home stream with great precision. Salmon die after spawning, but their decomposed bodies provide essential nutrients that contribute to the productivity of the entire stream ecosystem (Walker and Davis 2004).

In 2000, the Alaska Board of Fisheries adopted the Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) which strengthened long-time principles of salmon management by ADF&G and provided a systematic approach for evaluating the health of salmon populations. Criteria were included to identify three levels of concern for salmon populations. As of spring 2006, of the many populations of salmon in Alaska, only three were characterized in the lowest concern level, five were of intermediate concern, and none were at the highest level of concern. None of the eight populations of concern were in the Cook Inlet area (Clark et al. 2006). However, in 2008, the Susitna River sockeye salmon stock was designated a “stock of yield concern” by the Alaska Board of Fisheries because of failure to meet targeted escapement goals (ADF&G 2008k).

Fish hatcheries, which include private non-profit hatcheries for commercial fisheries and state hatcheries for sport fisheries, supplement wild stocks and can help divert fishing pressure from wild stocks. Two state hatcheries (Ft. Richardson and Elmendorf) and three non-profit hatcheries (Trail Lakes, Tutka Bay, and Pt. Graham) operate in the Cook Inlet area (Clark et al. 2006). Strict policies on transporting, possessing, raising, and stocking fish, as well as on genetics and pathology, ensure that wild stocks are not negatively affected by stocking. Species stocked by ADF&G include salmon, rainbow trout, Arctic grayling, Arctic char, and lake trout (ADF&G 2008e).

Chinook salmon.

Chinook (king) salmon are the largest of the Pacific salmon species at maturity, frequently exceeding 50 lbs (ADF&G 1994a). They return to Cook Inlet area streams from early May through early August (ADF&G 2008g, h, i). Females lay 3,000-14,000 eggs (Armstrong 1996). After hatching and emerging from the gravel, juvenile Chinook feed on plankton and insects while in freshwater (ADF&G 1994a). Most Chinook salmon remain in freshwater for one or two years before their seaward migration, and they spend 3-5 years in the ocean (Armstrong 1996). In the ocean, Chinook feed on herring, pilchard, sandlance, squid and crustaceans as well as other available fish and shellfish (ADF&G 1994a).

Chinook salmon are distributed widely throughout the Cook Inlet area with particularly large runs to the Kenai and Deshka rivers, and Alexander, Lake and Prairie creeks (Fair et al. 2007). Escapement goals have been set for three stocks in lower Cook Inlet and 21 stocks in upper Cook Inlet (Table 4.3).

Table 4.3. Chinook salmon stocks with escapement goals in 2007.

Lower Cook Inlet	Upper Cook Inlet	
Anchor River	Alexander Creek	Lake Creek
Deep Creek	Campbell Creek	Lewis River
Ninilchik River	Chuitna River	Little Susitna River
	Chulitna River	Little Willow Creek
	Clear (Chunilna) Creek	Montana Creek
	Crooked Creek	Peters Creek
	Deshka River	Prairie Creek
	Eagle River-S. Fork	Sheep Creek
	Goose Creek	Talachulitna River
	Kenai River - Early Run	Theodore River
	Kenai River - Late Run	Willow Creek

Source: Otis and Szarzi 2007; Fair et al. 2007.

Sockeye (red) salmon are unique in that after emerging from the gravel, they usually spend one to two years in lakes as juveniles (Armstrong 1996). Important food sources in lakes include plankton and insects. Some important lakes in the Cook Inlet area for sockeye rearing are Tustamena Lake and Upper and Lower Kenai Lakes. After moving to the ocean, sockeye migrate through the Gulf of Alaska and into the North Pacific Ocean, but they do not enter the Bering Sea (Burgner 1991). However, sockeye stocks from central Alaska (which includes the Cook Inlet area) have been found west of 175°E (west of the Aleutian Islands; Burgner 1991). Some populations of sockeye, called kokanee, remain in lakes for their entire life cycle. After 2 or 3 years at sea, mature sockeye salmon return to Cook Inlet area streams to spawn in mid June, and runs continue through August (ADF&G 2008g, h, i). Escapement goals have been set for eight stocks in Lower Cook Inlet (Otis and Szarzi 2007) and eight stocks in Upper Cook Inlet (Fair et al. 2007; Table 4.4). The Susitna River sockeye salmon stock was designated a "stock of yield concern" by the Alaska Board of Fisheries in 2008 because of failure to meet targeted escapement goals (ADF&G 2008k). The stock will be managed conservatively while research is conducted to better understand this stock's productivity. There are many other stocks of sockeye in the Cook Inlet area for which escapement goals have not been set, either because data are unavailable or harvest levels are low.

Table 4.4. Sockeye salmon stocks with escapement goals in 2007.

Lower Cook Inlet	Upper Cook Inlet
English Bay	Crescent River
Delight Bay	Fish Creek (Knik)
Desire Bay	Kasilof River
Bear Lake	Kenai River
Aialik Lake	Packers Creek
Mikfik Lake	Russian River-Early Run
Chenik Lake	Russian River-Late Run
Amakdedori Creek	Yentna River

Source: Otis and Szarzi 2007; Fair et al. 2007.

Coho (silver) salmon begin entering rivers and streams of the Cook Inlet area in mid-July through late September (ADF&G 2008g, h, i). Females deposit from 2,400-4,500 eggs in stream gravel (Armstrong 1996). Most coho remain in freshwater until the following spring. During fall and winter, juvenile coho seek out deep pools and side channels in which to overwinter (ADF&G 1994a). In Cook Inlet, smolt usually migrate to the ocean from March through June, but in some systems such as the Kenai River and Deep Creek, the smolt migration is protracted, lasting all summer (King and Breakfield 1998). Coho salmon usually spend just one year at sea, although there is variability (Sandercock 1991). Escapement goals have been set for three coho stocks in Upper Cook Inlet (Table 4.5); there are no escapement goals for Lower Cook Inlet stocks (Otis and Szarzi 2007; Fair et al. 2007). However, there are many other stocks of coho in the Cook Inlet area for which escapement goals have not been set, either because data are unavailable or harvest levels are low.

Table 4.5. Coho salmon stocks with escapement goals in 2007.

Lower Cook Inlet	Upper Cook Inlet
No Escapement Goals	Campbell Creek
	Jim Creek
	Little Susitna River

Source: Otis and Szarzi 2007; Fair et al. 2007.

Pink salmon are the smallest of the five species of Pacific salmon. They return to freshwater to spawn from early July through August in the Cook Inlet area (ADF&G 2008g, h, i). Pink salmon generally spawn in the lower reaches of streams within a few miles of the ocean, and may even spawn in intertidal areas (ADF&G 1994a). Females deposit from 1,500-2,000 eggs in the gravel of spawning streams (Armstrong 1996). Juvenile pink salmon do not rear in freshwater. Rather, after emerging from the gravel, they immediately migrate downstream (ADF&G 1994a). Young pink salmon form large schools in estuarine areas where they remain for several months before migrating out to sea in the fall (ADF&G 1994a).

Pink salmon remain at sea for one year, feeding mainly on zooplankton, squid, and fish (Armstrong 1996). Because pink salmon migrate to sea shortly after emerging from the gravel and spend only one year at sea, they have a distinct two-year life cycle from egg to spawning; therefore, populations are characterized as either odd- or even-year (ADF&G 1994a). In the Cook Inlet area, most populations are even-year, but there are also odd-year populations (Shields 2007). In 2007, there were escapement goals for 21 stocks in Lower Cook Inlet (Otis and Szarzi 2007) and no stocks in Upper Cook Inlet (Fair et al. 2007; Table 4.6).

Table 4.6. Pink salmon stocks with escapement goals in 2007.

Lower Cook Inlet		Upper Cook Inlet
Humpy Creek	Island Creek	No Escapement Goals
China Poot Creek	S. Nuka Island Creek	
Tutka Creek	Desire Lake Creek	
Barabara Creek	Bear & Salmon Creeks	
Seldovia Creek	Thumb Cove	
Port Graham River	Humpy Cove	
Port Chatham	Tonsina Creek	
Windy Creek Right	Bruin River	
Windy Creek Left	Sunday Creek	
Rocky River	Brown's Peak Creek	
Port Dick Creek		

Source: Otis and Szarzi 2007; Fair et al. 2007.

Chum (dog) salmon are found in many systems of the Cook Inlet area. They enter the Cook Inlet area beginning in mid-July, and runs continue through mid-August (ADF&G 2008i). On average, females lay 2,000-4,000 eggs (Armstrong 1996). After hatching in the spring, young chum immediately migrate to the ocean. They form large schools and remain in estuaries and near-shore waters feeding on plankton until fall, when they migrate to the open ocean (ADF&G 1994a). After three to six years at sea, chum return to their home streams to spawn. Lower Cook Inlet stocks with escapement goals include the McNeil River, Big Kamishak River, Little Kamishak River, and Island Creek (Table 4.7; Otis and Szarzi 2007); only Clearwater Creek of Upper Cook Inlet has an escapement goal for chum salmon (Fair et al. 2007).

Table 4.7. Chum salmon stocks with escapement goals in 2007.

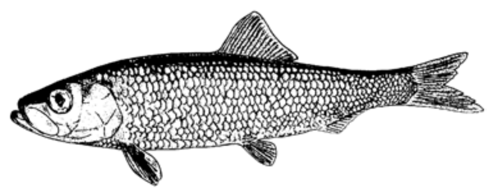
Lower Cook Inlet		Upper Cook Inlet
Port Graham River	Little Kamishak River	Clearwater
Dogfish Lagoon	McNeil River	
Rocky River	Bruin River	
Port Dick Creek	Ursus Cove	
Island Creek	Cottonwood Creek	
Big Kamishak River	Iniskin Bay	

Source: Otis and Szarzi 2007; Fair et al. 2007.

c. Marine Forage Fishes

Forage fishes are an important group of fish that provide food for a wide range of marine animals, including 2-3 million seabirds, marine mammals, and other fish species (LGL and BioSonics 1999). Some forage species are also important for commercial or personal use fisheries. In Cook Inlet, forage fishes include Pacific herring, walleye pollock (see Groundfish section), capelin, Pacific sand lance, and eulachon (LGL and BioSonics 1999) and three-spine stickleback (Pentec Environmental 2005). Nearshore fish communities may change dramatically, apparently related to large-scale regime shifts in the North Pacific (Robards et al. 1999).

Pacific herring *(Clupea pallasii pallasii)* are an important commercial fish species, and are also important prey for many other species of fish and marine mammal (Armstrong 1996). Herring spawn in the spring in vegetated areas in shallow, intertidal and subtidal areas (ADF&G 1994a). Herring, with a life span of about 8 years, reach sexual maturity at about 3 or 4 years and spawn annually thereafter.


ADF&G

Pacific herring.

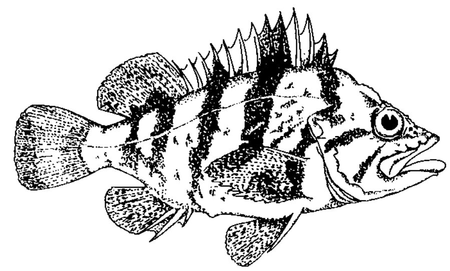
Eulachon *(Thaleichthys pacificus)* also known as candlefish or hooligan are anadromous, returning annually to river mouths of the Cook Inlet area to spawn. They move into nearshore waters in early May and spawn in drainages throughout Cook Inlet. The eggs are deposited on stream gravel, and they hatch in about 30 to 40 days, depending on water temperature (Morrow 1980). The larvae then move downstream to enter marine waters. Eulachon are important food for marine birds and eagles; fishes, including salmon; and marine mammals, including beluga whales (Armstrong 1996).

Pacific sand lance is a critical food source for seabirds, marine mammals, salmon, Pacific halibut, cod, Dolly Varden, and herring (Armstrong 1996). They occur in large schools in nearshore areas, including sandy beaches, channels, and intertidal sloughs, as well as in offshore areas. They bury themselves in the sand at night. Sand lance mature at the age of 2 or 3, and spawning occurs in October. They may live up to 5 years.

d. Groundfish

Walleye pollock *(Theragra chalcogramma)* and **Pacific cod** (*Gadus macrocephalus*) are important prey for a wide range of fish and marine mammals, including Steller sea lions. Walleye pollock and Pacific cod occur in large schools, inhabiting waters between 100-300 m deep (NMFS 2008e; NMFS 2008h). They generally reach sexual maturity at about 3-5 years, and have a lifespan of up to 17-18 years. Spawning usually occurs between March and May for walleye pollock and late winter to early spring for Pacific cod (NMFS 2008e; Armstrong 1996).

Sablefish *(Anoplopoma fimbria),* commonly called blackcod, also occur in large schools, usually on or near sandy or muddy ocean floors (Armstrong 1996). After reaching sexual maturity at 4-6 years, sablefish spawn in late winter, from January through March. They have a lifespan of up to 55 years. Their diet includes invertebrates, squid, and fish such as Pacific herring and rockfish. They are also an important food source for Pacific cod, Pacific halibut, lingcod, seabirds, and marine mammals (Armstrong 1996).



Tiger rockfish.

At least 35 **rockfish** species, genus *Sebastes*, are found in the Gulf of Alaska (Armstrong 1996). Based on incidence in sport harvests, the most common are black, dusky, and yelloweye rockfish (Szarzi et al. 2007). Rockfish can be categorized into three groups, or assemblages, based on habitat preference: pelagic, demersal shelf, and slope assemblages (Szarzi et al. 2007). Rockfish are very longlived, with maximum ages exceeding 100 years for some species (Armstrong 1996). Rockfish populations are highly vulnerable to overfishing because of their longevity (which translates into low productivity), age at which they reach sexual maturity (as old as 23 years), high site fidelity in which fish remain in the same area, preference of some species for structures such as pinnacles and reefs that are easily located by fishers, and an unvented swim bladder that is easily injured by decompression when fish are brought to the surface from depths greater than 15 m (ADF&G 1994a; Meyer 2000).

Pacific halibut (*Hippoglossus stenolepis*) are bottom-dwelling flat fish that also swim closer to the surface when feeding (Armstrong 1996). Pacific halibut spawn in deep waters at 600-1,500 ft. Ocean currents are an important factor in their life history, carrying fertilized eggs and young halibut to inshore areas where they settle to the ocean floor. Pacific halibut tend to migrate back into deeper waters after about three years, for overwintering, and then return to shallow coastal waters during the summer (Armstrong 1996). They are long-lived, up to 42 years; they mature at about age 8 for males and age 12 for females. Pacific halibut grow to very large sizes, up to 500 lbs. They prey on cod, Pacific sand lance, crabs, clams, squids, and other invertebrates (Armstrong 1996).

e. Shellfish

Shellfish species inhabiting intertidal and subtidal areas of Cook Inlet include sea urchins, chitons, limpets, whelks, mussels, clams, cockles, polychaetes, bryozoans, sponges, sea stars, sea cucumbers, snails, octopus, skate, barnacles, and crabs. Species in nearshore and offshore waters include sea cucumbers, many species of sea star, nudibranches, octopus, tunicates, worms, and sea leeches.

Clams are abundant along many Cook Inlet beaches. Stocks of razor clams (*Siliqua patula*) are concentrated in the Polly Creek area on the west side of Cook Inlet, and along the east side from Anchor Point to the Kasilof River. Razor clams are usually found on sandy beaches from about 4 ft above mean low water to depths of 180 ft (ADF&G 1994a). Razor clams become sexually mature between 3 and 7 years old. Breeding, which occurs in the summer between May and September, is closely associated with temperature. After hatching, microscopic larvae, which bear little resemblance to adult clams, spend 5 to 16 weeks in a free-swimming form, then begin to develop shells and settle into the sand (ADF&G 1994a). Razor clams can live to be as old as 18 years. Razor clams are filter feeders, obtaining their food by straining plankton from seawater (ADF&G 1994a).

Other clam species include littleneck (*Protothaca staminea*) and butter clams (*Saxidomus giganteus*), which are prolific in Kachemak Bay (Szarzi et al. 2007) south of the lease sale area, as well as species such as *Axe sp., Mya sp., Tresus sp., Spisula sp., Telina sp.,*and *Macoma sp*. Migrating birds and resident shorebirds may depend on stocks of a small bivalve, *Macoma balthica*, perhaps exclusively for rock sandpipers (Gill and Tibbitts 1999). Densities of littleneck clams were low in 2005, based on surveys at two islands (Trowbridge and Goldman 2006).

Tanner crabs (*Chionoecetes bairdi* and *C. opilio*) are found on the soft bottom of deep waters (Field and Field 1999). Tanner crabs reproduce at 5 or 6 years of age, and may brood up to 450,000 eggs each year. Eggs incubate for a year on the female's abdominal flap, hatching in spring (ADF&G 1994a). Tanner crab hatch into free-swimming larvae, molt many times through distinct stages, then settle to the ocean bottom. They may live up to 14 years. Their prey includes mussels, clams, snails, crabs, shrimps, and worms, and they scavenge on dead fish (Field and Field 1999). Although little is known of their migration patterns, males and females are found in separate areas for much of the year, and migrate to the same area during the reproductive period (ADF&G 1994a).

S. Kilka, ADF&G

Tanner crab.

Several species of **shrimp** are found in Cook Inlet, including pink (*Pandalus borealis*), sidestripes (*P. dispar*), humpy shrimp (*P. goniurus*), coonstripe shrimp (*P. hypsinotus*), and spot shrimp (*P. platyceros*) (ADF&G 2002b). Shrimp typically hatch in the spring into planktonic, free-swimming larvae. After undergoing several molts, they settle to the bottom where they live for a few years before maturing into adults (ADF&G 1994a). Depending on species and life stage, shrimp inhabit a wide range of habitats and water depths, ranging from rock piles, coral, debris-covered bottoms, and muddy bottoms; and depths ranging from shallow waters of a few fathoms to deep waters up to 800 fathoms (ADF&G 1994a). Shrimp may undergo seasonal migrations, from deep to shallow waters and vertically in the water column. Shrimp eat a wide variety of foods, including worms, diatoms, detritus, algae, and invertebrates. They are preyed upon by fish such as Pacific cod, walleye pollack, flounders, and salmon (ADF&G 1994a).

Other shellfish species include octopus, green urchin, sea cucumber, and scallops. The predominant octopus species in Cook Inlet is the giant Pacific octopus (*Enteroctopus dofleini*) (Trowbridge and Goldman 2006). Maximum age for octopus is probably 3-5 years and they reach sexual maturity at 1.5 to 2 years. Octopus spawn only once. They stop feeding and die soon after spawning. Abundance of green urchins (*Strongylocentrotus droebachiensis*) and sea cucumbers (*Parastichopus californicusappears*) are low (Trowbridge and Goldman 2006). Sea cucumbers are benthic detritus feeders. They are important in the marine food web because they recycle detritus into nutrients for primary producers by ingesting significant amounts of fine substrate (ADF&G 2008j). Weathervane scallop (*Patinopecten caurinus*) stocks declined sharply in 1987 in the Kamishak area, but by 1993 there appeared to be a small but healthy stock in the Kamishak area (Trowbridge and Goldman 2006). Sharp declines were observed in 2003, but based on age composition appear to be healthy (Trowbridge and Goldman 2006).

2. Birds

Over 450 species of birds are found in Alaska, most of which can be found living in the Cook Inlet area year round, or migrating through or breeding in the area (BLM 2006). These include waterfowl, seabirds and shorebirds, and land and water birds.

a. Waterfowl

Waterfowl of the Cook Inlet area include geese, swans, ducks, cranes and eiders. Cook Inlet is critical to these birds for nesting, molting, and staging.

Tule white-fronted geese.

Tule white-fronted geese (*Anser albifronsis gambelli*), a subspecies of the white-fronted goose, are found in the Cook Inlet area. The population is currently estimated to be about 6,000 birds, a 90 percent decrease since the early 1980s (ADF&G 2007, citing to Campbell 1992). Although their entire breeding range has not been fully determined, it is known that they breed in the coastal flats of upper Cook Inlet (ADF&G 2007; Figure 4.2). Nesting and molting habitat has been identified in the Bachatna Flats and Big River area, along the McArthur River drainage, (ADF&G 2007, citing to Trasky 1998); and in the Susitna Flats State Game Refuge, Trading Bay State Game Refuge, and the Redoubt Bay State Critical Habitat Area (ADF&G 2007). There is only one other area where Tule geese are known to nest, which is north of the Cook Inlet area along the Kahiltna River.

Studies indicate that Tule geese arrive in the Cook Inlet coastal areas and interior marshes from mid-April to early May, and then move to nesting areas (ADF&G 2007, citing to Ely et al. 2006, Densmore et al. 2006). Important locations include freshwater wetlands in the Susitna Valley and lowlands along Cook Inlet between the Susitna and Theodore rivers for nesting; and a molting area in a sub-glacial lake system in upper Cook Inlet (ADF&G 2007, citing to Densmore et al. 2006). Tule geese start to leave for wintering grounds in California by early fall, and are gone from Alaska by the end of September (ADF&G 1994a).

Abundance of **trumpeter swans** (*Cygnus buccinators*) in the Cook Inlet area has increased, from 1,545 in 2000 to 2,670 in 2005 (Table 4.8; ADF&G 2007). In 2005, 995 swans were observed in the Cook Inlet census unit and 182 were observed in the Kenai unit (Conant et al. 2007; Figure 4.3; Figure 4.4). Nesting is widespread in the Trading Bay and Redoubt Bay areas, with the most concentrated use occurring in the drainages of the Kustatan River, Bachatna Creek, North Fork Big River, and the lower Big and Chakachatna rivers (ADF&G 2007). Trumpeter swans prefer secluded regions, where they frequent shallow bodies of water and build their nests in extensive areas of marsh vegetation (ADF&G 1985). Most breeding pairs are at their nest sites by early May and the first hatching dates range from June 16 to June 29. In Alaska, young swans are unable to fly until 13 to 15 weeks of age.

After leaving the breeding areas, large numbers of trumpeter swans congregate on ponds and marshes along the coast in late summer and early fall. Most swans depart by mid-October but in some years may remain until freeze-up in November (ADF&G 1985). They winter on ice-free freshwater outlets. However, they may utilize saltwater, during extremely cold periods, when freshwater locations freeze (ADF&G 1985). Maintaining the present distribution of trumpeter swans in Alaska, losses of wintering habitat along the Pacific coast, and losses of swans to lead poisoning on the Pacific coast are of continued concern (ADF&G 2007, citing to Conant et al. 2005).

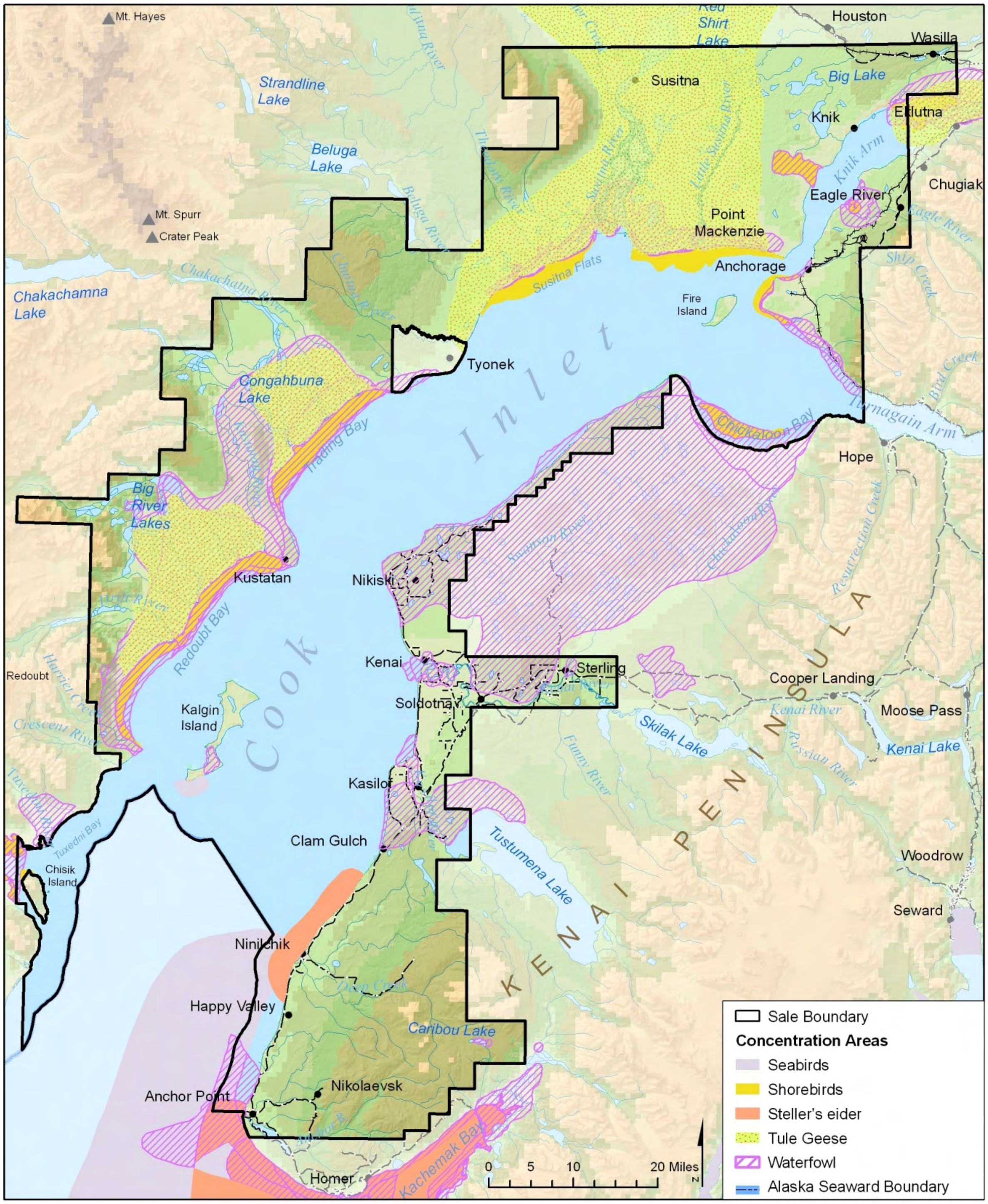
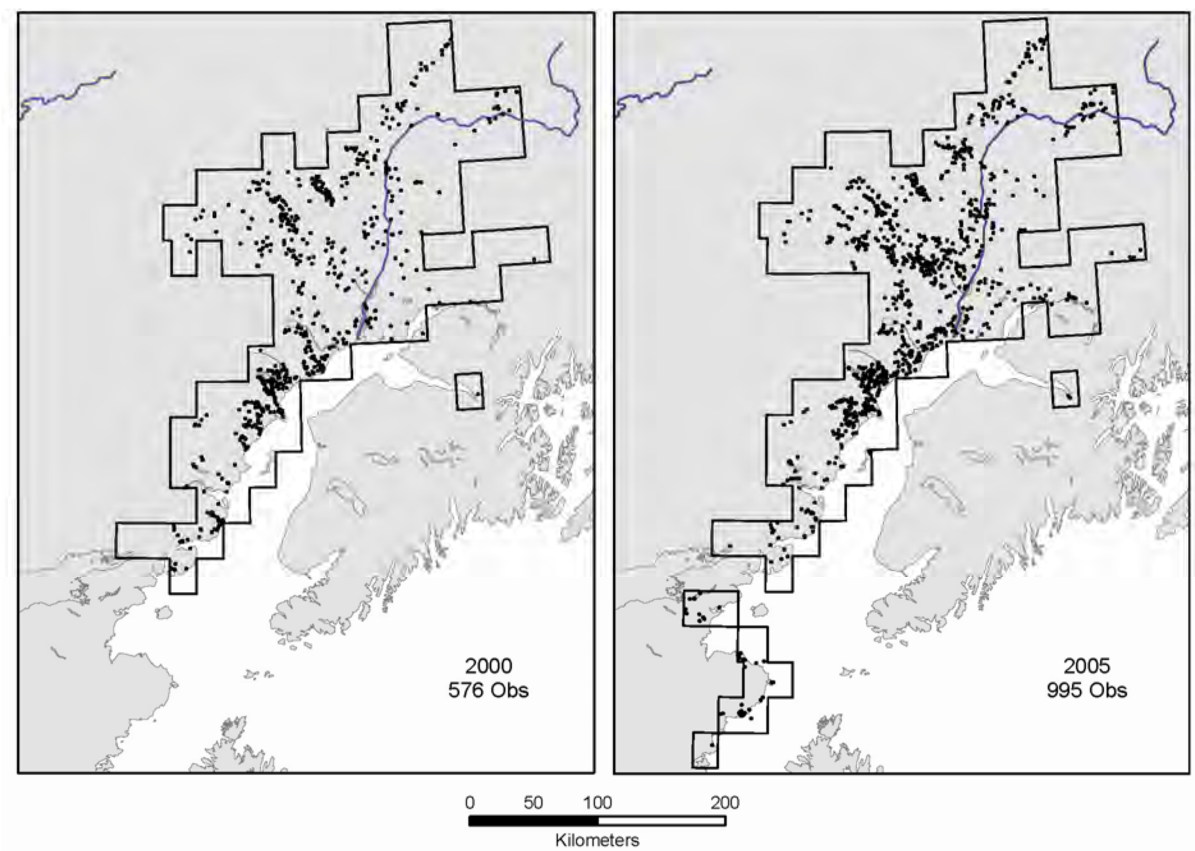


Figure 4.2. Important bird habitat.

Table 4.8. Summary of trumpeter swans in Cook Inlet from censuses during August – early September

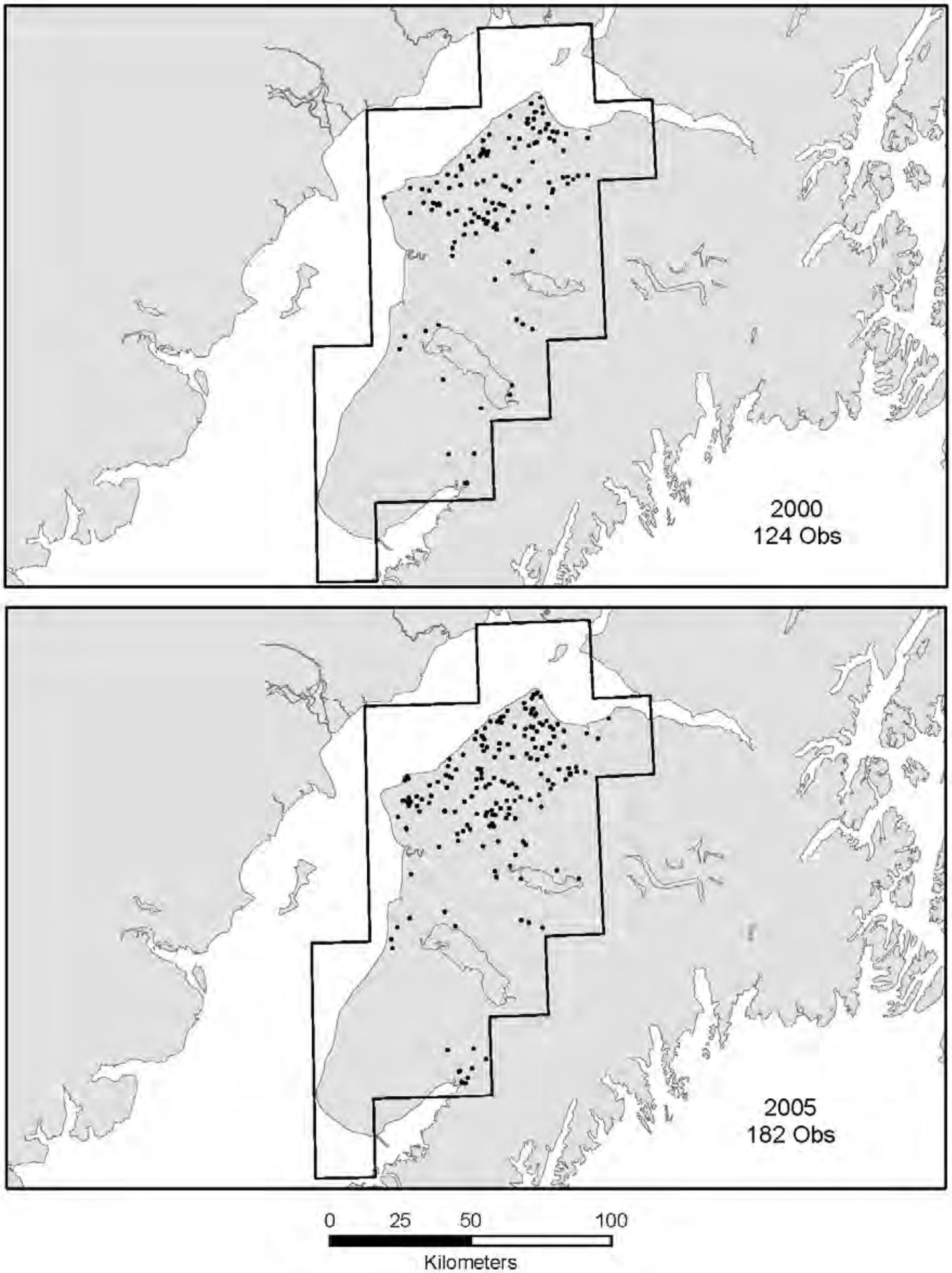
	White Swans					Total
Year	In Pairs	As Singles	In Flocks	Total	Cygnets	Swans
1968	224	19	50	293	124	417
1975	340	36	60	436	181	617
1980	608	38	186	832	369	1,201
1985	800	66	454	1,320	241	1,561
1990	904	79	162	1,145	516	1,661
1995	838	91	269	1,198	330	1,528
2000	938	57	219	1,214	331	1,545
2005	1,470	196	310	1,976	694	2,670

Source: ADF&G 2007, citing to Conant et al. 2005.



Source: Conant et al. 2007.

Figure 4.3. Comparison of swan distribution in the Cook Inlet area as depicted by point locations of observations from trumpeter swan censuses in Alaska in 2000 and 2005.



Source: Conant et al. 2007.

Figure 4.4. Comparison of swan distribution on the Kenai Peninsula as depicted by point locations of observations from trumpeter swan censuses in Alaska in 2000 and 2005.

Steller’s eiders (*Polysticta stelleri*), a species of sea duck, winter from the eastern Aleutian Islands to lower Cook Inlet. The Steller's eider, the smallest of the eiders, is approximately 18 inches long and usually weighs about 2 lbs. The Steller's eider is unusually colorful and has a unique plumage pattern for a sea duck (ADF&G 1994a). ADF&G listed the Alaska breeding population as a species of special concern in 1993 (DO&G 2004). The USFWS listed the Steller’s eider as threatened on June 11, 1997 because of apparent declines in abundance of nesting birds, but the reasons for the decline are unknown (ADF&G 2007; USFWS 2008e).


USFWS

Steller’s eider.

Steller's eiders are the least abundant eider in Alaska. They generally nest in northeastern Siberia, but also breed in Alaska along the coast from the Alaska Peninsula northward, including the Seward Peninsula, St. Lawrence and Nunivak islands, and the Beaufort Sea coast (ADF&G 1994a). Three breeding populations are recognized: two in Arctic Russia and one in Alaska but it is unknown if birds wintering in Cook Inlet are part of the Alaska breeding population (ADF&G 2007). Steller’s eiders winter from the eastern Aleutian Islands to lower Cook Inlet, as well as islands in southeastern Russia. They are usually found in protected nearshore waters that are less than 10 m in depth. From mid- to late-April, they leave wintering areas and migrate to their Arctic nesting areas. The species was most abundant on the Yukon Delta where 3,500 pairs were thought to nest, but sightings are now rare and no nests have been found in the region since the mid-1970s (ADF&G 2007). The unexplained disappearance of Steller's eiders from the Yukon-Kuskokwim Delta has caused great concern and recently stimulated intensive research into the problem (ADF&G 2007, citing to USFWS 2002).

Cook Inlet is the easternmost extent of the molting and winter range for Steller’s eider. Molting Steller’s eiders arrive from late August, and they may remain through the winter, departing for breeding grounds in April (ADF&G 2007). Several surveys of wintering Steller’s eiders have been conducted, including shoreline and aerial surveys from 1997-2003 that were conducted from the mouth of Kachemak Bay to Kenai. Counts ranged from 252-2,370, most within 2 km of shore. Additional surveys counted over 4,000 birds (ADF&G 2007). Within the lease sale area, substantial numbers of Steller’s eiders were observed in nearshore areas from Anchor Point to 25 km north of Ninilchik. South of the lease sale area, substantial numbers were observed in nearshore areas from Homer Spit to Anchor Point; nearshore areas in southern Kamishak Bay from Douglas River to Bruin Bay, including the shoreline between Bruin Bay and Ursus Cove; a shoal 12 km southeast of Bruin Bay; and the mouth of Iniskin Bay (Figure 4.2; ADF&G 2007; Larned 2006).

b. Seabirds and Shorebirds

i. Seabirds

Seabirds are birds that spend most of their lives at sea, including feeding, resting, and sleeping, although all nest on land (USGS 2008c). There are many species of seabirds in the Cook Inlet area, including murres, gulls, kittiwakes, cormorants, murrelets, and puffins. Lower Cook Inlet is one of the most productive areas for seabirds in Alaska, with 2.2 million seabirds foraging in the area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Chisik Island seabird colony.

in July 1992 (Piatt 1994). Shallow coastal habitats are particularly important for seabirds at sea, as these areas have high densities of forage fish (Piatt and Roseneau 1997), and the east side of lower Cook Inlet is particularly productive and important habitat for seabirds (Piatt and Harding 2007). Important food items include small fish, squid, and crustaceans such as krill and crabs (USGS 2008c).

Seabirds tend to nest in colonies on islands and bluffs, with nesting sites including beach rubble and boulders, cracks in cliff faces, rocky ledges, burrows in soft soil at a cliff edge, or flat ground (USGS 2008c). Important nesting sites include Chisik Island and Duck Island, located near Tuxedni Channel; Gull Island, located in Kachemak Bay outside the lease sale area; and Barren Islands and Shuyak Island, located south of the lease sale area (USGS 2008b; Piatt 1994). About 5,000 seabirds use Duck Island, including about 3,000 horned puffins, and more than 16,000 use Gull Island (USGS 2008a).

Population trends in seabird colonies appear to be related to differences in food availability (USGS 2008a). In the late 1970s, a significant regime shift occurred in the Gulf of Alaska, characterized by changes in seawater temperature and decreases in abundance of forage fish; this resulted in reduced food availability to seabirds, lower reproductive success, large-scale die-offs, and long-term decreases in some populations (Piatt and Harding 2007). In fact, although the 1989 Exxon Valdez oil spill had a serious and immediate impact on seabird populations, effects of the regime shift are considered to have had an even more significant effect (Piatt and Harding 2007).

ii. Shorebirds

The Cook Inlet area is important for many species of shorebirds as a stopover site during migrations and a wintering area; 28 species have been identified in the area (Table 4.9; Gill and Tibbitts 1999). Migrating shorebirds appear suddenly in the Cook Inlet area in early May, their numbers increase rapidly, and then they depart abruptly by late May. In excess of 150,000 birds have been counted in surveys during that time period (Gill and Tibbitts 1999). The Cook Inlet area supports from 11-21 percent of the Pacific flyway population of dunlin, and perhaps the entire population of rock sandpiper (Gill and Tibbitts 1999). Southern Redoubt Bay, with 73 percent of all shorebirds during the spring, is a particularly important area (Figure 4.2). Also important is Tuxedni Bay, which averaged over 6,000 birds per day in the spring (Figure 4.2; Gill and Tibbitts 1999). Few shorebirds use the intertidal habitat of Knik Arm (URS Corp. 2006).


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Sandpipers and dunlins, Kachemak Bay.

The Cook Inlet area is also an important wintering area for many species, including rock sandpipers, migrating western sandpipers and dunlin, and for breeding and migrating Hudsonian godwits, greater yellowlegs, solitary sandpipers, and short-billed dowitchers (ADF&G 2007; Gill and Tibbitts 1999). In the winter, the Susitna Flats is a particularly important area, with 82 percent of the shorebirds found there (Gill and Tibbitts 1999). Tidal flats are important to shorebirds, providing their food supply of bivalves, *Macoma balthica* (a small clam) and *Mytilus* (a mussel) (Gill and Tibbitts 1999). Sandpipers forage in the winter on mudflats kept free of ice, such as the Susitna Flats near the Beluga and Ivan rivers. Trading Bay, off Nikolai Creek, also provides important alternate foraging habitat in the winter, as well as mudflats in the area south of Redoubt, Tuxedni, and Kachemak bays and Homer Spit.

Few shorebirds use the area during the summer breeding season, except for the Hudsonian godwit, for which the Cook Inlet drainage is the preferred nesting site. The Cook Inlet area may be critical to a major portion of the continental population of the Hudsonian godwit (Gill and Tibbitts 1999).

Solitary sandpipers, rock sandpipers, and marbled godwit have been identified by ADF&G as featured species for conservation (ADF&G 2006). Breeding habitat of **solitary sandpipers** (*Tringa solitaria cinnamomea*) includes wooded wetlands in muskeg bogs, spruce forests, and deciduous riparian woodlands, and occasionally riparian shrub thickets (ADF&G 2007, citing to Muskoff 1995). Concerns for solitary sandpipers include low abundance estimates, rapid declines in counts for Alaska and Canadian Breeding Bird Surveys, and uncertainty in abundance estimates and indices (ADF&G 2007).

Rock sandpipers (*Calidris p. ptilocnemis*), the only shorebird known to overwinter in the Cook Inlet area, depend on intertidal habitats of upper Cook Inlet for foraging. It was identified as a featured species for conservation because of its limited distribution, low abundance, and potential threats during the nonbreeding season (ADF&G 2007). A few surveys have been conducted to estimate abundance of rock sandpipers. About 20,000 were estimated in a 1996 survey of the Beluga River flats during winter; 17,500 were counted in upper Cook Inlet in the winter of 2002-2003, and about 16,000 during the winter of 2003-2004 (ADF&G 2007). Rock sandpipers may move to southern Cook Inlet, such as Kamishak Bay, or out of Cook Inlet to the Kodiak Archipelago during very cold periods (ADF&G 2007, citing to Gill and Tibbitts 2003).

A small population of **marbled godwits** (*Limosa fedoa beringiae*), probably numbering less than 3,000 birds, breeds only on the Alaska Peninsula, with the remainder of the species wintering along the Atlantic and Pacific coasts between the U.S. and Central America (ADF&G 2007). During migration, birds from this population occasionally pass through the Cook Inlet area. Although this population does not breed in Cook Inlet, birds that do pass through the area represent a portion of this small population. Loss of wetland habitats on the U.S. Pacific coast is a concern.

Table 4.9. Shorebird species using the Cook Inlet area.

Black-bellied Plover	Whimbrel	Red Knot	Rock Sandpiper
American Golden-Plover	Hudsonian Godwit	Sanderling	Dunlin
Pacific Golden-Plover	Bar-tailed Godwit	Semipalmated Sandpiper	Ruff
Semipalmated-Plover	Marbled Godwit	Western Sandpiper	Short-billed Dowitcher
Greater Yellowlegs	Ruddy Turnstone	Least Sandpiper	Long-billed Dowitcher
Lesser Yellowlegs	Black Turnstone	Baird's Sandpiper	Common Snipe
Solitary Sandpiper	Surfbird	Pectoral Sandpiper	Red-necked Phalarope

Source: ADF&G 2000b, citing to Gill and Tibbitts 1999.

c. Land Birds and Waterbirds

A large variety of other birds rely on the land and freshwater habitats of the Cook Inlet area. These include eagles, hawks, owls, ravens, grouse, ptarmigan, loons, chickadees, and many others.

Bald eagles (*Haliaeetus leucocephalus*) are a common and visible raptor in the Cook Inlet lease sale area (Figure 4.5). These birds are protected by the federal Bald Eagle Act of 1940, which makes possession of an eagle, either alive or dead, illegal (ADF&G 1994a). Bald eagles are usually found near shorelines and river areas, which is probably related to food supply, as well as near prominences which are used for perches and nests (ADF&G 1985). Fish are the main diet of bald eagles, including salmon, herring, flounder, and pollock; they also prey on waterfowl, small mammals, sea urchins, clams, crabs, and carrion. They tend to congregate along salmon-spawning streams and shorelines where they search for stranded or dead fish. Bald eagles also take live fish from lakes, streams, and the ocean (ADF&G 1994a).

Bald eagles nest in trees that are close to water, with a clear view of the surrounding area, often in old cottonwoods (ADF&G 1994a). They tend to use and rebuild the same nest. Nest building begins in April, eggs are usually laid by late April, young hatch after about 35 days, and leave the next after about 75 days. Bald eagles reach sexual maturity at about 4 or 5 years of age (ADF&G 1994a).

Nest sites have been documented at numerous locations along the Cook Inlet coast, with the highest nest densities occurring outside the lease sale area, in and along the southern shore of Kachemak Bay (ADF&G 2007). Eagles congregate at the mouths of major rivers where salmon and hooligan school, such as the 20-Mile, Placer, Eagle, Knik, Matanuska, Susitna, Beluga, Fox, and other rivers. During a partial nest survey conducted in June 1992, the USFWS counted 55 active and 84 inactive nests around Kachemak Bay (ADF&G 2007). Hundreds of eagles also winter in Kachemak Bay and, to a lesser extent, other areas around Cook Inlet (ADF&G 2007).

Golden eagles (*Aquila chrysaetos*), also protected by the Bald Eagle Act, are also found throughout the Cook Inlet area. These raptors feed primarily on ground squirrels, hares, and birds, such as ptarmigan, cranes, and owls (ADF&G 1994a).

Both the **sharp-shinned hawk** (*Accipiter striatus*) and the **northern goshawk** (*Accipiter gentilis*) are abundant in Alaska, but rarely seen. These birds nest in woodland forests, most frequently in middle age (20-45 years old) spruce trees (ADF&G 1994a). Eggs hatch in late May or early June. Goshawks eat snowshoe hares, grouse, ptarmigan, ducks, squirrels, voles, shrews, and some songbirds and shorebirds. Sharp-shinned hawks eat songbirds, small mammals and large insects. While hawks have few natural predators, bears, lynx, and other climbing predators can sometimes reach their nests (ADF&G 1994a).

The **boreal owl** (*Aegolius funereus*) and **northern hawk owl** (*Surnia ulula*) inhabit the Cook Inlet area. They lay their eggs in cavities or old woodpecker nest cavities in old trees (ADF&G 1994a). The boreal owl feeds at night on voles, mice, shrews, and small birds; population cycles of voles are a limiting factor in owl populations. Marten are the main predator of the boreal owl. The northern hawk owl hunts mostly during the day, is noted for its unusual tolerance of human activity, and will nest close to human settlements. Its main predators are the great horned owl and northern goshawk (ADF&G 1994a).

The **common raven** (*Corvus corax*) is a member of the Corvidae family, which also includes jays, crows, and magpies. Ravens use a wide variety of habitats. Ravens feed on a variety of both plant and animal foods, and are also scavengers. Ravens breed at age 3 or 4 years, mate for life, and can live up to 30 years. Ravens congregate near human settlements during non-breeding times (ADF&G 1994a).

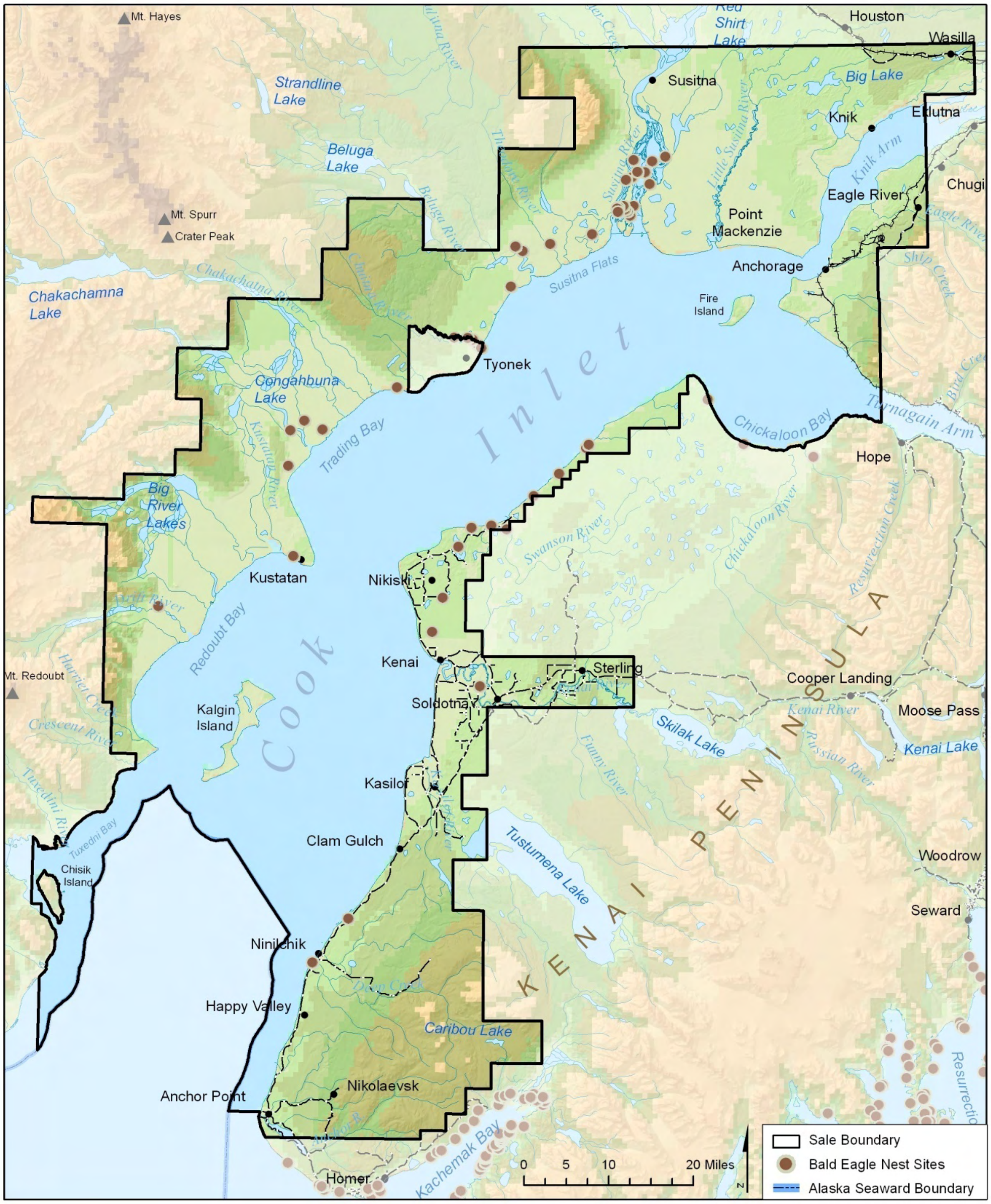

Figure 4.5. Bald eagle nest sites.

Spruce grouse (*Canachites canadensis*), also known as **spruce hens,** are common throughout the Cook Inlet area. Preferred habitat includes spruce-birch forest with a thick understory of cranberry, blueberry, crowberry, and spirea, above a moss-covered ground (ADF&G 1994a). During summer, spruce grouse eat flowers, green leaves, and berries. Insects provide food for newly hatched chicks. **Ruffed grouse** (*Bonnasa umbellus*) are common to woodlands along interior Alaska rivers, but were recently introduced to the Matanuska-Susitna Valley, where they are now abundant. Summer foods include blueberries, high-bush cranberries, rose hips, and aspen buds. In winter, they feed primarily on the buds and twigs of aspen, willow, and soapberry. Game bird populations in Alaska fluctuate widely, but rarely in a 10-year cycle, and are probably influenced by climate, food and cover conditions, predators, and genetic factors (ADF&G 1994a).

Willow ptarmigan (*Lagopus lagopus*), Alaska's state bird, are found throughout the Cook Inlet area in high, treeless areas, along with rock and white-tailed ptarmigan (*L. mutus* and *L. leucurus*). Willow ptarmigan tend to live closest to the tree line. Hens nest on the open ground after snowmelt and hatchlings arrive in late June or early July. Ptarmigan populations fluctuate dramatically and the causes remain unknown (ADF&G 1994a).


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Willow ptarmigan.

Common loons (*Gavia immer*) are found on lakes throughout the Cook Inlet area during the summer, and they winter along the coast from the Aleutians to Baja California. The **Pacific loon** (*G. pacifica*) is distributed widely throughout the Cook Inlet area, and is the most common wintering loon on the coasts of Southcentral Alaska. **Red-throated loons** (*G. stellata*) are also common throughout the lease sale area. Loons migrate to coastal areas in September or early October, and return to their freshwater nesting habitat in May. Loons mate for life and return each year to the same area to breed. Breeding success may be related to the presence of gulls, jaegers, and foxes. Loons are excellent divers and feed on small fish, aquatic vegetation, insects, mollusks, and frogs (ADF&G 1994a).

Several species of other land birds have been identified as species of conservation concern by ADF&G, including the olive-sided flycatcher, rusty blackbird, blackpoll warbler, gray-cheeked thrush, and Townsend's warbler (ADF&G 2007). Populations of Alaskan breeding **olive-sided flycatchers** have declined 2.3 percent per year from 1980-2004, and survey data show a consistent and widespread decline of 3.5 percent across the U.S. and Canada from 1966-2004, probably due to deforestation and forest fire suppression activities in their wintering habitat of Central and South America (ADF&G 2007). Populations of **rusty blackbird** breeding in Alaska have declined 5.2 percent per year, and have also declined across North America and Canada at a rate of 10.3 percent per year. Causes of the decrease in abundance are unknown (ADF&G 2007). **Blackpoll warbler** populations have also declined in Alaska and across North America at similar rates. They are especially vulnerable to removal of tropical forests, and are of concern in Alaska because a high percentage of the species' global breeding range is found here (ADF&G 2007).


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Blackpoll warbler.

Townsend's warbler is found in the Cook Inlet area in May and June, and breeds in northern coniferous forests. This species may be sensitive to disturbances to its habitat of mature boreal forests (ADF&G 2007). **Gray-cheeked thrush** breed in northern spruce forests, and are found in early summer in upland mixed-species deciduous and coniferous forests of the Cook Inlet area. Surveys indicate that populations have declined in eastern North America, and they are particularly vulnerable to alterations to their breeding habitat of tropical broadleaf forests in Central America (ADF&G 2007).

Chickadees (*Parus sp.*) are common throughout Alaska's forests with some species associated with conifers and others with deciduous forest cover. These small birds live an average of 2 to 3 years, and feed on insects, including several considered to be forest pests (ADF&G 1994a). Hawks and other flying predators eat chickadees.

3. Mammals

a. Terrestrial Mammals

Numerous species of terrestrial mammals inhabit the Cook Inlet area. Big game species include moose, caribou, black bear, brown bear, Dall sheep, and mountain goat. Other terrestrial mammals include furbearers, such as wolves, lynx, marten, otters, beaver, mink, wolverines, and small game.

Moose (*Alces alces gigas*) are found throughout Southcentral Alaska (Figure 4.6), especially along recently burned areas with willow and birch shrubs, on timberline plateaus, and along major rivers (ADF&G 1994a). They generally calve between mid-May and early June. Moose have high reproductive potential and can reach the carrying capacity of their range if not limited by predation, hunting and severe weather (ADF&G 1994a). Food abundance is an important limiting factor for moose populations (ADF&G 2008c). Moose populations throughout the Cook Inlet area are significantly affected by winter weather conditions (Del Frate 2004a, c, d; Sinnott 2004; Selinger 2004a; McDonough 2004a, b).

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Moose.

In the Matanuska Valley (ADF&G management unit 14A), where moose were once scarce, agricultural activities, a 37,000 acre fire, land clearing for construction and roads, and habitat enhancement projects have resulted in population increases (Del Frate 2004a). Populations have also increased in the Anchorage area (unit 14C) with the abundance of prime moose browse found on burned-over and rehabilitated military lands, and in parks, greenbelts, residential areas, and quality riparian habitat along urban streams and rivers. However, winter habitat is expected to decrease in the long-term as urban development continues and habitat enhancement options are limited (Sinnott 2004).

On the Kenai Peninsula (units 15A, 15B, 15C), a lack of large wildfires has resulted in less moose browse, although small wildfires and some habitat projects have resulted in a temporary reversal of decreasing moose abundance (Selinger 2004a). Large portions of the Kenai Peninsula were infested and killed by the spruce bark beetle, which is expected to affect the quality of moose habitat, but the nature of the effects remains uncertain (McDonough 2004a, b). Important winter habitat on the southern Kenai Peninsula includes the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, lower reaches of the Fox River and Sheep Creek, and the Homer Bench (McDonough 2004b).

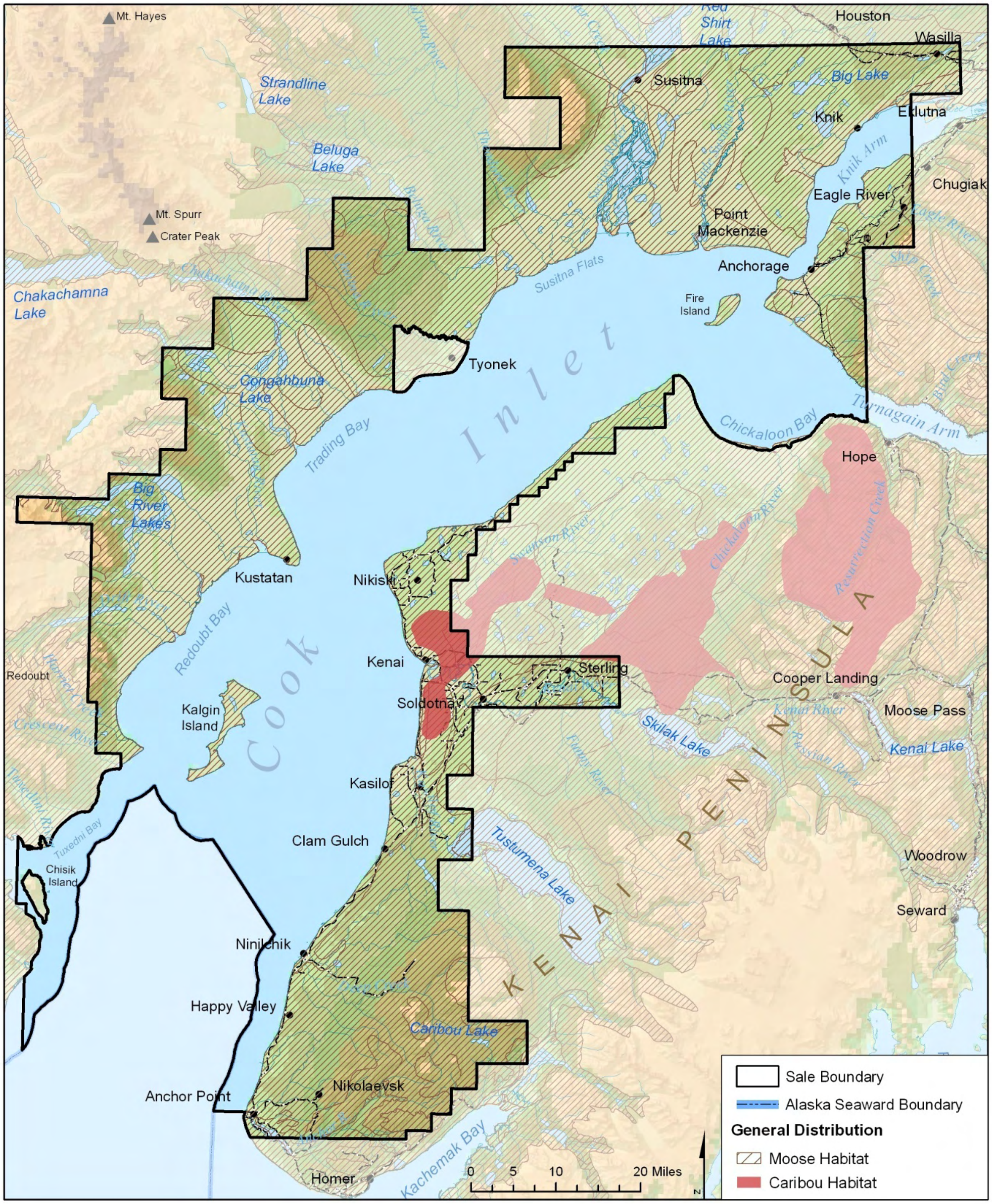

Figure 4.6. Important moose and caribou habitat in the Cook Inlet area.

Roadkill, predation, and habitat loss have been identified as chronic problems for moose populations in unit 15A (northern Kenai Peninsula; ADF&G 2007).

On the west side of Cook Inlet (units 16A and 16B), few wildfires and habitat enhancement projects have resulted in limited increases in moose habitat (Del Frate 2004c, d). In unit 16B (west side of Cook Inlet and Kalgin Island), population levels have been below management objectives, and have been too low to sustain normal harvest levels, and thus general hunting seasons and Federal subsistence cow hunts have been closed until the population increases (ADF&G 2007).

Abundance of moose ranged from about 1,000 animals in unit 16B to over 6,500 animals in unit 14A during regulatory years 1993/1994 through 2003/2004 (Table 4.10, Table 4.11, Table 4.12). Harvest of moose was also highest in unit 14A. Moose mortalities from vehicle and train accidents were significant throughout most of the Cook Inlet area (Table 4.10, Table 4.11, Table 4.12).

Known calving areas on the Kenai Peninsula include regions northeast of Kenai, along the coast between the Kenai and Kasilof rivers, northeast of Homer, and at the head of Kachemak Bay (ADF&G 2007). Moose are year-round residents, although many exhibit seasonal movements related to snow depth and the availability of food. They are found in both lowland and upland shrub communities and lowland areas with ponds during summer and fall. In winter, moose concentrate in areas of relatively shallow snow depth, frequently along river drainages. Wintering areas have been identified along several drainages in Trading and Redoubt; the lower McArthur River, upper Middle River, Noautka Slough, lower Chakachatna River, and Nikolai Creek. On the east side of Cook Inlet wintering areas occur northeast of Kenai, in the Soldotna area, along the coast between the Kasilof River and Ninilchik, along the Anchor River and Fritz Creek, and at the head of Kachemak Bay (ADF&G 2007). Moose also winter and calve along the Skwentna, Yentna, Kahiltna, Susitna, Little Susitna, and Matanuska Rivers (Figure 4.6; ADF&G 1985).

Table 4.10. Estimates of abundance, harvest, and road and train mortalities of moose in the Matanuska-Susitna and Anchorage areas, regulatory years 1993-2003.

Regulatory Year	Unit 14A[a] Abund.[b]	Unit 14A[a] Harvest	Unit 14A[a] Road/ Train[c]	Unit 14B[a] Abund.[b]	Unit 14B[a] Harvest	Unit 14B[a] Road/ Train[c]	Unit 14C[a] Abund.[b]	Unit 14C[a] Harvest	Unit 14C[a] Road/ Train[c]
1993–94	5,672	490	184		49	24			
1994–95	6,000	605	299	2,336	55	91			
1995–96	5,250	543	96		80	27			
1996–97	6,000	940	202		121	17			
1997–98	5,500	834	184		101	27			
1998–99	4,729	671	149		109	34	2,100	117	158
1999–00	5,348	415	215	1,687	94	101	1,650	93	161
2000–01	5,552	401	140		82	21		107	165
2001–02	6,679	467	267		94	41	1,965	106	238
2002–03		624	132		94	13		114	154
2003–04	6,564								

Notes: Cells without values indicate surveys were not conducted or that the estimate is not available.
Sources: Del Frate 2004a, b; Sinnott 2004.

[a] Unit 14A is the Matanuska Valley; Unit 14B is the western Talkeetna Mountains; Unit 14C is the Anchorage area.
[b] Estimates of abundance.
[c] Road and train mortalities.

Table 4.11. Estimates of abundance, harvest, and road and train mortalities of moose in the Kenai Peninsula area, regulatory years 1993-2003.

Regulatory	Unit 15A[a]			Unit 15B[a]			Unit 15C[a]		
Year	Abund.[b]	Harvest	Road/ Train[c]	Abund.[b]	Harvest	Road/ Train[c]	Abund.[b]	Harvest	Road/ Train[c]
1993–94									
1994–95									
1995–96									
1996–97									
1997–98									
1998–99	3,400	311	138		77	74	2,650	310	76
1999–00		131	81		63	47	2,750	201	59
2000–01	1,704	171	59	958	67	30	2,750	238	58
2001–02	2,000	268	100		70	42	2,981	343	87
2002–03	1,500	181	73		61	33	3,000	292	78
2003–04									

Notes: Cells without values indicate surveys were not conducted or that the estimate is not available.
Sources: Selinger 2004a; McDonough 2004a, b.

[a] Unit 15A is the northern Kenai Peninsula; Unit 15B is the Kenai Peninsula; Unit 15C is the southern Kenai Peninsula.
[b] Estimates of abundance.
[c] Road and train mortalities.

Table 4.12. Estimates of abundance, harvest, and road and train mortalities of moose in the west side Susitna River and west side Cook Inlet, regulatory years 1993-2003.

Regulatory	Unit 16A (Westside Susitna)			Unit 16B (Westside of Cook Inlet and Kalgin Is.)		
Year	Abundance	Harvest	Road/Train[a]	Abundance	Harvest	Road/Train[a]
1993–94	3,284	128	9	5,659	220	0
1994–95	3,300	143	4	1,075	280	5
1995–96		166	15	1,156	234	0
1996–97		241	4	2,007	350	1
1997–98	3,636	237	14		376	1
1998–99		205	10		347	0
1999–00		208	16	3,384	396	0
2000–01	2,420	175	20	999	351	0
2001–02		189	15	3,923	199	0
2002–03		190	12		150	0
2003–04				1,023		

Notes: Cells without values indicate surveys were not conducted or that the estimate is not available.
Sources: Del Frate 2004c, d.

[a] Road and train mortalities.

The primary herds of **caribou** (*Rangifer tarandus granti*) in the Cook Inlet area are found on the Kenai Peninsula, the result of reintroductions in 1965-1966 and 1985-1986 (Selinger 2005b). Four herds of caribou inhabit the Kenai Peninsula: the Kenai Mountains caribou herd (KMCH), Kenai Lowlands caribou herd (KLCH), Killey River caribou herd (KRCH), and Fox River caribou herd (FRCH; Figure 4.6). A fifth herd, the Twin Lakes herd, is now considered part of the Killey River herd (Selinger 2005b). Herd sizes in 2003-2004 were estimated to be 300 caribou for the KMCH, 135 for the KLCH, 400 for the KRCH, 30 for FRCH.

The KMCH is found in the drainages of the Chikaloon River, Big Indian Creek, and Resurrection Creek. The KLCH uses an area north of the Kenai airport to the Swanson River in the summer; the Kenai National Wildlife Refuge includes important winter habitat for the KLCH, particularly along the Moose River and the Skilak Lake outlet, and south to Brown's Lake (Selinger 2005b). The upper drainages of the Funny River and Killey River are important habitat for the KRCH; and the FRCH uses the area between the upper Fox River and Truuli Creek (Selinger 2005b).

Caribou are found in subalpine habitat that is seldom used by moose, but they may compete with Dall sheep for winter range (Selinger 2005b). Caribou feed on willow leaves, sedges, flowering tundra plants, mushrooms, lichens, dried sedges, and small shrubs such as blueberries (ADF&G 1994a). They may use ridge tops, frozen lakes and bogs, and other open areas for resting to avoid predators such as wolves (ADF&G 1985). They also appear to avoid, or are very cautious, when entering riparian willow and other heavy brush, as these may be areas in which they would be more vulnerable to attacks by wolves and bears (ADF&G 1985). Open, gently-sloping terrain with a wide view is used by caribou during calving, probably to avoid predators. Caribou calve from approximately mid-May through early June (ADF&G 1994a). In general, abundance is limited by predation, including domestic dogs, coyotes, bears, and wolves, rather than habitat (Selinger 2005b).

Wetlands in the vicinity of the Kenai airport and along the coast to the south of the Kenai River provide calving habitat for the KLCH. Caribou stay in the vicinity of the calving grounds all summer. Following the rutting season in October, the herd moves northeast to winter on the Moose River Flats. Caribou remain on the Flats through April or early May, and then return to the Kenai area to calve (ADF&G 2007).

Black bears (*Ursus americanus*) and **brown bears** (*U. arctos*) are found throughout the Cook Inlet area. Black bears range throughout forested habitats of the Cook Inlet area, and may also be found from sea level to alpine areas (ADF&G 1994a). Brown bears are especially prevalent in remote lowland forests and intermountain valleys (Selinger 2005a). The game refuges and critical habitat areas located in the Cook Inlet area provide important habitat for both bear species, including the Susitna Flats State Game Refuge, Goose Bay State Game Refuge, Trading Bay State Game Refuge, Redoubt Bay Critical Habitat Area, Anchor River Critical Habitat Area, and Fox River Critical Habitat Area (ADF&G 2008f). Populations of black bears are estimated to be about 3,000-4,000 bears for the Kenai Peninsula, 530-1,080 bears in the upper Cook Inlet area, and a minimum of 1,825-3,650 bears in the west side of Cook Inlet area (Kavalok 2005a, c, McDonough 2005). An estimated 277 brown bears inhabit the Kenai Peninsula, 185-239 in upper Cook Inlet, and 586-1,156 in the west side of Cook Inlet (Kavalok 2005b, d; Selinger 2005a).


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Brown bear.

Other than during mating in June and July, black and brown bears are usually solitary, except for sows with cubs (ADF&G 1994a). However, concentrations of brown bears do occur where food is concentrated, such as on salmon spawning streams (ADF&G 1994a). They are most abundant in wooded areas, and along the Cook Inlet shoreline in the vicinity of streams, bogs, and clearings (ADF&G 2007). Black bears eat a wide variety of food, including green vegetation in the spring, winter-killed animals, newborn moose calves, small mammals, salmon, berries, ants, grubs, and other insects (ADF&G 1994a). They may also become habituated to eating garbage (ADF&G 1994a). The distribution and abundance of devil's club appears to be an important factor in the distribution and movement of black bears, and they seem to occur in higher densities along the southern outer coast, probably because of large runs of salmon and lower densities of brown bears (McDonough 2005). Brown bears eat a wide variety of foods, including berries, grasses, sedges, horsetails, cow parsnip, fish, squirrels, and many kinds of roots; and they prey on newborn moose and caribou calves, and can also kill and eat adult moose and caribou as well as domestic animals (ADF&G 1994a). Brown bears eat most carrion, and will also become habituated to eating garbage.

Black bears hibernate in dens during the winter, which may be located from sea level to alpine areas, and may be in rock cavities, hollow trees, or excavations (ADF&G 1994a). Most brown bears also hibernate during the winter (ADF&G 1994a). Cubs are born in dens in the winter, and bears emerge from their dens in spring, often in May (ADF&G 1994a).

ADF&G

Black bear.

Brown bears of the Kenai Peninsula rely heavily on spawning salmon for food; therefore, access to spawning streams is critical for brown bears (ADF&G 2000a). Upland habitat adjacent to the riparian areas is used for loafing, cover, and other foraging when not feeding on salmon (ADF&G 2007). Large, undeveloped land masses contribute to stable bear populations, brown bears have large home ranges, and they also require habitat linkages such as travel corridors to food sources, and cover for security (ADF&G 2000a; ADF&G 2007).

Most of the Redoubt Bay Critical Habitat Area is intensively used by brown bears from spring through fall. Black bear spring concentration areas have been documented along the shore at the Kustatan River, the upper McArthur River, and the slopes bordering the critical habitat area between Drift River and the South Fork Big River. Both species are concentrated along salmon streams in late summer and fall, particularly the Kustatan River (ADF&G 2007). Known intensive use areas for black bear include the Susitna River at its mouth and an area about the river west of Willow. Black bears are also present in the Anchor River and Fritz Creek Critical Habitat Area during their active period (i.e., May-September), and probably den within the South Fork of the Anchor River and Fritz Creek drainages. Brown bears also inhabit the area, and both species concentrate along the South Fork of the Anchor River in July and August to feed on spawning salmon. Brown bears continue to feed on salmon at the headwaters of the South Fork of the Anchor River through early October (ADF&G 2007). Salmon heads and abundant streamside blueberries are favorite foods for bears.

After emerging from their dens in late April, black and brown bears move into grassy flatlands to graze on sedges, grasses, and other plants (ADF&G 2007). Brown bears are found throughout the coastal wetlands of Redoubt Bay during this time of year, and several black bear spring concentration areas have been documented in Redoubt and Trading bays. Bears also concentrate along salmon streams during the summer and fall. The Kustatan River, Anchor River, and headwaters of the Ninilchik River and Deep Creek support particularly high numbers of bears during salmon spawning periods (ADF&G 2007).

Because of alterations to bear habitat from development activities, and expansion into bear habitat by residents and visitors that led to increases in the number of bears killed in defense of life or property, brown bears of the Kenai Peninsula were designated a species of special concern by ADF&G in 1998 (ADF&G 2000a). As a result, an interagency brown bear study team was formed to coordinate basic research among the various state and federal agencies responsible for brown bears on the Kenai Peninsula, and the Kenai Peninsula Brown Bear Conservation Strategy was developed to identify policies and management actions that will help ensure the future of brown bears and their habitat, and avoid brown bears of the Kenai Peninsula being listed under the federal Endangered Species Act (ADF&G 2008d). A conservation assessment for Kenai Peninsula brown bears was developed in 2001 (IBBST 2001). Reducing non-hunting human-caused mortalities is a high priority for management of the Kenai Peninsula brown bear population (ADF&G 2007).

Several recent studies have added to the body of knowledge concerning Kenai Peninsula brown bears. A study of the genetics of Kenai brown bears found that there was no significant inbreeding of the population, and that there was no evidence of population substructuring (Jackson et al. 2008). Another study examined frequency and distribution of highway crossings by brown bears, finding that highways affected brown bear travel patterns (Graves et al. 2006).

Mountain goats (*Oreamnos americanus*), characterized by relatively short horns, are relatively abundant in Alaska. They usually inhabit rugged terrain, occupying steep and broken mountain areas from sea level to as high as 10,000 feet (ADF&G 1994a). In Southcentral Alaska, they are found primarily in the Chugach and Wrangell mountains, although their range extends into the Talkeetna Mountains, which is considered marginal habitat (Coltrane 2004). Mountain goats are also found throughout the Kenai Mountains, but primarily within the Kenai Fjords National Park, Kenai National Wildlife Refuge, Chugach National Forest, and Kachemak Bay State Park. Populations on the Kenai Peninsula are currently stable at about 3,500-4,500 animals (McDonough 2004c).


USFWS

Mountain goat.

Mountain goats normally summer in high alpine meadows where they graze on grasses, herbs, and low-growing shrubs. In winter, they migrate closer to the treeline in search of browse. Hemlock is an important winter food for mountain goats (ADF&G 1994a). Predators include wolves and bears. Mountain goats mate in November and December. Males may wander considerable distances in search of females. Usually a single kid is born in late May or early June. Kids usually remain with their mothers until the next breeding season. Mountain goats may live 14 to 15 years, though most live fewer than 12 years (ADF&G 1994a).

Wolves (*Canus lupus*) are present throughout the Cook Inlet area. Abundance of wolves varies with prey availability, disease, malnutrition, accidents, and harvest pressure (ADF&G 1994a). Wolves were not found on the Kenai Peninsula during the first half of the 20th century, but recolonized the area beginning in the 1960s. The current population is estimated to be about 200 wolves in 20 packs (Selinger 2003). About 120-150 wolves are estimated to inhabit the Matanuska-Susitna area (Del Frate 2003a), and about 120-140 in 16-19 packs in the west side of Cook Inlet (Del Frate 2003b).

Wolves usually live in packs ranging from 2 to 12 wolves (with an average of 6 or 7), however packs as large as 20 to 30 wolves may occur (ADF&G 1994a). Wolf packs tend to be territorial and stay within a particular range. On the other hand, wolves that depend on migratory caribou may temporarily abandon their territory and travel long distances for food. Pack territory size ranges from 300 to 1,000 square miles with an average of 600 square miles of habitat. Moose or caribou are the wolf's primary food source, although the summer diet is supplemented by voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish (ADF&G 1994a). Wolves den in dug-out holes in well-drained soils as deep as 10 feet. Breeding occurs in February and March, and litters are born in May or early June (ADF&G 1994a).

Other terrestrial mammals also inhabit the Cook Inlet area. Small furbearers include coyote, beaver, lynx, marmot, marten, mink, muskrat, squirrel, red fox, river otter, weasels, and wolverine. These are found throughout the area depending on habitat quality and prey abundance (Selinger 2004b; Kavalok 2004a, b). Other small game include bats, hares, lemmings, pikas, porcupine, shrews, voles, and mice.

b. Marine Mammals

Beluga whales (*Delphinapterus leucas*) are a medium-sized cetacean related to narwhales, sperm and killer whales, dolphins, and porpoises (ADF&G 1994a). They are found in the Northern Hemisphere throughout arctic and subarctic waters, both coastal and offshore (NMFS 2008a). Their distribution varies by season and region, and is affected by a range of conditions such as temperature, ice cover, tides, and prey availability (NMFS 2008a). Adult beluga males range in size from 11-15 ft and in weight from 1,000-2,000 lbs; females tend to be smaller, usually no more than 12 ft in length (ADF&G 1994a). Female belugas attain sexual maturity between 4 and 5 years old, and males mature slightly later. In Cook Inlet, breeding is believed to occur in late spring and early summer, but mating periods, calving periods, and calving areas are poorly documented (Hobbs et al. 2006). The gestation period is about 14.5 months, and females may produce a calf about every three years (ADF&G 1994a). Belugas can live to be about 40 years old.

NMFS

Beluga whale.

Belugas are predators and consume a wide range of prey, probably influenced by both seasonal prey abundance and preference. Some species found in stomachs of belugas in Cook Inlet during spring, summer and fall include eulachon, salmon, walleye pollock, cod, flatfish, sculpin, crab, and shrimp, some of which may have resulted from secondary ingestion; there are no data on feeding habits of belugas during the winter, November through March (Hobbs et al. 2006).

NMFS currently considers belugas of Cook Inlet to be a discrete population that remains in Cook Inlet year round (Hobbs et al. 2006). However, this conclusion has been challenged as being based on data that are too limited, and on a faulty and subjective application of the definitions and criteria for designating a population as a "Distinct Population Segment" under the Endangered Species Act (Hartig et al. 2007).

Based on aerial surveys and one radio telemetry study of 14 animals, beluga distribution is currently believed to be concentrated in upper Cook Inlet, particularly near river mouths and mudflats, and in shallow, relatively warm, low-salinity water near major river outflows such as the Susitna River, Knik Arm, and Chikaloon Bay, although in the past they were also seen to a lesser extent in Kachemak Bay, Redoubt Bay, and Trading Bay (Moore et al. 2000; Hobbs et al. 2006; Hobbs et al. 2005; Goetz et al. 2007). It is unknown if this reflects a preference for those conditions, or is indirectly related to prey availability and distribution, and low occurrence of predators (Moore et al. 2000; Goetz et al. 2007). In winter, belugas are more dispersed (Moore et al. 2000). In Knik Arm, movement of belugas and their usage of habitat is greatly influenced by extreme tidal fluctuations that result in changes in water depths of up to 39 ft (Funk et al. 2005). Although distribution of belugas is highly variable, movements through Knik Arm appear to follow corridors along the eastern shoreline (Ireland et al. 2005).

Studies of belugas in Knik Arm in 2004 and 2005 concluded that,

> "The pattern of beluga whale use of Knik Arm might best be described as high during the fall (August through October), reduced and more sporadic in shoulder seasons (April through July and November through early December), and occasional visitation at other times of year (mid-December through March). This description best fits observations made in Knik Arm as well as available data on the relative use of different parts of Cook Inlet by beluga whales" (Markowitz et al. 2005).

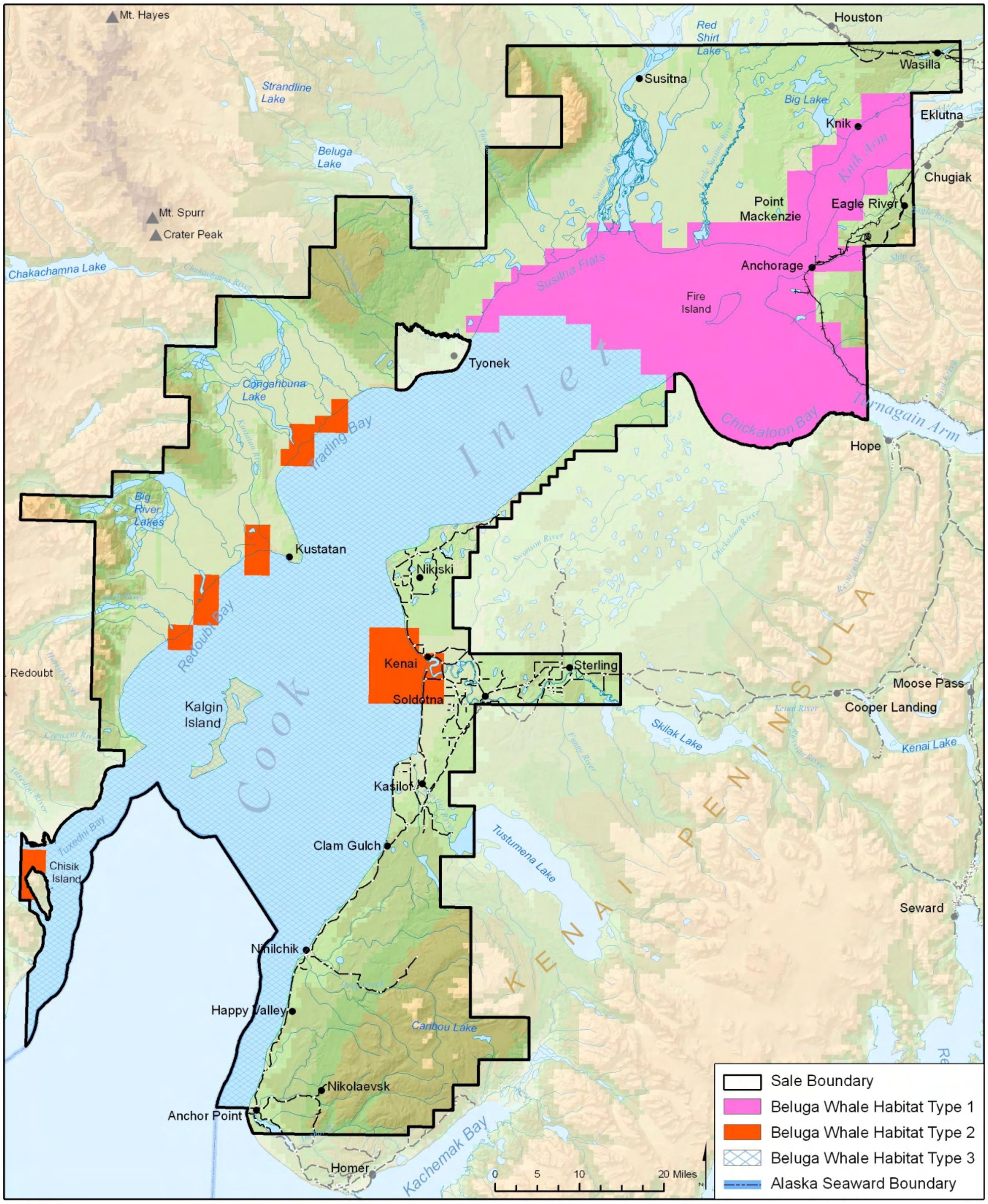
The current distribution of belugas in the core areas of their range, relative to past sitings, may be a result of a smaller population, and in addition, belugas may prefer estuarine waters (Goetz et al. 2007). As the population recovers after cessation of subsistence hunting, beluga distribution will probably expand into portions of habitat that are currently unused (Goetz et al. 2007). Based on information concerning habitat usage provided to DO&G by NMFS, supplements to the 1999 Best Interest Finding for Cook Inlet were issued in 2004 and 2008 adding restrictions to tracts to the mitigation measures (Figure 4.7; DO&G 2004, 2008).


NMFS

Beluga whales.

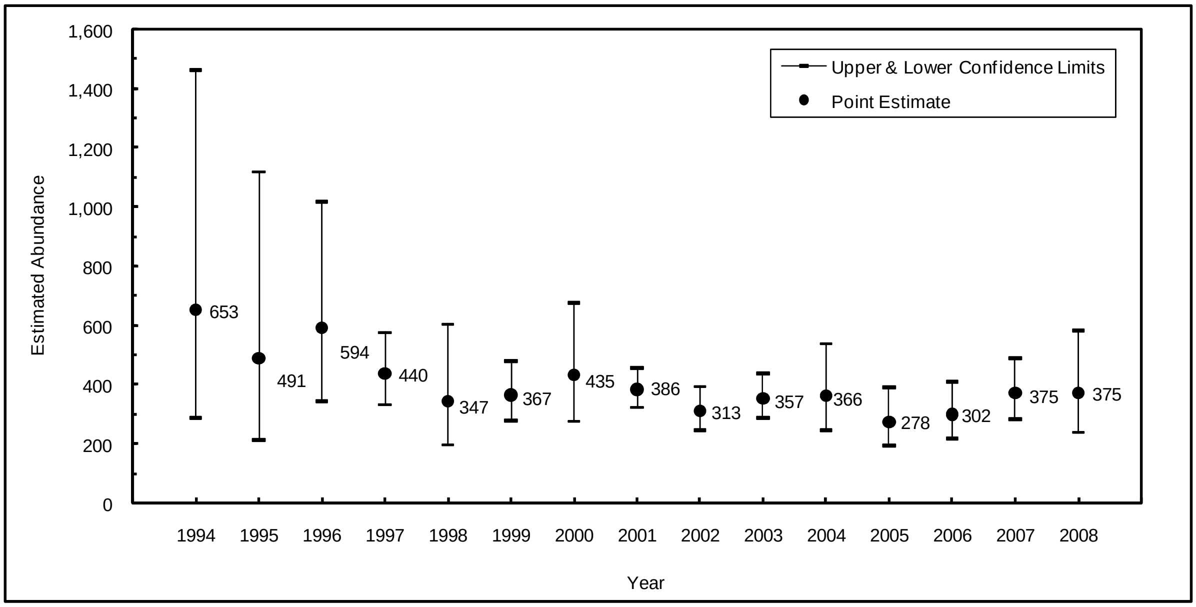
Abundance of belugas in Cook Inlet decreased from 1994-1998, most likely due to Native subsistence hunts (Hobbs et al. 2006). Estimating abundance of Cook Inlet belugas is difficult because of several sources of variability during aerial surveys, including variable surfacing intervals of belugas, varying correction factors to account for missed whales, observer variability, and because high densities of beluga aggregations make them difficult to count (Hobbs et al. 2000a; Hobbs et al. 2000b). Estimating beluga abundance is also difficult because of differences in visibility of older, white belugas which are relatively easy to spot, and younger, blue-gray whales which are difficult to see (Hartig et al. 2007). Abundance estimates with their associated variances are available for 1994-2008 (Figure 4.8; Hobbs et al. 2000a; Hobbs et al. 2006; Hobbs et al. 2008). Estimates for 1994-1998 showed a significantly decreasing trend; there was no significant trend in estimates for 1999-2005 (Angliss and Outlaw 2006). Point estimates of abundance in 2006 (302 animals) and 2007 (375 animals) were higher than for 2005 (278 animals), the lowest point estimate since 1994 (Hobbs et al. 2008). The point estimate for 2008 was 375 beluga whales (NMFS 2008j).

On April 20, 2007, NMFS proposed endangered status for Cook Inlet belugas (72FR 76, 19854). On July 31, 2007, the State of Alaska submitted comments to NMFS objecting to the proposal. The state's objections were based on issues with how abundance estimates were calculated, assumptions underlying abundance estimates and reproductive rates, lack of scientific and commercial data to support a claim of danger of extinction, issues with whether or not the Cook Inlet beluga population is a "Distinct Population Segment", lack of impacts on belugas or their habitat, and the large amount of protected habitat (over 15 million acres) in the Cook Inlet area (Hartig et al. 2007). On April 22, 2008, NMFS extended the date by which a final determination on endangered status would be made



Notes: See Chapter 9, Section A2p-A2r.

Figure 4.7. Location of tracts with restrictions on oil and gas development, based on beluga habitat types defined by NMFS.



Source: Hobbs et al. 2008; NMFS 2008j.

Figure 4.8. Estimated abundance of beluga whales in Cook Inlet, 1994-2008.

to October 20, 2008 (73FR 78, 21578). On October 22, 2008, a final determination to list Cook Inlet beluga whales as endangered was issued, with an effective date of December 22, 2008 (73 FR 205, 62919). A conservation plan for Cook Inlet belugas was also published by NMFS in October 2008 (NMFS 2008b). NMFS critical habitat designations are pending.

Fin whales (*Balaenoptera physalus*) are found off the coast of North America and in the Bering Sea during the summer (Angliss and Outlaw 2008), although little is known of their distribution in, and use of, Cook Inlet. Fin whales migrate to subtropical waters in the winter, where they mate and calve (ACS 2004). Females reach sexual maturity at 6-8 years old, and give birth every 2-3 years (NMFS 2005). They migrate to the Arctic and Antarctic during the summer for feeding. Although they are usually solitary, they may be found in groups of three to seven, and at times, in larger concentrations. As a baleen whale, the diet of fin whales consists mostly of krill and schooling fish (ACS 2004).

The fin whale is listed as endangered under the Endangered Species Act of 1973, and the Northeast Pacific stock is classified as a strategic stock. Reliable estimates of populations size and population trends are lacking (Angliss and Outlaw 2008).

Humpback whales (*Megaptera novaeangliae*) are found throughout the world's oceans (Angliss and Outlaw 2008). They occur in subtropical and tropical waters during the winter. Humpback whales feed on euphasiids and small schooling fish. The Central North Pacific stock migrates between wintering areas in Hawaii or Mexico where they calve, and a summer feeding area in the North Pacific that includes Cook Inlet. The entire North Pacific stock is thought to number about 4,000 (Angliss and Outlaw 2008). Humpback whales reach sexual maturity at 4 to 6 years, and females give birth every two to three years (ADF&G 1994a).

Humpback whales are listed as endangered species under the Endangered Species Act, and the Central North Pacific stock is classified as a strategic stock (Angliss and Outlaw 2008).

Harbor porpoises (*Phocoena phocoena*) are widely distributed and may be locally abundant (NMFS 2008g). Those occurring in Cook Inlet belong to the Gulf of Alaska stock, one of three stocks found in Alaska (Angliss and Outlaw 2008). They are generally found in harbors, bays, and river mouths (MMS 2003). Densities of harbor porpoises in Cook Inlet have been reported at 0.72 animals per square kilometer (MMS 2003, citing to Dahlheim et al. 2000). Based on a 1991 aerial survey, 422 harbor porpoises were estimated to inhabit Cook Inlet (Small and DeMaster 1995). They make inshore-offshore seasonal movements that may be related to prey or ice conditions (NMFS 2008g). Harbor porpoises feed on a wide variety of fish and cephalopods, particularly schooling fish such as herring, mackerel, and pollock (MMS 2003, citing to Leatherwood and Reeves 1987). Harbor porpoises are usually found singly, in pairs, or in groups up to 10 (NMFS 2008g). Little is known of their reproductive behavior, although mating occurs in summer and births occur between May and July (NMFS 2008g).

Harbor seals (*Phoca vitulina richardsi*) are found in marine and estuarine waters of the Cook Inlet area (Figure 4.9), but are also occasionally found seasonally in freshwater rivers and lakes (Angliss and Outlaw 2008; ADF&G 1994a). The most recent estimates put abundance of harbor seals in the Gulf of Alaska, which includes Cook Inlet, at 45,975 animals for 1996-2000, but there are no data available on population trends for Cook Inlet harbor seals (Angliss and Outlaw 2008). Harbor seals in Alaska are currently considered to comprise three stocks, but new genetic information is being analyzed and is expected to result in revisions to the current stock divisions (Angliss and Outlaw 2008). Harbor seals are listed as an Alaska species of special concern (ADF&G 2008b).


USFWS

Harbor seal

Harbor seals are generally non-migratory, but they make local movements related to tides, weather, season, food availability, and reproduction (Angliss and Outlaw 2008). Haul out areas include rocks, reefs, beaches, and drifting glacial ice (Angliss and Outlaw 2008). They use haul outs to rest, give birth, nurse their pups, and for thermal regulation, social interaction, and to avoid predators (ADF&G 1994a; NMFS 2008f). They have a strong tendency to return to the same haul out sites in June and July (Angliss and Outlaw 2008). Harbor seals become sexually mature between 3-7 years old, and their pups are born from May through mid-July (ADF&G 1994a). Common prey includes walleye, pollock, Pacific cod, capelin, eulachon, Pacific herring, salmon, octopus, and squid (ADF&G 1994a).

Three stocks of **northern sea otter** (*Enhydra lutris kenyoni*) occur in Alaska: Southeast, Southcentral, and Southwest stocks. The Southcentral Alaska stock is found in lower Cook Inlet but at generally low densities; they do not occur in upper Cook Inlet (Figure 4.9; Angliss and Outlaw 2008). They are generally found in shallower waters because they forage in subtidal and intertidal habitats (Angliss and Outlaw 2008). Sea otters are generally not migratory, although they may travel long distances if an area becomes overpopulated or food is scarce (Angliss and Outlaw 2008; ADF&G 1994a). Sea otters feed on sea urchins, crabs, clams, mussels, octopus, other marine invertebrates, and fish (ADF&G 1994a). The sea otter body temperature is maintained by air trapped in their fur (ADF&G 1994a).

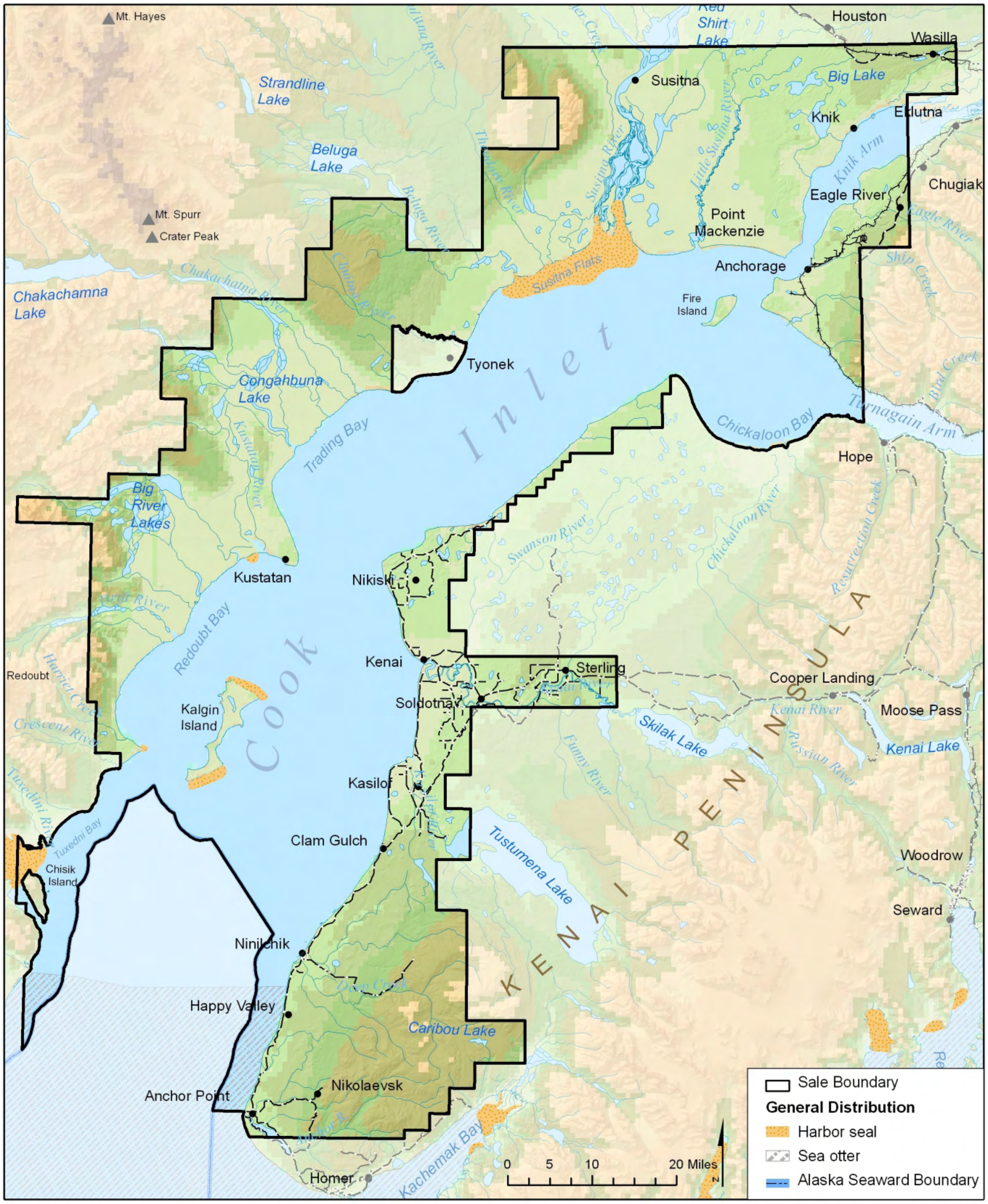


Figure 4.9. Important harbor seal and sea otter habitat.

In 2002, abundance of sea otters in lower Cook Inlet and Kenai Fjords was estimated to be 2,673 animals. The overall trend for the Southcentral stock, which includes Cook Inlet, appears to be stable or slightly increasing, and the population in lower Cook Inlet and Kenai Fjords also appears to be increasing slightly (Angliss and Outlaw 2008). The Southcentral, as well as the Southeast, sea otter stocks are not listed as depleted, threatened or endangered under federal regulations; however, the Southwest stock was listed as threatened under the Endangered Species Act on August 9, 2005 (70 FR 46365 46386).

Steller sea lions (*Eumetopias jubatus*) found in the Cook Inlet area belong to the western stock, one of two stocks of sea lions inhabiting the North Pacific Ocean rim (NMFS 2008l). However, rookeries and haul-outs identified by NMFS are outside the lease sale area (Figure 4.10; NMFS 2008k). Rookeries, used by sea lions for breeding, are usually found on remote island beaches exposed to wind and waves, usually with access that is difficult to predators. Rookeries vary from expanses across low-lying reefs and islands, to narrow strips of beach by steep cliffs; substrates may be sand, gravel, cobble, boulder, or bedrock (NMFS 1992). Haulouts, used by adults during the non-breeding season, include areas used as rookeries during the breeding season, as well as rocks, reefs, beaches, jetties, breakwaters, navigational aids, floating docks, and sea ice (NMFS 1992).

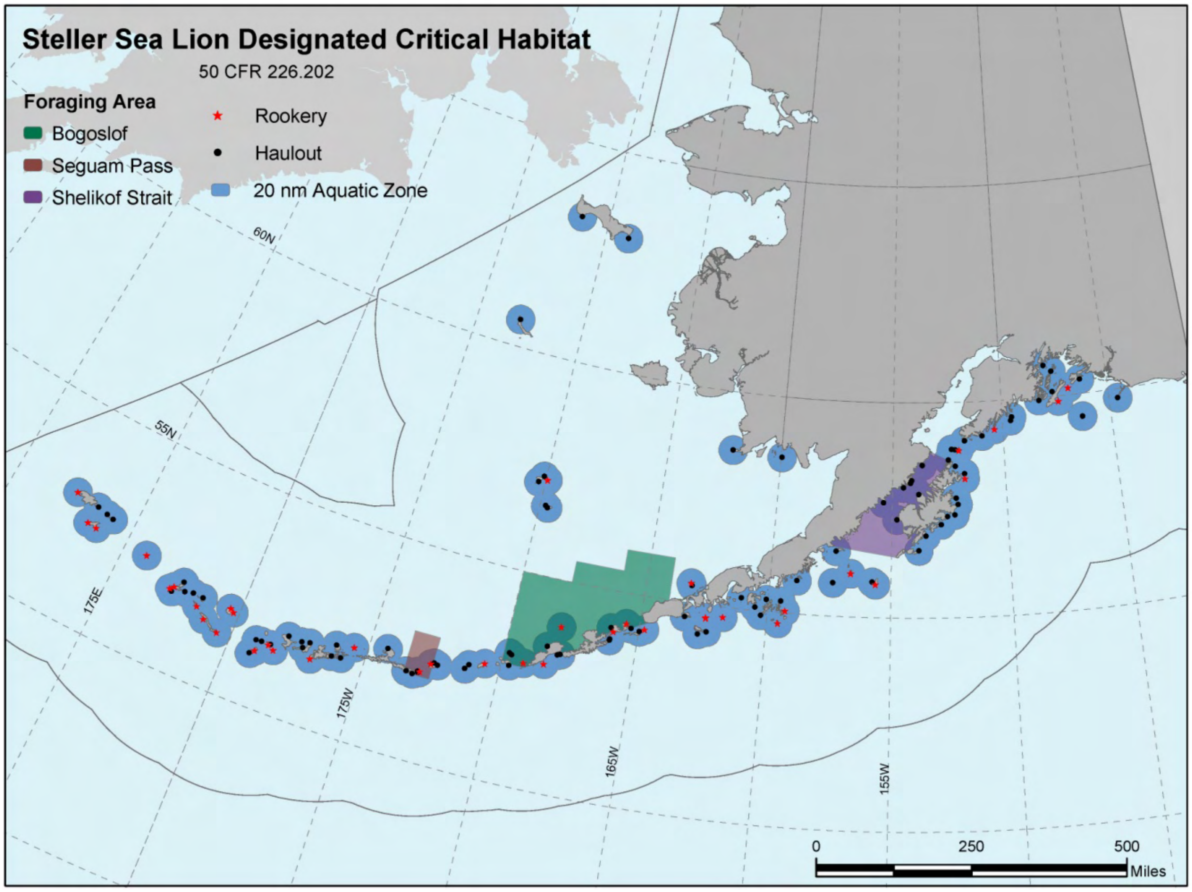

NMFS

Steller sea lions

Steller sea lions can move long distances, and they make seasonal movements from exposed summer areas to protected areas in the winter (ADF&G 1994a). Males that breed in California appear to spend the non-breeding season in Alaska and British Columbia (NMFS 1992). They congregate on rookeries to breed, usually mid-May through mid-July (ADF&G 1994a). Females usually return to the rookery of their birth for breeding (NMFS 1992).

Steller sea lions feed from the intertidal zone to the continental shelf on a wide variety of fish, including pollock, flounder, herring, capelin, Pacific cod, salmon, rockfish, sculpin, and invertebrates such as squid and octopus (ADF&G 1994a).

Steller sea lions were listed as a threatened species under the Endangered Species Act on April 5, 1990 because of a substantial decline in the western stock (NMFS 2008i). Critical habitat was designated by NMFS in 1993, including a 20 nautical mile buffer zone around all major haulouts and rookeries, associated land, air, and aquatic zones, and three large offshore foraging areas (NMFS 2008i). The western stock, reclassified as endangered in 1997, continued to decline during the 1990s, and the total population of the western stock in Alaska is now estimated to be about 45,000 animals (Angliss and Outlaw 2008). From the late 1970s through 1990, the western populations declined by about 70 percent, and by as much as 15 percent annually. It is believed that a combination of several factors contributed to the decline, including changes in the quantity and quality of prey, natural environmental shifts, incidental mortality from commercial fishing, predation, and disease (NMFS 1992; NMFS 2008i). The decline decreased to about 5 percent annually during the 1990s, and recent counts indicate that the decline has stabilized (NMFS 2008i; Angliss and Outlaw 2008).



Source: NMFS 2008k.

Figure 4.10. Federally-designated critical habitat for Steller sea lion.

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Chapter Five: Current and Projected Uses in the Cook Inlet Area

AS 38.05.035(g) directs that best interest findings consider and discuss the current and projected uses in the area, including uses and value of fish and wildlife. The Cook Inlet area provides important habitat for moose, black and brown bear, caribou, and waterfowl, and many fish species that form the resource base for subsistence and sport fishing, hunting and gathering, and for commercial, personal use, and educational fishing. These activities are integral to the history and culture of the area, as well as contributing significantly to the economy. Residents and visitors use the area extensively for recreation and tourism. The surface waters and groundwater of the area provide area residents, businesses, and industry with public water supplies. Other abundant natural resources support forestry, agriculture, mining, and oil and gas industries.

A. State Game Refuges, Wildlife Refuges, Critical Habitat Areas, and Other Designated Areas

A number of state and federal wildlife refuges, critical habitat areas, recreation areas, and parks exist within or near the lease sale area. These areas have significant scenic and recreational value, provide important habitat for fish and wildlife populations, and are used extensively by recreationists, fishers, and hunters. This section focuses on uses of these areas; additional information about the areas, including background and purposes for their designations, is found in Chapter 4, Section A4.

Susitna Flats State Game Refuge produces about 10 percent of the statewide waterfowl harvest. Many hunters land float planes to access the refuge's lakes. The Theodore and Lewis rivers are popular fly-in fishing streams for Chinook salmon from late May through June. Boaters access Susitna Flats from Ship Creek in Anchorage. Producing gas fields within the Susitna Flats include Pretty Creek, Lewis River, Ivan River, and Stump Lake. Natural gas from these fields is used to generate electricity and heat energy for Southcentral Alaska communities.

ADF&G

Little Susitna River boat launch.

Palmer Hay Flats State Game Refuge is important wetland habitat, and also provides recreation, horseback riding, skiing, snow machining, and hunting opportunities for residents. Currently there is no oil or gas activity in the refuge.

Goose Bay State Game Refuge is located in on the west side of upper Cook Inlet. It provides important wetland habitat for waterfowl, and is a moose calving area. In the fall, waterfowl hunting takes place in the refuge. Currently there is no oil or gas activity in the refuge.

Anchorage Coastal Wildlife Refuge is heavily used by residents of Anchorage and visitors to the area. Thousands of people use the refuge each year to view wildlife. Waterfowl hunting is allowed in portions of the refuge. Area residents also enjoy the refuge for other seasonal activities such as ice skating and cross-country skiing.

Oil and gas leases were issued in **Trading Bay State Game Refuge** in 1961, prior to designation of the area as a state game refuge in 1976. It is an important habitat area for waterfowl. Oil and gas activities are permitted by statute within the refuge, when compatible with the purpose for which the state game refuge was established, but restrictions on activities in this special area apply. Current producing fields near the refuge include Nikolai Creek, Trading Bay, and McArthur River. The Trading Bay production facility is sited just south of the refuge. Oil and gas are also produced from about 10 platforms offshore.

Oil and gas leases were issued in **Redoubt Bay Critical Habitat Area** in 1961. Although this critical habitat area was established to protect a variety of fish and wildlife species, it is best known for its prime waterfowl habitat. Oil and gas activities are permitted by statute within the Redoubt Bay Critical Habitat Area when compatible with the purpose for which the area was established although there are restrictions on activities. Current producing fields near the Redoubt Bay Critical Habitat Area include West Forelands and West McArthur River. The Drift River oil storage and transfer terminal is located adjacent to the critical habitat area boundary on the south side of the Drift River.

Kalgin Island Critical Habitat Area receives few visitors, in part because of its remote and relatively inaccessible location. However, setnet fishing for salmon occurs along the shore in summer, and boaters enjoy opportunities for wildlife watching and beach combing. Currently there is no oil and gas activity on Kalgin Island, however some exploration has occurred.

Some lands in the **Clam Gulch Critical Habitat Area** are currently leased and companies are exploring the area's petroleum potential. The Falls Creek gas field is located within the critical habitat area, although it is not currently producing.

About 60 percent of the **Anchor River and Fritz Creek Critical Habitat Area** is included in the lease sale area. No oil or gas production exists in the critical habitat area. The North Fork gas field, located to the north, was delineated in the 1960s but is not a producing field.

A few tracts of the Cook Inlet lease sale area are within the **Kenai National Wildlife Refuge** and **Chugach State Park**. BLM manages federal oil and gas leases in the Swanson River and Beaver Creek oil fields, located north of Soldotna within the Kenai National Wildlife Refuge. Chugach State Park provides unique recreation, camping, hunting, and mining opportunities for residents and tourists.

Other areas with special designations are located near the lease sale area, including the Matanuska Valley Moose Range, Willow Mountain Critical Habitat Area, Kachemak Bay Critical Habitat Area, Homer Airport Critical Habitat Area, Fox River Flats Critical Habitat Area, Tuxedni National Wildlife Refuge, Lake Clark National Park and Preserve, and Nancy Lakes State Recreation Area. Oil and gas development is prohibited in the waters of Kachemak Bay

B. Fish and Wildlife Uses and Value

1. Commercial Fishing

The State of Alaska has primary jurisdiction for managing fish in Alaska; this includes commercial, sport, personal use, and educational fisheries. State jurisdiction includes freshwaters, and marine waters within 3 miles of shore (Clark et al. 2006b). Article 8 of the Alaska Constitution mandates that state fish resources be managed under the sustained yield principle. The Alaska Board of Fisheries sets fishing regulations and management guidelines. Advisory committees are local groups that make recommendations to the Board; there are 81 advisory committees statewide, and nine in the Cook Inlet area. ADF&G implements regulations passed by the Board, manages the state's fisheries according to management guidelines, and provides information and recommendations on fish populations and harvest through research.

There are a few exceptions to state fisheries management. NMFS manages fisheries in federal waters, from 3 miles to 200 miles off shore, as well as most groundfish fisheries. Similar to the

Alaska Board of Fisheries, the North Pacific Fishery Management Council sets regulations and management guidelines for federal marine fisheries (Clark et al. 2006b). The USFWS, with the Federal Subsistence Board, manages subsistence fisheries on waters in which the federal government has reserved water rights.

Cook Inlet is frequently divided into two main management areas: Upper Cook Inlet and Lower Cook Inlet. The Upper Cook Inlet area includes waters north of Anchor Point; the Lower Cook Inlet area includes the remainder of Cook Inlet waters, Kachemak and Kamishak bays south to Cape Douglas, and the Barren Islands.

All five species of Pacific salmon are harvested commercially in Cook Inlet. Commercial fisheries for halibut, groundfish, herring, and razor clams also occur in Lower Cook Inlet and Kamishak Bay. Fish are delivered to docks at Anchorage, Nikiski, Ninilchik, Kenai, Kasilof and Homer for processing.

a. Salmon


ADF&G

Drift gillnetter fishing for salmon.

The most significant commercial fisheries in the Cook Inlet area are for salmon. Sockeye salmon are the most important economically, followed by coho, Chinook, chum, and pink (Shields 2007). In Lower Cook Inlet, commercial fisheries occur in four districts: Kamishak Bay; the Southern District, which includes portions of Kachemak Bay that are not included in the lease sale area; and the Outer and Eastern districts which are outside the lease sale area (Figure 5.1). In Upper Cook Inlet, commercial fisheries occur in the Central and Northern Districts. Cook Inlet districts are further divided into sub-districts. Three types of commercial fishing gear are allowed for salmon in Cook Inlet: set gillnets, drift gillnets, and seines. However, all gears are not allowed in all districts, and the locations, times, and other details of fishery prosecution are tightly controlled through fishing regulations and inseason emergency orders guided by management plans.

In Cook Inlet, the east, middle, and west rip zones are important for drift gillnetting (Petterson and Glazier 2004). Along the west side of Cook Inlet, drift gillnetting tends to follow the bottom contours around Kalgin Island to the Kalgin Island Buoy. A highly regulated area known as “the corridor” runs along the eastern shore of Cook Inlet from south of Point Nikiski to just north of Ninilchik, and three miles offshore. This area may be crowded at times with commercial fishing vessels. Most drift gillnetting occurs in relatively deep water, with shallow areas avoided because of the possibility of nets snagging and tearing (Petterson and Glazier 2004). Defining specific patterns of fishing by location and time is not feasible because fishing strategies vary extensively across the fleet (Petterson and Glazier 2004).

Cook Inlet commercial salmon fisheries are primarily mixed-stock, mixed-species fisheries, because the areas through which various Cook Inlet stocks and species migrate, and the timing of their migrations, overlap significantly (Shields 2007). Cook Inlet salmon harvests make up about 4 percent of the statewide catch (Clark et al. 2006a).

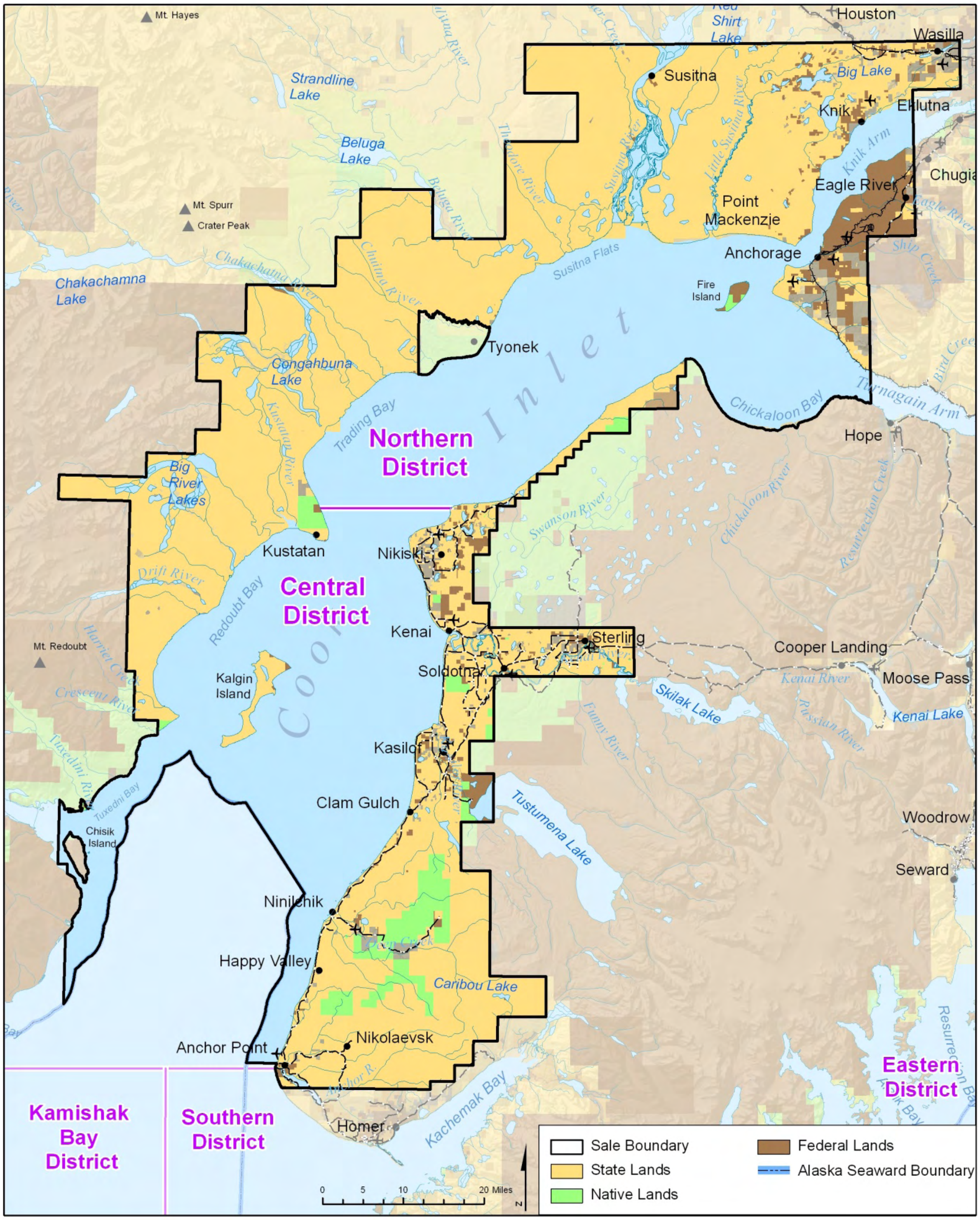


Figure 5.1. Map of commercial salmon fishing districts in the Cook Inlet area.

Since 1973, the number of participants in Alaskan salmon fisheries has been limited through the "limited entry program". The purpose of the program is to stabilize the number of commercial fishers, and thus the total amount of fishing gear used in each fishery (Clark et al. 2006b). This type of fishery structure results in improved management effectiveness by giving managers greater ability to control the fisheries so that fish in excess of needs for spawning escapements can be harvested by the commercial fishery in an orderly and predictable manner (Clark et al. 2006b).

In 2006, 82 purse seine permits were issued for Cook Inlet, 77 held by Alaska residents and 5 held by non-residents; only 24 (about 30 percent) of the permits were fished (CFEC 2007). For the drift gillnet fishery, 570 permits were issued, 401 to residents and 169 to non-residents; 396 permits (about 70 percent) were fished. For the set gillnet fishery, 738 permits were issued, 616 to residents and 122 to non-residents; 482 permits (about 65 percent) were fished. There was little change in the number of permits issued in each fishery during the 10 years from 1997-2006: the number of purse seine permits issued varied from 81-85; drift gillnet permits from 570-582; and set gillnet from 737-745 (CFEC 2007). However, the value of permits decreased significantly, and the percent of permits not fished increased (CFEC 2007; Figure 5.2; Figure 5.3).

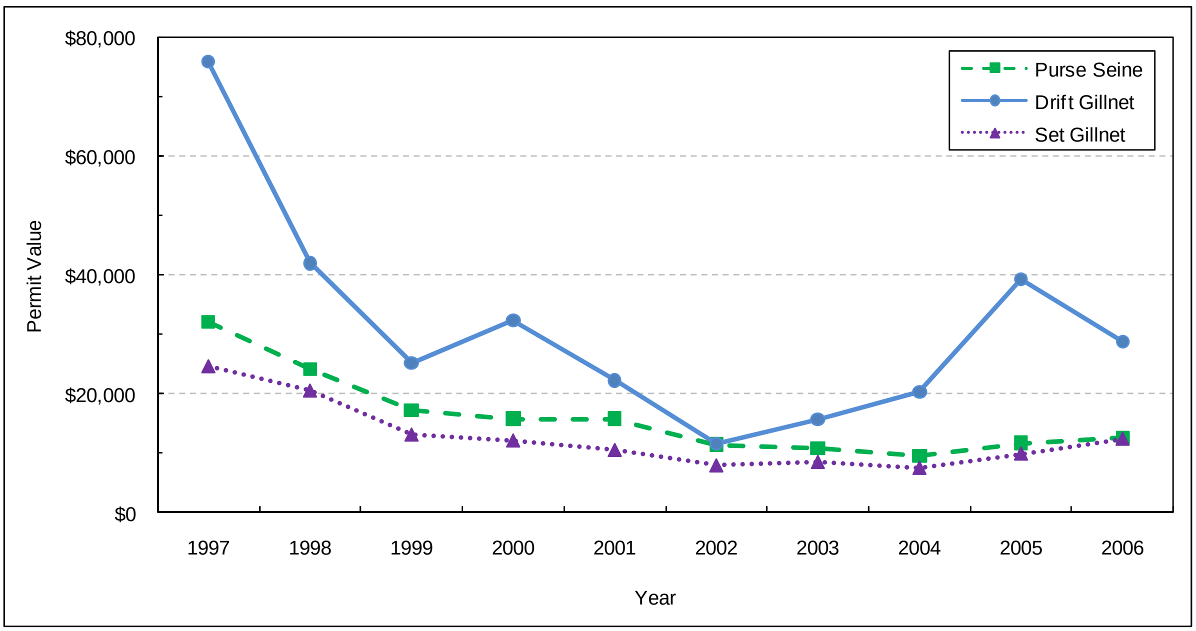


Figure 5.2. Value of Cook Inlet commercial salmon permits, 1997-2006.

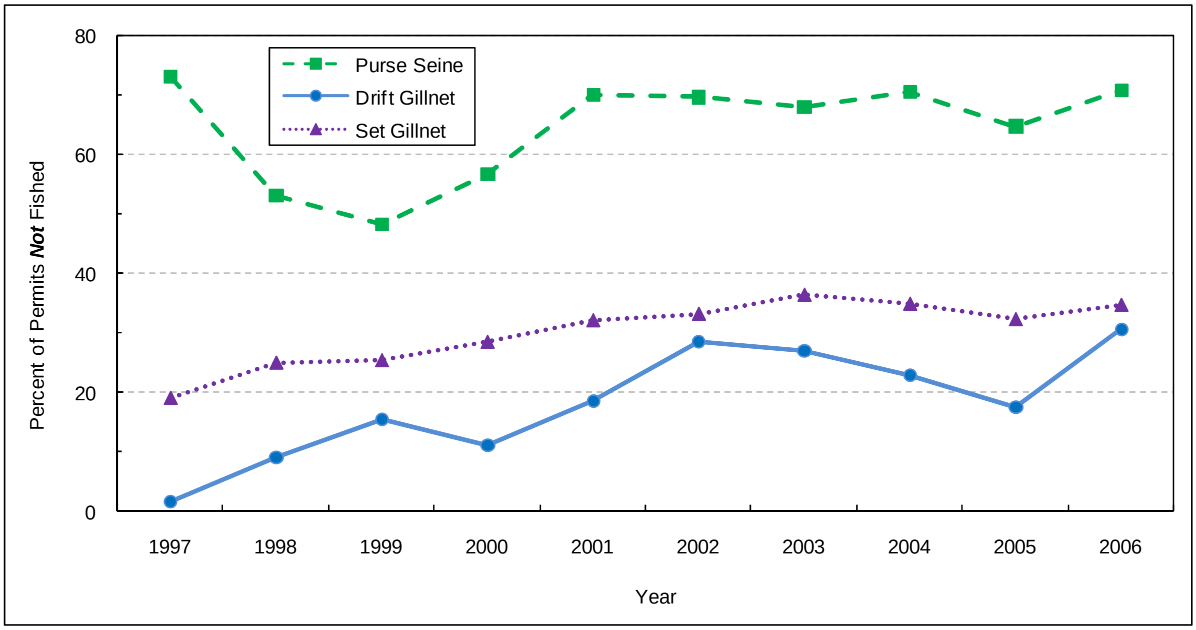


Figure 5.3. Percent of Cook Inlet commercial salmon permits not fished, 1997-2006.

Commercial harvest and ex-vessel value of salmon in Upper Cook Inlet are dominated by sockeye salmon. In 2007, a total of about 3.7 million salmon were harvested, of which 3.3 million were sockeye; total ex-vessel value was about $23.4 million for all salmon, and about $21.9 million for sockeye (Shields 2007; Table 5.1). Harvest and ex-vessel value of sockeye salmon increased from 2000-2005, but decreased sharply in 2006 (Table 5.1). Pink salmon tend to bring the lowest price per pound and Chinook salmon the highest (Table 5.1).

In Lower Cook Inlet, commercial salmon harvests are generally composed predominantly of pink salmon, sockeye salmon tend to have the greatest ex-vessel value, and Chinook salmon bring the highest price per pound (Table 5.2). In 2007, pink salmon harvests were very low, not because of poor returns but because of very low prices paid for them, and in fact, almost all pink salmon escapement goals were met or exceeded in Lower Cook Inlet in 2007 (Hammarstrom et al. 2007). In 2007, total harvest of all salmon was less than 700,000, a sharp decrease from total harvest of about 1.8 million salmon in 2006; total ex-vessel value was about $1.6 million in 2007 (Table 5.2).

Table 5.1. Commercial harvest, ex-vessel value, and price per pound of salmon in Upper Cook Inlet, 1998-2007.

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
Harvest						
1998	8,124	1,219,242	160,660	551,260	95,654	2,034,940
1999	14,383	2,680,510	125,908	16,174	174,541	3,011,516
2000	7,350	1,322,482	236,871	146,482	127,069	1,840,254
2001	9,295	1,826,833	113,311	72,559	84,494	2,106,492
2002	12,714	2,773,118	246,281	446,960	237,949	3,717,022
2003	18,490	3,476,159	101,756	48,789	120,767	3,765,961
2004	27,476	4,926,220	311,056	357,939	146,164	5,768,855
2005	28,171	5,238,168	224,657	48,419	69,740	5,609,155
2006	18,029	2,192,730	177,853	404,111	64,033	2,856,756
2007	17,625	3,316,779	177,339	147,020	77,240	3,736,003
Ex-Vessel Value						
1998	$181,318	$7,686,993	$497,050	$187,759	$132,025	$8,685,145
1999	$337,482	$20,095,838	$329,164	$5,995	$265,026	$21,033,505
2000	$183,044	$7,115,614	$626,287	$47,065	$186,385	$8,158,395
2001	$169,593	$7,135,690	$297,387	$20,312	$111,028	$7,734,010
2002	$326,051	$10,682,051	$329,031	$84,922	$224,148	$11,646,203
2003	$358,688	$11,659,037	$132,079	$8,660	$99,850	$12,258,314
2004	$675,910	$19,404,381	$416,193	$65,861	$129,794	$20,692,138
2005	$575,082	$31,316,655	$720,766	$13,971	$101,917	$32,728,391
2006	$617,133	$12,301,215	$679,754	$174,576	$121,343	$13,894,021
2007	$629,643	$21,916,852	$682,747	$53,029	$141,097	$23,423,367
Price per Pound						
1998	$1.00	$1.15	$0.45	$0.09	$0.19	
1999	$1.00	$1.30	$0.45	$0.12	$0.19	
2000	$1.10	$0.85	$0.40	$0.09	$0.19	
2001	$1.00	$0.65	$0.40	$0.08	$0.19	
2002	$1.15	$0.60	$0.20	$0.05	$0.12	
2003	$0.95	$0.60	$0.20	$0.05	$0.12	
2004	$1.00	$0.65	$0.20	$0.05	$0.12	
2005	$1.00	$0.95	$0.50	$0.08	$0.20	
2006	$1.75	$1.10	$0.60	$0.10	$0.25	
2007	$1.75	$1.05	$0.60	$0.10	$0.25	

Note: Ex-vessel value is the value paid to fishers; the total value of the fishery is considerably higher.
Source: Shields 2007.

Table 5.2 Commercial harvest, ex-vessel value, and price per pound of salmon in Lower Cook Inlet, 1998-2007.

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
Harvest						
1998	1,071	284,029	16,653	1,457,819	4,647	1,764,219
1999	1,764	476,779	8,033	1,140,488	7,941	1,635,005
2000	1,188	240,932	8,203	1,387,307	73,254	1,710,884
2001	988	216,271	6,667	592,931	88,969	905,826
2002	1,553	290,654	8,329	1,970,061	43,259	2,313,856
2003	1,180	644,257	11,302	856,711	35,686	1,549,136
2004	1,658	130,083	12,426	2,517,555	206,679	2,868,401
2005	622	232,678	9,126	2,306,842	98,602	2,647,870
2006	639	224,345	32,230	1,471,578	71,954	1,800,746
2007	467	366,225	3,351	287,411	1,777	662,199
Ex-Vessel Value						
1998	$20,000	$1,224,000	$37,000	$712,000	$9,000	$2,002,000
1999	$51,000	$2,459,000	$23,000	$470,000	$20,000	$3,023,000
2000	$31,000	$1,112,000	$19,000	$431,000	$192,000	$1,786,000
2001	$24,000	$627,000	$15,000	$277,000	$295,000	$1,238,000
2002	$24,000	$817,000	$18,000	$441,000	$58,000	$1,359,000
2003	$15,000	$1,965,000	$18,000	$154,000	$40,000	$2,192,000
2004	$32,000	$503,000	$40,000	$352,000	$339,000	$1,266,000
2005	$14,000	$848,000	$27,000	$542,000	$196,000	$1,627,000
2006	$19,000	$1,018,000	$124,000	$576,000	$185,000	$1,922,000
2007	$20,000	$1,502,000	$25,000	$89,000	$3,000	$1,639,000
Average Price per Pound						
1998	$1.45	$0.96	$0.36	$0.16	$0.27	
1999	$1.96	$1.22	$0.45	$0.16	$0.32	
2000	$1.86	$0.87	$0.60	$0.12	$0.28	
2001	$1.76	$0.62	$0.41	$0.15	$0.28	
2002	$1.11	$0.55	$0.33	$0.07	$0.16	
2003	$1.03	$0.60	$0.28	$0.06	$0.16	
2004	$1.56	$0.77	$0.47	$0.04	$0.20	
2005	$1.54	$0.86	$0.53	$0.07	$0.23	
2006	$2.25	$1.01	$0.54	$0.11	$0.31	
2007	$2.62	$0.91	$0.60	$0.10	$0.25	

Sources: Harvest, ex-vessel value, and 2007 average price per pound from Hammarstrom et al. 2007; 1998-2006 average price per pound from Hammarstrom and Dickson 2007.

b. Other Commercial Fisheries

Pacific halibut have been commercially harvested in Cook Inlet for many years. Halibut are managed by several different state, federal, and international agencies (ADF&G 2008f; Clark and Hare 2006; Meyer 2006; NMFS 2008; PFMC 2007). The International Pacific Halibut Commission (IPHC), created in 1923 by a convention between the U.S. and Canada, sets harvest strategies and total allowable harvest levels for the U.S. and Canada, and conducts studies on population dynamics of halibut. The North Pacific Fishery Management Council (NPFMC), a federal agency, deals with allocation issues within Alaska. The National Marine Fisheries Service (NMFS), another federal agency, manages individual fishing quotas for the commercial fishery. Although it does not have management jurisdiction over halibut, the Alaska Board of Fisheries has adopted sport fishing regulations that do not conflict with IPHC regulations to facilitate enforcement of regulations, and ADF&G monitors and conducts research on the sport fishery.

In 1995, an individual fishing quota (IFQ) system was implemented in Alaska for the commercial halibut fishery. Under this system, individual fishers are given a percentage share of the total commercial harvest that will be allowed each year. After implementation of IFQs, the commercial fishery was quickly transformed from a "derby fishery" in which the entire annual harvest was taken in a few days in chaos and danger, to a fishery that now extends through most of the year. In addition, the value of the harvest has increased, bycatch of other species has decreased, and the fishery is much less dangerous (ADF&G 2008f; Clark and Hare 2006; Meyer 2006; NMFS 2008; PFMC 2007). Including the guided (charter) sport fishery in the IFQ program has been debated for many years, but although the NPFMC has developed a framework and recommendations, a final decision has not been made yet (Alaska Sea Grant 2007).

From 1997-2006, commercial harvest of halibut ranged from about 700,000 lbs in 2000 to over one million lbs in 1997, 1998, 2004 and 2005 (Table 5.3). These harvests came from IPHC statistical area 261 which includes Kachemak Bay, which is outside the lease sale area.

Table 5.3. Commercial harvest of Pacific halibut from Cook Inlet (IPHC statistical area 261 of Area 3A), 1997-2006.

Year	Harvest Net wt (lbs)
1997	1,135,921
1998	1,033,844
1999	934,833
2000	706,941
2001	934,965
2002	790,775
2003	939,164
2004	1,168,140
2005	1,181,746
2006	984,662

Note: Catch is net weight pounds (head-off, dressed, ice/slime deducted); may include landings from Kachemak Bay which is not included in the lease sale area.

Source: IPHC 2008.

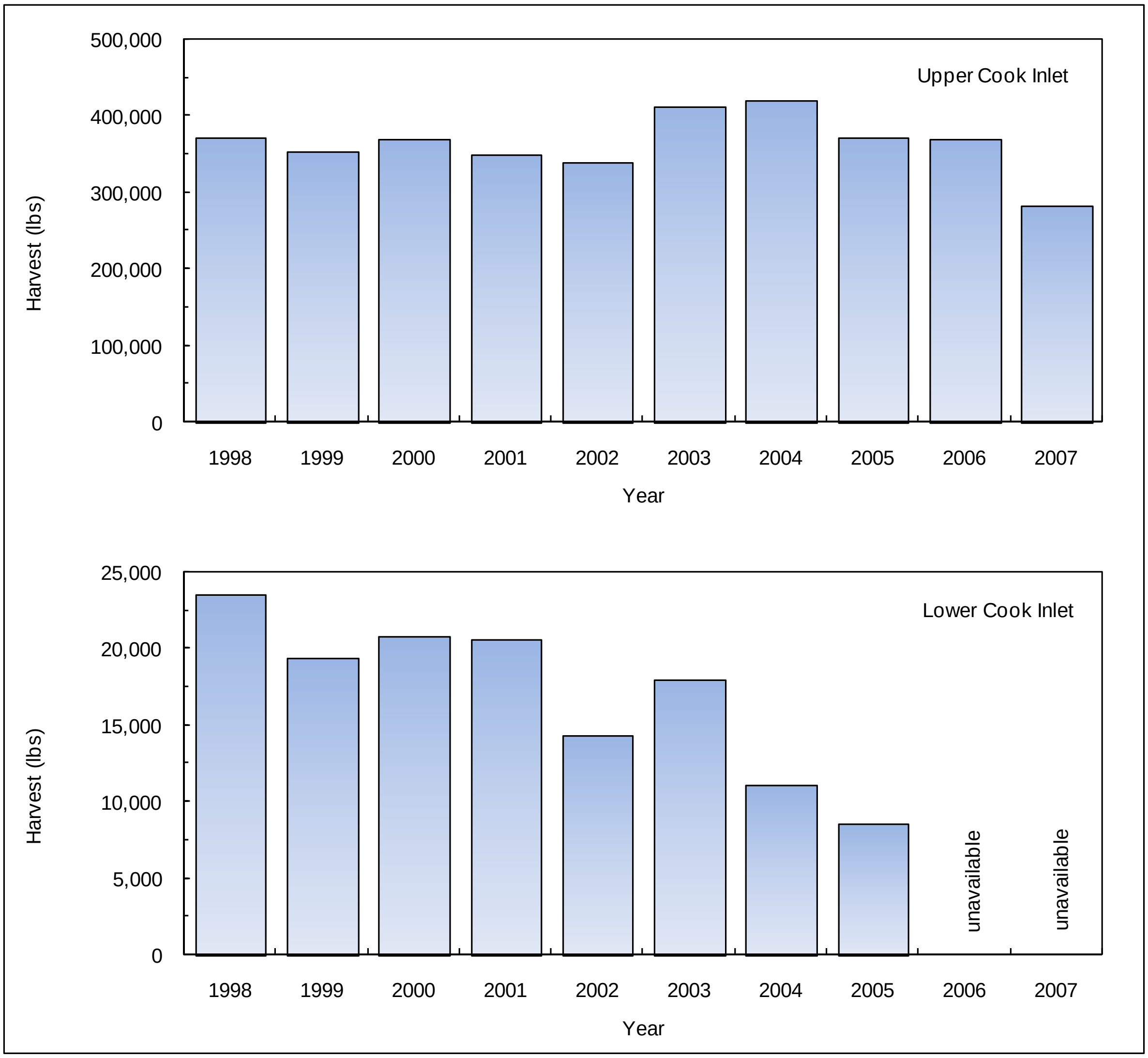
Pacific herring were harvested at varying levels in the Cook Inlet area from the early 1900s through the 1990s, primarily in Kamishak Bay on the west side of Lower Cook Inlet. Declines in abundance, as well as market conditions, resulted in decreased harvests, and herring fisheries in Lower Cook Inlet were completely closed in 1980-1984, and 1999 through the present (Hammarstrom et al. 2007). The commercial herring fishery in Upper Cook Inlet dates from 1973, but decreases in abundance and a shift in age structure were observed in 1988, leading to closures and additional restrictive seasons (Shields 2007). Harvest, abundance and closures have fluctuated widely. Although there is a herring management plan and commercial fisheries in several subdistricts were reopened in 2002, participation has been low (13.4 tons and 15 permit holders in 2007) (Shields 2007).

Other finfish species harvested in Cook Inlet include **lingcod**, **Pacific cod**, **sablefish**, **rockfish**, and **walleye pollock**. Harvest of these species totaled about 1.5 million pounds (round) in state-managed fisheries in 2007; ex-vessel value was about $886,000 (ADF&G 2008a).

Several species of **clams** are harvested commercially in the Cook Inlet area. DEC is required to certify beaches for commercial clam harvest to ensure that clams are safe for human consumption (Trowbridge and Goldman 2006). Razor clams are harvested in Upper Cook Inlet, mainly from the Polly Creek area on the west side of Cook Inlet between Crescent River and Redoubt Point; beaches on the east side of Upper Cook Inlet are open to sport harvest only (Shields 2007). In Lower Cook Inlet, littleneck clams, butter clams, and cockles are harvested commercially, but all commercial harvest occurs in Kachemak Bay (Trowbridge and Goldman 2006) which is not included in the Cook Inlet lease sale area. Kachemak Bay beaches are opened for commercial clam harvests on an alternating schedule, with half the certified beaches open in even years and the other half in odd years. Commercial harvests of clams have decreased recently (Figure 5.4) because of competition with farmed clams (Trowbridge and Goldman 2006). The ex-vessel value of razor clams was $175,000 in 2007 (Shields 2007).

King, Tanner and Dungeness crab stocks have been harvested in the Cook Inlet area since the early 1900s. Crab fisheries in the Cook Inlet area are managed as part of ADF&G shellfish Area H which is divided into Central, Southern (includes Kachemak Bay), Kamishak Bay, Barren Islands, Outer, and Eastern districts (Figure 5.5). The Barren Islands, Outer, and Eastern districts are outside the lease sale area; and Kachemak Bay, which is within the Southern District, is not included in the lease sale area.

Commercial fisheries for king crab in Cook Inlet began in 1937, peaking at 8 million lbs per year in the 1960s and ranging from 2.5-4.8 million lbs annually during the late 1960s and early 1970s (ADF&G 2002). Red king crab was the primary king crab species harvested commercially, and most of the harvest came from the Southern District and Kamishak/Barren Islands districts (Figure 5.5). After 1976, harvests declined and the commercial fishery was closed during the 1981-1982 season in the Southern District and during the 1983-1984 season in the Kamishak/Barren Islands districts because of low abundance, and the fishery has remained closed since. Causes for the decline in abundance and subsequent failure of the population to recover, even after the fishery has been closed for many years, are poorly understood, but overfishing and environmental conditions are considered likely explanations (ADF&G 2002). The commercial king crab fishery will remain closed until stocks recover sufficiently for a harvest strategy to be developed by the department and adopted by the Alaska Board of Fisheries (5 AAC 34.310).



Sources: Shields 2007; Trowbridge and Goldman 2006.

Notes: Upper Cook Inlet harvests are razor clams; Lower Cook Inlet harvests are littleneck clams, butter clams, and cockles. Lower Cook Inlet harvest estimates are unavailable for 2006 and 2007. Note that Upper Cook Inlet and Lower Cook Inlet scales are different.

Figure 5.4. Commercial harvest of clams in Upper Cook Inlet and Lower Cook Inlet, 1998-2007.

Commercial fisheries for Tanner crab developed during the mid-1960s in Kachemak Bay as they were harvested incidentally to red king crab (ADF&G 2002). However, the fishery soon expanded to other areas of Cook Inlet and harvests increased rapidly, peaking at 8.0 million lbs in 1973-1974. The commercial fishery was closed in 1989, and has remained closed since 1995 in the Southern District and since 1992 in the Kamishak Bay/Barren Islands districts (ADF&G 2002), and non-commercial fisheries have been closed since 2002 (Szarzi et al. 2007), due to low abundance. Possible causes for the collapse of the stock and its continued depression, despite many years of the fishery remaining closed, include warm ocean conditions that favor production of predators and suboptimal environmental conditions for crab larvae survival, overfishing of legal crabs, high incidental handling-induced mortality of non- and sub-legal crabs, and mortality from lost and derelict crab fishing pots (ADF&G 2002). The Alaska Board of Fisheries adopted conditions under which the commercial Tanner crab fishery could be reopened, in particular, setting specific abundance levels (5 AAC 35.408). Trawl surveys in 2006 suggested that abundance of Tanner crabs might be increasing (Szarzi et al. 2007).

During the late 1970s, a commercial fishery for Dungeness crab developed in the Cook Inlet area, primarily in the Southern District, with harvests averaging 1.0 million lbs from 1978-1991 (Trowbridge and Goldman 2006). As with other crab fisheries in the Cook Inlet area, abundance decreased sharply, and in 1991 the commercial fishery was closed and has remained closed since. In addition to natural fluctuations, the sharp decrease in abundance is due to three primary factors: “1) depression of the stock due to handling and trapping mortality that was the result of fishing during and immediately after the molting period; 2) extremely high effort over long seasons with the resultant high annual fishing mortality due to ease of access by both commercial and recreational fishermen; 3) violation of the 150 pot limit by a portion of the fleet” (ADF&G 2002).

The Cook Inlet Area Dungeness Crab Fisheries Management Plan specifies that fisheries will not be reopened until crab stocks recover and the Alaska Board of Fisheries adopts a further management plan that addresses 14 factors such as allowable exploitation rates, biological composition of the stock, reporting requirements, and ecosystem functions (5 AAC 32.390). Despite the long-term, continued fishery closure, Cook Inlet Dungeness crab stocks remain depressed and increases in abundance are considered unlikely in the near future (Trowbridge and Goldman 2006).

Shrimp were harvested commercially with trawls and pots in the Cook Inlet area from 1970 through the mid-1980s, primarily in Kachemak Bay (Trowbridge and Goldman 2006) which is not included in the lease sale area. Annual harvests averaged over 5 million lbs, but abundance declined and the fishery was closed in 1987 and has remained closed since (Trowbridge and Goldman 2006). Causes for the collapse of shrimp stocks and subsequent continued lack of recovery is unknown, but it is suspected that stocks were overfished during the 1970s and 1980s, and that failure of the stocks to recover despite long-term fishery closures may be due to changing environmental conditions which could result in greater mortality of shrimp larvae, greater mortality of the forage base, and increased production of shrimp predators (ADF&G 2002). Shrimp stocks remain at low levels but show signs of recovery in some locations (Trowbridge and Goldman 2006).

Other shellfish species that are harvested commercially in the Cook Inlet area include weathervane scallops, octopus, green sea urchins, and sea cucumbers. Weathervane scallops are harvested from two beds located in the Kamishak Bay District, just east of Augustine Island (Figure 5.5). Development of the fishery began in 1983, harvest and participation in the fishery has been variable, and regulations and management of the fishery have become increasingly restrictive and complex (Trowbridge and Goldman 2006).

Although fisheries for octopus are closed, they are harvested incidentally to other commercial fisheries, particularly the Pacific cod pot fishery, and harvests are highly variable, ranging from 435 lbs to 48,067 lbs (Trowbridge and Goldman 2006). Small commercial fisheries for green sea urchins and sea cucumbers have also occurred in the Cook Inlet area. From 1987-1996, harvest ranged from 80 lbs to 195,403 lbs; in some years there was no participation in the fishery (Trowbridge and Goldman 2006). From 1990-1996, sea cucumbers were harvested in four years, and harvest ranged from 22,525-30,940 lbs (Trowbridge and Goldman 2006).

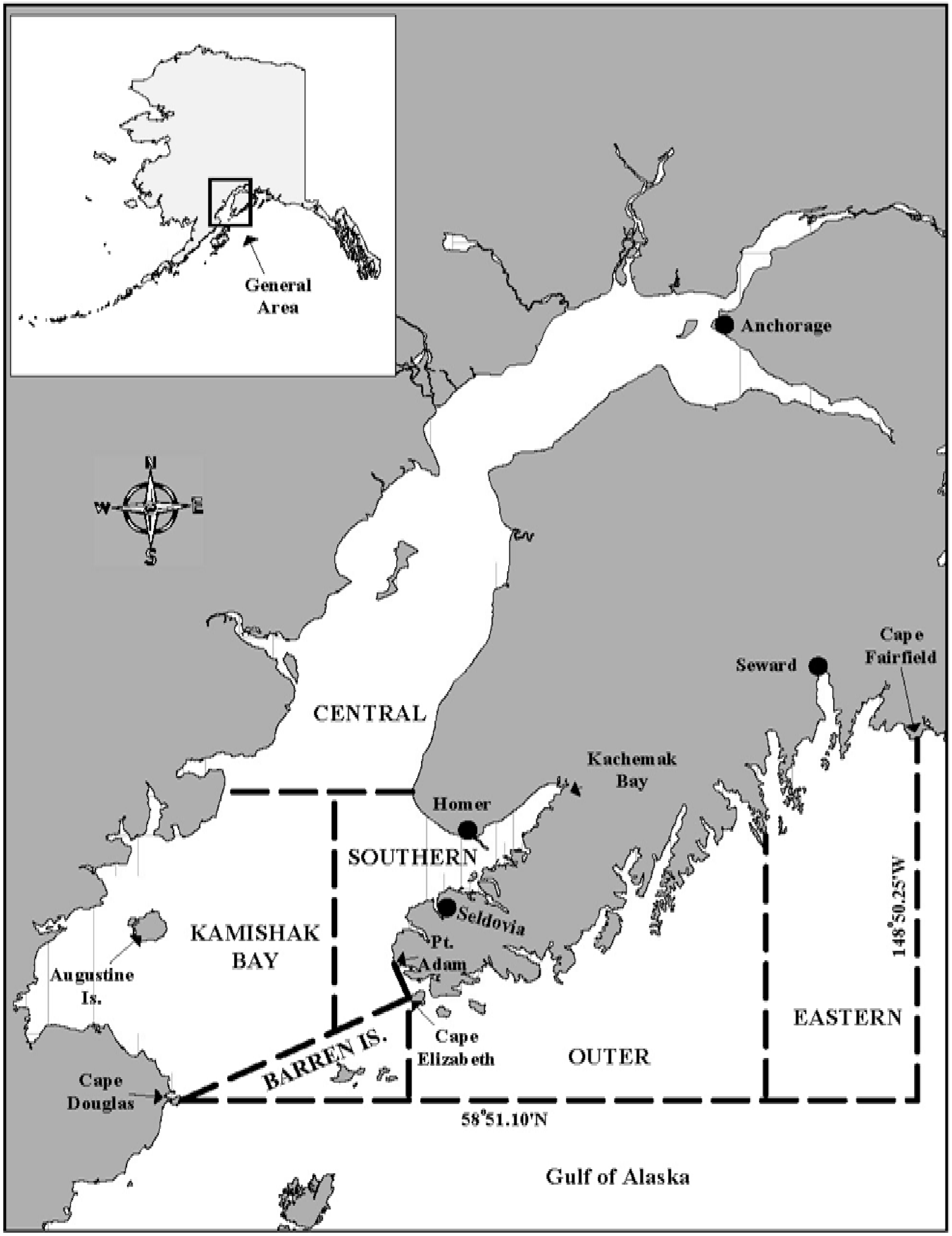


Figure 5.5. Map of the six districts of ADF&G shellfish management Area H that encompasses Cook Inlet and Prince William Sound.

In 1997, the commercial fisheries for green sea urchins and sea cucumbers, as well as other miscellaneous shellfish, were closed when the Alaska Board of Fisheries adopted the Cook Inlet Miscellaneous Shellfish Management Plan (5 AAC 38.390) which closed all commercial fisheries for miscellaneous shellfish (not including shellfish which have other plans or regulations) until the Board adopts another plan. Based on surveys conducted by ADF&G in several locations in Kachemak Bay (outside the lease sale area) in 2004 and 2005, fisheries for green sea urchins and sea cucumbers are expected to remain closed (Trowbridge and Goldman 2006).

c. Mariculture

Mariculture, or the farming of shellfish in marine waters, began in Southeast Alaska in the early 1900s. In 1988, passage of the Aquatic Farm Act was intended to encourage development of an Alaskan shellfish industry that would increase competiveness of the Alaska seafood industry (Timothy and Petree 2003). Mariculture fisheries are managed by DNR and ADF&G, but finfish farming is prohibited in Alaska. From 1997-2006, the number of farms in Southcentral Alaska (including Kodiak, Resurrection Bay and Prince William Sound in addition to Cook Inlet) ranged from 27-37, sales of oysters ranged from about $96,000 to $333,000; and sales of mussels ranged from about $1,000 to $13,000 (ADF&G 2007). In April 2004, there were 17 aquatic farms, all located in Kachemak Bay (Timothy and Petree 2003). Two shellfish nurseries in Cook Inlet provide seedstock to shellfish growers (Timothy and Petree 2003). Both are located in Kachemak Bay, which is not included in the lease sale area.

2. Sport Fishing

Sport fishing is an important part of the culture and economy of the Cook Inlet area, providing recreation, food, and jobs to both residents and visitors. However, results of recent research show that people are increasingly disconnected with the outdoors, and that there is a "fundamental and pervasive shift away from nature-based recreation" (Pergams and Zaradic 2008). This shift is not restricted to just the U.S. but "extends beyond U.S. political and cultural boundaries" to other countries as well (Pergams and Zaradic 2008).


T. McKinley

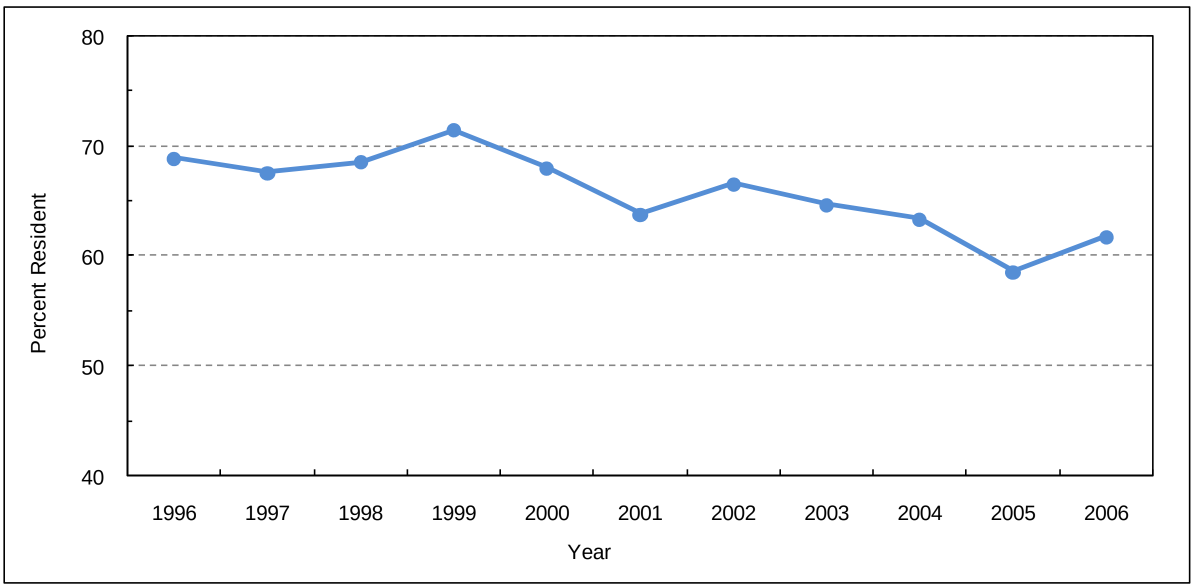
Sport angler with Chinook salmon, Cook Inlet.

In the U.S., declining trends in sport fishing have prompted concerns that decreasing license sales will translate to decreased funding for conservation efforts and less support for policies that support conservation (Southwick Associates 2007). In Alaska, statewide decreasing sales of sport fishing licenses to Alaska residents since 1999 have caused ADF&G to be alarmed that resultant decreased revenue from license sales could affect the ability of ADF&G to effectively manage the state's sport fisheries (Romberg 2006). In addition to decreasing license sales, the percent of resident sport fishing effort out of total effort has also decreased in Southcentral Alaska (Figure 5.6). In fact, in an effort to reverse the decline in resident anglers, ADF&G has joined a national marketing effort to increase license sales to lapsed anglers (RBFF 2008).

Nationally, many studies have shown that the motivations people have for sport fishing are complex and diverse and include factors beyond simply catching fish (Fedler and Ditton 1994). In Alaska as well, research has shown that factors affecting sport fishing participation are "complex" and "multi-dimensional", but research also indicates that crowding, and lack of interest, time, partners to fish with, and personal resources such as equipment are important constraints for many people (Romberg 2006). Specific to Southcentral Alaska, which includes the Cook Inlet area, crowding, lack of facilities and access to fishing locations, and complicated fishing regulations are also important issues (Romberg 2006).

In the Cook Inlet area, sport fishing, as measured by effort in angler-days, increased steadily during the late 1970s through 1995 to about 1.53 million angler-days, but then decreased sharply through 1998 (Figure 5.7; Mills 1987; Howe et al. 1996; ADF&G 2008k). From 1999-2006, sport fishing peaked in 2000 at 1.46 million angler-days, but otherwise ranged from about 1.11-1.30 million angler-days. In 2006, about 50 percent of the total statewide sport fishing effort occurred in the Cook Inlet area (ADF&G 2008k).

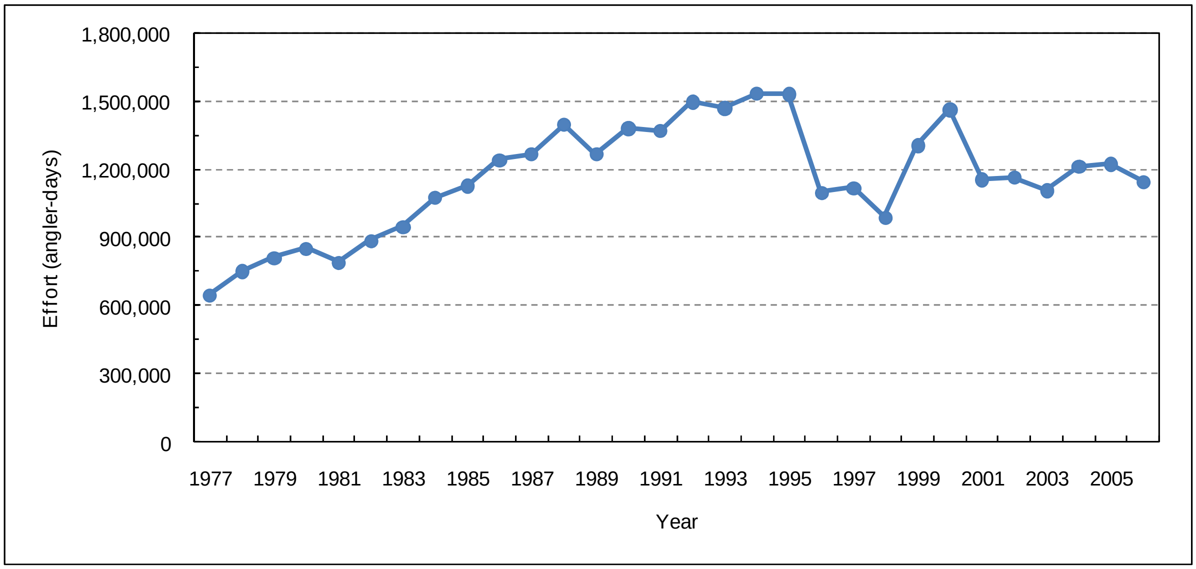
In 2006, statewide sport fishing in Alaska generated $530 million in expenditures, $253 million in wages and salaries, and 8,465 jobs. These expenditures rippled through the statewide economy resulting in an estimated impact of $800 million (ASA 2006). This was a decrease from 2003 (Table 5.4). It should be noted that these estimates, which use data from the U.S. Fish and Wildlife Service’s National Survey of Fishing, Hunting and Wildlife-Associated Recreation, probably underestimate the total economic impact of sport fishing in Alaska because they do not include expenditures made outside Alaska, for example on fishing equipment that was purchased in another state but was used for fishing in Alaska (ADF&G 2008d). Current economic estimates for sport fishing specific to the Cook Inlet area are unavailable, although a study is underway by ADF&G (ADF&G 2008e).



Source: From query of online database ADF&G 2008k.[1]

Figure 5.6. Percent of total sport fishing effort in Southcentral Alaska by resident anglers, 1996-2006.

[1] Totals for Cook Inlet were calculated as the sum of ADF&G Statewide Harvest survey areas K (Knik Arm), L (Anchorage), E (East Susitna River Drainage), N (West Cook Inlet Drainage), and P (Kenai Peninsula). For 1996-2006, estimates for area P were calculated as the sum of subareas P0 (Kenai Peninsula Freshwater), P1 (Kenai Peninsula Saltwater non-guided), P2 (Kenai Peninsula Shellfish), P4 (Kenai River non-guided), P5 (Kenai River guided), and P6 (Kenai Peninsula saltwater guided).



Sources: Estimates for 1977-1986 from Mills 1987; 1987-1995 from Howe et al. 1996; 1996-2006 from query of online database ADF&G 2008k.[1]

Figure 5.7. Sport fishing effort (angler-days) in the Cook Inlet area, 1977-2006.

Table 5.4. Economic impact of sport fishing in Alaska in 2001, 2003, and 2006.

Year	Retail Sales	Output	Wages and Salaries	Jobs
2001	$587,028,597	$959,821,921	$238,011,311	11,064
2003	$640,167,515	$1,046,706,782	$259,556,537	12,065
2006	$530,165,682	$800,921,744	$252,957,398	8,465

Sources: ASA 2001, 2003, 2006.

Notes: Estimates use data from the U.S. Fish and Wildlife Service's National Survey of Fishing, Hunting and Wildlife-Associated Recreation, and probably underestimate the total economic impact of sport fishing in Alaska because they do not include expenditures made outside Alaska (ADF&G 2008d).

An Alaska sport fishing license is generally required to sport fish in Alaska. License fees are more expensive for non-residents: for example, an annual license is $24 for residents and $140 for non-residents. Anglers under 16 years old are not required to have a license, and Alaska residents age 60 and older may apply for a free permanent identification card that replaces the fishing license; these anglers may be required to carry and fill out a free harvest record card for some fisheries. In addition to a fishing license, anglers fishing for Chinook (king) salmon must also purchase a king salmon stamp at an additional cost of $10 for residents and $100 for non-residents (ADF&G 2008g).

State of Alaska fishing regulations allow proxy fishing to provide food for Alaska residents who are unable to harvest fish for themselves. Only Alaska residents who are at least 65 years old, who are legally blind, or who are 70 percent or greater disabled are allowed to designate a proxy, and the proxy fisher must also be a licensed Alaska resident. A proxy form, certified by ADF&G, is required. In 2007, proxies were certified for almost 3,000 elderly or disabled Alaskans in Southcentral (Table 5.5; ADF&G 2008c).

Many sport anglers, particularly non-residents, utilize the services of sport fishing guides and charters. The guided fishing industry provides significant economic benefits to Alaska and the Cook Inlet area by providing jobs and supporting tourism. Sport fishing guides are required to be licensed, and must meet minimum professional standards such as first aid, U.S. Coast Guard operator's license, business license, and proof of insurance (ADF&G 2008i). In 2007, over 1,500 guides were licensed in Southcentral (Table 5.6).

ADF&G, Division of Sport Fish operates a hatchery program to ensure adequate numbers of salmon and other species are available to meet sport fishing needs, and to protect wild fish stocks by providing alternate sport fishing opportunities (ADF&G 2008j). Over 1 million Chinook salmon were scheduled to be stocked in the Cook Inlet area in 2008 (ADF&G 2008l). Stocked Chinook salmon fisheries include Willow Creek in the Matanuska-Susitna area; the Eklutna Tailrace and Ship Creek in Anchorage; and the Kasilof River, Crooked Creek and the Ninilchik River on the Kenai Peninsula (ADF&G 2008l). Homer Spit, Halibut Cove, and Seldovia Bay, located outside the lease sale area, are also stocked. About 777,000 coho salmon were scheduled to be stocked, including fisheries at the Eklutna Tailrace, and Bird, Campbell, and Ship creeks in the Anchorage area; and Homer Spit (outside the lease sale area). In addition, about 750,000 rainbow trout and other non-anadromous species are stocked in many lakes throughout the Cook Inlet area, including about 75 lakes in the Matanuska-Susitna area, about 17 lakes in the Anchorage area, and about 30 lakes on the Kenai Peninsula (ADF&G 2008l).

Although sport fisheries occur on many species throughout the fresh and marine waters of the Cook Inlet area, particularly prominent fisheries include wild salmon on tributaries of the Susitna River; wild coho salmon on the Little Susitna River and Knik Arm tributaries; stocked Chinook and coho salmon at Ship Creek and Bird Creek in the Anchorage area; wild Chinook, coho, and sockeye salmon on the Kenai, Russian, Anchor, and Kasilof rivers of the Kenai Peninsula; stocked rainbow trout in lakes throughout the Cook Inlet area; halibut in marine waters; and clams from beaches of Lower Cook Inlet. From 1997-2006, sport harvest for all species of salmon, including stocked landlocked salmon, varied between about 600,000 and 800,000 salmon (Figure 5.8). Harvest of halibut varied between about 150,000 and 250,000 fish (Figure 5.8). Detailed harvest by site and species is available in ADF&G Statewide Harvest Survey reports (for example, see Jennings et al. 2007 for the most recent published report).

Table 5.5. Number of sport fish proxies issued in Southcentral Alaska, 2007.

Beneficiary Residence	Proxies Issued
Mat-Su	609
Anchorage	1,742
Kenai Peninsula	584
Total	2,935

Source: ADF&G 2008c.

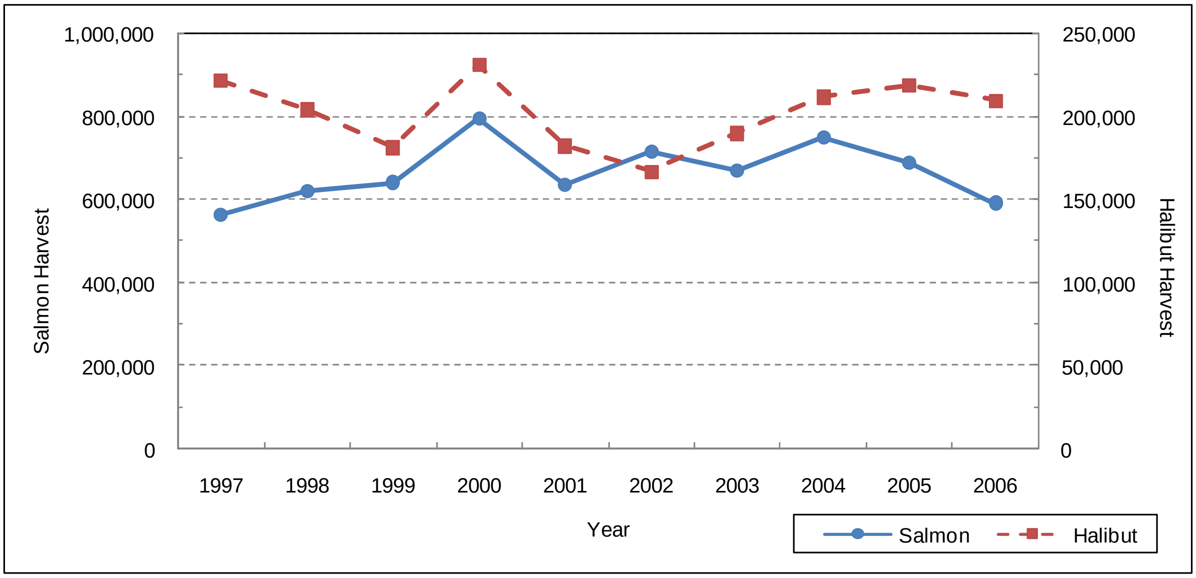
Table 5.6. Number of registered or licensed guides in Southcentral Alaska and Cook Inlet, 1998-2007.

Year	Southcentral Guides [a]	Active Guides in Cook Inlet [b]
1998	1,850	
1999	1,963	
2000	2,052	
2001	2,144	
2002	2,227	
2003	2,236	
2004	2,262	
2005	1,429	871[c]
2006	1,521	1,001
2007	1,560	1,042

[a] Includes any person who was registered (prior to 2004) or licensed (after 2004) to guide with a permanent mailing address in Southcentral Alaska. This includes people registered or licensed as guides, and people registered or licensed as business/guide, as both groups are eligible to guide.

[b] Active guides in Cook Inlet includes licensed guides and business/guides that guided at least one trip in Cook Inlet in the year indicated. Cook Inlet is defined as ADF&G Sport Fish Division Statewide Harvest Survey Areas L, K, M, N and P. Includes all guides who guided a trip in Cook Inlet waters regardless of their permanent mailing address. Active guides can only be calculated back to 2005 because freshwater trip information was not collected prior to 2005.

[c] In 2005, the guide program changed from a registration requirement with no cost to guides, to a license program in which guides were required to pay a fee and meet minimum insurance and first aid requirements.



Sources: ADF&G 2008k.

Figure 5.8. Harvest of salmon (all species) and halibut in the Cook Inlet area, 1997-2006.

3. Personal Use Fishing

ADF&G

Personal use dip net fishery, Kenai River.

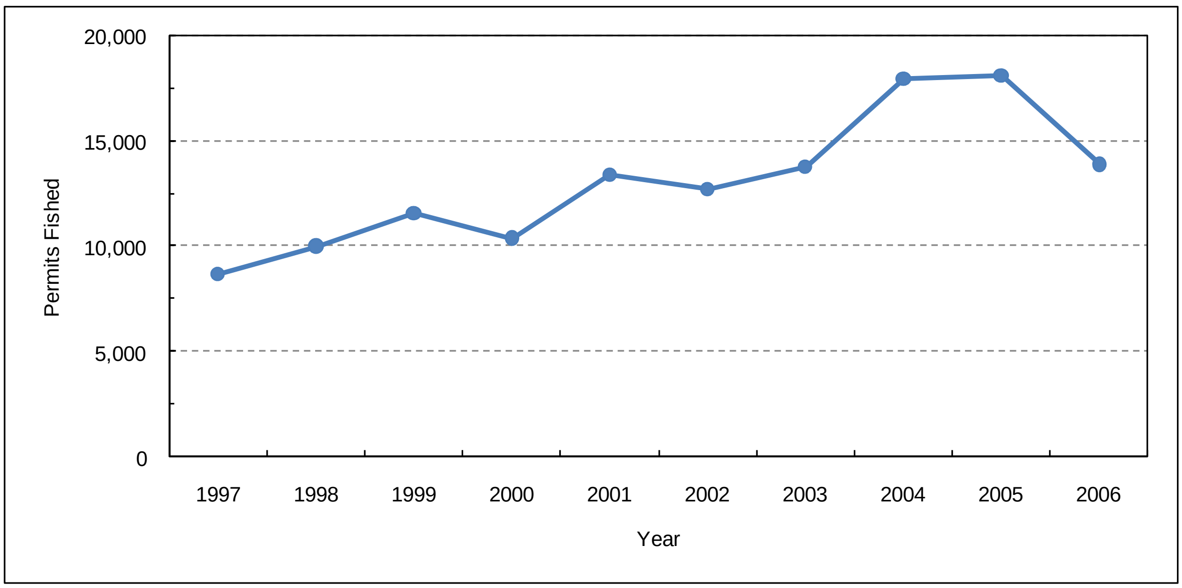
Personal use salmon fisheries in the Cook Inlet area are an important source of food for many Alaskans. These fisheries were authorized by the Alaska Board of Fisheries in 1982 as a substitute for subsistence fisheries for Alaska residents in urban areas where subsistence fishing is not allowed. Creation of these fisheries culminated from lengthy legal battles concerning definitions of subsistence, who had subsistence fishing rights in Alaska, where subsistence fishing could occur, and conflicts over state and federal fishery jurisdiction that resulted from discrepancies between the Alaska Constitution and the federal Alaska National Interest Lands Conservation Act. Four personal use fisheries were established in the Cook Inlet area: Kasilof River set gillnet, Kasilof River dip net, Kenai River dip net, and Fish Creek dip net. The Fish Creek dip net fishery has been closed since 2002 because of low numbers of sockeye salmon returning to the creek. An additional personal use set gillnet fishery is authorized for Kachemak Bay in Lower Cook Inlet; this fishery is outside the Cook Inlet lease sale area.

The primary purpose of personal use fisheries is to allow Alaskans to harvest fish for food. Therefore, regulations are structured to make harvesting highly efficient. Gear consists of dip nets or gillnets. Harvest limits are generous and based on household size. Households are allowed an annual limit of 25 fish for the first member and an another 10 fish for each additional member; thus the annual limit for a household of four is 55 salmon (Dunker and Lafferty 2007; Hammarstrom and

Dickson 2007). Only Alaska residents may participate in these fisheries. A free personal use permit is required, issued to the household, and participants must have an Alaska sport fishing license or permanent identification card if they are 16 years old or older.

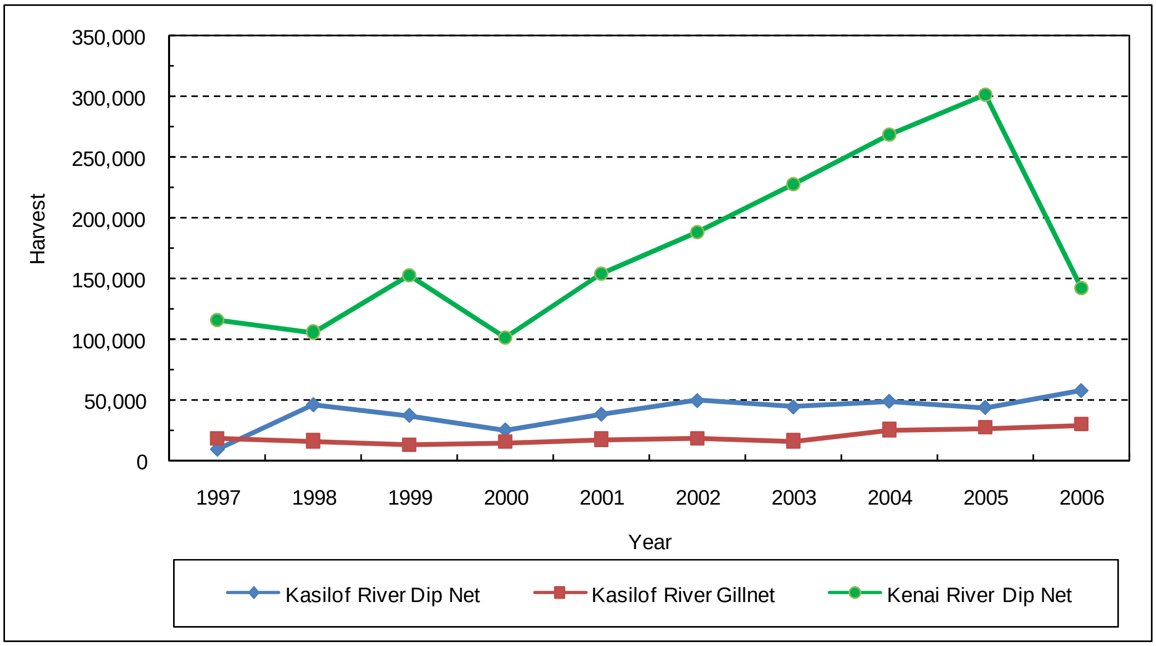
From 1997-2006, up to 18,000 Alaskan households were issued permits and fished in Upper Cook Inlet personal use fisheries (Figure 5.9). Harvest in these fisheries increased steadily through 2005 when a total of about 377,000 salmon were harvested (Figure 5.10). Harvests were composed primarily of sockeye salmon (97-99 percent in most years), and most of the harvest came from the Kenai River dip net fishery (Reimer and Sigurdsson 2004; Dunker and Lafferty 2007). The lower harvest in 2006 was a result of unusually late timing of the Kenai River sockeye salmon run and subsequent emergency closures of the fishery (Dunker and Lafferty 2007).

The number of permits fished in the Kachemak Bay set gillnet fishery decreased from 185 in 1997 to 62 in 2006, and total harvest of salmon also decreased (Figure 5.11; Figure 5.12). This fishery targets coho salmon, and the harvest was composed of 68-86 percent coho salmon (Hammarstrom and Dickson 2007).



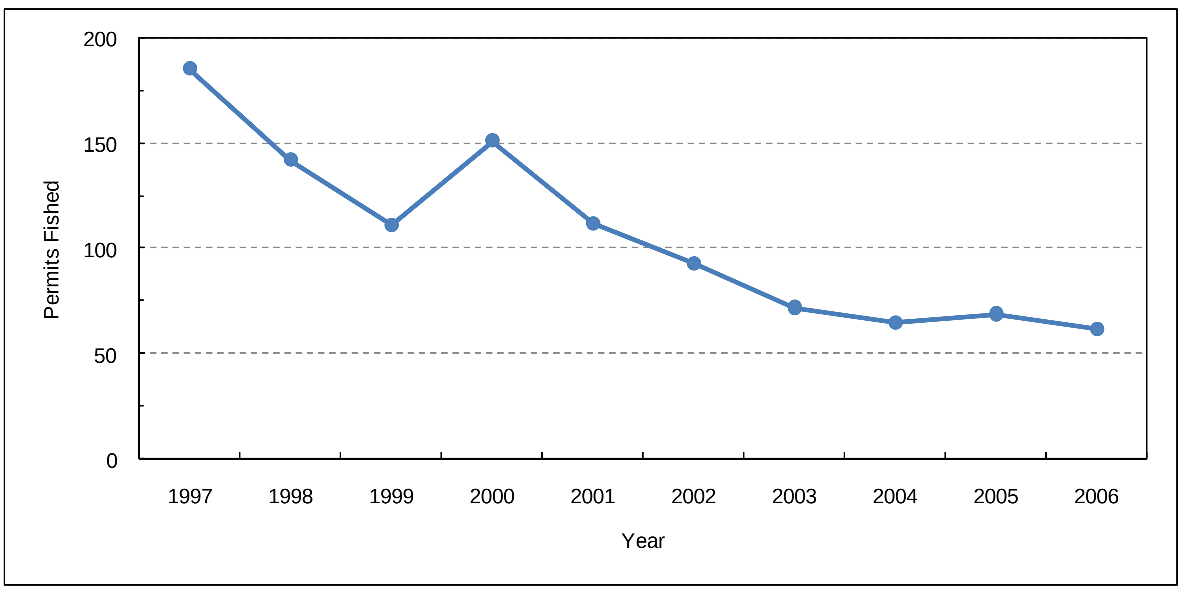
Sources: 1997-2003 Reimer and Sigurdsson 2004; 2004-2006 Dunker and Lafferty 2007.

Figure 5.9. Number of permits that were issued and fished in Cook Inlet personal use fisheries, 1997-2006.



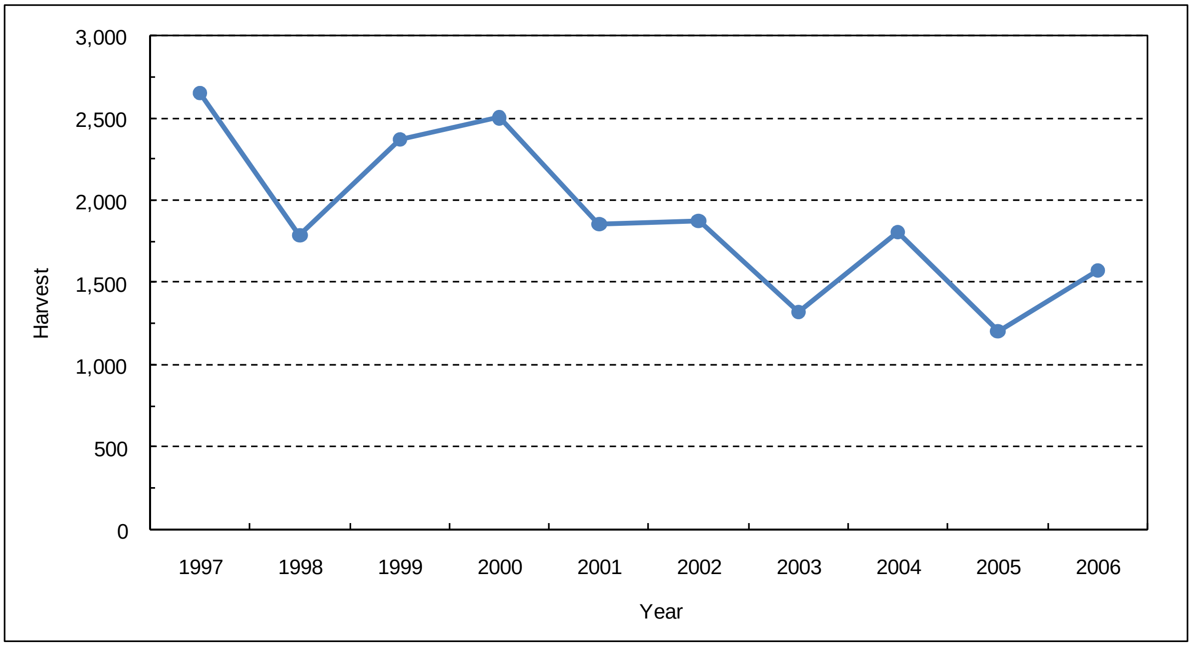
Sources: 1997-2003 Reimer and Sigurdsson 2004; 2004-2006 Dunker and Lafferty 2007.

Figure 5.10. Harvest of salmon in three personal use fisheries in Cook Inlet, 1997-2006.



Source: Hammarstrom and Dickson 2007.

Figure 5.11. Permits fished in the set gillnet personal use fishery in Kachemak Bay, 1997-2006.



Source: Hammarstrom and Dickson 2007.

Figure 5.12. Harvest of salmon in the set gillnet personal use fishery in Kachemak Bay, 1997-2006.

4. Educational Fishing

Educational fisheries also originated out of the lengthy legal battles concerning subsistence in Alaska (Nelson et al. 1999). The first educational fishery was ordered by the Alaska Superior Court in 1993 for the Kenaitze Tribe on the Kenai Peninsula. The Alaska Board of Fisheries defined and set conditions for educational fisheries in 5 AAC 93.200-220, which specifies that educational fishery programs must have: instructors who are qualified to teach the subject matter; enrolled students; minimum attendance requirements; procedures for testing a student's knowledge of the subject matter or the student's proficiency in performing learned tasks; and standards for successful completion of the program. Educational fisheries require a permit that is issued by ADF&G and permitees are required to report the number and species of fish harvested, along with other fishery information.

In 2007, two educational fisheries in Lower Cook Inlet, operated by the Ninilchik Tribal Council and Ninilchik Native Descendents, harvested about 2,500 salmon (Szarzi et al. 2007). The most recent published data are for 2001 for Upper Cook Inlet (Gamblin et al. 2004) and 2002 for Northern Cook Inlet (Sweet et al. 2003). In Upper Cook Inlet, one educational fishery was operated, the Kenaitze Indian Tribe Educational Fishery, which harvested about 4,300 salmon. In Northern Cook Inlet, two educational fisheries, operated by the Knik Tribal Council and the Eklutna Native Village, harvested a total of about 1,100 salmon.

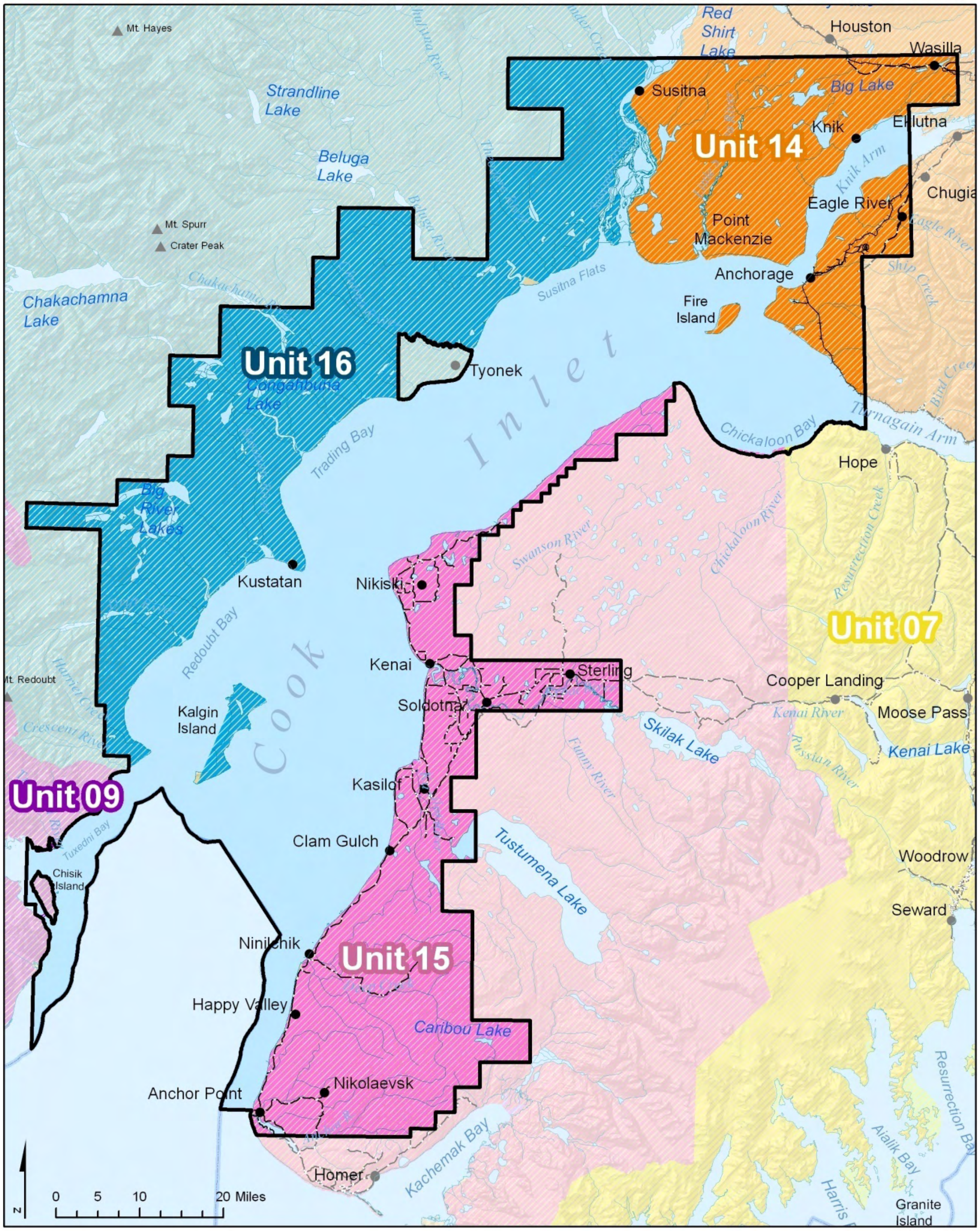
5. Sport Hunting and Trapping

ADF&G manages and monitors sport harvest of wildlife in the Cook Inlet area, which encompasses most or parts of three game management units (GMUs), 14, 15, and 16, and a small portion of GMU 9a (Figure 5.13). Harvests are estimated by management year which is defined as July 1 through June 30, or by calendar year. Estimates of the number of hunters in the Cook Inlet area are unavailable, but in 2001, there were 93,000 hunters 16 years old and older in Alaska; 72,000 were Alaska residents and 21,000 were non-residents (USFWS and USCB 2003). Hunters spent an estimated $217 million on hunting trips, equipment, and other related expenditures in Alaska in 2001 (USFWS and USCB 2003).

Hunters and trappers harvest large and small mammals, furbearers, and waterfowl in the Cook Inlet area. During management year 2005-2006, hunters harvested an average of 563 black bears, 131 brown bears, and 1,512 moose from management units 14, 15, and 16, as well as mountain goats, sheep, wolves and caribou (Table 5.7). An average of 494 beavers, 112 land otters, 113 lynx, 28 wolverines, and 127 marten were harvested from the three GMUs (Table 5.8).

Waterfowl are harvested at several locations within the Cook Inlet lease sale area. Harvest of waterfowl, and hunting pressure (or “effort”) as measured by hunter days, were estimated by ADF&G through 1997 with a statewide hunter survey using a postal questionnaire; the survey provided estimates of harvest and effort by region and location (ADF&G 2008m). Beginning in 1998, Alaska joined the national Harvest Information Program that provided better estimates of harvest at the statewide level, but harvest estimates were no longer available at the regional and local levels. Therefore, harvest of waterfowl and hunting effort estimates specific to the Cook Inlet area are not available after 1997. However, harvest and effort levels prior to 1998 can be assumed to be reasonably representative of current levels, with the caveat that the number of hunters increased through 1975 as a result of an influx of workers on the Trans-Alaska Pipeline; and the number of hunters declined from 1988-1995 because of low duck populations and resultant hunting restrictions (ADF&G 2008m).

From 1971-1998, total annual harvest of ducks from three state game refuges in the Cook Inlet area (Palmer Hay Flats, Susitna Flats, and Trading Bay) ranged from 10,039-32,220 ducks and averaged 17,667 ducks (Figure 5.14). Hunter effort ranged from 4,960-17,134 hunter days and averaged 8,909 (Figure 5.15). For all of Cook Inlet, harvest ranged from 18,913- 56,899 ducks, average 31,683; 226-4,348 geese, average 1,658; 16-550 sandhill cranes, average 135; 353-4,146 common snipe, average 1,132; and 21,832-67,549 migratory birds combined, average 36,243 birds (Figure 5.16, Figure 5.17, Figure 5.18, Figure 5.19, Figure 5.20).



Source: ADF&G 2008b.

Figure 5.13. Map of ADF&G game management units in the Cook Inlet area.

Table 5.7. Harvest of large mammal game species in ADF&G game management units (GMU) 14, 15, and 16, by management year (July 1 – June 30).

GMU	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	5 Year Average
Black Bear						
14	105	135	143	172	170	145
15	247	179	196	176	293	218
16	160	186	224	208	220	200
Total	512	500	563	556	683	563
Brown Bear						
14	21	20	26	14	22	21
15	12	14	9	9	9	11
16	88	70	91	126	126	100
Total	121	104	126	149	157	131
Moose						
14	539	702	760	636	689	665
15	610	479	572	485	498	529
16	308	258	399	358	269	318
Total	1,457	1,439	1,731	1,479	1,456	1,512
Mountain Goat						
14	26	33	44	27	11	28
15	27	29	23	20	28	25
Total	53	62	67	47	39	54
Sheep						
14	96	120	111	119	115	112
15	16	17	20	16	10	16
16	11	7	9	10	2	8
Total	123	144	140	145	127	136
Wolf						
14	21	32	27	31	14	25
15	30	33	42	38	23	33
16	88	47	70	127	60	78
Total	139	112	139	196	97	137
Caribou (by herd)						
Kenai Mtns	23	21	22	19	19	21
Killy River	53	46	17	12	3	26
Total	76	67	39	31	22	47

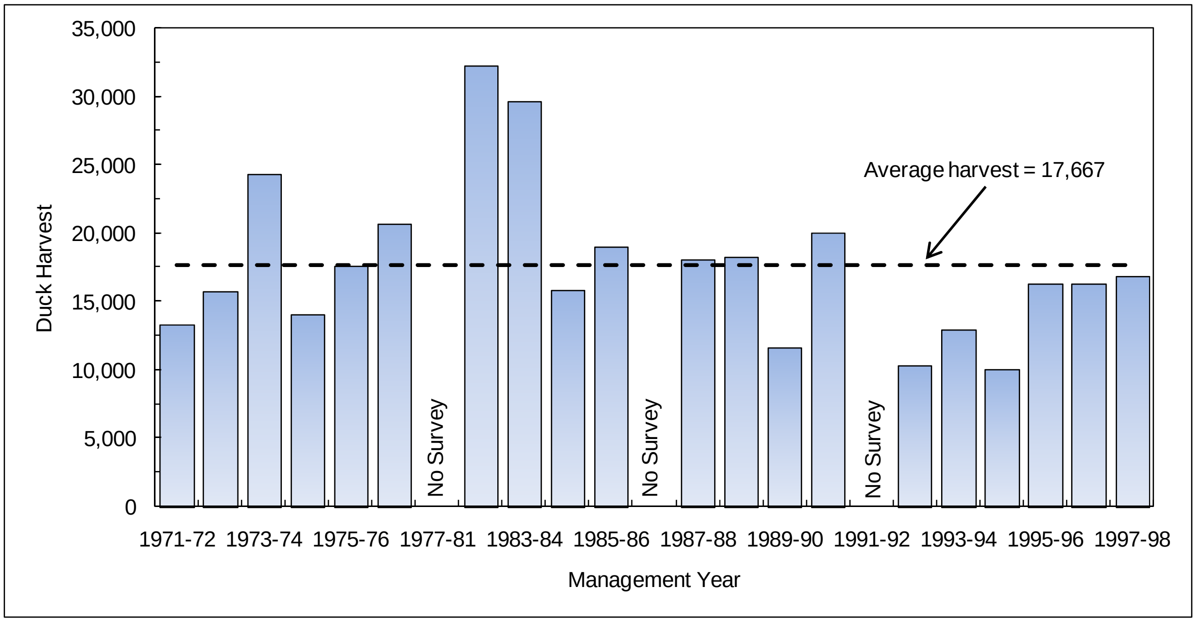
Source: ADF&G 2006.

Notes: Estimates provided in this table are qualified by the following statement: "Most of these harvest totals do not include unreported harvest which may be substantial and can even exceed the reported harvest for black bear where sealing is not required, or for certain caribou herds. In addition most harvest totals do not include harvest from federal hunts. Information is from the harvest/sealing files posted on 7/31/06 by Information Management. Some of the numbers for caribou…are estimated harvest provided by area biologists. The harvest totals for the 2005-2006 regulatory year are considered preliminary" (ADF&G 2006).

Table 5.8. Harvest of furbearer species in ADF&G game management units (GMU) 14, 15, and 16, by management year (July 1 – June 30).

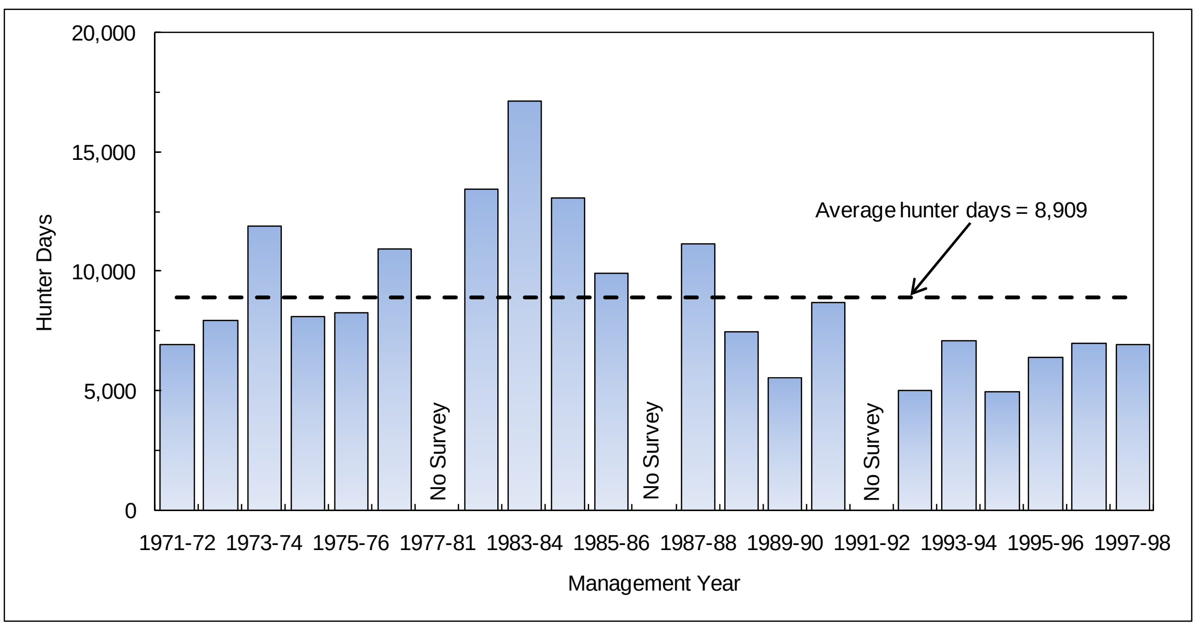
GMU	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	5 Year Average
Beaver						
14	192	173	241	147	219	194
15	65	94	171	94	134	112
16	115	173	196	163	294	188
Total	372	440	608	404	647	494
Land Otter						
14	33	30	32	32	53	36
15	33	33	37	27	41	34
16	18	42	32	60	56	42
Total	84	105	101	119	150	112
Lynx						
14	4	9	45	47	33	28
15	119	130	82	59	8	80
16	1	2	2	16	6	5
Total	124	141	129	122	47	113
Wolverine						
14	6	5	11	12	1	7
15	5	3	3	7	0	4
16	12	20	17	28	11	18
Total	23	28	31	47	12	28
Marten						
14	62	74	131	128	70	93
15	0	0	0	1	0	0
16	33	31	29	40	35	34
Total	95	105	160	169	105	127

Sources: Kavalok 2004a, b; Selinger 2004.



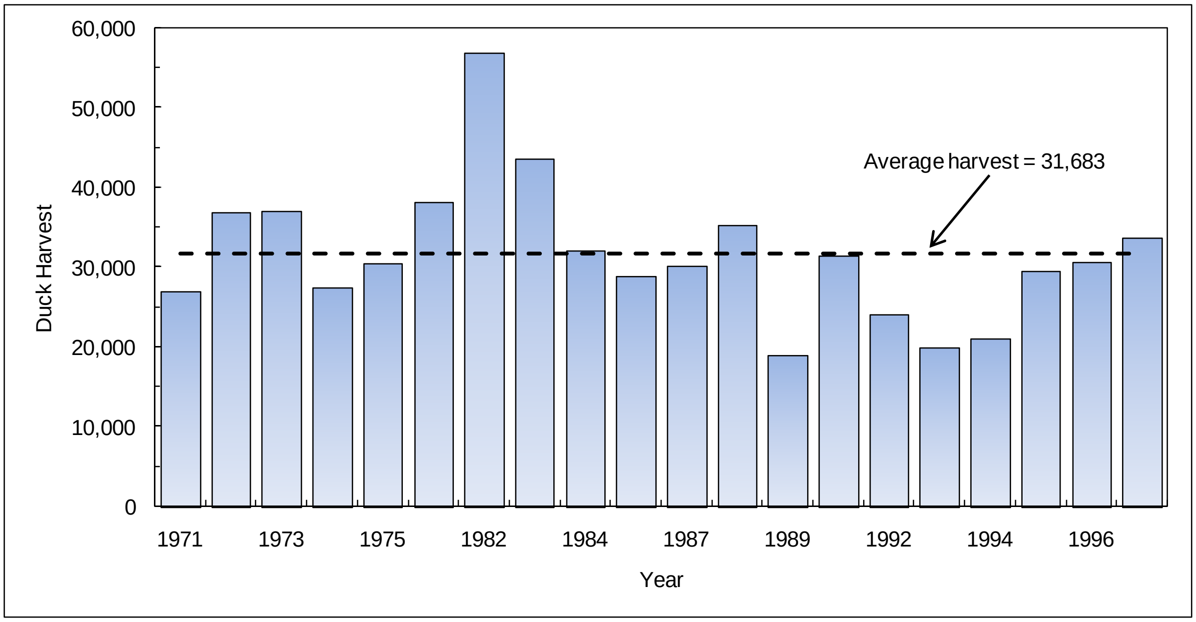
Source: ADF&G 2008m.

Figure 5.14. Harvest of ducks on three state game refuges in the Cook Inlet area, for management years 1971-1972 through 1997-1998.



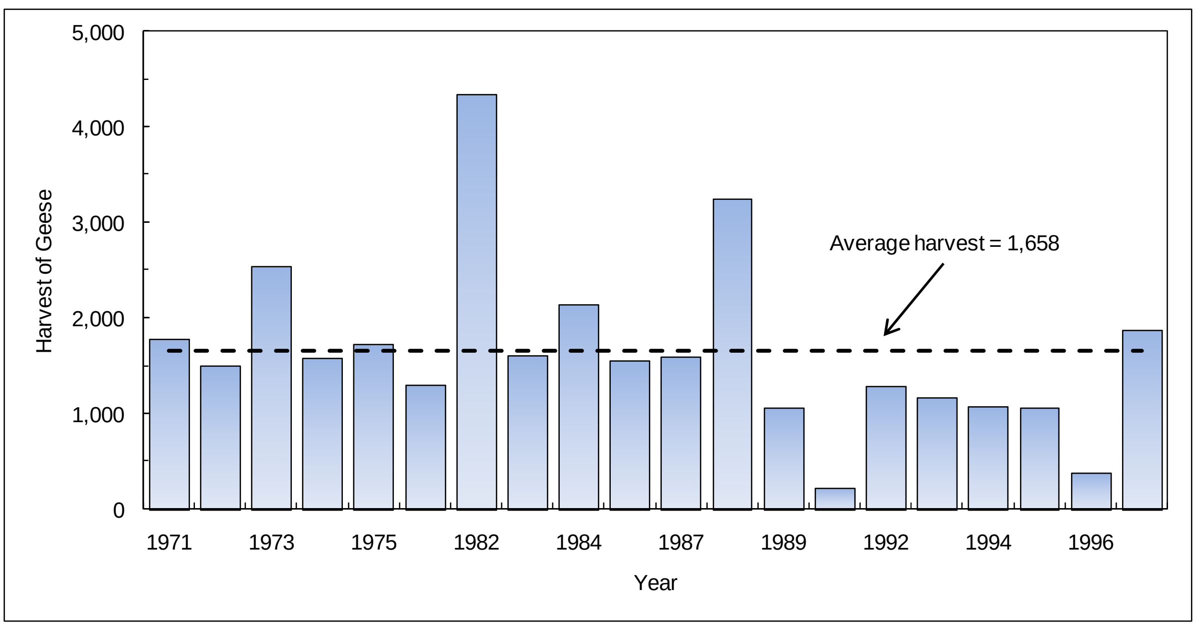
Source: ADF&G 2008m.

Figure 5.15. Effort, as measured in hunter days, for ducks on three state game refuges in the Cook Inlet area, for management years 1971-1972 through 1997-1998.



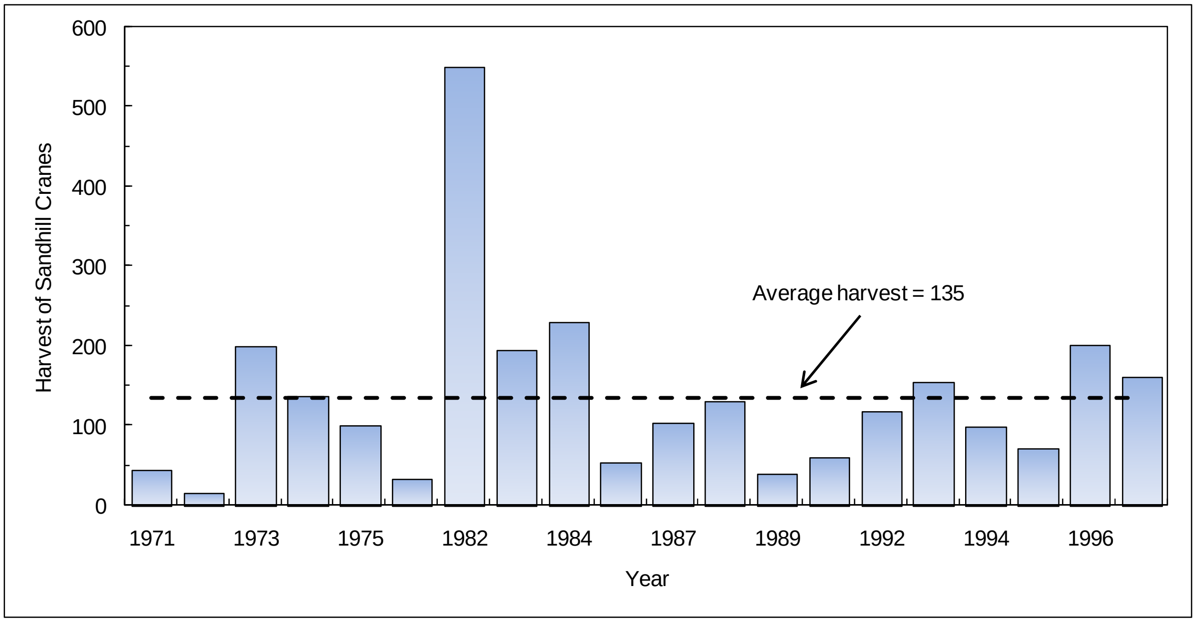
Source: ADF&G 2008m.

Figure 5.16. Total harvest of ducks from the Cook Inlet area, 1971-1997.



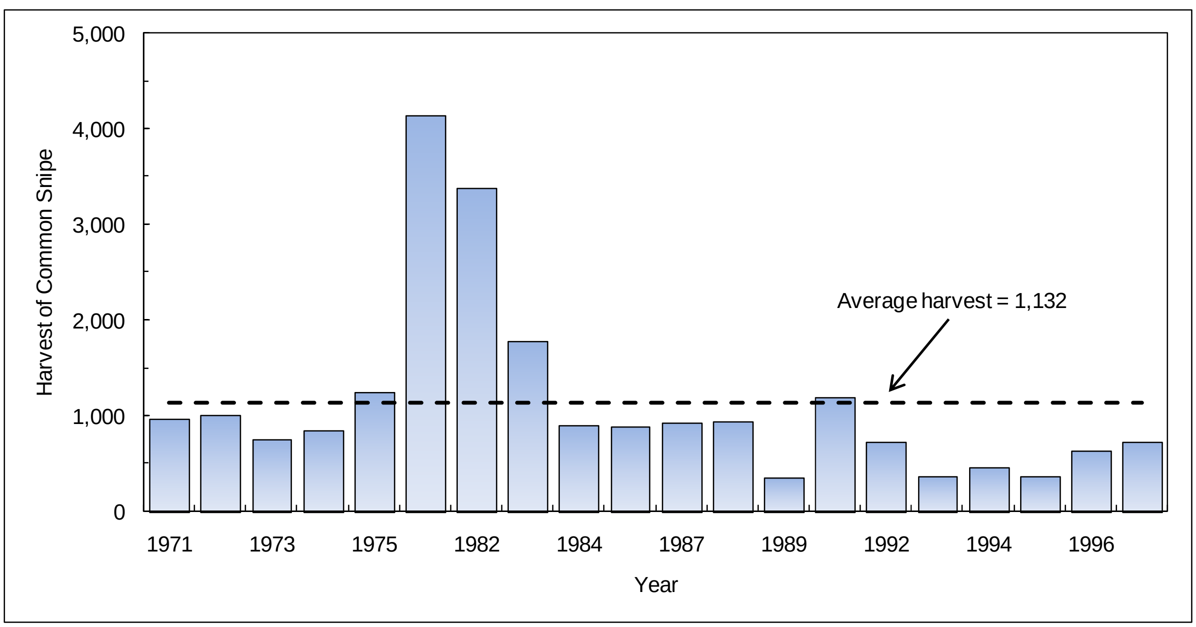
Source: ADF&G 2008m.

Figure 5.17. Total harvest of geese from the Cook Inlet area, 1971-1997.



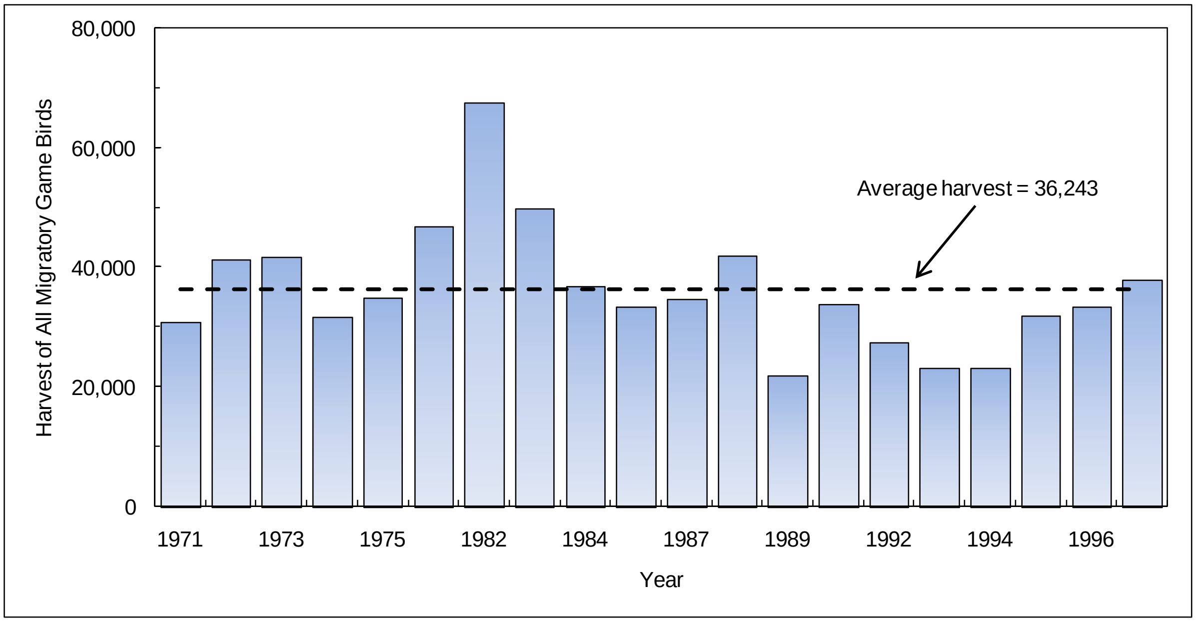
Source: ADF&G 2008m.

Figure 5.18. Total harvest of sandhill cranes from the Cook Inlet area, 1971-1997.



Source: ADF&G 2008m.

Figure 5.19. Total harvest of common snipe from the Cook Inlet area, 1971-1997.



Source: ADF&G 2008m.

Figure 5.20. Total harvest of all migratory game birds from the Cook Inlet area, 1971-1997.

6. Subsistence Fishing, Hunting, and Gathering

The fish, wildlife, and plant resources of the Cook Inlet area have been used for subsistence by area residents for centuries, including both Alaska Native populations and non-Natives (Fall et al. 2004b). In the broad sense, subsistence refers to "any harvest or use of fish, wildlife, and wild plants for home use. It also incorporates the noncommercial exchange or sharing of resources…" (Fall et al. 2004b). Under this general definition, detailed information about subsistence uses by residents of the Cook Inlet area is available for only a few selected communities with predominantly Alaska Native populations, but is not available for the broader Cook Inlet population, except for estimates of harvest from personal use fisheries, and sport fishing and hunting harvests provided above.

Alaska State Library, ASL-P201-150

Men cleaning salmon in Southcentral Alaska, 1898.

The subsistence uses of wild resources by residents of the communities of Tyonek and Beluga, which have predominantly Alaska Native populations, were profiled in a 2005-2006 study. In the study, Stanek et al. (2007) found that wild resources were used by 96 percent of Tyonek households, and 94 percent of residents had harvested at least one type of fish, wildlife or plant. Over 60 percent of Tyonek's residents participated in gathering plants, 50 percent harvested and processed fish, 40 percent hunted birds and wild game, and 17 percent trapped or hunted furbearers. Based on self-reporting, the study indicated that about half the Tyonek residents relied on wild sources for over half the meat, fish and birds they used annually, and 26 percent estimated that over 75 percent came from wild sources. Some of the wild resources used by the community include eulachon, black bear, beaver, muskrat, migrating waterfowl such as ducks and geese, Chinook salmon, fireweed, cow parsnip, bluebells, rainbow trout, Dolly Varden, blueberries, currants, highbush cranberries, beluga whales, moose, ruffed and spruce grouse, ptarmigan, marten, wolves, coyotes, and northern pike (Stanek et al. 2007). Relative to a study conducted in 1983-1984, residents harvested about 17 percent less wild resources per person in 2005-2006 (Stanek et al. 2007).

The study also found that 95 percent of Beluga residents participated in at least one resource activity, and that over 75 percent of residents participated in harvesting and processing fish, game birds, and mammals, and in gathering and processing plants. About half of Beluga households reported that more than half their supply of meat, fish, and birds came from wild sources (Stanek et al. 2007). Beluga residents used a variety of wild resources, including rainbow trout, pike, eulachon, brown and black bear, beaver, salmon, moose, ruffed and spruce grouse, ptarmigan, cranes, ducks, geese, beaver, red squirrels, plants, and berries (Stanek et al. 2007).

Since the 1970s, the broad definition of subsistence as “any harvest or use of fish, wildlife, and wild plants for home use” (Fall et al. 2004b) has become the subject of fierce debate, and the term “subsistence” is now frequently used in a legal or regulatory context. Disagreement about who has the right to participate in subsistence activities has grown increasingly contentious throughout Alaska, including in the Cook Inlet area as the population has increased and harvest of fish and game has become increasingly regulated.

Div. of Community & Business Development

Blueberries.

A few studies have examined the perceptions, attitudes, and opinions about subsistence. A study looking at five small communities on the Kenai Peninsula found that a high percentage of residents were born in states other than Alaska or in other countries, ranging from 58 percent to 74 percent; and when only heads of household were considered (i.e., children were excluded), a very small portion of the population was born in Alaska, ranging from 9 percent to 23 percent (Fall et al. 2004b). In over half the communities studied, a majority of the household heads had lived in the community 10 years or less (Fall et al. 2004b). There was no significant difference found between per capita fish harvest for Alaska Native households and other households (Fall et al. 2004b). Another study found a wide divergence in the definitions of “subsistence” and “rural”, and concluded that the definition may be dependent on the person’s stake in subsistence rights (Wolfe 2003).

The ensuing lengthy legal battles concerning the right to subsistence fish and hunt have brought about numerous and contentious regulatory changes to subsistence fishing and hunting. Issues have included the phrase “customary and traditional uses” in the definition of subsistence, and the use of “rural” as a criteria for a subsistence priority. Particularly important were conflicts between the federal Alaska National Interest Conservation Act and Article 8 of the Alaska Constitution, stating that “…fish, wildlife, and waters are reserved to the people for common use”, and state versus federal jurisdiction in fish and wildlife management. As a result of state and federal legal decisions, two management regimes currently exist for subsistence fishing and hunting in Alaska: a state system and a federal system.

a. <u>State Subsistence Program</u>

Under Alaska law, subsistence is defined as "noncommercial, customary and traditional uses" of fish or game resources for a variety of purposes (ADF&G 2005). Only Alaska residents may participate in subsistence fishing and hunting, but local residency is not a criteria for determining eligibility for subsistence. Rather than defining subsistence areas, the Joint Board of Fisheries and Game identify "nonsubsistence areas" based on the economy, culture, and way of life of the area or community. Most of the Cook Inlet area is designated as "nonsubsistence". Alaska law (AS 16.05.258) requires that subsistence uses must be consistent with sustained yield.

The Alaska Board of Fisheries and Alaska Board of Game are required to provide subsistence fishing and hunting opportunities when possible, and if harvests must be restricted, subsistence uses must be given priority over other uses. If a fish or game population cannot support harvests for all users, then other consumptive uses must be eliminated first before subsistence uses are limited. If the fish or wildlife population cannot support all subsistence users, then the Boards may distinguish among subsistence users through a system known as "Tier II". In this situation, subsistence users are prioritized based on a point system that takes into account: "1) the customary and direct dependence on the fish stock or game population by the subsistence user for human consumption as a mainstay of livelihood; 2) the proximity of the domicile of the subsistence user to the stock or population; and 3) the ability of the subsistence user to obtain food if subsistence use is restricted or eliminated."

i. Subsistence Fisheries in the Cook Inlet Area

Four state subsistence fisheries located outside the nonsubsistence area are authorized in the Cook Inlet area: a set gillnet fishery in the Port Graham and Koyuktolik subdistricts, a set gillnet fishery in the Seldovia area, a set gillnet fishery in the Tyonek subdistrict, and a fish wheel fishery on the upper Yentna River. Communities in these areas include Nanwalek, Port Graham, Seldovia, Tyonek, Alexander, and Skwentna.

V. R. Ciccone, ADF&G

Subsistence gillnet fishery, Nanwalek.

It should be noted that despite the fact that most of the Cook Inlet area is defined by the Joint Alaska Boards of Fish and Game as "non-subsistence", many Cook Inlet area residents takes part in other state personal use, sport, and commercial fisheries as a means of meeting their subsistence needs. Studies have found that these other fisheries meet most residents' needs for subsistence uses, and that in fact, users feel that limits in many fisheries are too high, resulting in wasted fish (Fall et al. 2004b).

The state set gillnet fishery in the Port Graham and Koyuktolik subdistricts is located in Lower Cook Inlet, outside the lease sale area. This fishery was expanded to include Port Chatham and Windy Bay subdistricts in 2002. The fishery is open from April 1, and it closes on August 1 (Port Chatham and Windy Bay) or September 30 (Port Graham and Koyuktolik subdistricts). A household permit is required, issued by the local village council through a cooperative agreement with ADF&G, and it is mandatory to record harvests. There are no daily bag and possession limits, and participants are not limited on how many fish they can harvest for the season. Sockeye, pink and coho salmon are the primary species harvested (ADF&G 2005).

The Seldovia set gillnet fishery is also located outside the lease sale area. The fishery is open from April 1 – May 30, targeting Chinook salmon, and again for the first two weekends of August, targeting coho salmon. There is no annual household limit on salmon, except for an annual household limit of 20 Chinook salmon. Participants must report their harvest to ADF&G on a daily basis, as well as return their permit at the end of each segment of the season.

The Tyonek set gillnet fishery has an annual limit of 25 salmon for the head of household, and 10 for each dependent. In addition, households may take 70 Chinook salmon. A maximum of 4,200 Chinook salmon may be taken from the Tyonek subdistrict from May 15-June 30.

From 1997-2006, harvest of salmon in the Tyonek subsistence fishery ranged from 886-2,233, from 272-653 for the Yentna fishery, 274-3,153 for the Port Graham fishery, and 16-13,441 at Nanwalek, (Table 5.9, Table 5.10, Table 5.11, Table 5.12). For Seldovia, harvest of salmon ranged from 44-452 from 1997-2006, the most recent available data (Table 5.13). These harvests include only fish from these specific fisheries.

Table 5.9. Permits issued and harvest of salmon in the state set gillnet subsistence fishery at Tyonek, 1998-2006.

Year	Permits Issued	Chinook	Sockeye	Coho	Pink	Chum	Total
1998	74	978	163	64	1	2	1,208
1999	76	1,230	144	94	32	11	1,511
2000	60	1,157	63	87	6	0	1,313
2001	84	976	172	49	4	6	1,207
2002	102	1,080	209	115	9	4	1,417
2003	91	1,183	111	44	7	10	1,355
2004	97	1,345	93	130	0	0	1,568
2005	81	720	60	104	0	2	886
2006	81	904	21	36	0	0	961
2007	[a]	1,275	327	604	16	11	2,233

[a] Number of permits unavailable for 2007.

Source: Hammarstrom and Dickson 2007.

Table 5.10. Permits issued and harvest of salmon in the state fish wheel subsistence fishery at Yentna, 1998-2006.

Year	Permits Issued	Chinook	Sockeye	Coho	Pink	Chum	Total
1998	21	0	495	113	30	15	653
1999	18	0	516	48	18	13	595
2000	19	0	379	92	4	7	482
2001	16	0	545	50	10	4	609
2002	25	0	454	133	14	31	632
2003	19	0	553	67	2	8	630
2004	21	0	441	146	36	3	626
2005	18	0	181	42	25	24	272
2006	22	0	388	178	15	27	608
2007	21	0	367	66	17	18	468

Source: Hammarstrom and Dickson 2007.

Table 5.11. Number of households reporting, and harvest of salmon, in the state set gillnet subsistence fishery at Port Graham, 1998-2006.

Year	Households Reporting	Chinook	Sockeye	Coho	Pink	Chum	Total Salmon	Dolly Varden
1997	25	202	324	203	497	152	1,378	57
1998	16	164	271	243	459	240	1,377	20
1999	21	383	360	427	150	214	1,534	64
2000	35	241	784	252	355	483	2,115	
2001	15	104	176	57	20	32	389	
2002	23	250	417	90	150	74	981	
2003	16	321	1,991	425	266	150	3,153	87
2004	50	283	572	514	363	130	1,862	
2005	46	265	192	51	349	52	909	
2006	[a]	192	31	1	26	24	274	207

[a] Number of households reporting unavailable for 2007.

Source: Hammarstrom and Dickson 2007.

Table 5.12. Number of households reporting, and harvest of salmon, in the state set gillnet subsistence fishery at Nanwalek, 1998-2006.

Year	Households Reporting	Chinook	Sockeye	Coho	Pink	Chum	Total Salmon	Dolly Varden
1997	1	0	1	0	14	1	16	0
1998	3	5	18	0	0	0	23	31
1999	32	102	2,755	1,320	1,873	890	6,940	631
2000	32	18	3,880	1,579	1,251	471	7,199	
2001	34	29	909	1,238	1,434	196	3,806	
2002	56	96	10,203	967	1,681	414	13,441	230
2003	35	144	3,221	513	1,306	381	5,565	102
2004	24	52	2,968	842	1,277	95	5,234	291
2005	23	27	1,934	1,142	1,259	128	4,490	605
2006[a]								

[a] Number of household reporting unavailable for 2007.

Source: Hammarstrom and Dickson 2007.

Table 5.13. Number of permits issued and fished, and harvest of salmon, in the state set gillnet subsistence fishery at Seldovia, 1998-2006.

	Permits		Harvest					
Year	Issued	Fished	Chinook	Sockeye	Coho	Pink	Chum	Total
1997	20	12	44	19	0	0	0	63
1998	23	11	132	61	0	8	0	201
1999	16	12	150	130	0	0	38	318
2000	28	17	189	249	0	0	14	452
2001	19	14	134	124	0	0	0	258
2002	21	13	123	231	13	31	9	407
2003	20	11	67	220	1	13	55	356
2004	14	10	91	63	4	0	15	173
2005	18	6	46	70	13	93	12	234
2006	17	7	12	10	0	22	0	44

Source: Hammarstrom and Dickson 2007.

ii. Subsistence Hunting in the Cook Inlet Area

Although most of the Cook Inlet area falls within non-subsistence areas, there are two Tier II subsistence hunts in the area. One occurs in GMU 15C on the southern tip of the Kenai Peninsula (outside the lease sale area), and one occurs in GMU 16B on the west side of Cook Inlet in the Yentna and Beluga areas. Subsistence harvest of moose in GMU 15C ranged from 0-3 from 1998-2007, and harvest of mountain goats ranged from 0-10 (ADF&G 2008h; Table 5.14). Harvest of moose in GMU 16B ranged from 0-120, only 1 caribou was harvested, and no mountain goats (Table 5.14).

Table 5.14. Subsistence harvests in Tier II hunts in the Cook Inlet area, 1998-2007.

Regulatory Year	Moose	Caribou	Mountain Goat
Game Management Unit 15C[a]			
1998	2	0	4
1999	0	0	5
2000	0	0	5
2001	0	0	4
2002	0	0	4
2003	2	0	7
2004	1	0	6
2005	3	0	8
2006	1	0	10
2007	2	0	0
Game Management Unit 16B[b]			
1998	92	0	0
1999	103	0	0
2000	72	0	0
2001	120	0	0
2002	67	0	0
2003	79	0	0
2004	79	0	0
2005	77	1	0
2006	103	0	0
2007	0	0	0

Source: ADF&G 2008h.

[a] Southern Kenai Peninsula
[b] Includes Yentna, south Beluga, and north Beluga.

b. Federal Subsistence Program (Fish and Marine Mammals)

In 1989, the Alaska Supreme Court ruled that giving rural residents priority for subsistence uses as mandated by the federal Alaska National Interest Lands Conservation Act (ANILCA) violated the Alaska Constitution, and the state's subsistence program was no longer in compliance with ANILCA. As a result, in 1990 the federal government took over management of subsistence hunting on federal lands, and fishing in non-navigable waters; federal management was expanded to include additional navigable waters adjacent to federal lands in 1999 (USFWS 2008b). The federal subsistence program is overseen by the Federal Subsistence Board, which includes the regional directors of the USFWS, NPS, BLM, BIA, and USDA Forest Service. The Board chair is appointed by the secretaries of the Interior and Agriculture. Ten Regional Advisory Councils make recommendations, provide information, review regulations and policy, and provide a public forum for federal subsistence issues (USFWS 2008b). The federal Southcentral Regional Advisory Council, which includes Prince William Sound, has 13 members.

Only residents of rural communities are allowed to subsistence fish and hunt under the federal subsistence program. The federal program defines rural areas where only rural residents may participate, and non-rural areas whose residents are excluded from participation, as opposed to the state program that designates subsistence and non-subsistence areas where all Alaskans can participate. Many communities of the Cook Inlet area are designated non-rural under the federal program, including Wasilla and Houston, the entire Municipality of Anchorage, and communities of the Kenai Peninsula on the road system such as Kenai and Soldotna, Kasilof, Kalifornsky, Clam Gulch, Anchor Point, Homer, and Fritz Creek (Figure 5.21 ;USFWS 2007). Ninilchik, Hope, and Cooper Landing are designated as rural.

In 2007, 112 individual Cook Inlet residents were granted federal subsistence permits: 72 from Cooper Landing, 8 from Hope, and 32 from Ninilchik (USFWS 2008a). These individuals received a total of 198 permits for fishing the Kenai and Kasilof rivers for salmon and resident species (Table 5.15). Federal subsistence fishers harvested 610 sockeye salmon from the Russian River, 66 from the upper Kenai River, 16 from the Moose Range Meadows area, and 30 from the Kasilof River, for a total of 722 sockeye salmon (Table 5.16). Additionally, 5 coho salmon from the Kenai River, 1 rainbow trout from the Russian River, and 6 Dolly Varden from the Kasilof River were harvested (USFWS 2008a).

A federal subsistence fishery for halibut, restricted to rural residents and members of Alaska Native tribes exclusively, occurs in Alaska marine waters including Cook Inlet (Fall et al. 2007). The fishery began in 2003. A Subsistence Halibut Registration Certificate (SHARC), obtained from the NMFS Restricted Access Management Program, is required to participate in the fishery. Although the fishery is managed by NMFS and the NPFMC, ADF&G conducted studies to estimate subsistence harvest of halibut, lingcod, and rockfish in 2003-2006 (Fall et al. 2004a, 2005-2007). In 2004, 251 SHARCs were fished in Cook Inlet; 210 in 2005; and 317 in 2006; the number of SHARCs fished in Cook Inlet was not available for 2003, but 360 were issued (Fall et al. 2004a, 2005-2007). Harvest in the federal subsistence fishery in Cook Inlet ranged from 2,955-4,646 halibut, 103-266 lingcod, and 330-934 rockfish (Table 5.17).

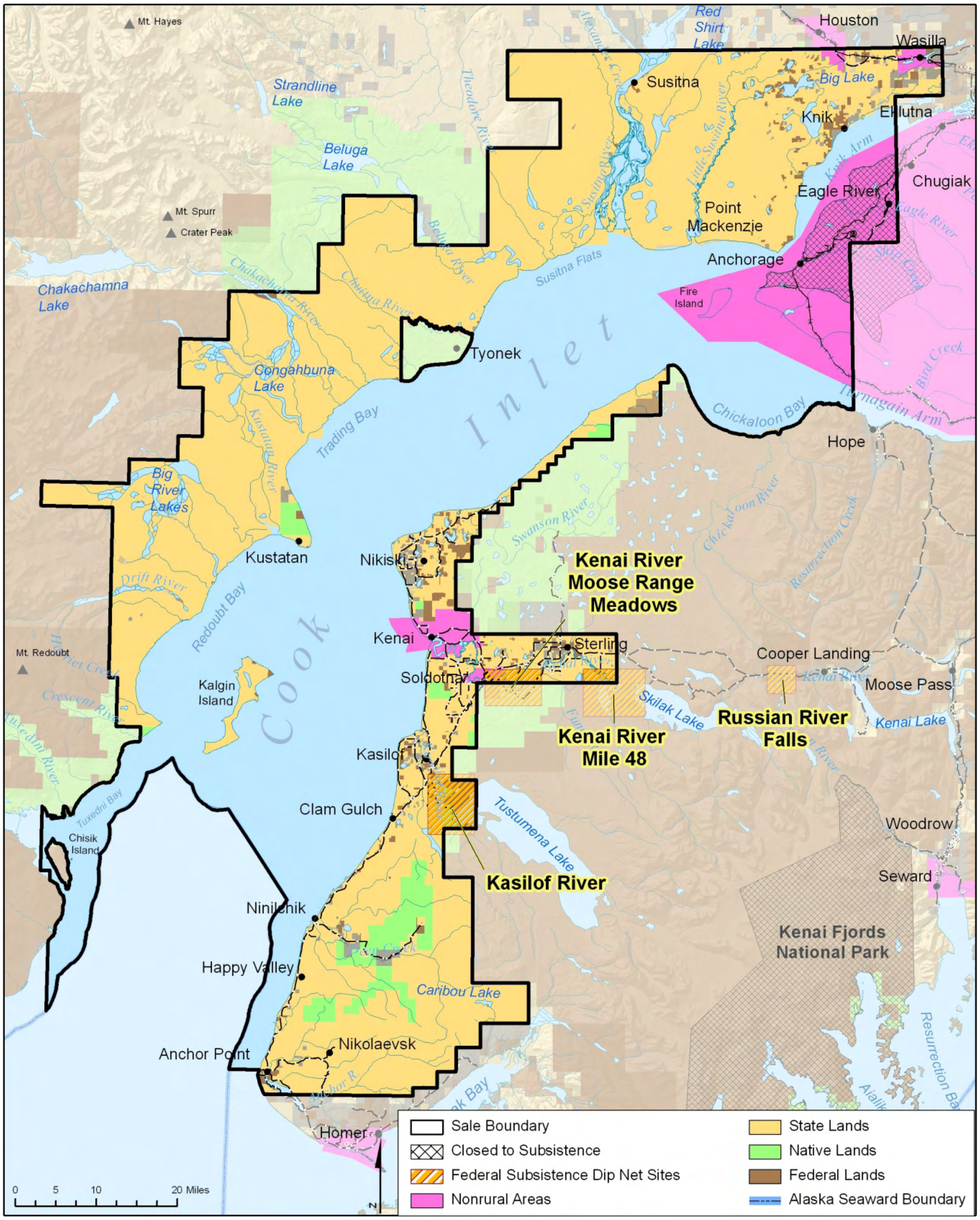


Figure 5.21. Areas determined to be non-rural, areas closed to subsistence, and subsistence dip net sites under federal subsistence rules in the Cook Inlet area.

Table 5.15. Number of federal subsistence permits issued for the Kenai and Kasilof rivers, by permit type, 2007.

Type of Permit	Issued	Returned
Kenai River		
Salmon	110	103
Resident Species	47	19
Total	157	122
Kasilof River		
Salmon	26	26
Resident Species	15	6
Total	41	32
Total Permits	198	154

Source: USFWS 2008a.

Table 5.16. Harvest of sockeye salmon in federal subsistence fisheries on the Kenai and Kasilof rivers, 2007.

	Kenai River					
Gear	Russian River	Upper Kenai River	Moose Range Meadows	Total	Kasilof River	Federal Subsistence Total
Dip Net	450	0	12	462	25	487
Rod-and-Reel	160	66	4	230	5	235
Total	610	66	16	692	30	722

Source: USFWS 2008a.

Table 5.17. Number of Subsistence Halibut Registration Certificates (SHARCs) fished, and harvest of halibut, lingcod, and rockfish, in federal subsistence fisheries in Cook Inlet, 2003-2006.

		Harvest		
Year	Number of SHARCs Fished	Halibut	Lingcod	Rockfish
2003	360[a]	2,955	117	815
2004	251	4,368	266	934
2005	210	4,646	103	679
2006	317	3,194	228	330

Sources: Fall et al. 2004a, 2005-2007.

[a] SHARCs issued.


From Mahoney and Shelden 2000.
Cook Inlet beluga hunt, 1995.

Several species of marine mammals are harvested in federal subsistence hunts in Alaska. From 2000-2004, from 688-857 harbor seals were taken by subsistence hunts in the Gulf of Alaska (Angliss and Outlaw 2008). In the Cook Inlet area, Alaska Natives have hunted beluga whales prior to and subsequent to the Marine Mammal Protection Act in 1972 (Hobbs et al. 2006). Subsistence hunting probably removed up to 20 percent of the Cook Inlet population in 1996, and is thought to account for annual population declines of 14 percent annually from 1994-1988 (Hobbs et al. 2006). NMFS implemented regulations on subsistence hunting of belugas in Cook Inlet beginning in 2001. In 2001 and 2002, subsistence harvest was 1 beluga each year, no belugas were harvested in 2003 and 2004, 2 were harvested in 2005, and none were harvested in 2006 and 2007 (Angliss and Outlaw 2008; Hobbs et al. 2006; Hobbs et al. 2008). Belugas were listed as endangered under the Endangered Species Act in October 2008 (73 FR 205, 62919).

C. Public Water Supplies

The Cook Inlet aquifer system, and the numerous rivers, lakes, and streams of the area provide important sources of public water supplies throughout the area. These freshwaters provide drinking water for public water systems, private wells, and surface springs.

The Matanuska-Susitna Borough operates and maintains public water systems for the community of Talkeetna and the Palmer Garden Terrace Subdivision (DCCED 2008e). Public water for the City of Palmer comes from three deep wells. Although most of Palmer’s residents are on the public water system, over 60 percent of Wasilla households and nearly all households in other Mat-Su communities have individual water wells (DCCED 2008e).

Eklutna Lake and Ship Creek provide about two-thirds of the public water supply in the Anchorage area (Glass 1999), with the remainder coming from underground aquifers. The Anchorage Water and Wastewater Utility, owned and operated by the Municipality of Anchorage, serves 80 percent of the municipality’s residents (DCCED 2008b). Residential, commercial, and business demand is about 25 million gallons per day.

The Ninilchik and Anchor rivers, Deep Creek, and Bridge Creek, a tributary of the Anchor River, are important water supplies for residents of the Kenai Peninsula (KPB 2007). The communities of Homer, Kenai, Nanwalek, Port Graham, Seldovia, Soldotna, and Tyonek have a high portion of households on public water systems (DCCED 2008d). Residents in other communities and locations have a high dependence on private water systems and individual wells.

D. Forestry

There are no designated state forests in the Cook Inlet area, although much of the state’s public domain land is available for forestry activities (DOF 2006). Historically, the Cook Inlet area has had relatively low economic value for forestry products, but in the Matanuska-Susitna area and the Kenai Peninsula, interest is growing in pellet mills, ethanol plants and co-generation plants that could provide alternative energy sources. The Municipality of Anchorage has no forestland of commercial value although it is an important market for forest products from other areas such as the Matanuska-Susitna Borough and Kenai Peninsula (DCCED 2003a). From 1998-2006, the Division of Forestry offered up to 37,929 mbf (thousand board feet) and sold a high of 17,754 mbf (Table 5.18; DOF 2006).

Table 5.18. Commercial timber sales, in mbf (thousand board feet), offered and sold by the Division of Forestry in the Coastal Region-Southcentral, by fiscal year 1998-2006.

Fiscal Year	Timber Volume Offered for Sale	Timber Volume Sold
1998	18,412	17,754
1999	7,777	2,803
2000	9,361	5,774
2001	8,568	1,857
2002	3,749	1,333
2003	12,470	9,779
2004	21,133	957
2005	37,929	4,564
2006	37,346	1,703

Source: DOF 2006.

In the Mat-Su Borough, about 300,000 acres of land are under state ownership, the Mat-Su Borough owns and manages about 114,000 acres of forestland, and other landowners include the Alaska Mental Health Trust, Tyonek Native Corp., Eklutna Inc., and Cook Inlet Region Inc. However, not all of this land is considered commercial timberland. The Mat-Su Borough established 14 forest management units in 1990, totaling about 111,000 acres of which about 73,000 (66 percent) are considered commercial forestland capable of producing at least 20 cu. ft./acre per year under management (DCCED 2003c). Forests in the area are composed primarily of three species of hardwoods, Alaska birch, balsam poplar, black cottonwood; and one species of softwood, white spruce.

Although there have been numerous attempts to develop a commercial market for wood products in the Matanuska-Susitna area, success has been limited because forest density and quality are relatively low, and residential and recreational activities have increasingly competed against logging. However, there are a few commercial operations in the area including about 10 sawmills, most of which sell roughcut lumber or house logs. One supplies kiln-dried birch products in Alaska, and one is a large chip mill that uses spruce and birch and exports its products through Point MacKenzie (DOF 2006). In 2006, the state offered or readied to offer 2,883 acres of timber in the Houston, Willow, and Petersville areas (DOF 2006). A total of 11,465 acres is scheduled to be offered from 2007-2011 (Table 5.19; DOF 2007).

Kenai Peninsula forests are composed predominantly of old growth Sitka spruce, western hemlock, white spruce, paper birch, and Lutz spruce (a white spruce – Sitka spruce hybrid) (DOF 2006). Most commercial timber activity on the Kenai Peninsula takes place on state and Native corporation lands (DCCED 2003b). The Kenai Peninsula includes an estimated 481,700 acres are of commercial timberland (DCCED 2003b). At 5.3 million acres, the Chugach National Forest is the second largest national forest in the country. But although portions of it is located on the Kenai Peninsula, none is within the Cook Inlet lease sale area. The westside of Cook Inlet includes an additional 163,000 acres of commercial timberland (DCCED 2003b). The Kenai Peninsula has a longer and more significant history of commercial timber operations than the Matanuska-Susitna area, primarily small-scale production that is used locally. However, a major and continuing infestation of spruce bark beetle since the 1990s has significantly affected the industry. Although salvage and fire prevention measures have provided some economic benefit, most beetle-killed timber is only suitable for chipping. In 2006, a wood pellet mill was being planned for the area (DOF 2006). DOF offered three competitive timber sales in 2006, totaling 2,976 mbf, and sold an additional 33,257 mbf in over-the-counter timber sales (DOF 2007). A total of 20,544 acres is scheduled to be offered from 2007-2011 (Table 5.20; DOF 2007).

Table 5.19. Timber sales planned for the Mat-Su District, calendar years 2007-2011.

Calendar Year	Houston Small Sales	Willer-Kash (Copper)	Moose Range	Rabideux Sale Area	West Petersville	Fish Creek 1/ Fish Creek 2	Total[a]
2007	250	1,174	90				1,514
2008	130	1,100		70		2,500	1,300
2009	245	1,200				2,200	1,445
2010	50			80	1,286		1,416
2011	250	840					1,090
2007-2011							11,465

Source: DOF 2007.

[a] Totals for individual calendar years do not include Fish Creek because the Fish Creek Management Area is classified for agriculture, not forestry. Total for 2007-2011 includes both Fish Creek sales.

Table 5.20. Timber sales planned for the Kenai-Kodiak area, calendar years 2007-2011.

Timber Sale Name	Estimated Acreage	Timber Sale Name	Estimated Acreage	Timber Sale Name	Estimated Acreage
2007		**2009**		**2011**	
Pothole #7	33	North Ranch	160	Fox	1,310
Pothole #8	37	Kasilof	22	Ohlson	342
Pothole #9	72	Chakok	133	Ohlson West	144
Pothole Block	238	Chakok Hills	99	Chin	114
Subtotal	380	Subtotal	414	Sunshine	87
				Subtotal	1,997
2008		**2010**			
Corners	149	East Ninilchik	270		
Reflection	96	Slikok	157		
Bluff	142	Pioneer	46		
Whiskey	40	American	133		
Fork	35	Garden	97		
Three Rs	41	Wolverine	104		
Pothole #10	85	English	64		
Pothole #11	103	Center Plateau	7,310		
Pothole #12	116	Subtotal	8,181		
Circle	245				
Caribou Hills II	8,520				
Subtotal	9,572			**2007-2011 Total**	**20,544**

Source: DOF 2007.

E. Agriculture

Since the 1930s, crops and cattle have been raised in the Matanuska Valley and Kenai Peninsula but agriculture is of relatively minor importance to the economy of the Cook Inlet area because of the far north latitude and poor climate for agriculture (DCCED 2002). In 2005, farm production values were $820,000 for crops and $235,000 for livestock and poultry on the Kenai Peninsula (KPB 2008). In 2006, earnings from crop production totaled about $660,000 for the Mat-Su Borough (ADLWD 2006).

Matanuska Valley farm.

Alaska Div. of Tourism

Important crops of the Matanuska Valley include vegetables, beef, potatoes, oats, hay, and greenhouse plants and vegetables (DCCED 2002).

A few value-added products are produced in the Mat-Su area, including birch syrup and candies that are marketed to the tourist industry, and the greenhouse industry that provides landscaping products throughout Southcentral Alaska (Wells and Hanson 2006). Dairy and livestock operators face serious obstacles such as increasing costs for fuel and fertilizer, and housing development that competes for agricultural lands (Wells and Hanson 2006). Five dairies operate in the Mat-Su area (Wells and Hanson 2006), but the only dairy processor, Matanuska Maid, closed in 2007 because of increasing costs for supply, energy, and security (Matanuska Maid 2007) leaving dairy operators with few options for selling their product. Another facility that processes livestock, Mt. McKinley Meat and Sausage, is operated at a loss by the state and is an additional serious infrastructure concern for the agricultural industry of the Mat-Su area (Wells and Hanson 2006).

F. Mining

Mineral resources in the Cook Inlet area include coal, sand and gravel, peat, zeolites, gypsum, limestone, gold, copper, silver, zinc, molybdenum, tin, tungsten, lead, arsenic, mercury, chromium, iron, titanium, and tellurium (DCCED 2008f). Although there were large operations for gold and coal in the past, mining in the Mat-Su area is now limited to a few small operations; gravel extraction has increased, however, with most of the product destined for the Anchorage construction market (Wells and Hanson 2006). There are only a few mineral resources in the Anchorage area, including sand and gravel, gold, and small amounts of silver, copper, lead, zinc, molybdenum, and arsenic. Actual commercial activities are limited to several small sand and gravel operations, and limited placer gold has been produced from the Crow Creek and Girdwood areas (DCCED 2008a). Growth potential is severely limited because the Anchorage area is densely populated (DCCED 2008a). Several seasonal sand and gravel operations constitute the primary mining activity on the Kenai Peninsula (DCCED 2008c).

Expenditures for exploration in Southcentral Alaska totaled $9.7 million in 2006 (Szumigala and Hughes 2006). Note that this includes operations outside the Cook Inlet lease sale area because statistics are not available for smaller geographic areas. Major projects include exploration for copper and gold on the Whistler property near Rainy Pass, and for gold on the Lucky Shot property in the Willow Creek mining district. Exploration for diamonds was conducted at Shulin Lake and near Yenlo Hills. In May 2007, the permitting process was begun for a drilling program in the Chickaloon portion of the Matanuska Coal Field (Szumigala and Hughes 2006). Exploration activities resulted in over 10,000 work days of employment, as reported by 23 companies (Table 5.21).

Expenditures for mining development in Southcentral Alaska totaled almost $9 million in 2006 (Szumigala and Hughes 2006), which also includes operations outside the Cook Inlet lease sale area. Development activities resulted in almost 11,000 work days of employment, as reported by 7 companies (Table 5.21). The Chuitna coal project, a particularly large and important project, is located on the west side of Cook Inlet, about 45 miles west of Anchorage, and lies within the lease sale area. This project is being developed by PacRim Coal on land owned by a combination of public and private entities, including the State of Alaska, Mental Health Trust, Kenai Peninsula Borough, Tyonek Native Corporation, Cook Inlet Region, Inc., and individuals (Chuitna Coal Project 2008). The project is anticipated to include a surface coal mine, access road, coal transport conveyor, air strip, personnel housing, logistic center, and an export terminal that includes a 10,000 foot trestle from shore to load coal transport ships (Chuitna Coal Project 2008). Agencies involved in permitting and consulting for the project include EPA, Army Corps of Engineers, ADNR, and USFWS. In March 2008, Agrium Corp. canceled plans for a coal gasification project at its Kenai plant that would have utilized coal from Usibelli Mines located in Healy (Bradner 2008).

Table 5.21. Expenditures and employment resulting from mining exploration and development activities, 2006.

	Exploration	Development
Expenditures		
Placer	$109,000	$145,250
Lode	$9,684,317	$320,000
Coal and Peat		$8,000,000
Industrial Minerals		$516,000
Total	$9,793,317	$8,981,250
Employment		
Work Days	10,435	10,820
Work Years	40	42
Companies Reporting	23	7

Source: Szumigala and Hughes 2006.

Notes: Includes activities for all of Southcentral Alaska, including activities occurring outside the Cook Inlet areawide lease sale area.

The primary mining production in Southcentral was for rock, sand, gravel, and peat (topsoil) in 2006 with 71 operators in the area (Szumigala and Hughes 2006). A total of 6.42 million tons of sand and gravel was produced with a value of $27 million and 386,567 tons of rock valued at almost $5.0 million. Sand and gravel operations provided 105 full-time equivalent jobs, rock provided 11 jobs. A total of 41,500 cubic yards of peat were produced resulting in 7 full-time equivalent jobs. Additionally in 2006, placer gold production was 5,837 ounces by 25 operators (10 of which were recreational) with full-time equivalent employment of 36 (Szumigala and Hughes 2006).

G. Oil and Gas

Oil and gas exploration, development, and production has been ongoing in the Cook Inlet area since the early 1960s. The oil and gas industry is an important employer in the area, and is critical to the area's economy. Chapter 6 provides a detailed description of the oil and gas industry in the Cook Inlet area.

H. Recreation and Tourism

The Cook Inlet area is well known for its recreational opportunities, and tourism is a vital component of most local economies. During summer 2006, visitors totaled 139,000 to the Palmer/Wasilla area, 814,000 in Anchorage, and 439,00 on the Kenai Peninsula (McDowell Group 2007). Compared to other parts of the state, visitors to Southcentral Alaska tend to be more likely to enter and exit the state by air, as opposed to cruise ship; they tend to stay slightly longer, averaging 10.9 nights; and they are more likely to participate in tours and activities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RV at pullout along Turnagain Arm.

(McDowell Group 2007). The communities of Palmer/Wasilla, Homer, and Kenai/Soldotna had a high percentage of highway and ferry travelers, and had the longest length of stay in Alaska, ranging from 14.6-18.8 nights (McDowell Group 2007). Average expenditure was $1,290 in Palmer/Wasilla, $1,181 in Anchorage, and $1,407 in Kenai/Soldotna. Total out-of-pocket expenditures for visitors statewide was $1.5 billion, excluding transportation costs to and from Alaska (McDowell Group 2007).

The top activities visitors participated in were shopping, wildlife viewing, sightseeing tours, day cruises, train excursions, hiking and nature walks, museums, Native cultural tours and activities, fishing, and historical and cultural attractions (McDowell Group 2007). “Soft-adventure” recreation and tourist activities, ranging from helicopters to whitewater rafting to dog mushing, are growing rapidly in the area (Colt et al. 2002) and are expected to continue to grow (Brooks and Haynes 2001). Rates and intensity of participation in outdoor recreation are higher in Alaska than in the lower 48 states, and rates are expected to remain high (Brooks and Haynes 2001). The five activities with the greatest growth are scenic driving, biking, bird and wildlife viewing, recreational vehicle camping, and fishing, indicating that roads and waterways are heavily relied on for outdoor recreation (Brooks and Haynes 2001).

I. Renewable Energy

Renewable energy resources that hold the most potential in the Cook Inlet area include geothermal, wind, and hydropower (Papp et al. 2008).

1. Geothermal

Geothermal energy is heat from the earth that is accessed from water or steam wells (EERE 2008). Geothermal resources are found in the Cook Inlet area associated with the Ring of Fire volcanoes (AEA 2007). Geothermal resources occur in shallow ground, as well as several miles below earth’s surface in the form of hot water and rock, and even deeper as hot molten rock (magma). Wells can be drilled to a mile or more, tapping into steam and very hot water that is brought to the surface to drive turbines to generate electricity and heat buildings (EERE 2008). Other potential uses in Alaska include district heating, greenhouses, absorption chilling, mariculture, process heating in the seafood industry, swimming pool heating, and hydrogen production (AEA 2007). Geothermal energy results in little or no greenhouse gases, is reliable, and is a domestic energy supply (EERE 2008). Geothermal plants are relatively expensive to develop. They may produce some byproduct sludges that require disposal at approved sites and other waste materials and excess water may be reinjected (EERE 2008).

2. Wind

Wind energy is used to generate mechanical power, which can be used to pump water, or a generator can convert the mechanical power into electricity (EERE 2008). Western and coastal areas of Alaska hold the most promise for wind energy where there are strong high and low pressure systems and associated storm tracks (AEA 2007). Possible locations for harnessing wind energy in the Cook Inlet area include Fire Island and the upper Matanuska Valley (AEA 2007). To harness wind energy, wind turns the blades of a wind turbine, which spin a shaft, which is connected to a generator that makes electricity (EERE 2008). Wind turbines can range from small, for use in homes, to large enough to provide electricity on a utility scale. Wind energy is considered a clean fuel source because it does not result in emissions, and is also a domestic energy source (EERE 2008). However, some wind farms may not be cost competitive with conventional energy sources because a higher investment is required than for fossil-fueled generators. In addition, the wind source may be intermittent so that it does not provide a reliable energy source; wind sources are often found in remote areas far from where they are needed; they may compete with other land uses, produce unacceptable noise levels, and have aesthetic impacts; and birds can be killed by the rotors (EERE 2008).

3. Hydropower

Hydropower is the use of water to power machinery or make electricity (EERE 2008). The Cook Inlet area has abundant potential for hydropower because of its location in a mountainous region with moderate to high precipitation and its location on the coast with access to marine waters (AEA 2007). The Bradley Lake project near Homer is an important source of power for the area, providing about 8 percent of the electrical energy for the Railbelt (AEA 2007). Power is captured from the kinetic energy of water flowing downstream. Energy is converted into electricity by turbines and generators, which is then transferred into electrical grids for use in homes, businesses, and industry (EERE 2008). Hydropower can be captured by impounding water behind a dam in a reservoir or without a dam (AEA 2007). Ocean energy includes thermal energy, tidal energy, and wave energy. Hydropower is considered a clean fuel because it does not produce emissions, and it is a domestic energy source. Hydropower is generally reliable, as flow through turbines can be controlled based on power needs. Tidal energy is reliable as well because of the predictability of tides. However, during drought, water may not be available for systems dependant on freshwater sources. In addition, hydropower associated with dams can have serious environmental issues, including impeding fish passage, fish mortality from turbines, impacts on water quality and flow, and impacts on habitat (EERE 2008).

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Chapter Six: Oil and Gas in Cook Inlet

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Chapter Six: Oil and Gas in Cook Inlet

A. Geology of Cook Inlet

The Cook Inlet Lowland encompasses an area that lies generally below an elevation of 1,000 feet. It is bordered by the Alaska and Aleutian ranges to the north and west and by the Talkeetna, Chugach, and Kenai mountains to the northeast and east. The marine waters of Cook Inlet, including its Turnagain Arm and Knik Arm extensions, divide the Cook Inlet Lowland into several natural subunits. These subunits consist of the Kenai Lowland to the east, the Kustatan Lowland to the west, the Susitna Lowland to the north, and the Matanuska Lowland to the northeast (Karlstrom 1964).

L. Silliphant, DO&G

Beluga River, west side Cook Inlet.

The Cook Inlet Lowland occupies a structural trough known colloquially as the Cook Inlet Basin. This basin is underlain by rocks of Quaternary, Tertiary, Mesozoic, and older age (Table 6.1). Three major fault zones border the Cook Inlet Basin: the Bruin Bay and Castle Mountain faults, to the west and north respectively, and the Border Ranges fault to the east and northeast. Tertiary sediments south of the Castle Mountain fault are estimated to be as thick as 26,000 feet at the structural axis of the basin (DO&G 2008b). North of the Castle Mountain fault these sediments are only on the order of 2,000 feet thick (Maynard 1987; DO&G 1998).

The lease sale area encompasses the Cook Inlet Basin and a small section due north of the Castle Mountain fault. Rock sequences with proven oil and gas potential underlie the region. Cook Inlet Basin surficial and bedrock geology are discussed in the following sections.

1. Surficial Geology

Modern topography of the Cook Inlet Lowland has been dominantly influenced by five episodes of Pleistocene glaciation and two post-Pleistocene glacial periods (Reger et al. 2007; Karlstrom 1964). During these glaciations, ice lobes fed directly into the Cook Inlet Basin from the surrounding mountain ranges. The advance and retreat of these glaciers are responsible for many of the distinctive land features present in and surrounding the Cook Inlet Basin today such as scraped and scoured valley floors, broad outwash plains, and alpine troughs. The unsorted deposits of gravel, sand, silt, and clay remaining after a period of glaciation are called glacial till. Moraines, which are linear piles of till laid down in fairly regular, low-lying hills, are the most common glacial deposit found in the region. Moraines represent a glacier’s maximum advance during its given episode (Selkregg 1975).

The Kenai Peninsula, from Point Possession to the head of Kachemak Bay, and including Kenai, Soldotna, and Homer, contains numerous low, rolling glacial moraines and glacial depressions filled by lakes and muskeg. Many rivers and streams flow through this area. Soils range from gravely clay loam to gravely sand mantled with silty material and bands of volcanic ash (KPB 1990).

On the west side of Cook Inlet, the coastal lowlands between Tuxedni Bay and Granite Point consist of nearly level, poorly drained outwash plains deposited by large glaciers in the Aleutian Range and Chigmit Mountains. The outwash plains are braided with meandering and shifting stream channels. Most soils consist of sandy glacial outwash, silt, tidal sediments and gravelly river wash. The water table is high in most of this area with the exception of a few well-drained natural levees and ridges.

North of Granite Point, topography and soils are similar to the coastal lowlands on the east side of Cook Inlet, and consist of glacial moraines and depressions of gravely clay, sand, and silt composition (KPB 1990).

Table 6.1. Geologic time.

Era	Period	Epoch	Age (Millions of years)
Cenozoic	Quaternary	Holocene	0.01
		Pleistocene	1.8
	Tertiary	Pliocene	5.3
		Miocene	23.0
		Oligocene	33.9
		Eocene	55.8
		Paleocene	65.5
Mesozoic	Cretaceous	Early to Late	145.5
	Jurassic	Early to Late	199.6
	Triassic	Early to Late	251.0
Paleozoic	Permian	Early to Late	299.0
	Pennsylvanian	Early to Late	318.1
	Mississippian	Early to Late	359.2
	Devonian	Early to Late	416.0
	Silurian	Early to Late	443.7
	Ordovician	Early to Late	488.3
	Cambrian	Early to Late	542.0

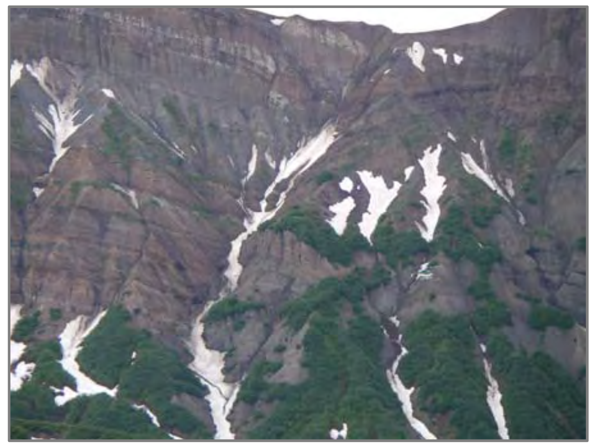
Notes: Adapted from U.S. Geological Survey Geologic Names Committee, 2007, Divisions of geologic time--Major chronostratigraphic and geochronologic units (USGS 2007).

2. Bedrock Geology

The Cook Inlet Basin is a geologically active convergent margin where the Pacific tectonic plate is subducting (i.e. plunging) beneath the North American tectonic plate. The Pacific plate is moving north-northwest sliding past the North American Plate near California and the Pacific Northwest. The northern edge of the Pacific plate extends from directly east of Asia through Prince William Sound and into central Alaska and is actively subducting beneath the North American plate in the vicinity of the Aleutian Islands and southern Alaska (Selkregg 1975). Active subduction and associated tectonic faulting have created the deep ocean Aleutian trench with an associated arc of volcanic islands known as the Aleutian archipelago, in addition to a chain of coastal mountain ranges including the Chugach and Kenai mountains. Tectonic processes of uplift and subsidence coupled with erosion, deposition, and sea level changes combined to form the Cook Inlet basin bedrock geology.

During late Paleozoic and early Mesozoic time (Table 6.1), sediments were deposited in a sea that occupied Southcentral Alaska. A volcanic island arc, similar in form to the modern Aleutian island arc, occupied a widespread area in the general vicinity of the now existing Alaska Range. The area occupied by the island arc was folded, faulted, and uplifted during Triassic time and provided the source from which sediments were eroded and deposited in a southerly direction into the adjacent marine basin (Selkregg 1975; DO&G 1997).

Uplift and erosion of granitic bodies during Jurassic and Cretaceous time provided material for a thick sequence of continental shelf sediments deposited in an adjacent, low lying basin which extended from the southern Alaska Peninsula through the Cook Inlet region to the Copper River basin. Fine-grain sediments, rich in organic matter, were deposited creating source material for potential Tertiary age petroleum systems (Selkregg 1975; DO&G 1997). Concurrent with the Late Jurassic and Cretaceous continental shelf sediment deposition, Pacific plate subduction and fault slipping produced a thick accretionary wedge of oceanic sediments. This accretionary wedge was uplifted to form the Chugach and Kenai mountains.


L. Silliphant, DO&G

Alluvial fans of West Foreland Formation, near Capps Glacier.

During Tertiary time the trough between the granitic bodies to the west and northwest and the accretionary wedge to the east and north east was subsiding. A system of alluvial fans composed of gravels and coarse-grained sands developed along the mountain fronts. Streams reworked and transported sediment from the distal ends of the alluvial fans out into the floodplain. Swamps, highly vegetated interfluves, and flood basins provided biotic material that later developed into coals. The repetitive cycle of vegetative growth and subsequent flooding by sediment deposition resulted in thick accumulations of gravel, sandstone, siltstone, mudstone, and coal. The gravels and sands, possessing excellent porosity, would later become oil and gas reservoirs.

In the late Tertiary extensive right lateral faults, with associated dip-slip motion, developed along the Bruin Bay and Castle Mountain fault zones and the Border Ranges fault zone. This relative movement reactivated pre-existing structures throughout the basin and created a series of anticlinal and synclinal folds. Fold axes are generally subparallel to the basin margins and trend northeast-southwest. Many of these faulting-induced folds act as hydrocarbon traps and are sources of current oil and gas production today.

The southern edge of the Susitna Basin is generally interpreted as a northwestern extension of the Cook Inlet Basin. The structural style of the Susitna Basin is a combination of graben and half-graben basement faulting. Tertiary age formations in the southern Susitna Basin, although generally much thinner, are nearly identical to those found in Cook Inlet Basin proper. Eocene and Oligocene-age reservoir rocks however, appear to be missing from the Susitna Basin stratigraphic section. Jurassic age oil-prone source rocks, found in the Cook Inlet Basin, have not been found in wells or outcrops from the Susitna Basin (DO&G 1997).

B. Petroleum Potential

The area considered in this best interest finding has low to moderate petroleum exploration potential. This represents ADNR’s general assessment of the oil and gas potential of the area and is based on a resource evaluation made by the state. This resource evaluation involves several factors including geology, seismic data, exploration history of the area, and proximity to known hydrocarbon accumulations.

Cook Inlet is a mature, producing petroleum basin which has seen extensive exploration and development over the past 40 years. The chances of finding undiscovered petroleum reservoirs is reduced by the fact that extensive exploration has already taken place and there is a corresponding lack of major new discoveries.

Outcrop of permeable rock, Sterling Formation, near Clam Gulch.

In order for an accumulation of hydrocarbons to be recoverable, the underlying geology must be favorable. This may depend on the presence of source and reservoir rock; the depth and time of burial; and the presence of migration routes and geologic traps or reservoirs. Source rocks are organic-rich sediments, generally marine shales, which have been buried for a sufficient time, and with sufficient temperature and pressure to form hydrocarbons.

As hydrocarbons are formed, they will naturally progress toward the surface if a migration route exists. An example of a migration route might be a permeable layer of rock in contact with the source layer, or fault fractures that penetrate organic-rich sediments. A hydrocarbon reservoir is permeable rock that has been geologically sealed at the correct time to form a "trap." The presence of migration routes therefore affects the depth and location where oil or gas may pool and form a reservoir. For a hydrocarbon reservoir to be producible, the reservoir rock must be of sufficient thickness and quality (good permeability and porosity), and must contain a sufficient volume or fill of hydrocarbons to be produced.

Another factor used by the division to assess the petroleum potential of the area considered in this best interest finding is the area's history of petroleum exploration and development. A well-documented history of petroleum discoveries and production indicates that petroleum reservoirs do exist.

Some portions of this area have higher potential because of more favorable geology and proximity to existing fields, while other portions of the area may have lower potential because they are either more distant from production areas, the geology is less favorable, or the exploration history is less encouraging. Areas with lower potential may still contain hydrocarbon accumulations.

The process of evaluating the oil and gas potential involves the use of data including seismic and well engineering information, which by law the division must keep confidential under AS 38.05.035(a)(9)(C). In order to protect these data, the division must generalize the assessment that is made public.

C. Phases of Oil and Gas Development

Lease-related activities proceed in phases, moving from leasing, to exploration, and then to development and production. Each phase's activities depend on the completion or initiation of the preceding phase. Table 6.2 lists activities that may occur during the exploration, development, and production phases.

1. Lease Phase

Oil and gas lease sales are the first step in developing the state's oil and gas resources. Annually, ADNR prepares and presents a five-year program of proposed oil and gas lease sales to the legislature. Currently, DO&G conducts competitive annual areawide lease sales, offering for lease all available state acreage within five areas (North Slope, Beaufort Sea, Cook Inlet, North Slope Foothills, and Alaska Peninsula). The lease sale area is divided into tracts, and interested parties that qualify may bid on one or more tracts.

Not later than 45 days before the lease sale, DO&G issues a notice describing the interests to be offered, the location and time of the sale, and the terms and conditions of the sale. The announcement includes a tract map showing generalized land status, estimated tract acreages, and instructions for submitting bids. The actual lease sale consists of opening and reading the sealed bids and awarding a lease to the highest bid per acre by a qualified bidder on a tract. DO&G verifies the state's ownership interest only for the acreage within tracts that received bids. Only those state-owned lands within the tracts that are determined to be free and clear of title conflicts are available to lease.

Alaska has several leasing method options designed to encourage oil and gas exploration and maximize state revenue. These methods include combinations of fixed and variable bonus bids, royalty shares, and net profit shares. Lease terms are set at 5, 7, or 10 years, depending on a number of factors, including geographical location. An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances. A lease plan of operations must be approved before any operations may be undertaken on or in the leased area, except for activities that would not require a land use permit or for operations undertaken under an approved unit plan of operations.

Although beyond the scope of this best interest finding, exploration licensing supplements the state's areawide oil and gas leasing program by targeting areas outside of known oil and gas provinces. The intent of licensing is to encourage exploration in areas far from existing infrastructure, with relatively low or unknown hydrocarbon potential, where there is a higher investment risk to the operator. Because bonus payments are required to win a lease, lease sales held in some of these higher-risk areas tend to attract little participation. Exploration licensing gives an interested party the exclusive right to conduct oil and gas exploration without this initial expense. Through exploration licensing the state receives valuable subsurface geologic information on these regions and, should development occur, additional revenue through royalties and taxes. (AS 38.05.131-134.)

Table 6.2. Potential activities during exploration, development, and production phases.

Exploration	Development	Production
Permitting	Gravel pits, pads, and roads	Well work over (rigs)
Water usage	Dock and bridge construction	Gravel pads and roads
Environmental studies	Drilling rigs	Produced water
Seismic tests	Pipelines	Air emissions
Exploratory drilling rigs	Work camps	Pipeline maintenance
Land clearing	Permitting	Work camps
Drilling muds and discharges	Monitoring	Trucking
Gravel road beds	Well heads	
Work camp	Injection wells	
Increased air traffic	Seismic	
Temporary gravel pads		
Research and analysis		

2. Exploration Phase

During the exploration phase, information is gathered about the petroleum potential of an area by examining surface geology, researching data from existing wells, performing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. Surface analysis includes the study of surface topography or the natural surface features of the area, near-surface structures revealed by examining and mapping exposed rock layers, and geographic features such as hills, mountains, and valleys. Geophysical exploration and exploration drilling are the primary activities that could result in potential effects to the Cook Inlet lease sale area. Geophysical surveys, primarily seismic, help reveal what the subsurface may look like. Geophysical exploration of the Cook Inlet area has been ongoing since prospectors discovered oil seeps in the early 20th century.

a. Geophysical Exploration

Geophysical exploration activities are regulated by 11 AAC 96. Before proceeding, companies must acquire one or more permits from the state, depending on the timing and extent of the proposed activity. ADNR tailors each permit approval to the specifics of the proposed project. Restrictions on geophysical exploration permits depend on the duration, location, and intensity of the project. They also depend on the potential effects the activity may have on fish and wildlife resources or human use in the area. The extent of potential effects varies, depending on the survey method and the time of year the survey is conducted.

Seismic surveys are the most common type of geophysical exploration, and are typically conducted by geophysical companies under contract to leaseholders or as multi-client and speculative surveys run directly by the seismic contractors. At the survey location, an energy source is emitted into the subsurface and reflected energy waves are recorded by geophones and/or hydrophones, land and marine vibration-sensitive receivers. Different densities of rock layers beneath the surface result in a unique seismic profile that can be analyzed by geophysicists to determine subsurface structures and petroleum potential. Both two-dimensional (2D) and three-dimensional (3D) data are gathered from seismic surveys. In the Cook Inlet area, seismic surveys are conducted on land, in tidal areas, and in marine waters.

Land-based seismic surveys are usually conducted in winter to minimize effects to fish and wildlife habitats. Surveys can be run year round in uplands areas, but are limited to the winter season on wetlands, typically the end of October through the end of March, to best protect habitat and wildlife.


B. Havelock, DO&G

A Tucker SnoCat, used for winter access.

To conduct a seismic survey, source and receiver locations are surveyed using GPS (Global Positioning Systems) and laid out in predesigned patterns. For 2D data, the receivers and sources lie in as straight a line as possible given the terrain, and can extend for many tens of miles. For 3D data, data is collected over a much wider swath, and can cover tens to hundreds of square miles. 2D seismic programs usually have fewer crewmembers and employ much less equipment than 3D programs.

In areas of high habitat sensitivity, such as wildlife and game refuges, heli-portable crews and/or backpackers are used to transport equipment. In more accessible areas, narrow tracked vehicles are used for transport. If needed to facilitate access, mulchers are used to clear brush, small alders and willows in 2-3 meter wide paths. Mulchers are not used in old growth or larger trees. Surveys now use global satellite positioning instruments, making the past practice of long clear-cuts through forests for line-of-sight measurements unnecessary.

Multiple seismic sources can be used on land surveys, based on the terrain and conditions, including explosives, weight drop, and hydraulic devices (vibrator trucks).

Explosives may be placed into drill holes and detonated, or, much less commonly, they may be suspended on stakes above the ground (Poulter method). When buried, drill holes are typically 20-30 feet deep with 2.5-5 pounds of explosives set at the bottom of the hole. Holes are either drilled with track-mounted drills or, if in remote or sensitive areas, drills are slung into position by helicopters. Soil is disturbed in the immediate vicinity of the explosive charges placed into the ground. At locations with existing developments, allowable maximum peak particle velocity is mapped and if explosives are contra-indicated, vibrators or a weight drop are used to produce the seismic wave energy.

Vibroseis, a more common practice, utilizes a vibrator as the energy source. A vibrating plate is attached to a low ground pressure vehicle and creates a vibration of continuously varying frequency to put energy into the ground, typically lasting four seconds or longer. This method is less destructive than an impulsive explosive source, where all the energy is imparted in an instant.

B. Havelock, DO&G

Example of vibroseis trucks conducting a seismic survey.

Finally, a weight drop method can be used. The weight drop mechanism is transported via narrow tracked vehicles and is becoming a more routine acquisition source. Depending on the location, terrain and varying vegetation cover, several energy source techniques might be needed for the same project.

In intertidal (transition) zones, either shallow hole explosive sources at low tide, or very shallow towed airguns at high tide can be used. The receivers are typically housed in cables laid directly on the mud. Transition surveys are usually acquired from mid March through mid May, and from September until freeze-up. The season is limited by protections for fishing, wildlife, and recreational users, as well as safety concerns due to ice formation and flows.

Seismic surveys may also be conducted in marine waters, usually between April and mid-November. Marine seismic programs typically use a vessel between 100-175 feet long. Shore-based helicopters, which can land on the vessel's helideck, resupply the operation and transfer crew when necessary. Marine seismic equipment consists of an airgun array for the energy source, hydrophones to detect sound, an amplifier and recording system, and a navigation system. The airgun array, towed directly behind the ship at a depth of 30 to 40 feet, consists of several sub-arrays, each containing several airguns of various sizes. Hydrophones, which detect the sound energy waves generated by the airguns and reflected back from the sub-surface geologic boundaries, are housed in long streamer cables (1-2 miles) which are towed behind the ship at depths between 20 and 40 feet. For 2D surveys, one cable is towed at a time. For 3D surveys, multiple cables can be towed. Due to extreme tides and currents in Cook Inlet waters, towing multiple cables is problematic; more than two at a time is unusual here. For some seismic surveys, the detectors and cables are placed directly on the bottom (ocean bottom cable, or OBC) where they remain stationary as the shooting boat traverses across them.

Additional geophysical techniques can be used to gather information specifically about the ocean bottom and very near surface geology, usually to identify drilling hazards. They include high resolution shallow seismic, side-scan sonar, fathometer recordings and shallow coring programs. High resolution shallow seismic surveys are specifically designed to image the ocean bottom and very shallow geology. They employ smaller vessels and a lower energy seismic source than surveys targeting oil and gas potential, and use a much shorter cable.

b. Exploration Drilling

Courtesy Pioneer Natural Resources, Alaska

Rowan-68 rig drilling the Hansen 1AL1 exploration well near Anchor Point.

Exploratory drilling often occurs after seismic surveys are conducted, and when the interpretation of the seismic data incorporated with all available geologic data reveals oil and gas prospects. Exploration drilling, which proceeds only after obtaining the appropriate permits, is the best way to learn whether a prospect contains commercial quantities of oil or gas, and aids in determining whether to proceed to the development phase. Drilling operations collect well logs, core samples, cuttings, and a variety of other data. A well log is a record of one or more physical measurements as a function of depth in a borehole and is achieved by lowering measuring instruments into the well bore. Well logs can also be recorded while drilling. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled.

The drilling process is as follows:

- Special steel pipe (conductor casing) is bored into the soil.
- A drill bit, connected to the end of the drill pipe, rotates and drills a hole through the rock formations below the surface.
- After a prescribed depth of drilling, the hole is cleaned up and surface casing, a smaller diameter steel pipe, is lowered into the hole and cemented in place to keep the hole from caving in; seal off rock formations; seal the well bore from groundwater; and provide a conduit from the bottom of the hole to the drilling rig.
- After surface casing is set, drilling continues until the objective formation is reached. In instances where subsurface pressures are extremely high, an intermediate casing string may be lowered into the hole and cemented in place.
- The well produces, is capped, or is plugged and abandoned.

When drilling onshore, the drill site is selected to provide access to the prospect and, if possible, is located to minimize the surface area that may have to be cleared. Sometimes temporary roads must be built to the area. Roads are constructed of sand and gravel placed on a liner above undisturbed ground. Construction of support facilities such as production pads, roads, and pipelines may be required. A typical drill pad is made of sand and gravel placed over a liner and is about 300 feet by 400 feet. The pad supports the drill rig which is brought in and assembled at the site, if necessary a fuel storage area, and a camp for workers. If possible, an operator will use nearby existing facilities for housing and feeding its crew. If the facilities are not available, a temporary camp of trailers on skids may be placed on the pad.

Enough fuel is stored on-site to satisfy the operation’s short term needs. The storage area is a diked gravel pad lined with an 80 mil synthetic membrane. Additional amounts of fuel may be stored at the nearest existing facility for transport to the drilling area as needed (Chevron 1991).

Offshore exploratory drilling rigs include bottom-supported rigs such as submersibles and jackup rigs, barges, floating rigs such as drill ships, and semi-submersibles. Water depth and bottom conditions determine which equipment will be used. Some mobile offshore drilling units (MODUs) that may be used during the exploration phase, their support types, and operational depths are listed below:


Courtesy ConocoPhillips

Sunfish prospect jack-up drilling rig.

- Bottom supported
  - Submersibles
    - Posted barges (water <30 feet)
    - Bottle-type submersibles (water <200 feet)
    - Arctic submersibles (concrete island drilling system (CIDS; water up to 150’)
  - Jackups
    - Columnar legs (water 300’ to 600’)
    - Truss legs (water 300’ to 600’)
  - Inland barges (shallow water)
  - Ship-shaped barges and drill ships
- Semi-submersibles (deep water applications).

When a prospect cannot be reached from directional drilling (Appendix C) from shore, jackup rigs are the most likely to be used in Cook Inlet for exploratory wells, as they are best suited to withstanding the very large currents and tidal variations experienced here. These rigs have watertight barge hulls that can float on the surface of the water while the unit is being moved between drill sites. Some units are towed while others are self-propelled. Before the location is finalized, the operator performs a geological hazards survey to make sure that the sea floor can support the rig. High resolution shallow seismic surveys look for shallow gas (methane) deposits and faults. When the jackup is positioned at the drill site, the legs are jacked down until they rest on the seabed. The hull is then jacked up above the water’s surface until a sufficient gap exists to accommodate tides and waves.

An exploratory drilling operation generates approximately 12,000 cubic feet of drilling cuttings. Cuttings are fragments of rock cut by the drill bit. These fragments are carried up from the drill bit by the mud pumped into the well (Gerding 1986). Gas, formation water, fluids, and additives used in the drilling process are also produced from drilling operations. The fluids pumped down the well are called “mud” and are naturally occurring clays with small amounts of biologically inert products. Different formulations of mud are used to meet the various conditions encountered in the well. The mud cools and lubricates the drill bit, prevents the drill pipe from sticking to the sides of the hole, seals off cracks in down-hole formations to prevent the flow of drilling fluids into those formations, and carries cuttings to the surface.

Disposal of mud, cuttings, and other effluent is regulated by the National Pollutant Discharge Elimination System (NPDES) and the EPA’s Underground Injection Control program administered by the Alaska Oil and Gas Conservation Commission under regulations in 20 AAC Chapter 25. The state discourages the use of reserve pits, and most operators store drilling solids and fluids in tanks or in temporary on-pad storage areas until they can be disposed of, generally down the annulus of the well or in a disposal well that is completed and equipped to take mud and cuttings, and permitted in accordance with 20 AAC 25.080 and 20 AAC 25.252. If a reserve pit is necessary, it is constructed off the drill pad and could be as large as 5 feet deep and 40 feet by 60 feet. It is lined with an 80 mil geotextile liner to prevent contamination of surrounding soils. Drilling muds, fluids, and cuttings produced from the well are separated and disposed of, often by reinjection into an approved disposal well annulus or disposal well, or they may be shipped to a disposal facility out-of-state. With appropriate permits, solids may be left in place in a capped reserve pit. If necessary, a flare pit may be constructed off of the drill pad to allow for the safe venting of natural gas that may be encountered in the well.

If oil or gas is discovered at the exploratory well, it is likely that the gravel pad used for the exploratory well will also be used for development and production operations. Gravel pads are semi-permanent structures and can be rehabilitated following field depletion.

3. Development and Production Phases

The development and production phases are interrelated and overlap in time; therefore, this section discusses them together. During the development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery. These phases can begin only after exploration has been completed and tests show that a discovery is economically viable (Gerding 1986).

After designing the facilities and obtaining the necessary permits, the operator constructs permanent structures and drills production wells. The operator must build production structures that will last the life of the field and may have to design and add new facilities for enhanced recovery operations as production proceeds. Figure 6.1 depicts a production wellbore schematic for Cook Inlet.


B. Havelock, DO&G

Typical producing gas well, Cook Inlet area.

The development "footprint" has decreased in recent years as advances in drilling technology have led to smaller, more consolidated pad sizes. Directional drilling (Appendix C) allows more wells to be drilled from a common location (drill pad). A single production pad and several directionally drilled wells can develop more than one and possibly several 640-acre sections. Sometimes a well is drilled at an angle through a formation to increase productivity and allow the oil and gas to be extracted from a larger subsurface area (by increasing the drainage area) than would be possible from a single straight wellbore.

The Alaska Oil and Gas Conservation Commission through its statutory and regulatory mandate oversees drilling and production practices to maximize oil and gas recovery, prevent waste and ensure protection of correlative rights within the state. It is a quasi-judicial agency that conducts hearings to review drilling and development to ensure regulatory compliance.

Natural gas is occasionally flared for safety reasons. Flaring is "the controlled burning of natural gas at a well site or facility; venting is the release of uncombusted natural gas to the atmosphere" (Centre for Energy 2008). However, operators in Alaska are required to minimize the volume of gas released, burned, or permitted to escape into the air (20 AAC 23.235(c)). Operators must report monthly to AOGCC any flaring event lasting over an hour. AOGCC investigates these incidents to determine if

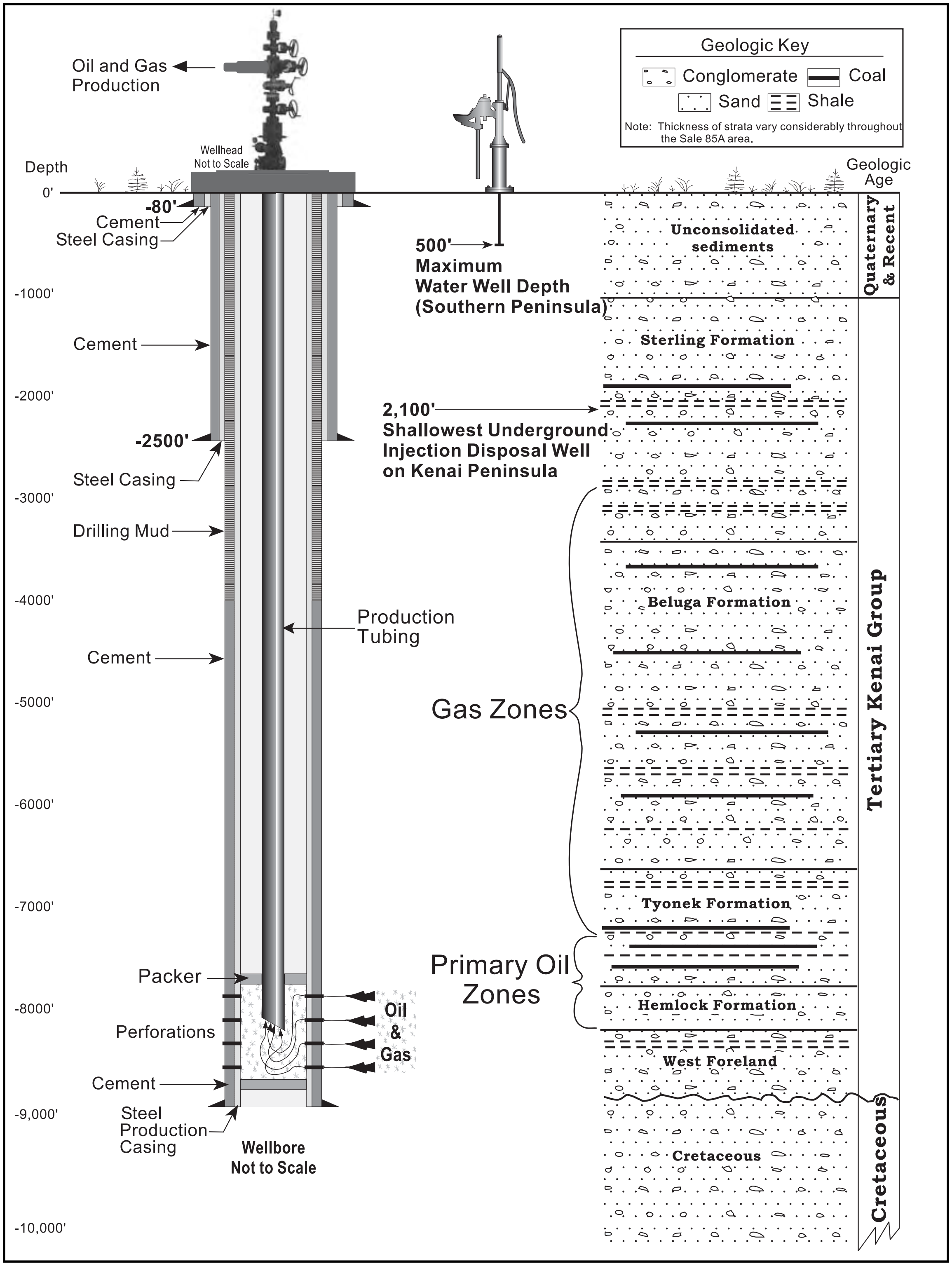


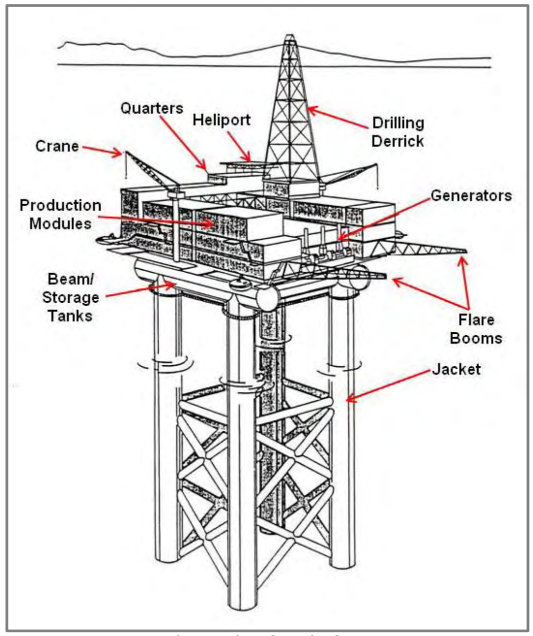
Figure 6.1. Schematic of a typical wellbore, Cook Inlet, Alaska.

there was unnecessary waste. In Cook Inlet, 1.07 bcf of gas was flared or vented during 2004, a decrease of 11.3% from 2003 (AOGCC 2004). For additional discussion about air quality regulations and the AOGCC, see Chapter 7, Sections B1, D, and F1.

The AOGCC may issue Conservation Orders (pool rules) to grant exceptions to regulations conditioned on prevention of waste, maximizing ultimate oil and gas recovery. Unless pool rules (oil or gas field rules governing well drilling, casing, and spacing that are designed to maximize recovery and minimize waste) have been adopted under 20 AAC 25.520, existing spacing rules stipulate that where oil has been discovered, not more than one well may be drilled to that pool on any governmental quarter section (20 AAC 25.055(a)). This would theoretically allow a maximum of four well sites per 640-acre section.

Where gas has been discovered, not more than one well per section may be drilled into the pool. An oil and gas producer may apply to change the spacing requirements if there is technical justification to support greater ultimate recovery by changing the spacing requirements. A Conservation Order will grant exception to regulations under 20 AAC 25 upon finding and concluding the spacing exception will not cause waste.

When the development area is offshore and not within reach of existing infrastructure, a new platform may be proposed. Existing platforms in Cook Inlet were constructed onshore, floated to the desired location, sunk, and driven in place. A Cook Inlet platform consists of a steel jacket with legs fastened to the seabed and the topside which houses the staff and equipment necessary for producing oil and gas. Each leg is fastened to the seafloor with piles that penetrate about 135 feet below the surface. The piles serve as drilling slots and conductor pipe. Offshore drilling units that may be used during the production phase include:



Schematic of a platform.

- Rigid platforms
  - Steel-jacket platform (piles; >1,000 feet water)
  - Concrete gravity platforms
  - Steel-caisson platform (tide and ice resistant; Cook Inlet)
- Compliant platforms (moves with wind, currents and waves)
  - Guyed-tower platforms (guy wires, clump weights)
  - Tension-leg platforms (steel tubes to bottom, tensioned by buoyancy).

Production facilities will likely include several production wells, water injectors, gas injection wells, and a waste disposal well. Wellhead spacing may be as little as 10 feet. A separation facility removes water and gas from the produced crude, and pipelines carry the crude to the onshore storage and terminal facilities. The oil is then piped to the local refinery at Nikiski or loaded onto tankers for shipment to outside refineries. Some of the natural gas produced is used to power equipment on the platform, well pad or processing facility but most is re-injected to maintain reservoir pressure in those reservoirs that have a surplus of produced gas. Produced water is also reinjected into an oil producing formation to maintain reservoir pressure. Often, seawater is treated and injected into the reservoir in addition to produced water in order to maintain pressure, improve recovery, and replace produced fluids.

Oil and gas production facilities found on the topside of a platform include gas and oil processing facilities to remove some of the water produced with the petroleum, water and sewage treatment equipment, power generators, a drilling rig that can move between legs, housing for about 75 workers, and a helipad. Onshore support facilities include a production facility to receive and treat the oil and gas for transportation to a refinery or other processing facilities, a supply base and vessel to provide the platform with cement, mud, water, food, and other necessary items, a supply vessel to bring the items to the platform, and a helicopter base. Helicopters carry crews to and from the platforms.

Onshore and offshore production operations for natural gas generally follow these steps:

- Natural gas flows through a high-pressure separator system where any liquids (water, condensate, etc.) are removed. Produced oil goes through a separator to remove the natural gas from the oil.
- The gas is compressed if necessary.
- The gas is dehydrated to lower its water content.
- The gas is then metered, i.e. the amount of gas produced is measured.
- The gas is transported to an onshore facility where it passes through a water precipitator to remove any liquid.

Onshore and offshore oil production steps are:

- Produced crude oil goes through a separator to remove water and gas from the oil stream.
- The oil moves to an onshore processing facility via a pipeline.
- The gas removed from the oil may be used to power production facilities or compressed and reinjected to keep the pressure up in the producing formation to assist in oil production.

At the best interest finding phase it is impossible to predict what a full development scenario will entail. The final project parameters will depend on the surface location, size, depth, and geology of a specific commercial discovery.

4. Subsurface Oil and Gas Storage

Under AS 38.05.180(u), the Commissioner of ADNR may authorize the subsurface storage of oil or gas to avoid waste or to promote conservation of natural resources. In Alaska, depleted reservoirs with established well control data are preferred storage zones. By memorandum dated September 2, 2004, the Commissioner approved a supplement to Department Order 003 and delegated the authority to authorize subsurface storage of oil or gas to the Division of Oil and Gas Director.

Gas for use in the Cook Inlet region along the gas pipeline distribution system is in short supply during the winter months of peak demand. When demand exceeds supply, gas delivery contracts specify that industrial use be curtailed, thus requiring plant operators to shut down facilities and output. Subsurface storage of gas increases reliability of gas delivery to electric utility companies, industrial users, and all residents who use gas in the Cook Inlet Basin.

A subsurface storage authorization allows the storage of gas and associated substances in the portions of the gas storage formation, subject to the terms and applicable statutes and regulations, including mitigation measures and advisories incorporated by reference into the authorization. It does not matter whether the oil or gas is produced from state land, so long as storage occurs in land leased or subject to lease under AS 38.05.180. An oil and gas lease on which storage is authorized shall be extended at least for the period of storage and so long thereafter as oil or gas not previously produced is produced in paying quantities. The feasibility of subsurface storage depends on favorable geological and engineering properties of the storage reservoir, including its size and its gas cushion (or base gas requirements). It also depends on access to transportation, pipeline infrastructure, existing production infrastructure, gas production sources, and delivery points.

Subsurface storage must comply with all applicable local, state, and federal statutes and regulations, and with any terms imposed in the authorization or in any subsequent plan of operation approvals, or in the AOGCC Storage Injection Order. The plans of operation must identify the specific measures, design criteria, construction methods, and standards that will be employed to meet the provisions of the subsurface storage authorization. Plans of operation are subject to extensive technical agency review. They are also subject to consistency with the ACMP standards if the affected lands are within the coastal zone. The plans are available for public review upon submittal to the state. Oil and gas storage-related activities will be permitted only if proposed future operations comply with all borough, state, and federal laws and the provisions of the authorization.

A storage authorization is for only specified sand horizons and does not grant the right to drill, develop, produce, extract, remove or market gas other than injected gas. A storage authorization allows the overlying oil and gas leases to continue as long as their original terms are met. Subsurface storage will be subject to terms and conditions identical to existing oil and gas lease permitting and bonding requirements. Storage operations may not interfere with existing oil and gas lease operations. Subsurface storage must comply with 20 AAC 25, specifically 20 AAC 25.252 and 20 AAC 25.055. Before any gas may be injected, approval of the Injection Order from AOGCC must be obtained.

Some unproduced “native” gas may remain in gas storage reservoirs and serve as “cushion gas” to support gas withdrawal and delivery rates. Cushion gas is the volume of gas intended as permanent inventory in a storage reservoir to maintain adequate pressure and deliverability rates throughout the withdrawal season. Royalty on this native cushion gas is paid from a percentage of each year’s annual gas withdrawal as if it were originally produced from the overlying oil and gas lease, and allocated according to the unit agreement. Injected gas will mix with native gas in the reservoirs. Royalty on the native gas within the gas storage formation under the leased area is computed at the royalty rate and paid at the value as specified in the applicable oil and gas leases.

ADNR may amend a subsurface storage authorization if stored gas migrates from the gas storage formation to other formations or if stored gas expands beyond the limits of the authorized area. DO&G shall be notified of any anticipated changes in the project resulting in alteration of conditions that were originally approved and further approval must be obtained before those changes are implemented.

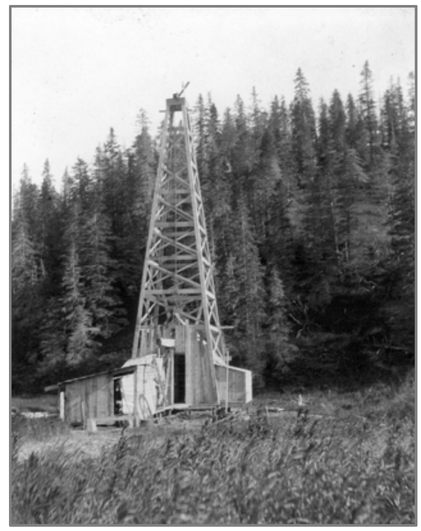
D. Oil and Gas Exploration, Development, and Production in Cook Inlet

The Cook Inlet Basin is a mature petroleum province. The area of gas and oil discoveries in the upper Cook Inlet Basin extends from the Kachemak Bay area north to the mouth of the Susitna River and includes fields in offshore Cook Inlet, the west shore of Cook Inlet and the western half of the Kenai Peninsula. The entire area covers approximately 4,400 square miles.

1. History of Oil and Gas in Cook Inlet

a. Prior to 1959

Exploration for oil in the Cook Inlet area began in the 1800s. Oil was reported on the west side of Cook Inlet in the vicinity of the Iniskin Peninsula by the Russians as early as 1853 (ADF&G 1985). In the early 1900s, Austin Lathrop drilled three wells on the west side of Cook Inlet. One was abandoned after a few hundred feet. The second well reached crude oil but encroaching water caused its abandonment. The third well was drilled but turned out to be unsuccessful (Berry 1973).



T. W. Stanton, USGS

Derrick of the Alaskan Petroleum Company, Oil Bay, Cook Inlet, 1904.

Drilling continued sporadically in the first half of the century with little success. The end of World War II brought increased settlement to the Kenai Peninsula and the development of a road system. This inspired oilmen to study Alaska's resources again. In 1955, Richfield Oil Corporation began exploration on the Kenai Peninsula in the Swanson River area. Oil was discovered on July 23, 1957, at a depth of 11,000 feet and flowed at a rate of about 900 barrels a day (Berry 1973)

Shortly after the Swanson River discovery, Standard Oil Company of California and Richfield formed a joint venture to explore for oil. Additional wells were drilled in the Swanson River area, and more leases were taken on both sides of Cook Inlet. Several other oil companies moved in to participate in drilling activities on the Kenai Peninsula (Berry 1973). By 1959, the state's competitive leasing process was instituted, and 187,000 bbls of crude oil were produced annually. In 1960, following further development of the Swanson River and Soldotna Creek units, annual production rose to 600,000 bbls.

b. 1959-1989

In October 1959, Union Oil Company of California and Ohio Oil Company made the first major gas discovery in the Cook Inlet area at their Kenai Unit No. 14 in the Kalifornsky Beach gas field near Kenai (Berry 1973). The three wells Union-Ohio drilled in 1959 had sufficient capacity to fulfill a twenty-year contract with Anchorage Natural Gas Corporation (Berry 1973).

Alaska State Library, ASL-Industry-Petroleum-CookInlet-05

"Trading Bay" oil drilling platform, owned by Marathon Oil Company and Union Oil, 1969.

In 1962, Pan American Petroleum Corporation discovered the first offshore oil in Cook Inlet. This led to extensive exploration throughout the Cook Inlet region in the 1960s and 1970s (Figure 6.2, Figure 6.3). At the peak of Cook Inlet's development drilling in the late 1960s, there were 14 offshore production facilities in upper Cook Inlet. Shortly after, in 1970, annual oil production peaked at 83 million bbls (ADNR 2007). In the early 1980s, exploration was focused in the lower Cook Inlet Federal Outer Continental Shelf, Upper Cook Inlet, Kalgin Island, Fire Island, and the SRS structure. The fifteenth platform, Steelhead, was installed in 1986.

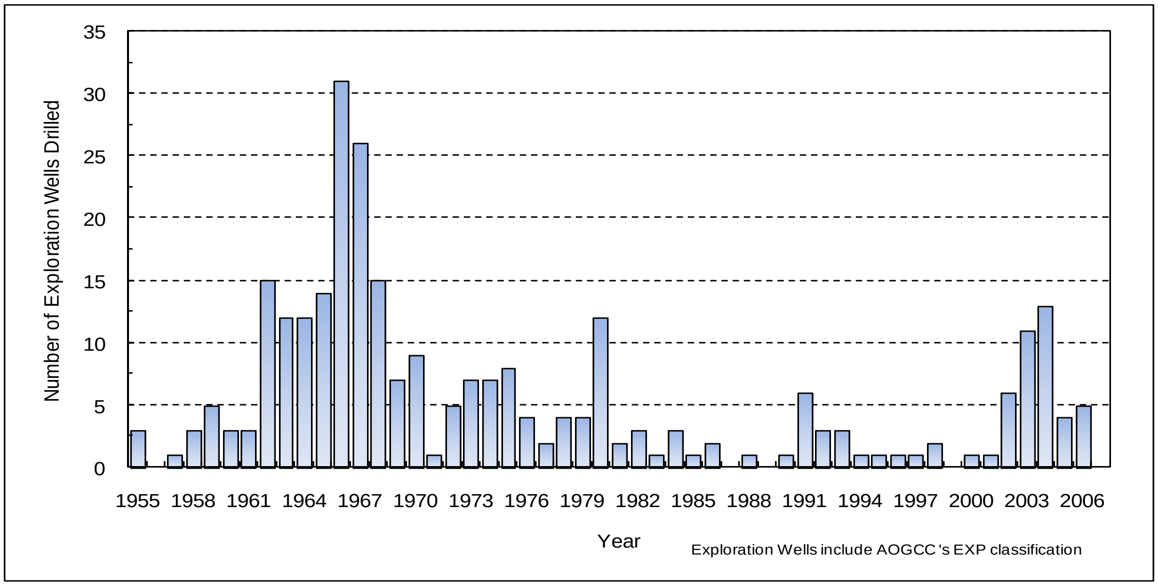


Figure 6.2. Exploration wells drilled in Cook Inlet, 1955-2007.

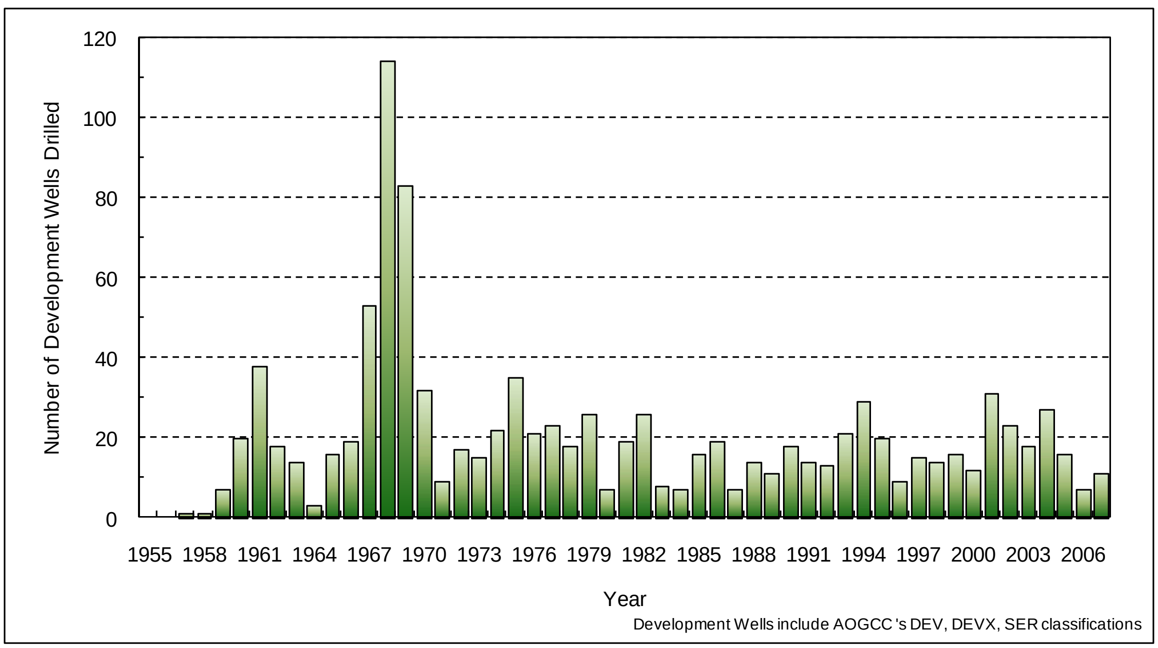


Figure 6.3. Development wells drilled in Cook Inlet, 1955-2007.

c. 1990-Present

In the 1990s and early 2000s, new oil developments and production began in the West MacArthur River Unit and in the Redoubt Unit respectively. Force Energy built the Osprey Platform in order to develop the Redoubt Field. Redevelopment efforts by XTO Energy, formally Cross Timbers Oil Company, doubled the oil reserves at Middle Ground Shoal (Cashman 2007). XTO Energy bought the field from Shell Oil and then developed the more difficult west flank of the field. In the early 1990s ARCO and Phillips Petroleum drilled multiple wells to evaluate the Sunfish sands (also known as Tyonek Deep). ADNR (2007) estimates the Tyonek Deep resource to be approximately 25 million barrels of oil and 30 Bcf of gas. Annual natural gas production also peaked in the late 1990s and early 2000s at 222 Bcf (ADNR 2007).

Coal bed methane (CBM) exploration in the Cook Inlet area started in 1994 with the Division of Oil and Gas drilling Alaska's first coal bed methane well, AK-94-CBM-1, near Wasilla. In 1997, Unocal formed the Pioneer Unit, located in the northern portion of the lease sale area, with a plan to explore for CBM. In 1998, the first commercial drilling for CBM occurred north of the lease sale area near Houston by Growth Resources Inc. of Australia. In 1999, Ocean Energy Resources Inc. acquired an interest in the Pioneer Unit and became the operator for the unit. Ocean drilled two CBM wells, one water injection well, and reentered one well. In 2001, Evergreen Resources, Inc. (Evergreen) purchased 100 percent working interest from both Ocean and Unocal, and then drilled and set casing on eight wells. In 2003, Evergreen announced that the two clusters of wells drilled by the company in the Pioneer Unit showed disappointing results. Between December 2003 and May 2004, Evergreen made a second attempt to understand the CBM potential in the area by completing a five hole mineral exploration core drilling program. On November 29, 2004 Evergreen Resources Alaska (Evergreen) was merged into Pioneer Natural Resources Alaska, Inc. In September, 2005, at Pioneer Natural Resources request, the DO&G approved the termination of the Pioneer Unit and accepted the surrender of all Pioneer Unit leases.

During the early 2000s, exploration and development drilling activity and 3-D seismic acquisition have increased in Cook Inlet. Companies are looking for reserves to replace declining fields. Modern 3-D seismic technology is being utilized to indentify previously unseen accumulations in existing fields; and smaller accumulations, once uneconomic, are now being explored. This opens a new class of exploration targets: stratigraphic traps.

D. Colley, DO&G

Cook Inlet oil production platform.

A significant amount of new activity has occurred in the southern portion of the lease sale area. Marathon and Chevron (formally Unocal) have drilled a number of exploratory and/or delineation wells in the Ninilchik, Nikolaevsk, and Deep Creek units. ConocoPhillips drilled a delineation well in the Cosmopolitan Unit; and more recently, Pioneer Natural Resources drilled a sidetrack to further delineate the Cosmopolitan Unit. Armstrong LLC is planning to drill a delineation well in the North Fork Unit in 2008. On the westside of Cook Inlet, Aurora Gas LLC drilled or sidetracked wells in the Three Mile Creek Unit, Moquawkie Unit, Lone Creek Unit, Nicolai Creek Unit, and Albert Kaloa Field. In addition to the areas mentioned above, Forest Oil's West Foreland Field, now owned and operated by Pacific Energy Resources LTD, had its first natural gas production in 2001. Chevron, Marathon, Pioneer, Forest Oil, and ConocoPhillips have all recently shot 3-D seismic data over their leases. Both Chevron USA and ConocoPhillips have redevelopment programs in their onshore and offshore fields in Cook Inlet boost declining oil and gas production rates.

Gas storage in Cook Inlet was initiated in the early 2000s. Gas storage is used when the rate and timing of production of natural gas does not match the local demand. When production exceeds demand, the gas can be injected back into the ground to be extracted later when demand exceeds production. In 2001, the depleted gas reservoirs with good seals in the Tyonek formation at Swanson River Unit were the first reservoirs to be injected with natural gas. Gas injection into the Beluga formation at Pretty Creek started in 2005, and injection into Pool 6 of the Sterling formation at Kenai River Unit commenced in 2006.

The Cook Inlet region continues to be of interest to the petroleum industry. Annual oil production as of 2006 was 6 million bbls and annual gas production as of 2006 was 196 Bcf (ADNR 2007). As of the third quarter of 2007, the remaining resource in these fields consists of about 109 million barrels of oil and 1.5 trillion cubic feet of natural gas (DO&G 2008c). Existing developed and undeveloped accumulations in Cook Inlet are presented in Table 6.3.

2. Current Oil and Gas Infrastructure in Cook Inlet

Oil and gas infrastructure in the Cook Inlet area is well developed (Figure 6.4, Figure 6.5). Existing Cook Inlet oil production is handled through the Trading Bay production facility located on the west side of Cook Inlet and the Tesoro Refinery located at Nikiski. The Trading Bay facility pipelines crude oil production it receives to the Drift River Terminal. Almost all of the Drift River crude is transported to the oil refinery in Nikiski.

The Tesoro Refinery normally processes up to 55,000 bbl per day. Recent refinery production has been augmented by North Slope oil transported by tanker from Valdez. Almost all of the Tesoro refinery output is consumed within Alaska. A products pipeline links the Nikiski refinery with the Tesoro fuel depot located at the Port of Anchorage. A pipeline spur allows direct delivery into the airport’s tank farms. Tesoro's refined products include multigrades of gasoline, propane, Jet A, Diesel, No. 2 Diesel, JP4, and No. 6 fuel oil (MMS 1995). Asphalt produced at Nikiski is sold in Alaska. Nearly all of the remaining heavy oil, for which there is no local market, is exported to other states.

The ConocoPhillips-Marathon LNG plant was constructed in 1969 and produces 1.3 million tons of LNG annually. The LNG plant is operated by ConocoPhillips. The produced LNG is carried to Tokyo on two tankers, both operated by Marathon. The tankers travel a round trip of 6,600 nautical miles and make 16 to 19 trips per year. Each ship can carry 555,000 bbl of LNG. The LNG export license was extended for 10 years in 1999 and was most recently extended to 2011.


J. Rogers, ADOR

ConocoPhillips-Marathon LNG plant.

Natural gas produced from the Kenai Gas Field is transported by pipeline to Anchorage and Girdwood for domestic consumption. Gas produced from the Beluga River field is used on-site at the Beluga River power plant and is transported by pipeline to Anchorage via Wasilla and Palmer for domestic consumption (MMS 1995). Enstar Natural Gas Company has expanded its distribution system to encompass Palmer, Houston, and neighborhoods south of Soldotna.

In 1969, the Union Chemical plant started processing gas to produce ammonia and a similar quantity of urea pills and granules (for fertilizer). In 1978, the fertilizer plant was expanded; and then in 2000, Agrium purchased the Union Chemical plant. Some of the produced urea was used in Alaska; the rest was shipped to the U.S. West Coast in tankers and bulk freighters (MMS 1995). In September 2007, Agrium shut down its fertilizer plant due to gas shortages and increasing wholesale costs in Cook Inlet.

The lower portion of the lease sale area (south of Happy Valley) lacks the oil and gas infrastructure of upper Cook Inlet (Figure 6.5). Exploration and development would require construction of onshore drilling pads and possibly offshore platforms. A commercial discovery in this part of the lease sale area would require the construction of pipelines to connect with existing facilities. Some new roads may also be required.

Table 6.3. Estimated ultimate recovery and remaining oil and gas resources in Cook Inlet.

Field	Oil EUR. MMSTB	Oil Cum 10/2007, MMSTB	Oil Remaining Resources, MMSTB	Gas EUR, BCF	Gas Cum 10/2007, BCF	Gas Remaining Resources, BCF
McArthur River (TBU)*	655	627	29	1,452	1,329	123
Swanson River*	232	229	3	22	14	8
Middle Ground Shoal*	213	195	18	115	109	6
Granite Point*	165	145	20	142	130	11
Trading Bay	108	102	5	81	78	3
West McArthur River*	16	12	4	4	3	1
Beaver Creek*	7	6	1	218	195	23
ReDoubt Shoal	6	2	4	2	0	1
Tyonek Deep (Sunfish)			25	30		30
Kenai				2,458	2,332	126
North Cook Inlet				1,992	1,771	221
Beluga River				1,546	1,056	490
Under Development				389		389
Kenai Cannery Loop				186	159	28
Ninilchik				109	63	46
Ivan River				83	79	4
Kasilof				24	2	22
Deep Creek (Happy Valley)				16	9	7
Sterling				15	10	6
West Foreland				14	10	4
Lewis River				12	12	0
Moquawkie & Lone Creek				10	9	1
Pretty Creek				9	10	(0)
Nicolai Creek				7	4	2
West Fork				6	5	1
Stump Lake				6	6	0
Albert Kaloa				4	3	1
Three Mile Creek				2	1	0
Wolf Lake				1	1	0
Kustatan				0	0	0
North Fork				0	-	0
Totals	1,402	1,319	109	8,955	7,400	1,555

Source: DO&G 2008c.

Notes: EUR = estimated ultimate recovery; Cum = cumulative; MMSTB = million stock tank barrels; BCF = billion cubic ft.

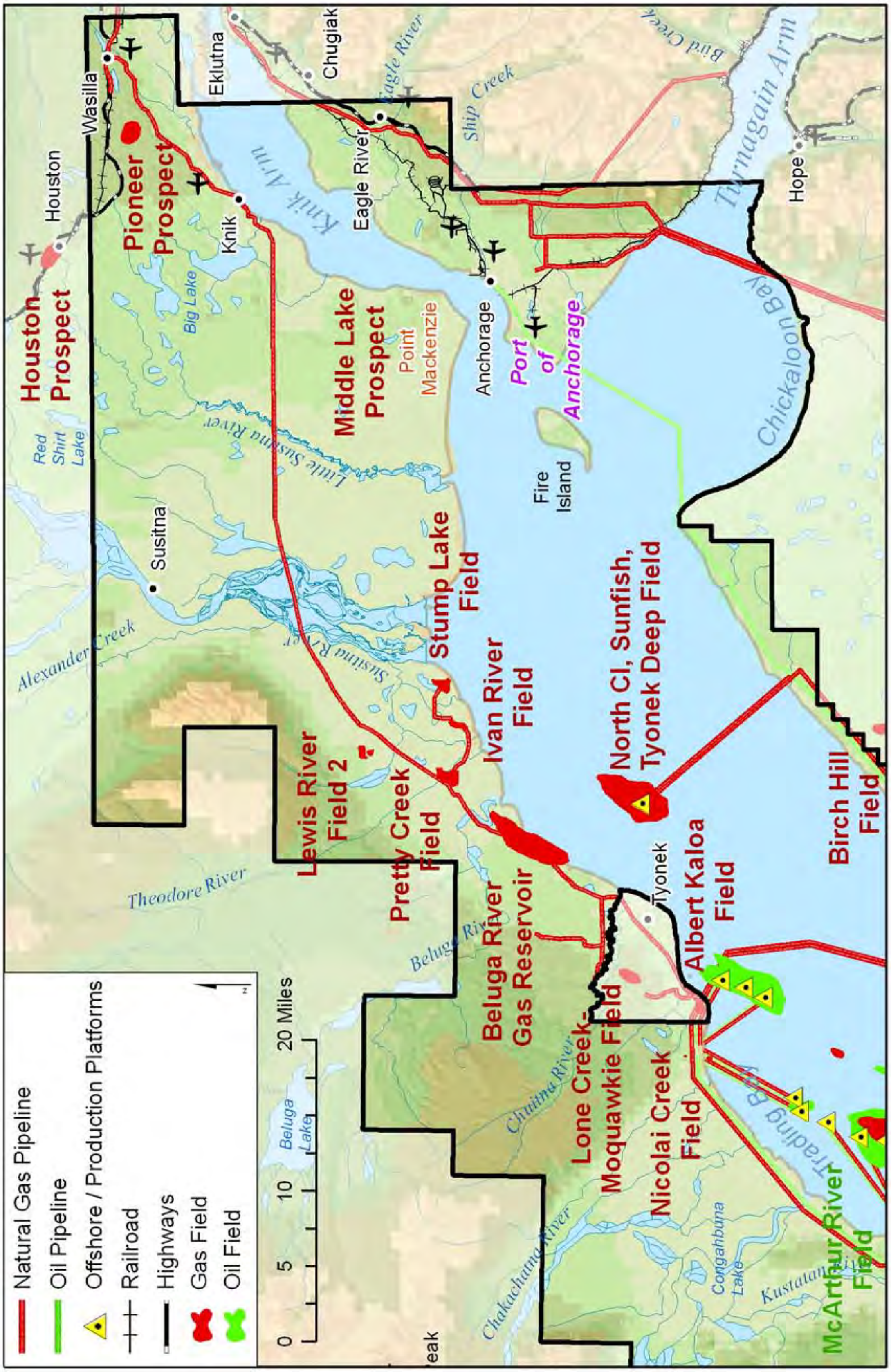


Figure 6.4. Oil and gas infrastructure in the upper Cook Inlet area.

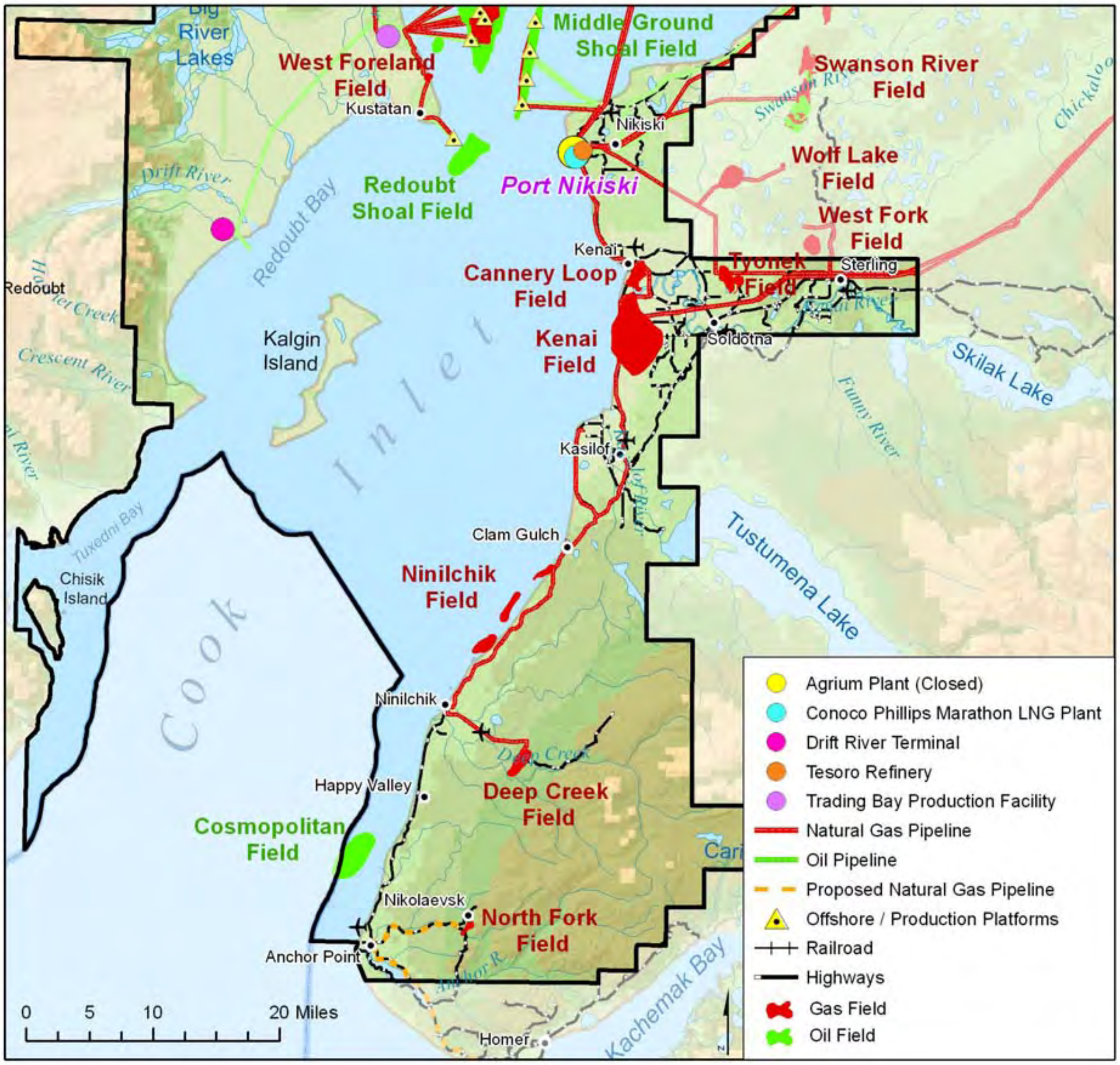


Figure 6.5. Oil and gas infrastructure in the lower Cook Inlet area.

3. Oil and Gas Leases in the Cook Inlet Area

Many factors contribute to the outcome of oil and gas lease sales in Alaska and Cook Inlet. These include national and world economies, exploration budgets of oil and gas companies, oil and gas potential of the area, technological advances, the number of tracts available for lease, and the number of expired and relinquished tracts.

Over 5.9 million acres of state land have been leased in 52 state oil and gas lease sales in the Cook Inlet region since 1959, not including lease sales from mixed areas (Table 6.4; Figure 6.6), generating up to $67.7 million in bonuses received by the state (Figure 6.7). Some of this acreage has been leased more than once because some leases had previously expired or were relinquished. As of December 30, 2008, about 1,186,331 acres were under lease, 510,705 acres offshore and 675,626 acres onshore (DO&G 2008a).

Federal oil and gas lease sales have also taken place in the Cook Inlet area. The Cook Inlet Outer Continental Shelf (OCS) area, encompassing about 2.5 million acres and 517 lease blocks, is assumed to hold about 140 million barrels of crude oil and 190 billion cubic feet of natural gas (MMS 2003). Additional lease sales have been proposed for 2009 and 2011 with net benefits estimated to be $1.38 billion (MMS 2006). The Cosmopolitan Unit, located in lower Cook Inlet, is a joint Federal OCS and state oil and gas unit. It comprises two federal and eight state leases, totaling 23,516 acres, and is in the exploration and development phases (MMS 2007). Additional oil and gas is estimated to occur on federal onshore lands, but 98 percent of those federal lands are inaccessible for development because of statutory and executive order restrictions (USDOI et al. 2008).

Table 6.4. Oil and gas lease sales in the Cook Inlet, 1959-2008.

Date	Sale	Description
12/10/59	1	Wide Bay; offshore Kenai to Ninilchik, Kachemak Bay
07/13/60	2	Kenai Pen., West Forelands, Nushagak Bay; offshore/uplands
12/07/60	3	Katalla, Kalifonsky Beach, Herendeen Bay; offshore Kodiak
01/25/61	4	Uplands Ninilchik
05/23/61	5	Tyonek, Controller Bay, Pavlov Bay; offshore/uplands
12/19/61	7	Icy, Yakutat & Kachemak Bays, So. Kenai Pen., N. Cook Inlet; offshore/uplands
04/24/62	8	Big Lake; uplands
07/11/62	9	Tyonek, W. Forelands, Knik Arm/Kalgin Is., Chisik Is., So. Kenai Pen., Wide Bay; offshore/uplands
05/08/63	10	Tyonek, Kenai; offshore/uplands
12/11/63	12	S. of Forelands, Knik & Turnagain Arms, Upper Cook Inlet, Kenai Pen., Tyonek to Katunu River; offshore/uplands
12/09/64	13	Fire Is., W. Forelands, Trinity Is., Prudhoe West; offshore/uplands
09/28/65	15	Fire Is. & N. Cook Inlet, Kalgin Is., Redoubt Bay, Knik, S. Kenai Pen.; offshore/uplands
07/19/66	16	Kenai Pen. & Knik, Middleton Is., Fire Is., Redoubt Bay, Kalgin Is., Iliamna Mt., N. Cook Inlet; offshore/uplands
11/22/66	17	Big Lake, Kenai; offshore/uplands
01/24/67	18	Katalla, Prudhoe; offshore/uplands
03/28/67	19	Lower Cook Inlet; offshore RULED INVALID ON 12/09/74
07/25/67	20	Big Lake, Knik, Iliamna Mt., Belukha, N. Cook Inlet, Kalgin Is., Ninilchik; offshore/uplands

-Continued-

Table 6.4. Page 2 of 2.

Date	Sale	Description
10/29/68	22	Big Lake, Knik, Belukha, West Forelands, Ninilchik, Kachemak & Kenai; uplands
05/12/71	24	Big Lake, Knik, Kenai, West Forelands; uplands
09/26/72	25	Big Lake, Knik, Belukha, North Cook Inlet; offshore/uplands
12/11/72	26	Cook Inlet (Between Forelands & Turnagain Arm); offshore/uplands
05/09/73	27	Tuxedni, Ninilchik, Kenai, Kalgin; offshore/uplands
12/13/73	28	Ninilchik, Kachemak Bay, Belukha; offshore/uplands
10/23/74	29	Kalgin & West Forelands, Chisik, Ninilchik, N. Cook Inlet, Turnagain, Big Lake; offshore/uplands
08/25/81	32	Lower Cook Inlet: Kenai Pen. and offshore
05/13/81	33	Upper Cook Inlet: Kenai Pen., Trading Bay, Beluga, Susitna R., Susitna Flats, uplands; offshore north of Salamatof
02/02/82	35	Lower Cook Inlet: Kenai Pen., Redoubt Cr. north to Drift R., uplands; offshore lower Cook Inlet
08/24/82	37A	Chakok River Exempt (Kenai Pen.); uplands
09/28/83	40	Upper Cook Inlet: Anchorage south to Homer; offshore/uplands
02/26/85	46A	Cook Inlet Exempt: Kenai Pen., Susitna R., Pt. MacKenzie, uplands; upper Cook Inlet
06/24/86	49	Cook Inlet: Kalgin Is., Kahiltna, Yentna, Skwentna rivers, Alexander Cr.; offshore/uplands
01/29/91	67A	Cook Inlet Exempt: Anch., lower Susitna Valley, Redoubt & Trading Bay, Kenai Pen., uplands; upper inlet, offshore
09/24/91	74A	Cook Inlet: Nikishka to Ninilchik, Drift R., West Forelands, uplands; Kalgin Is. north to Kenai Pen., offshore
01/26/93	76	Cook Inlet: Big Lake to Salamatof; onshore/offshore
01/26/93	67A-W	Cook Inlet Reoffer: Nancy Lake to West Forelands; onshore/offshore
10/31/94	78	Cook Inlet: Susitna R. to Stariski Cr.; onshore/offshore
11/14/95	67A-W2	Cook Inlet Reoffer: Trading Bay and Susitna R., onshore/offshore
11/14/95	74W	Cook Inlet Reoffer: Onshore/offshore, mouth of Kasilof R.
11/14/95	76W	Cook Inlet Reoffer: Onshore between Tyonek and Palmer, Knik Arm
11/14/95	78W	Cook Inlet Reoffer: Forelands to Little Susitna R, Kasilof R. to Stariski Pt., onshore/offshore
12/18/96	85A	Cook Inlet Exempt: Anchor Pt. and Tuxedni Bay to Turnagain Arm, Beluga R. offshore/onshore
02/24/98	85A-W	Cook Inlet Reoffer: Onshore/offshore; Tyonek to Tuxedni Bay and Chickaloon Bay to Ninilchik
Beginning of areawide lease sales		
04/21/99	Cook Inlet Areawide 1999	State acreage between Anchor Pt. and Houston
08/16/00	Cook Inlet Areawide 2000	State acreage between Anchor Pt. and Houston
05/16/01	Cook Inlet Areawide 2001	State acreage between Anchor Pt. and Houston
05/01/02	Cook Inlet Areawide 2002	State acreage between Anchor Pt. and Houston
05/07/03	Cook Inlet Areawide 2003	State acreage between Anchor Pt. and Houston
05/19/04	Cook Inlet Areawide 2004	State acreage between Anchor Pt. and Houston
05/18/05	Cook Inlet Areawide 2005	State acreage between Anchor Pt. and Houston
05/24/06	Cook Inlet Areawide 2006	State acreage between Anchor Pt. and Houston
05/23/07	Cook Inlet Areawide 2007	State acreage between Anchor Pt. and Houston
05/21/08	Cook Inlet Areawide 2008	State acreage between Anchor Pt. and Houston

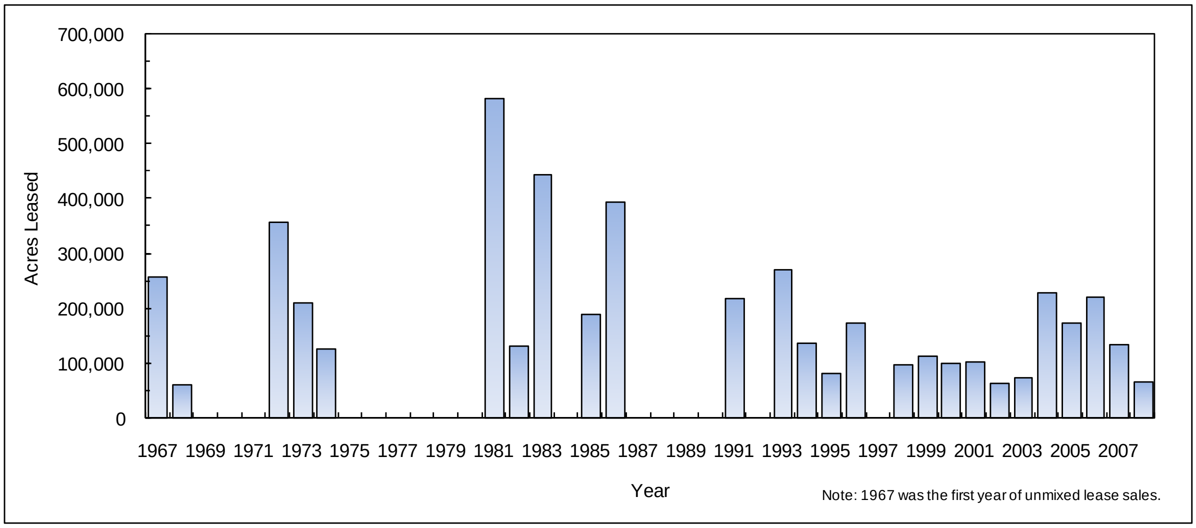


Figure 6.6. Acres leased in Cook Inlet state oil and gas lease sales, 1967-2008.

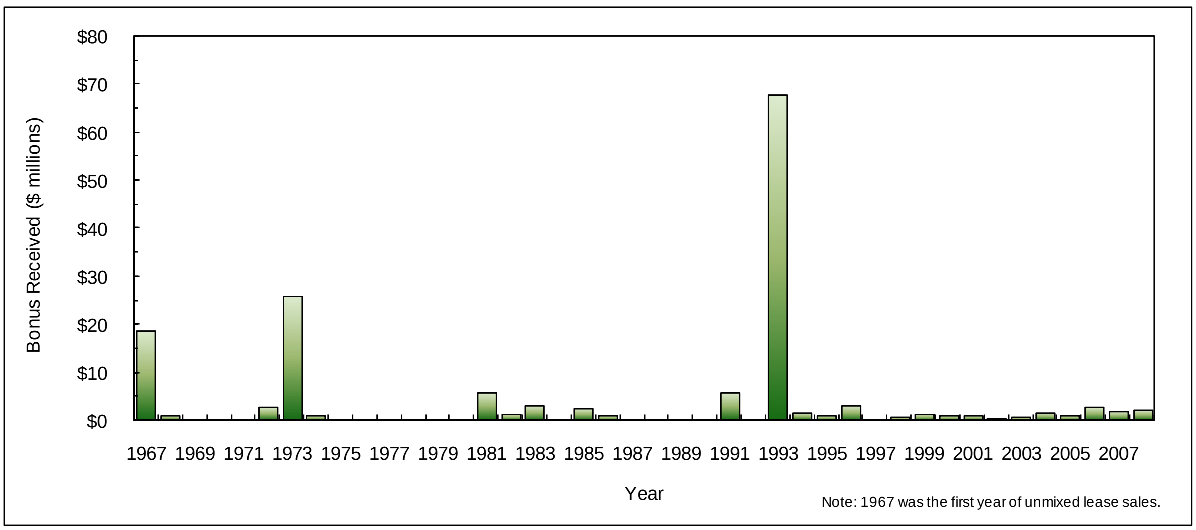


Figure 6.7. Bonuses received in state oil and gas lease sales in Cook Inlet, 1967-2008.

E. Likely Methods of Oil and Gas Transportation in Cook Inlet

AS 38.05.035(g) directs that best interest findings shall consider and discuss the method or methods most likely to be used to transport oil or gas from the lease sale area, and the advantages, disadvantages, and relative risks of each.

A discussion of specific transportation alternatives for oil from the lease sale area is not possible at this time because strategies used to transport potential petroleum resources depend on many factors, most of which are unique to an individual discovery. The location and nature of oil or gas deposits determine the type and extent of facilities necessary to develop and transport the resource. ADNR and other state, federal, and local agencies will review the specific transportation system when it is actually proposed. Modern oil and gas transportation systems usually include the following major components: 1) pipelines; 2) marine terminals; and 3) tank vessels. Oil and gas produced in the lease sale area would most likely be transported by a combination of these depending on the type, size, and location of the discovery.

The Cook Inlet basin has produced crude oil and natural gas since the 1960s. As a result, the basin has a well-developed infrastructure for transporting petroleum at least in the upper Cook Inlet area. The lower Cook Inlet area (south of Ninilchik) lacks the oil and gas infrastructure of upper Cook Inlet (KPB 2005). From 1997 to 2006, over 2,115 billion cubic feet of natural gas and almost 100 million barrels of crude oil have been produced in the region (DO&G 2007).

The possible modes of transport from a discovery will be an important factor in determining whether future discoveries can be economically produced – the more expensive a given transportation option is, the larger a discovery will have to be in order to be economically viable.

1. Pipelines

Offshore and onshore pipelines have operated in the Cook Inlet area since the 1960s. There are approximately 221 miles of undersea pipelines, 78 miles of oil pipelines, and 149 miles of gas pipelines (MMS 2003).

B. Havelock, DO&G

Oil transit lines, Nikiski.

Since original construction and startup of operations of the pipelines in the Cook Inlet area, the Pipeline Safety Improvement Act of 2002 was signed into law (Pipeline Safety Bill H.R. 3609). In December 2003, the Office of Pipeline Safety issued a final rule requiring natural gas pipeline operators to develop integrity management programs for gas transmission pipelines located where a leak or rupture could do the most harm; that is, could impact high-consequence areas (HCAs).

On December 29, 2006, the “Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006” (Pipes Act H.R. 5782) was signed into law. The Pipes Act issued a final rule requiring hazardous liquid pipeline operators to develop integrity management programs for transmission pipelines.

Basic requirements for an Integrity Management Plan include:

- Periodic integrity assessment of pipelines that could affect HCAs. Integrity assessments are performed by in-line inspection (also referred to as “smart pigging”), hydrostatic pressure testing, or direct assessment. Through these assessment methods, potentially injurious pipeline defects that have the potential to eventually weaken the pipe, or even cause it to fail, are identified early on and can be repaired, thus improving the pipe’s integrity.
- Development and implementation of a set of safety management and analytical processes, collectively referred to as an integrity management program (IMP). The purpose of the program is to assure pipeline operators have systematic, rigorous, and documented processes in place to protect HCAs.

Integrity management inspections are comprehensive, and a team of inspectors is often used to conduct the inspection. For operators with significant mileage, integrity management inspections generally require two weeks (PHMSA 2008).

Elevated pipelines onshore are relatively easy to maintain and visually inspect for leaks but they can restrict wildlife movements unless provisions are made to allow for their unimpeded passage. However, because onshore pipelines in the Cook Inlet area are usually buried and the ground reseeded, they do not pose an obstacle to wildlife or result in scenic degradation.

An offshore pipeline moves oil from the Middle Ground Shoal field, located in the middle of Cook Inlet, to the Nikiski marine terminal on the east side of Cook Inlet. The Cook Inlet Pipe Line Company transports crude oil via an offshore pipeline system from the Trading Bay, McArthur River, and Granite Point fields to the Drift River marine terminal on the west side of Cook Inlet (MMS 2003).

Subsea pipelines are the most likely system for transporting oil or gas from new offshore development areas to loading or processing facilities. Pipelines have transported petroleum liquids under Cook Inlet waters since the 1960s. Offshore pipelines that are properly designed and maintained do not hinder water circulation and minimally affect fish and wildlife habitat. If offshore pipelines are not buried they can hinder or disrupt normal water circulation. Pipelines may be buried in trenches in shallower waters to avoid creating a navigational hazard, being damaged by a ship's anchor or sea ice, or being caught in fishing nets. In deeper water, the pipelines may become silted-in or self-buried. The risk of spills from subsea pipelines is considerably less than for tankers (MMS 1992). However, subsea pipelines are expensive to build and maintain. Although significant advances have been made in recent years, they can also be difficult to monitor for leaks, defects, and corrosion problems. See Section F2b below for further information on leak detection methods.

2. Tankers

Tanker traffic in Cook Inlet currently carries oil produced from the west side of Cook Inlet to the east side to be refined. Tankers then deliver refined petroleum products from the Nikiski complex to other parts of Alaska. Tankers calling at the Nikiski terminals and refineries transfer about 22 million barrels of crude and refined (non-persistent) oil each year and transfer about 4.8 million barrels of crude from the Drift River Terminal to Nikiski each year.

Courtesy Polar Tankers, Inc.

Example of a tanker used to transport oil.

The Kenai Liquefaction Plant includes facilities for liquefying, storing, and loading natural gas. The gas is processed to remove impurities such as water or carbon dioxide, then liquefied by lowering its temperature to -259°. During this process the gas shrinks to 1/600th of its original volume. The liquefied natural gas (LNG) is then transferred to three heavily insulated, 225,000-barrel (bbl) storage tanks. While in storage, some of the LNG “boils off.” This maintains the remaining LNG at its liquid temperature and provides fuel for the plant’s large refrigeration unit. Finally, the LNG is loaded onto tankers from transport to Japan. (Kenai LNG 2007). Every 10-20 days, the Phillips-Marathon LNG facility loads 80,000 cubic meters of LNG onto tankers for shipment to Japan and delivers refined petroleum products from its Nikiski complex to other parts of Alaska and the Pacific Rim. Refined oil from the Tesoro Refinery is also put onto tankers at the Nikiski Terminal Wharf (MMS 2003).

3. Marine Terminals

The marine crude oil terminals in Cook Inlet include storage facilities and offshore loading platforms. The Nikiski complex has been in operation since 1963 and includes the Phillips/Marathon LNG plant, and Tesoro’s refinery. The complex receives, stores, and pumps crude oil to the Tesoro refinery. The

Drift River marine terminal started operating in 1967. It receives Cook Inlet crude oil via pipeline from production areas on the west side of Cook Inlet and stores the oil until tankers move it across Cook Inlet to the Tesoro refinery. Currently, no Cook Inlet crude oil is shipped out of the state.

4. Mitigation Measures and Other Regulatory Protections

Any product ultimately produced from lease sale tracts will have to be transported to market, however it is important to note that the decision to lease oil and gas resources in the state does not authorize the transportation of any product. If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transportation will be made through the local, state, and federal application and permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards, and will involve public participation. The state has broad authority to withhold, restrict, and condition its approval of transportation facilities. In addition, boroughs, municipalities, and the federal government have jurisdiction over various aspects of any transportation alternative. Measures are included in this best interest finding to avoid, minimize, and mitigate potential negative effects of transporting oil and gas (see Chapter 9). Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

F. Oil Spill Risk, Prevention and Response

1. Oil Spill History and Risk

The risk of a spill exists any time crude oil or petroleum products are handled. Oil spills associated with the exploration, development, production, storage, and transportation of crude oil may occur from well blowouts or pipeline or tanker accidents. Petroleum activities may also generate chronic low volume spills involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels, and other facilities for gathering, processing, loading, and storing of crude oil. Spills may also be associated with the transportation of refined products to provide fuel for generators, marine vessels, and other vehicles used in exploration and development activities. A worst case oil discharge from an exploration facility, production facility, pipeline, or storage facility is restricted by the maximum tank or vessel storage capacity or by a well’s ability to produce oil.

Since 1999 there have been 18 crude oil spills of 100 gallons or more from pipelines, platforms, onshore production facilities, storage facilities, and marine tankers in the Cook Inlet area. Six of these were more than 500 gallons (ADEC 2008c).

On January 6, 1999, a leak was discovered in an eight-inch crude oil pipeline buried forty inches below the surface in the Swanson River Oil Field in the Kenai National Wildlife Refuge. The responsible party, Unocal, estimated that 60 barrels (2,520 gallons) of crude oil and 1,300 barrels (54,600 gallons) of produced water spilled. Cleanup consisted of removing contaminated snow and transporting it to Unocal's solid waste facility (ADEC 1999).

On February 6, 1999 the *Chesapeake Trader* spilled 420 gallons of crude oil into Cook Inlet between Nikiski and Homer. Large tanker spills include the 1987 tanker *Glacier Bay* spill of 2,350-3,800 bbl of North Slope crude oil being transported into Cook Inlet for processing at the Nikiski Refinery (ADEC 1988). Less than 10 percent of the oil was recovered, and the spill interrupted commercial fishing activities in the vicinity of Kalgin Island during the peak of the sockeye salmon run.

The March 1989 *Exxon Valdez* oil spill, the largest recorded spill in U. S. waters, spilled nearly 261,900 bbl. Oil from the *Exxon Valdez* contaminated fishing gear, fish, and shellfish; killed numerous marine birds and mammals; and led to the closure or disruption of many Prince William Sound, Cook Inlet, Kodiak, and Chignik fisheries (Alaska Office of the Governor 1989). Effects of oil spills on fish and other wildlife are discussed in Chapter 8.

The oil spills from the *Glacier Bay* and the *Exxon Valdez* were not effectively contained, and the effectiveness of the cleanup efforts remains the subject of controversy. In the case of the *Glacier Bay* oil spill in Cook Inlet, cleanup was hampered by tidal currents and confusion concerning who would respond to the spill. In the *Exxon Valdez* oil spill in Prince William Sound, the sheer size of the spill quickly overtaxed available cleanup resources at a time when response plans had not been kept current. Although not on the scale of the *Exxon Valdez* spill, the *Glacier Bay* spill focused attention on oil spill response and cleanup capabilities in Cook Inlet.

Both incidents demonstrated that preventing catastrophic tanker spills is easier than cleaning them up and focused public, agency, and legislative attention on the prevention and clean up of oil spills. Numerous changes were effected on both the federal and state levels. At the state level, new statutes created the oil and hazardous substance spill response fund (AS 46.08.010), established the Spill Preparedness and Response (SPAR) Division of ADEC, (AS 46.08.100), and increased financial responsibility requirements for tankers or barges carrying crude oil up to a maximum of $100 million (AS 46.04.040(c)(1)). Regulations and laws regarding oil spills are discussed later in this section.

a. <u>Exploration and Production</u>

Spills related to petroleum exploration and production must be distinguished from those related to transportation because the phases have different risk factors and spill histories. Exploration and production facilities in the lease sale area may include onshore gravel pads; drill rigs; pipelines; and facilities for gathering, processing, storing, and moving oil. These facilities are discussed below. Spills occurring at these facilities are usually related to everyday operations, such as fuel transfers. Large spills are rare at the exploration and production stages because spill sizes are limited by production rates and by the amount of crude oil stored at the exploration or production facility.

The most dramatic form of spill can occur during a well blowout, which can take place when high pressure gas is encountered in the well and sufficient precautions, such as increasing the weight of the drilling mud, are not effective. The result is that oil, gas, or mud is suddenly and violently expelled from the well bore, followed by uncontrolled flow from the well. Blowout preventers, which immediately close off the open well to prevent or minimize any discharges, are required for all drilling and work-over rigs and are routinely inspected by the AOGCC. Blowouts are extremely rare in Alaska.

b. <u>Pipelines</u>

Both state and federal agencies have oversight of pipelines in Alaska. State agencies include the Petroleum Systems Integrity Office (PSIO) and DO&G within DNR; the State Pipeline Coordinator's Office; and DEC. Federal agencies include the Pipeline and Hazardous Materials Safety Administration (PHMSA) within the U.S. Department of Transportation; and MMS.

Pipelines vary in size, length and amount of oil contained. A 14-inch pipeline can store about 1,000 bbl per mile of pipeline length. Under static conditions, if oil were lost from a five mile stretch of this pipeline (a hypothetical distance between emergency block valves), a maximum of 5,000 bbl of oil could be discharged if the entire volume of oil in the segment drained from the pipeline.

Oil spills that occurred in 2006 made the oil and gas industry, local, state, and federal regulators, and the general public, acutely aware of potentially widespread pipeline corrosion issues on the North Slope. Addressing issues of corrosion and pipeline monitoring became a state priority. Increased state and national awareness resulted in a number of changes in the public and private sectors. First, operators assert they are now monitoring corrosion more closely, including pigging transit and common carrier lines on a regular basis, and updating and strictly enforcing best industry standards for routine maintenance practices. The state has also examined pipeline corrosion issues closely and has expanded efforts to monitor and regulate both gathering and common carrier lines. ADEC has promulgated new regulations regarding education, preparation for spills, and spill response; these regulations have been approved and went into effect in December 2006.

c. Marine Terminals and Tanker Vessels

Both the Nikiski and Drift River terminal facilities generally have good safety records. Volcanic activity associated with Mt. Redoubt in 1989 and 1990 caused the temporary closure of the Drift River facility between January and mid-June 1990 due to the threat of flooding. By August 1990, following construction of new protective dikes, the terminal resumed normal operations.

In March 1990, approximately 2,300 bbl (96,600 gal) were spilled at Drift River when a valve on tank number 3 was accidentally left open. The entire spill was contained within protective dikes and none was released into the water. Nearly all of the spilled oil was cleaned up by returning it to the storage tank or by direct treatment. In December 1990, another incident occurred when ice carried by swift currents forced the UNOCAL tanker *Coast Range* away from the dock at the Drift River facility. This caused a spill of approximately 15 bbl (630 gal) of oil located in the pipes between the dock and the ship. Cleanup workers used absorbents to clean up the spill because booms and skimmers were ineffective in the heavy ice (ADN 1990). ADEC estimates that 30 percent of the spill was cleaned up and 10-20 percent evaporated. This left approximately 7.5 bbl (315 gal) unrecovered.

On December 5, 1995, a spill occurred at the Tesoro tank farm in Nikiski. Crude oil overflowed when a high-fill-level alarm failed during a tank-to-tank transfer. Some of the oil escaped the secondary containment berm around the tank and reached Cook Inlet. The oil moved north in the water and into the rip currents. Cook Inlet Spill Prevention and Response, Inc. (CISPRI) responded and recovered some of the oil. The remainder disappeared within three days (ADEC 1995). Approximately 2,500 to 2,900 gallons of crude oil were released, and ADEC fined Tesoro (CISPRI 1998).

A tanker accident can result in the release of large quantities of oil in a short time, causing severe environmental damage. An oil spill in a marine water setting is also much more difficult to contain than one on land because ocean currents and tidal actions carry the oil over a much larger area. An example of the potential magnitude of a tanker spill is the March 1989 *Exxon Valdez* oil spill discussed above.

The Oil Pollution Act of 1990 (OPA), which was enacted after the *Exxon Valdez* oil spill, requires that all tank vessels greater than 5,000 gross tons that are constructed or that undergo major conversions under contracts awarded after June 30, 1990, must have double hulls to operate in U. S. navigable waters. Of the 51 major oil spills, all 24 major spills from tank vessels (tankers and tank barges) involved single-hull vessels (GAO 2007). Single-hulled tankers must be phased out by 2015. Double-hulled tankers currently transport the majority of oil in Cook Inlet (CIRCAC 2002). In 2008, a 6,700 horsepower tug funded by Tesoro was stationed in Cook Inlet to assist oil tankers docking at Nikisiki (Stuart 2008).

d. Alaska Risk Assessment of Oil and Gas Infrastructure

In May 2007, the Alaska Risk Assessment (ARA) project was launched. The purpose of this three-year, $5 million initiative is to evaluate Alaska’s oil and gas infrastructure for its ability to operate safely for another generation. It is expected that oil and gas infrastructure on the North Slope and Cook Inlet, and the Trans-Alaska Pipeline, will be included (ADEC 2008a).

The ARA will provide status of existing infrastructure, components, systems, and hazards. The likelihood and consequences of possible failures in Alaska's oil and gas infrastructure will be examined, and potential failures that could affect the reliability of the system or its ability to sustain production without unplanned interruptions, will identified and prioritized. Rankings will be based on consequences to state revenue, safety, and the environment. Mitigation measures will be recommended based on identified risks (ADEC 2008a).

2. Oil Spill Prevention

A number of measures contribute to the prevention of oil spills during the exploration, development, production, and transportation of crude oil. Some of these prevention measures are presented as mitigation measures in Chapter 9, and some are discussed at the beginning of this section. Prevention measures are also described in the oil discharge prevention and contingency plans that the industry must prepare prior to beginning operations. Thorough training, well-maintained equipment, and routine surveillance are important components of oil spill prevention.

Technical design of pipelines and other facilities reduces the chance of oil spills. As discussed in Chapter 3, Section G8, national industry standards, and federal, state, and local codes and standards, help assure the safe design, construction, operation, maintenance, and repair of pipelines and other facilities. A quality assurance program with adequate inspection of the pipelines to identify any safety or integrity concerns; regular maintenance, including installing improved cathodic protection, and using corrosion inhibitors; and continuing regular visual inspections to ensure safe and reliable operation. If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transportation will be made through the local, state, and federal application and permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards, and will involve public participation.

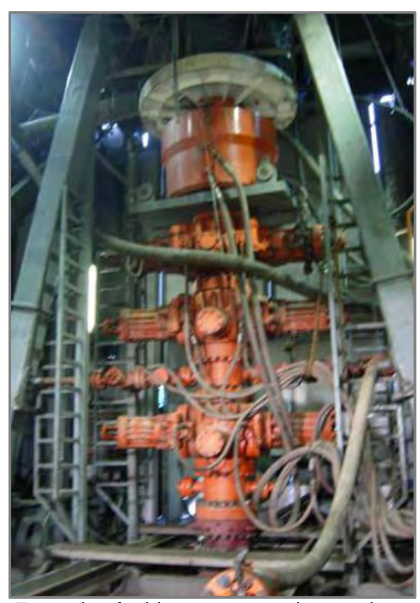
The oil industry employs, and is required to employ, many techniques and operating procedures to help reduce the possibility of spilling oil, including:

- Use of existing facilities and roads;
- Waterbody protection, including proper location of onshore oil storage and fuel transfer areas;
- Use of proper fuel transfer procedures;
- Use of secondary containment, such as impermeable liners and dikes;
- Proper management of oils, waste oils, and other hazardous materials to prevent ingestion by bears and other wildlife;
- Consolidation of facilities;
- Placement of facilities away from fishbearing streams and critical habitats;
- Siting pipelines to facilitate spilled oil containment and cleanup; and,
- Installation of pipeline leak detection and shutoff devices.

a. Blowout Prevention

Each well has a blowout prevention program that is developed before the well is drilled. Operators review bottom-hole pressure data from existing wells in the area and seismic data to learn what pressures might be expected in the well to be drilled. Engineers use this information to design a drilling mud program with sufficient hydrostatic head to overbalance the formation pressures from surface to the total depth of the well. They also design the casing strings to prevent various formation conditions from affecting well control performance. Blowout prevention (BOP) equipment is installed on the wellhead after the surface casing is set and before actual drilling begins. BOP stacks are routinely tested in accordance with government requirements (BPX 1996).

Wells are drilled according to the detailed plan. Drilling mud and well pressures are continuously monitored, and the mud is adjusted to meet the actual wellbore pressures. The weight of



J. Easton, DO&G

Example of a blowout prevention stack at Jacob's Ladder exploration well (North Slope).

the mud is the primary well control system. If a kick (sudden increase in well pressure) occurs, the well is shut in using the BOP equipment. The BOP closes off and contains fluids and pressures in the annulus and in the drillpipe. Technicians take pressure readings and adjust the weight of the drilling mud to compensate for the increased pressure. BOP drills are performed routinely with all crews to ensure wells are shut in quickly and properly. Rig foremen, tool pushers, drillers, derrick men and mud men all have certified training in well control that is renewed annually (BPX 1996).

If well control is lost and there is an uncontrolled flow of fluids at the surface, a well control plan is devised. The plan may include instituting additional surface control measures, igniting the blowout, or drilling a relief well. Regaining control at the surface is faster than drilling a relief well and has a high success rate. A blowout may bridge naturally due to the pressure drop across the formations. Under these conditions, reservoir formations flow to equalize pressure and the resulting bridging results in decreased flow at the surface. The exact mechanical surface control methods used depend on the individual situation. Operators may pump mud or cement down the well to kill it; replace failed equipment, remove part of the BOP stack and install a master valve; or divert the flow and install remotely-operated well control equipment (BPX 1996).

While operators consider mechanical surface control methods, they also begin planning to drill a relief well by assessing the situation and determining the location for the relief well. Additionally, logistical plans to move another drill rig to the site are necessary. Conditions may require the construction of an ice or gravel pad and road. The operator will look for the closest appropriate drill rig. If the rig is in use, industry practice dictates that, when requested, the operator will release the rig for emergency use. Arranging for and drilling a relief well could take from 10 to 15 weeks depending on weather, cause of the blowout, choice of surface location and depth of the well (BPX 1996).

b. Leak Detection

Leak detection systems and effective emergency shut-down equipment and procedures are essential in preventing discharges of oil from any pipeline that might be constructed in the lease sale area. Once a leak is detected, valves at both ends of the pipeline, as well as intermediate block valves, can be manually or remotely closed to limit the amount of discharge. The number and spacing of the block valves along the pipeline will depend on the size of the pipeline and the expected throughput rate (Nessim and Jordan 1986). Industry on the North Slope currently uses the volume balancing method, which involves comparing input volume to output volume.

B. Havelock, DO&G

Valve station, Kenai-Kachemak Pipeline.

The technology for monitoring pipelines is continually improving. Leak detection methods include acoustic monitoring, pressure point analysis, and combinations of some or all of the different methods (Yoon et al. 1988). The approximate location of a leak can be determined from the sensors along the pipeline. A computer network is used to monitor the sensors and signal any abnormal responses. In recent years, computer-based leak detection through a Real-Time Transient Model has come into use. This technology can minimize spills from both new and old pipelines (Yoon and Mensik 1988).

A similar technology for detecting leaks in oil and gas pipelines is termed Pressure Point Analysis (PPA). The method uses measured changes in the pressure and velocity of the fluid flowing in a pipeline to detect and locate leaks. PPA has successfully detected holes as small as 1/8-inch in diameter within a few seconds to a few minutes following a rupture (Farmer 1989). Automated leak detection systems such as PPA operate 24 hours per day and can be installed at remote sites. Information from the sensors can be transmitted by radio, microwave, or over a hardwire system.

Three systems can be employed which detect leaks down to 0.12 percent of rated capacity (100 bbl per hour). These include line volume balance, deviation alarms, and transient volume balance.

Line volume balance (LVB) checks the oil volume in the pipeline every 30 minutes. The system compares the volume entering the line with the volume leaving the line, adjusting for temperature, pressure, pump station tank-level changes, and slackline conditions.

There are three types of deviation alarms: pressure, flow, and flow rate balance. Pressure alarms are triggered if the pressure at the suction or discharge of any pump station deviates beyond a certain amount. Flow alarms are triggered if the amount of oil entering a pump station varies too much from one check time to the next. Flow rate balance alarms are triggered if the amount of oil leaving one pump station varies too much from the amount entering the next pump station downstream. This calculation is performed on each pipeline section about six times a minute.

Transient volume balance (TVB) can detect whether a leak may be occurring and identify the probable leak location by segment, especially with larger leaks. While the LVB leak detection system monitors the entire pipeline, the TVB system individually monitors each segment between pump stations. Since the TVB indicates in which area a leak may be occurring, focused reconnaissance, and earlier response mobilization are possible (Alyeska Pipeline Service Company 1999).

There are several other leak detection systems. Leck Erkennung und Ortangs System (LEOS) is a leak detection and location system manufactured by Siemens AG. The system has been in use for 21 years and in over 30 applications. LEOS consists of a three-layer gas-sensor tube that is laid next to the pipeline. The inner layer is a perforated gas transport tube of modified PVC (polyvinyl chloride). A diffusion layer of EVA (ethylene vinyl acetate) surrounds and allows gases to enter the inner tube. A protective layer of braided plastic strips forms the outer layer. The tube is filled with fresh air, and the air is evacuated through a leak detector at regular intervals. If a leak occurs, hydrocarbon gases associated with the leak enter the tube and are carried to the gas detector. The system is totally computer controlled, self-checking and re-setting. Background gases are calibrated at setup and checked regularly. The system will pick up previous contamination and organic decomposition. The location of the leak is determined by monitoring the time that leaked gas arrives at the detection device.

The system is very low maintenance and will last the life of the pipeline. Special protective adaptations are made if the system will operate in cold temperatures and for the backfill installation method used to install the pipeline. The tube is placed in a protective cover, and the system is tested continuously as the segments are installed. LEOS is strapped to the oil pipeline next to the poly spacers that separate the gas line from the oil line. The system detects leaks from both lines, and operators are able to tell the difference between the two. Engineers estimate that it takes about 5 to 6 hours for leaked molecules to migrate to the LEOS tube. The air inside the tube is evacuated and tested every 24 hours

Design and use of "smart pigs," data collection devices that are run through the pipeline while it is in operation, have greatly enhanced the ability of pipeline operators to detect internal and external corrosion and differential pipe settlement in pipelines. Pigs can be sent through the pipeline on a regular schedule to detect changes over time and give advance warning of any potential problems. The Trans-Alaska Pipeline System operation has pioneered this effort for Arctic pipelines. The technique is now available for use worldwide and represents a major tool for use in preventing pipeline failures.

The Forward Looking InfraRed (FLIR) pipeline monitoring program assists in detecting pipeline leaks and corrosion in the Kuparuk oil field. Infrared sensors have the ability to sense heat differentials. A leak shows up as a "hot spot" in an FLIR video. In addition, water-soaked insulation surrounding a pipeline is visible because of the heat transfer from the hot oil to the water in the insulation and finally to the exterior surface of the pipeline. FLIR is also effective in discovering water-soaked insulation areas that have produced corrosion on the exterior wall of the pipeline (ARCO 1998).

FLIR also has applications in spill response. Infrared photography can be used to quickly and accurately determine the area of the spill. This allows swift and accurate reporting of the spill parameters to the appropriate agencies. The incident command team is able to receive information near real-time, and can therefore make timely decisions. Various agencies involved in the process are able to see and verify the results of the cleanup process (ARCO 1998).

3. Oil Spill Response

a. Incident Command System

An Incident Command System (ICS) response is activated in the event of an actual or potential oil or hazardous material spill. The ICS system is designed to organize and manage responses to incidents involving a number of interested parties in a variety of activities. Since oil spills usually involve multiple jurisdictions, the joint federal/state response contingency plan incorporates a unified command structure in the oil and hazardous substance discharge ICS. The unified command consists of the Federal On-Scene Coordinator, the State On-Scene Coordinator, the Local On-Scene Coordinator, and the Responsible Party On-Scene Coordinator. The ICS is organized around five major functions: command, planning, operations, logistics, and finance/administration (ADEC 2006).

The Unified Command jointly makes decisions on objectives and response strategies; however, only one Incident Commander is in charge of the spill response. The Incident Commander is responsible for implementing these objectives and response strategies. If the Responsible Party is known, the Responsible Party Incident Commander may remain in charge until or unless the Federal On-Scene Coordinator and the State On-Scene Coordinator decide that the Responsible Party is not doing an adequate job of response (ADEC 2006).

b. Response Teams

The Alaska Regional Response Team (ARRT) monitors the actions of the Responsible Party. The Team is composed of representatives from 15 federal agencies and one representative agency from the state. The ARRT is co-chaired by the U.S. Coast Guard and Environmental Protection Agency. ADEC represents the State of Alaska. The team provides coordinated federal and state response policies to guide the Federal On-Scene Coordinator in responding effectively to spill incidents. The Statewide Oil and Hazardous Substance Incident Management System Workgroup, which consists of ADEC, industry, spill cooperatives, and federal agencies, published the *Alaska Incident Management System* (AIMS) for oil and hazardous substance response (ADEC 2006).

Each operator identifies a spill response team (SRT) for their facility, and each facility must have an approved spill contingency plan. Company teams provide on-site, immediate response to a spill event. First, responders attempt to stop the flow of oil and may deploy booms to confine oil that has entered the water. The responders may deploy booms to protect major inlets, wash-over channels, and small inlets. Finally, deflection booming would be placed to enclose smaller bays and channels to protect sensitive environmental areas. If the nature of the event exceeds the facility’s resources, the Responsible Party calls in its response organization. The Spill Response Team (SRT):

- identifies the threatened area;
- assesses the natural resources, i.e., environmentally sensitive areas such as major fishing areas, spawning or breeding grounds;
- identifies other high-risk areas such as offshore exploration and development sites and tank-vessel operations in the area;
- obtains information on local tides, currents, prevailing winds, and ice conditions; and,
- identifies the type, amount, and location of available equipment, supplies, and personnel.

The next action would be containment. It is especially important to prevent oil spills from spreading rapidly over a large area. Cleanup activities continue as long as necessary, without any time frame or deadline.

c. Training

Individual members of the SRT train in basic spill response; skimmer use; detection and tracking of oil; oil recovery on lakes; river booming; radio communications; ATV, snowmobile, and four-wheeler operations; oil discharge, prevention, and contingency plan review; communication equipment operations; Arctic survival; oil spill burning operations; pipeline leak plugging; and spill volume estimations.

d. Response Organizations

Cook Inlet Spill Prevention and Response, Inc. (CISPRI) is a major spill response organization in Cook Inlet. The non-profit corporation was formed in October 1990 to provide personnel and oil spill equipment to respond to any kind of oil spill at the request of a member company. Operators of various facilities contract with CISPRI for response activities. The U.S. Coast Guard designated CISPRI a Tier 3 Oil Spill Removal Organization (OSRO), which is the highest level of designation and is based on spill containment and removal requirements for an offshore/ocean response. CISPRI is registered with the State of Alaska as a Primary Response Action Contractor and as a Nontank Vessel Cleanup Contractor. No single entity owns CISPRI. It is a cooperative funded by oil industry companies with interests in Cook Inlet. CISPRI is governed by a board of directors comprised of members elected from the oil industry companies, and the following from the public sector: U.S. Coast Guard, ADEC, the Kenai Peninsula Borough, and the Municipality of Anchorage. CISPRI's response area extends from Palmer to the Barren Islands and into the Gulf of Alaska (CISPRI 2008).

CISPRI's major assets include:

- Over 82,500 feet of various sizes of oil containment boom, including fire boom;
- Over 98,304 bbl/day of spill removal equipment (skimming equipment);
- Over 87,000 barrels of on-water storage capacity;
- Pumps, powerpacks, and support equipment specifically designed to augment spill response;
- Extensive communication network established throughout Cook Inlet;
- 20 dedicated response vessels ranging from 16' to 204' in length;
- Contracts with over 120 fishing and commercial vessels to support spill response efforts;
- Dedicated warehouse/office/command center to support daily operations and emergency spill response efforts;
- Specialized equipment to conduct alternative response measures, including application of oil dispersants and conducting in-situ burning operations;
- Dedicated facilities and support equipment for the capture, cleaning, and rehabilitation of oiled birds and sea otters.

CISPRI's response center is located at Mile 26.5 North Spur Road near Nikiski, Alaska. In the event of a spill, the location serves as the emergency operations center for all federal, state, and industry personnel. CISPRI's response actions include:

- **Notification and Initiation of Response**: The CISPRI manager receives notification from the responsible party or the U.S. Coast Guard and in turn notifies the Operations Manager. The Operations Manager initiates a group call-out for CISPRI technicians to respond within one hour. All CISPRI employees carry cell phones for after-hours notification. In the event of a non-member or mystery spill, the U.S. Coast Guard calls the CISPRI manager and initiates a response.

- **<u>Organization and Call-out</u>**: CISPRI personnel assemble at the designated staging area and begin response actions appropriate to the problem. Personnel are dispatched to the location of the spill for site assessment. In an offshore spill, response personnel would activate the *Perseverance*, CISPRI's spill response vessel.
- **<u>Documentation</u>**: All CISPRI personnel are required to document their activities during an oil spill. The documentation covers actions taken, when and by whom directions were given, and where and by whom the action was performed. The Operations Section staff log who directed the action, what personnel and/or equipment was deployed, when it was deployed, and how long the action is expected to last.

CISPRI developed a technical manual that incorporates its emergency action plan, reporting and notification procedures, safety plan, communications, deployment strategies, response strategies, non-mechanical response options, description of its vessel, command system, realistic maximum response operating limitations, logistical support, response equipment, contractor information, training plans, and protection of environmentally sensitive areas. The technical manual is a part of the contingency plans prepared by each of CISPRI's member companies (CISPRI 1997).

Other response organizations may operate in the Cook Inlet area if they meet U.S. Coast Guard and ADEC standards. Each organization may operate a little differently, but the objective is the same – to minimize the impact of an oil spill. Some operators maintain mutual aid agreements with other operators so that if the spill exceeds their individual capabilities, they may access other resources.

Response actions vary greatly with the nature, location and size of the spill. General response activities may include:

- Locate and stop the spill if possible;
- Estimate the spill amount, determine the substance's chemistry, and estimate the trajectory;
- Determine what equipment would most effectively recover spilled oil;
- Mobilize appropriate equipment to confine spilled oil or to protect especially sensitive areas from oiling; and,
- Assess the damage to oiled areas, develop a plan for cleanup, and implement it.

Response equipment might include boats, earth-moving equipment, airplanes, helicopters, boom, skimmers, sorbants, in-situ burning, and dispersants application machinery. The responsible party and its contractors usually perform response activities with assistance and monitoring by federal and state agencies.

The history of crude oil spills in Cook Inlet and the low to moderate potential for discovering new reserves indicates that there is low to moderate probability of a major spill occurring as a result of the areawide lease sale. However, the environment of Cook Inlet can present extremes that might make it difficult to effectively contain and cleanup a major spill. The effects on the sensitive environments of Cook Inlet could be severe if they were unmitigated.

Spill responders in Cook Inlet face a challenging task. Strong currents and large tides in Cook Inlet move oil rapidly. Winter ice, darkness, and severe weather can endanger responders and interfere with the recovery of spilled oil. Thick ice could block access to spilled oil, although broken ice might actually help capture floating oil. Darkness increases the difficulty in observing oil on water. Severe weather could put responders at risk. Chapter 3 contains a description of the Cook Inlet environment.

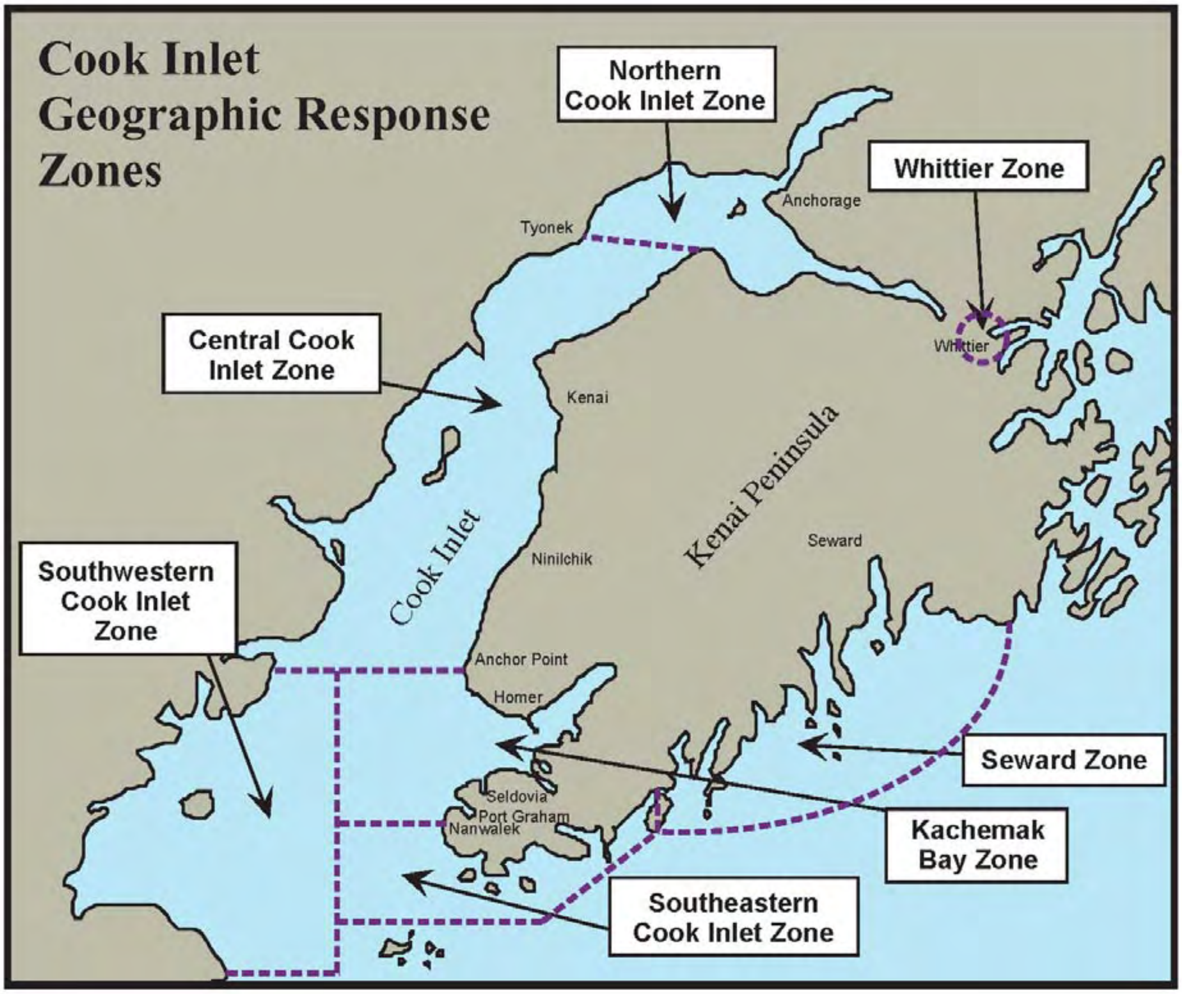
e. <u>Geographic Response Strategies</u>

Geographic Response Strategies (GRS) are oil spill response plans that protect specific sensitive areas from the effects of oil following a spill (ADEC 2008b). The purpose of these map-based strategies is to save time during the critical first few hours after an oil spill. They provide the location of sensitive areas and where to deploy oil spill protection equipment.

A workgroup, composed of local spill response experts and the state and federal agencies who make up the Cook Inlet Regional Citizen's Advisory Council, developed the GRS with public input (ADEC 2008b). Sites were selected based on environmental sensitivity, risk of being impacted from a water borne spill, and feasibility of successfully protecting the site with existing technology. Strategies focus on minimizing environmental damage, utilizing as small a footprint as possible to support the response operations, and selecting sites for equipment deployment that will not cause more damage than the spilled oil.

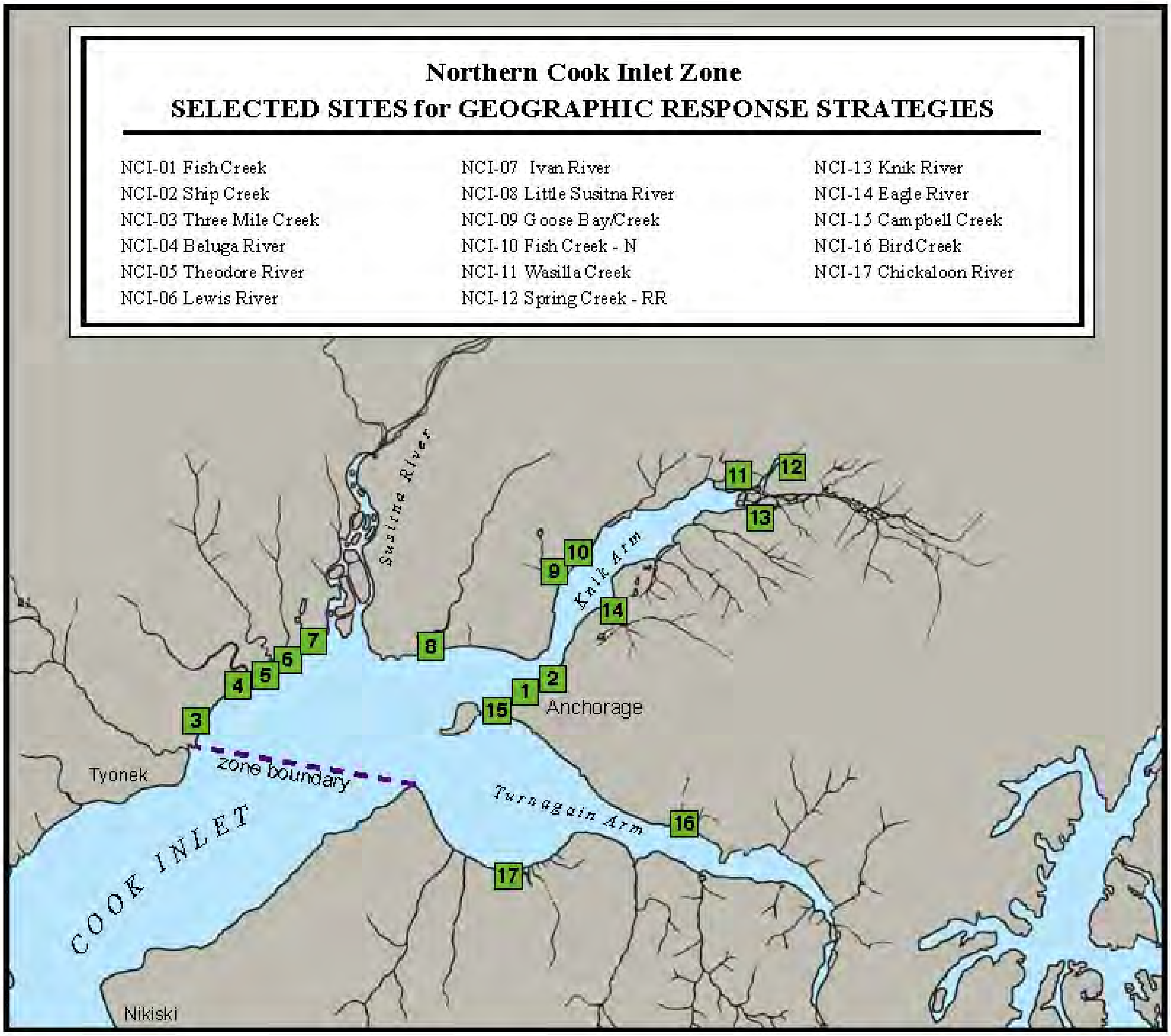
Within the Cook Inlet area, five geographic response zones fall within or adjacent to the lease sale area (Figure 6.8): northern Cook Inlet (from the Chuitna River on the west side of Cook Inlet to Point Possession on the east and north to the Matanuska River); central Cook Inlet (from Anchor Point north to just north of Tyonek including both the east and west coastlines of Cook Inlet); southwestern Cook Inlet (from Cape Douglas north to Sea Otter Point at the southern entrance to Chinitna Bay); Kachemak Bay (from Point Bede, just south of Nanwalek, north to Anchor Point at the northern entrance to Kachemak Bay); and southeastern Cook Inlet (from south of Point Bede northeast to Division Island at the northern entrance to Nuka Passage).

Within the northern Cook Inlet response zone, response strategies have been developed for 17 sites (Figure 6.9); 22 sites for central Cook Inlet (Figure 6.10); 18 sites for southwest Cook Inlet (Figure 6.11); 21 sites for Kachemak Bay (Figure 6.12); and 22 sites for southeast Cook Inlet (Figure 6.13). An example of a GRS for a specific site (the Kasilof River) is provided in Figure 6.14.



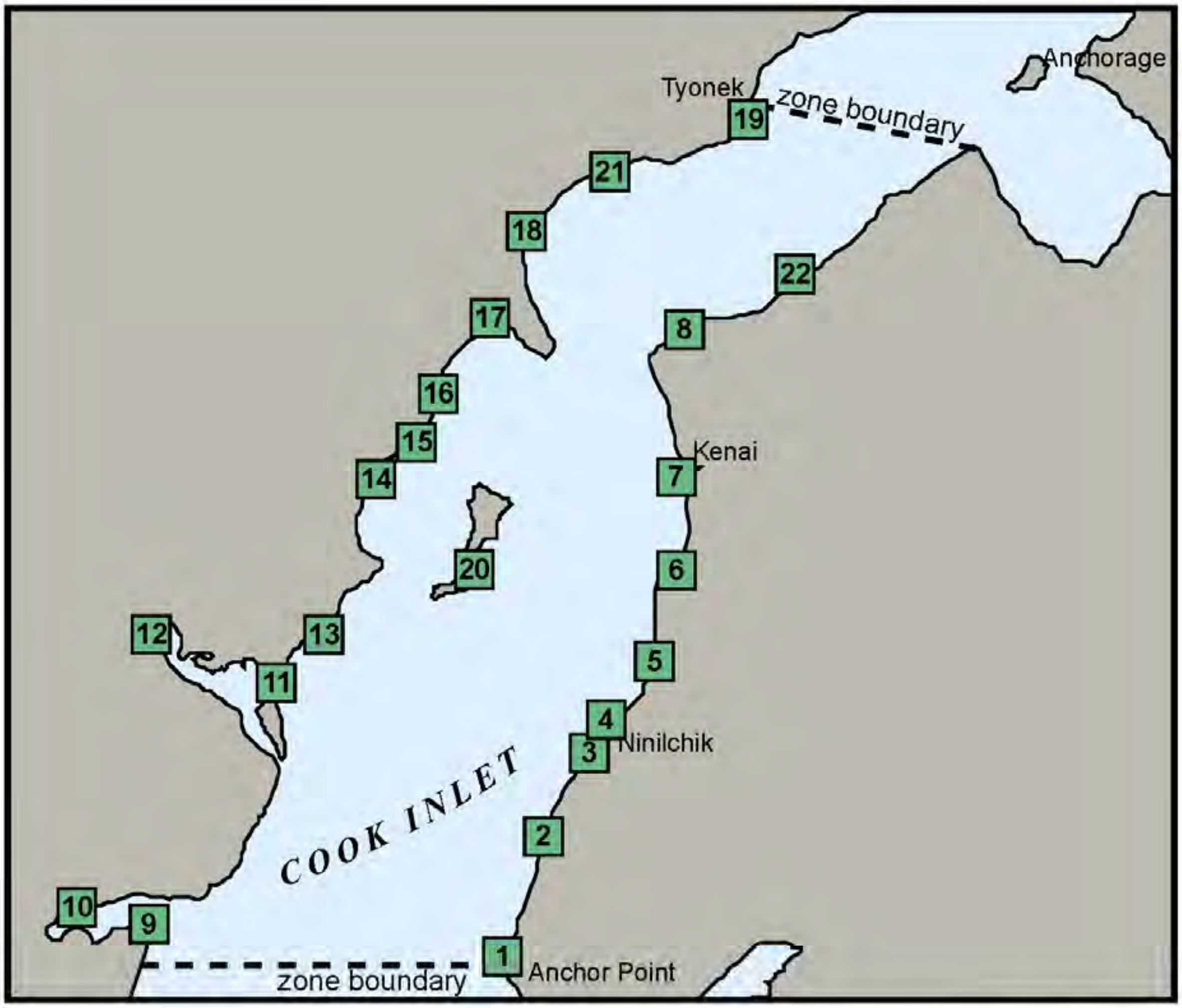
Source: ADEC 2008b.

Figure 6.8. Geographic Response Zones in Cook Inlet.



Source: ADEC 2008b.

Figure 6.9. Sites in northern Cook Inlet for which Geographic Response Strategies have been developed.



Central Cook Inlet

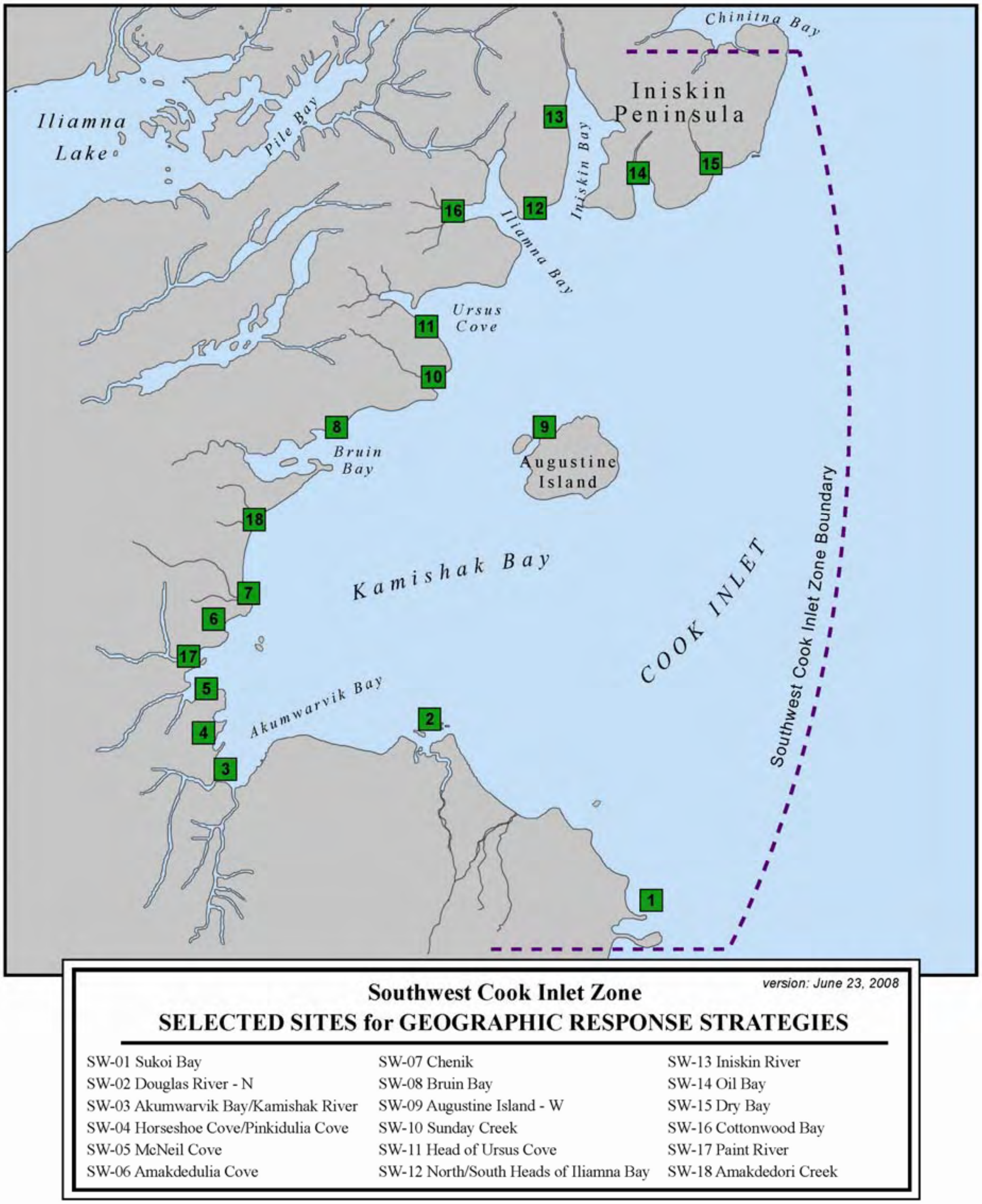
version: December 2001

SELECTED SITES for GEOGRAPHIC RESPONSE STRATEGIES

CCI-01 – Anchor River
CCI-02 – Stariski Creek
CCI-03 – Deep Creek
CCI-04 – Ninilchik River
CCI-05 – Clam Gulch
CCI-06 – Kasilof River
CCI-07 – Kenai River
CCI-08 – East Foreland
CCI-09 – Gull Island
CCI-10 – West Glacier Creek
CCI-11 – Crescent River
CCI-12 – Tuxedni River
CCI-13 – Polly Creek
CCI-14 – Little Jack Slough
CCI-15 – Drift River
CCI-16 – Big River
CCI-17 – Kustatan River
CCI-18 – McArthur River
CCI-19 – Chuitna River
CCI-20 – Swamp Creek
CCI-21 – Middle River
CCI-22 – Swanson River

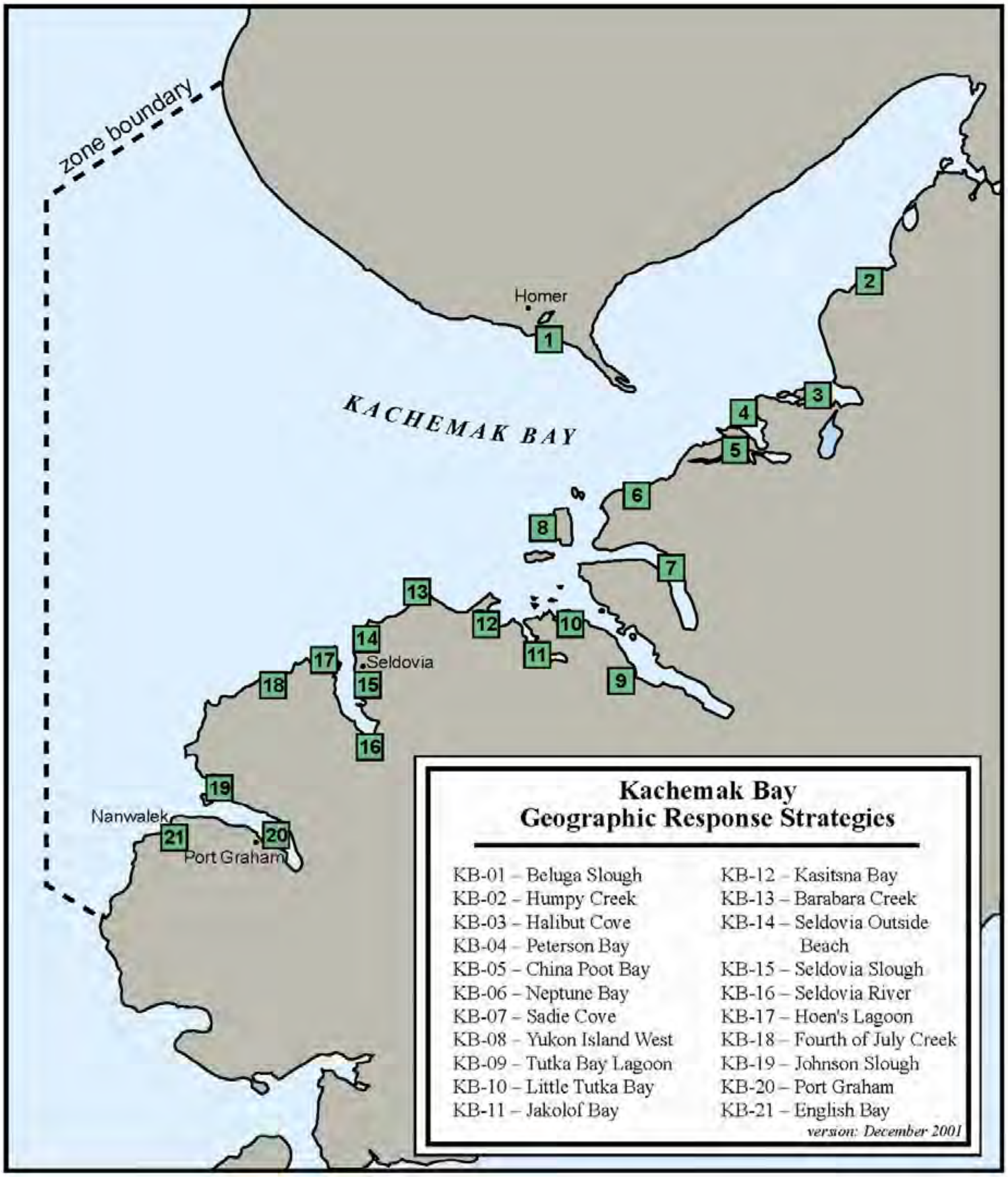
Source: ADEC 2008b.

Figure 6.10. Sites in central Cook Inlet for which Geographic Response Strategies have been developed.



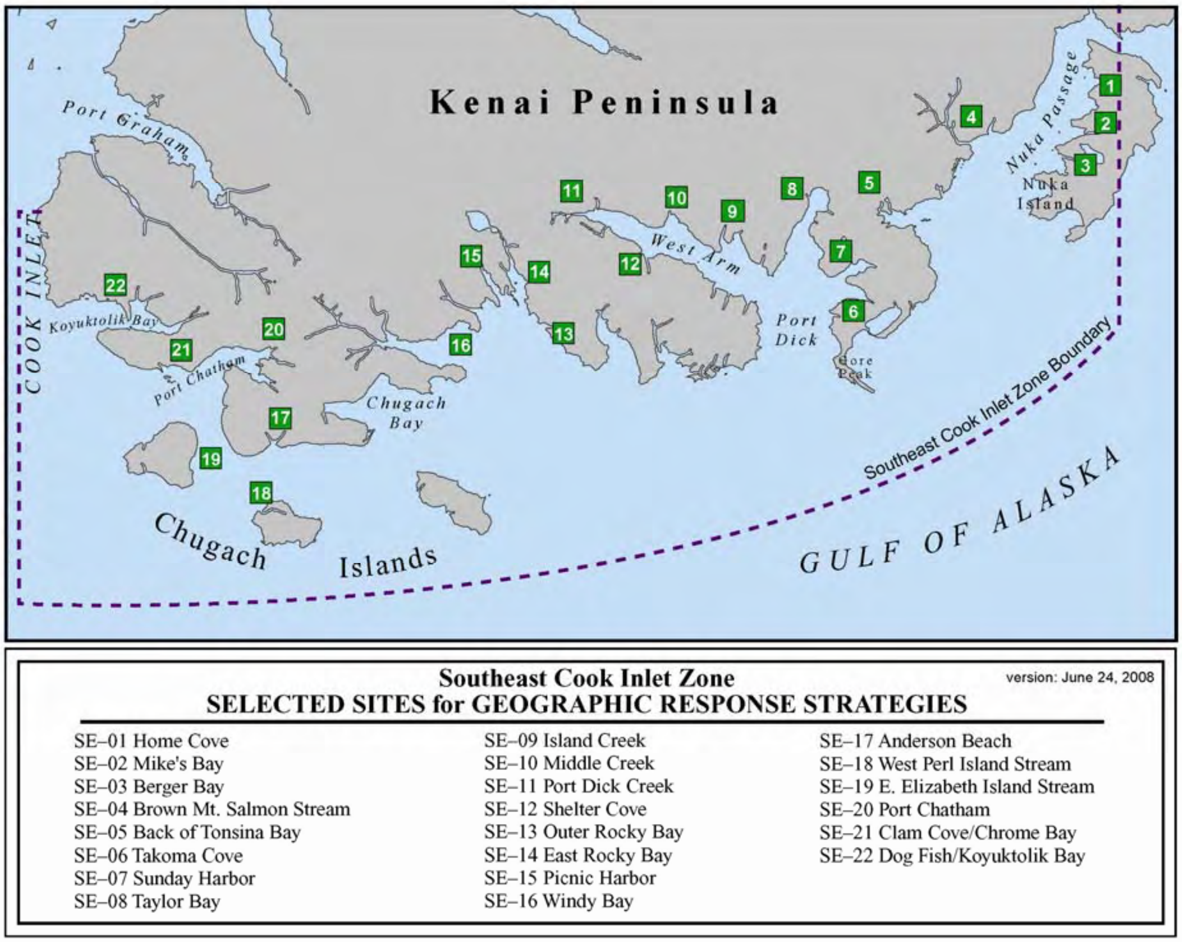
Source: ADEC 2008b.

Figure 6.11. Sites in southwest Cook Inlet for which Geographic Response Strategies have been developed.



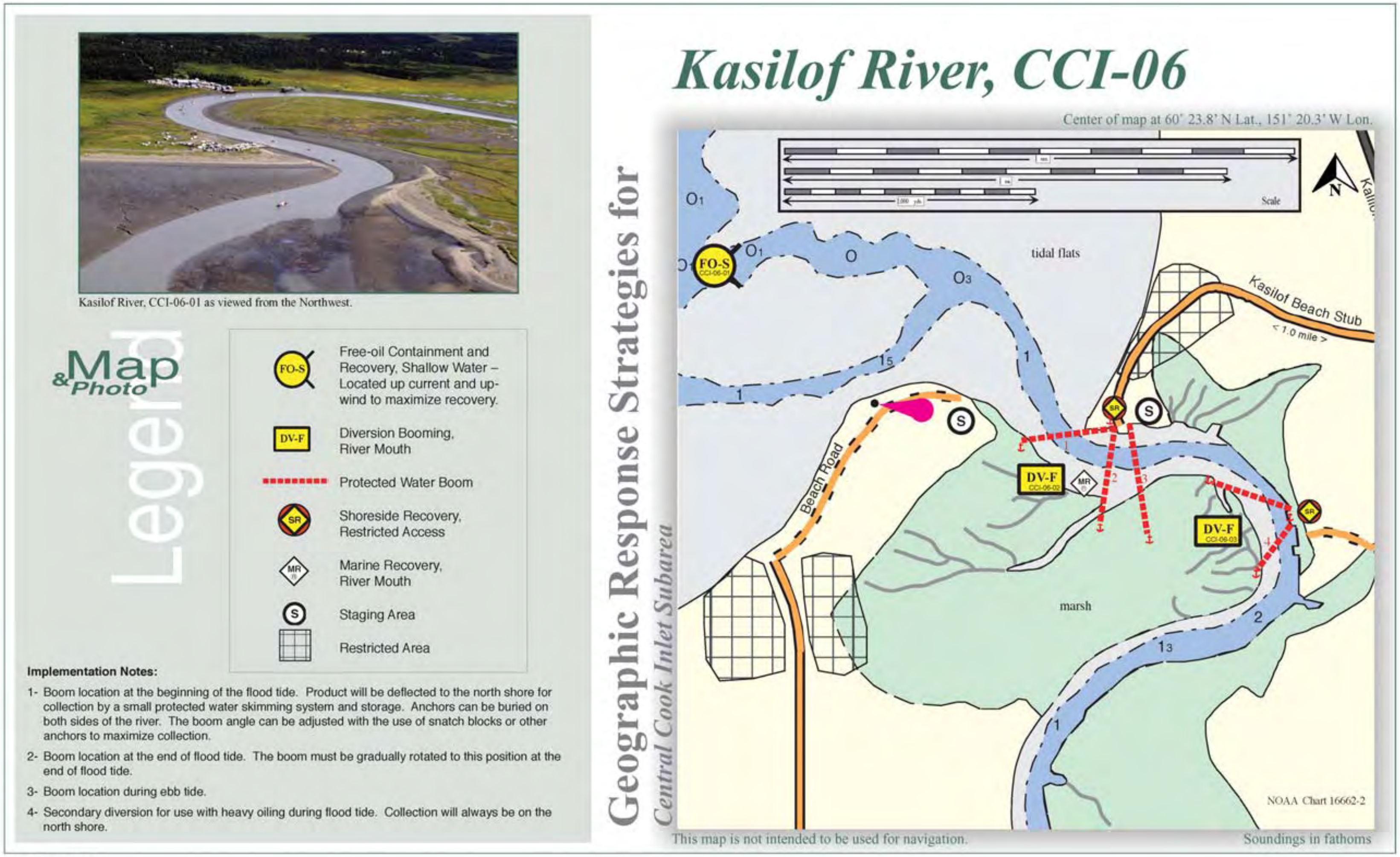
Source: ADEC 2008b.

Figure 6.12. Sites in Kachemak Bay for which Geographic Response Strategies have been developed.



Source: ADEC 2008b.

Figure 6.13. Sites in southeast Cook Inlet for which Geographic Response Strategies have been developed.



December 2001

Tim L. Robertson

Source: ADEC 2008b

Figure 6.14. Example of a Geographic Response Strategy for the Kasilof River.

-continued-

Cook Inlet Geographic Response Strategies

January 2004

ID	Location and Description	Response Strategy	Implementation	Response Resources	Staging Area	Site Access	Resources Protected (months)	Special Considerations
CCI-06-01	**Kasilof River** Nearshore waters in the general area of: Lat. 60° 23.8 N Lon. 151° 20.3 W	* Maximize on-water recovery in the offshore & nearshore environment / outside the mudflats.	Deploy nearshore strike teams upwind and up current of the river mouth. Use aerial surveillance to locate incoming oil.	Multiple nearshore free-oil recovery strike teams as required to maximize interception of oil before it impacts sensitive areas.	Kasilof Harbor or Kenai Harbor	Via marine waters. See NOAA Charts 16661-1, 16662-1 or 16662-2.	Same as CCI-06-02.	Strong tidal currents, shoal waters and rocks. Vessel master should have local knowledge.
CCI-06-02	**Kasilof River** Lat. 60° 23.13 N Lon. 151° 17.87 W 2.5 nm. north of Cape Kasilof on east side of Cook Inlet River Channel • entrance marked by lighted buoy (May - November). • not navigable at low tide. • strong currents. • narrow and winding. • boats ≤ 6' can navigate in river from entrance to 6 mi. upstream. Docks • located North side of river. • Cook Inlet Processing, 78' dock face, launch ramp and detached float.	* Divert spilled product to designated collection sites *Recover spilled product at designated collection sites. **Seasonal Restriction** River iced-in/not navigable from approximately November to April.	Place 1,000 ft. of diversion boom and collect product with an on-shore and/or marine collection unit.	**Equipment** 5 ea. 200 ft. river boom units 2 ea. protected water skimmer 600 ft. 2" discharge hose 2 ea. on-shore storage unit 12 ea. 40 lb. anchor systems 1 ea. marine storage unit 2000 ft. line **Support** 3 ea. vessel class #5/6 1 ea. truck 1 ea. truck with trailer 1 ea. shelter. 2 ea. ATV trailers 2 ea. ATVs 25 ea. fence posts 1 or 2 light plants **Personnel/Shift** 12 ea. deploy & set-up 8 ea. tend & maintain	**North shore:** • Services - crane, boat launch, electric power, heavy equipment access • Security - none. • Support - shelter. **South shore:** • Private land off Coho Loop • Service - none. • Security - none. • Support - shelter	**FOSC Historic Properties Specialist should INSPECT site prior to operations.** FOSC Historic Properties Title 16 permit may be required to work inside river. Contact Environmental Unit of the Unified Command for permit. **North shore:** Kalifornski Beach Road to Kasilof Beach Road, ends at beach near processor. **South shore:** Coho Loop road to end of dirt road, beach access via ATV or off road equipment. **Seasonal Restriction** Roads not plowed during winter approximately November - April.	• Tidal marshes (all year) • Salmon migration and spawning (May - October) • Intertidal salmon spawning (July - September) • Waterfowl and shore bird concentrations (May - September) • Fishing (July - September) • Heavy recreational use (June - September)	• Very difficult and unsafe to protect exposed tidal flats outside river mouth. • Working on banks of the river should be no problem. Take care not to work or walk on oiled shoreline, to avoid driving oil into the soils. • Access above intertidal area will have to be resolved with landowners before setting anchors or staging areas. **Seasonal** Vessel mooring buoys available during fishing season.
CCI-06-03	**Kasilof River** - Secondary Lat. 60° 22.97 N Lon. 151° 17.27 W Same as CCI-06-02.	* Duplicate primary tactics of diversion & collection further upstream, if required.	Place 1,000 ft. of diversion boom and collect oil with an on-shore unit.	**Equipment** 5 ea. 200 ft. river boom units 1 ea. protected water skimmer 600 ft. 2" discharge hose 2 ea. on-shore storage unit 10 ea. 40 lb. anchor systems 1000 ft. line **Support** 1 ea. vessel class #5/6 1 ea. truck 1 ea. truck with trailer 1 ea. shelter. 2 ea. ATV trailers 2 ea. ATVs 25 ea. fence posts 1 or 2 light plants **Personnel/Shift** 10 ea. deploy & set-up 6 ea. tend & maintain	**North shore:** • Services - crane, boat launch, electric power • Security - none. • Support - shelter. **South shore:** • Private land off Coho Loop • Service - none. • Security - none. • Support - shelter	Permits and inspection required (see CCI 06-02). **North shore:** Kalifornski Beach Road to Trans-Aqua sign, (1/4 mi. past Kasilof beach road). **South shore:** Coho Loop road to end of dirt road, beach access via ATV or off road equipment.	Same as CCI-06-02	Same as CCI-06-02

Figure 6.14 Page 2 of 2.

4. Cleanup and Remediation

Cleanup plans for terrestrial and wetlands spills must balance the objectives of maximizing recovery and minimizing ecological damage. Many past cleanup operations have caused as much or more damage than the oil itself. All oils are not the same, and knowledge of the chemistry, fate and toxicity of the spilled oil can help identify cleanup techniques that can reduce the ecological impacts of an oil spill. Hundreds of laboratory and field experiments have investigated the fate, uptake, toxicity, behavioral responses, and population and community responses to crude oil (Jorgenson and Carter 1996).

The best techniques are those that quickly remove volatile aromatic hydrocarbons. This is the portion of oil that causes the most concern regarding the physical fouling of birds and mammals. To limit the most serious effects, it is desirable to remove the maximum amount of oil as soon as possible after a spill. The objective is to promote ecological recovery and not allow the ecological effects of cleanup to exceed those caused by the spill itself. Table 6.5 lists cleanup objectives and techniques that may be applicable to each objective. Table 6.6 compares the advantages and disadvantages of cleanup techniques for crude oil in terrestrial and wetland ecosystems (Jorgenson and Carter 1996).

Table 6.5. Objectives and techniques for cleaning up crude oil in terrestrial and wetland ecosystems.

Objectives	Cleanup Techniques
Minimize:	
Movement of oil	Absorbent booms Sand bagging Sheet piling
Surface-water contamination	Same as above
Soil infiltration	Flood surface
Soil and vegetation contact and oil adhesion	Flood surface Use surfactants to reduce adhesion
Vegetation damage	Use boardwalks to reduce trampling Use flushing instead of mechanical techniques Perform work when vegetation is dormant
Thawing of Permafrost	Avoid vegetation and surface disturbance
Wildlife contact with oil	Fencing to prevent wildlife from entering site Plastic sheeting to prevent birds from landing on site Guards to haze wildlife Devices to haze wildlife
Acute and chronic toxicity of oil to humans, fish, and wildlife	Removal of oil Enhance biodegradation of remaining oil
Waste disposal	Use flushing Avoid absorbents and swabbing
Cost	Remove oil as fast as possible Achieve acceptable cleanup level quickly to minimize monitoring
Liability	Achieve acceptable cleanup level
Maximize:	
Recovery potential of tundra ecosystems	All of the above Add nutrients to aid recovery of plants
Worker safety	Air testing, training, clothing

Source: Jorgenson and Carter 1996.

Table 6.6. Advantages and disadvantages of techniques for cleaning up crude oil in terrestrial and wetland ecosystems.

Technique	Advantage	Disadvantage	Recommended
Wildlife			
Fencing	Keeps out large mammals	Does not keep out birds	Yes
Plastic sheeting	Keeps out both birds and mammals	Can no longer work area	Sometimes
Wildlife guard	Flexibility to respond	Higher cost	Sometimes
Devices	Lower cost	Animals become habituated	No
Containment			
Absorbent booms	Contains floating oil, quickly deployed	Misses water soluble oil	Yes
Sand bags	Contains both floating and soluble fractions, follows tundra contours	Slower to mobilize, some leakage	Yes
Sheet piling	Maximum containment	Slow to install, doesn't fit contours well	Sometimes
Earthen berms	Can easily be adapted to terrain, heavy equipment rapidly can create berms	Destroys existing vegetation and soil	No
Snow/ice berms	Can be used during winter cleanup or to prevent runoff during breakup	Can only be used during freezing periods	Yes
Contact			
Flooding	Keeps heavy oil suspended	Spreads out oil	Yes
Surfactants	Reduces stickiness, aids removal, and reduces volatilization	Reduces effectiveness of rope mop skimmer	Yes
Thickening agents	Untried, aids physical removal	Must be well drained, physical removal more difficult	No
Access			
Boardwalks	Reduces trampling	None	Yes
Removal			
Complete excavation	Eliminates long-term liability	Eliminates natural recovery, disposal costs	Sometimes
Partial excavation	Quickly reduces oil levels, less waste to dispose of than complete excavation	Causes partial ecological damage, disposal costs, still long-term liability	Sometimes
Burning	Low cost, high removal rate	Little testing, ecological damage	Sometimes
Flushing, high pressure	High removal rate	High ecological damage	No
Flushing, low pressure, cold	Moderate removal rate, little damage, easy waste disposal	Spreads oil, not as effective as warm water	No
Flushing, low pressure, warm	High removal rate, little vegetation damage, easy disposal of waste	Spreads oil	Yes
Aeration	Accelerates volatilization	Volatiles lost to air, may pose risk to humans	Yes
Raking	Can target hot spots	Partial vegetation damage	Sometimes
Cutting and trimming	Targets hot spots, reduces stickiness	Partial vegetation damage	Sometimes
Swabbing	Targets hot spots	Not very effective, adds to waste disposal, adds to trampling	No
Oil skimmers and rope mops	Removes heavier oil, works well with flooding, lowers disposal costs	Requires personnel to push oil to skimmer, adds to trampling	Yes
Vacuum pumping	Removes surface and miscible oil, works well with flooding, lowers disposal cost	None	Yes
Biodegradation	Removes low levels of hydrocarbons, non- destructive, lowers disposal costs	Long-term monitoring, site maintenance, may require wildlife protection	Yes

Source: Jorgenson and Carter 1996.

After a spill, the physical and chemical properties of the individual constituents in the oil begin to be altered by the physical, chemical, and biological characteristics of the environment; this is called weathering. The factors that are most important during the initial stages of cleanup are the evaporation, solubility, and movement of the spilled oil. As much as 40 percent of most crude oils may evaporate within a week after a spill. Over the long term, microscopic organisms (bacteria and fungi) break down oil (Jorgenson and Carter 1996).

Cleanup phases include initial response, remediation, and restoration. During initial response, the responsible party gains control of the source of the spilling oil; contains the spilled oil; protects the natural and cultural resource; removes, stores and disposes of collected oil; and assesses the condition of the impacted areas. During remediation, the responsible party performs site and risk assessments; develops a remediation plan; and removes, stores, and disposes of more collected oil. Restoration attempts to re-establish the ecological conditions that preceded the spill and usually includes a monitoring program to access the results of the restoration activities (Jorgenson and Carter 1996).

5. Regulation of Oil Spill Prevention and Response

a. Federal Statutes and Regulations

Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. §9605), and §311(c)(2) of the Clean Water Act, as amended (33 U.S.C. §1321(c)(2)) require environmental protection from oil spills. CERCLA regulations contain the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. §300). Under these regulations, the spiller must plan to prevent and immediately respond to oil and hazardous substance spills and be financially liable for any spill cleanup. If the pre-designated Federal On-Scene Coordinator (FOSC) determines that neither timely nor adequate response actions are being implemented, the federal government will respond to the spill, and then seek to recover cleanup costs from the responsible party.

The Oil Pollution Act of 1990 (OPA 90) requires the development of facility and tank vessel response plans and an area-level planning and coordination structure to coordinate federal, regional, and local government planning efforts with the industry. OPA 90 amended the Clean Water Act (§ 311(j)(4)), which established area committees and area contingency plans as the primary components of the national response planning structure. In addition to human health and safety, these area committees have three primary responsibilities:

- Prepare an area contingency plan;
- Work with state and local officials on contingency planning and preplanning of joint response efforts, including procedures for mechanical recovery, dispersal, shoreline cleanup, protection of sensitive areas, and protection, rescue and rehabilitation of fisheries and wildlife; and,
- Work with state and local officials to expedite decisions for the use of dispersants and other mitigating substances and devices.

In Alaska, the area committee structure has incorporated state and local agency representatives, and the jointly prepared plans coordinate the response activities of the various governmental entities that have responsibilities regarding oil spill response. The area contingency plan for Alaska is the Unified Plan. Since Alaska is so large and geographically diverse, the federal agencies have found it necessary to prepare sub-area contingency plans, also discussed in the Government Contingency Plans section below.

OPA 90 also created two citizen advisory groups: the Prince William Sound and the Cook Inlet Regional Citizens Advisory Councils.

b. Alaska Statutes and Regulations

As discussed above and in Chapter 7, ADEC is the agency responsible for implementing state oil spill response and planning regulations under AS 46.04.030. In 2006, ADEC adopted new regulations (18 AAC 75) for oilfield flowlines, new construction and maintenance standards apply to oil tanks and pipeline facilities. Additionally, ADEC is placing increased emphasis on oil spill prevention training.

ADF&G and ADNR support ADEC in these efforts by providing expertise and information. The industry must file oil spill prevention and contingency plans with ADEC before operations commence. ADNR reviews and comments to ADEC regarding the adequacy of the industry oil discharge prevention and contingency plans (C-plans).

c. Industry Contingency Plans

C-plans for exploration facilities must include: a description of methods for responding to and controlling blowouts; the location and identification of oil spill cleanup equipment; the location and availability of suitable drilling equipment; and an operations plan to mobilize and drill a relief well. If development and production should occur, additional contingency plans must be filed for each facility prior to commencement of activity, as part of the permitting process. Any vessels transporting crude oil from the potential development area must also have an approved contingency plan.

AS 46.04.030 provides that unless an oil discharge prevention and contingency plan has been approved by ADEC, and the operator is in compliance with the plan, no person may:

- Operate an oil terminal facility, a pipeline, or an exploration or production facility, a tank vessel, or an oil barge; or
- Permit the transfer of oil to or from a tank vessel or oil barge.

Parties with approved plans are required to have sufficient oil discharge containment, storage, transfer, cleanup equipment, personnel, and resources to meet the response planning standards for the particular type of facility, pipeline, tank vessel, or oil barge (AS 46.04.030(k)). Examples of these requirements are:

- The operator of an oil terminal facility must be able to contain or control, and clean up a spill volume equal to that of the largest oil storage tank at the facility within 72 hours. That volume may be increased by ADEC if natural or manmade conditions exist outside the facility that place the area at high risk (AS 46.04.030(k)(1)).
- Operators of exploration or production facilities, or pipelines, must be able to contain, control, and cleanup the realistic maximum oil discharge within 72 hours (AS 46.04.030(k)(2)). The realistic maximum oil discharge means the maximum and most damaging oil discharge that ADEC estimates could occur during the lifetime of the tank vessel, oil barge, facility, or pipeline based on (1) the size, location, and capacity; (2) ADEC's knowledge and experience with such; and (3) ADEC's analysis of possible mishaps (AS 46.04.030(r)(3)).

Discharges of oil or hazardous substances must be reported to ADEC on a time schedule depending on the volume released, whether the release is to land or to water, and whether the release has been contained by a secondary containment or structure. For example, 18 AAC 75.300(a)(1)(A)-(C) requires the operator to notify ADEC as soon as it has knowledge of the following types of discharges:

- Any discharge or release of a hazardous substance other than oil;
- Any discharge of or release of oil to water; and,
- Any discharge or release, including a cumulative discharge or release, of oil in excess of 55 gallons solely to land outside an impermeable secondary containment area or structure.

The discharge must be cleaned up to the satisfaction of ADEC, using methods approved by ADEC. ADEC will modify cleanup techniques or require additional cleanup techniques for the site as ADEC determines to be necessary to protect human health, safety, and welfare, and the environment (18 AAC 75.335(d). ADF&G and ADNR advise ADEC regarding the adequacy of cleanup.

A C-plan must describe the existing and proposed means of oil discharge detection, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation (AS 46.04.030; 18 AAC 75.425(e)(2)(E)). A C-plan and its preparation, application, approval, and demonstration of effectiveness require a major effort on the part of facility operators and plan holders. The C-plan must include a response action plan, a prevention plan, and supplemental information to support the response plan (18 AAC 75.425). These plans are described below.

The Response Action Plan (18 AAC 75.425(e)(1)) must include an emergency action checklist of immediate steps to be taken if a discharge occurs. The checklist must include:

- Names and telephone numbers of people within the operator’s organization who must be notified, and those responsible for notifying ADEC;
- Information on safety, communications, and deployment, and response strategies;
- Specific actions to stop a discharge at its source, to drill a relief well, to track the location of the oil on open water, and to forecast the location of its expected point of shoreline contact to prevent oil from affecting environmentally sensitive areas;
- Procedures for boom deployment, skimming or absorbing, lightening, and estimating the amount of recovered oil;
- Plans, procedures, and locations for the temporary storage and ultimate disposal of oil contaminated materials and oily wastes;
- Plans for the protection, recovery, disposal, rehabilitation, and release of potentially affected wildlife; and,
- If shorelines are affected, shoreline clean up and restoration methods.

The Prevention Plan (18 AAC 75.425(e)(2)) must:

- Include a description and schedule of regular pollution inspection and maintenance programs;
- Provide a history and description of known discharges greater than 55 gallons that have occurred at the facility, and specify the measures to be taken to prevent or mitigate similar future discharges;
- Provide an analysis of the size, frequency, cause, and duration of potential oil discharges, and any operational considerations, geophysical hazards, or other site-specific factors, which might increase the risk of a discharge, and measures taken to reduce such risks; and,
- Describe existing and proposed means of discharge detection, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation.

The Supplemental Information Section (18 AAC 75.425(e)(3)) must:

- Include bathymetric and topographic maps, charts, plans, drawings, diagrams, and photographs that describe the facility, show the normal routes of oil cargo vessels, show the locations of storage tanks, piping, containment structures, response equipment, emergency towing equipment, and other related information;
- Show the response command system; the realistic maximum response operation limitations such as weather, sea states (roughness of the sea), tides and currents, ice conditions, and visibility restrictions; the logistical support including identification of aircraft, vessels, and other transport equipment and personnel;
- Include a response equipment list including containment, control, cleanup, storage, transfer, lightering, and other related response equipment;

- Provide non-mechanical response information such as in situ burning or dispersant, including an environmental assessment of such use;
- Provide oil spill primary response action contractor information;
- Include a detailed description of the training programs for discharge response personnel;
- Provide a plan for protecting environmentally sensitive areas and areas of public concern; and,
- Include any additional information and a detailed bibliography.

The Best Available Technology Section (18 AAC 75.425(e)(4)) must:

- Identify technologies applicable to the applicant's operation that are not subject to response planning or performance standards;
- For each applicable technology listed, the plan must identify and analyze all available technologies; and,
- Include a written justification that the technology proposed to be used is the best available for the applicant's operation.

The Response Planning Standard Section (18 AAC 75.425(e)(5)) must include a calculation of the applicable response planning standards, including a detailed basis for the calculation of reductions, if any, to be applied to the response planning standards.

The current statute allows the sharing of oil spill response equipment, materials, and personnel among plan holders. ADEC determines by regulation the maximum amount of material, equipment, and personnel that can be transferred, and the time allowed for the return of those resources to the original plan holder (AS 46.04.030(o)). The statute also requires the plan holders to successfully demonstrate the ability to carry out the plan when required by ADEC (AS 46.04.030(r)(2)(E)). ADEC regulations require that exercises (announced or unannounced) be conducted to test the adequacy and execution of the contingency plan. No more than two exercises are required annually, unless the plan proves inadequate. ADEC may, at its discretion, consider regularly scheduled training exercises as discharge exercises (18 AAC 75.485(a) and (d)).

d. Financial Responsibility

Holders of approved contingency plans must provide proof of financial ability to respond (AS 46.04.040). Financial responsibility may be demonstrated by one or a combination of 1) self-insurance; 2) insurance; 3) surety; 4) guarantee; 5) approved letter of credit; or 6) other ADEC-approved proof of financial responsibility (AS 46.04.040(e)). Operators must provide proof of financial responsibility acceptable to ADEC as follows:

- Crude oil terminals: $50,000,000 in damages per incident
- Non-crude oil terminals: $25 per incident for each barrel of total non-crude oil storage capacity at the terminal or $1,000,000, whichever is greater, with a maximum of $50,000,000
- Pipelines and offshore exploration or production facilities: $50,000,000 per incident.
- Onshore production facilities:
  - $20,000,000 per incident if the facility produces over 10,000 barrels per day of oil;
  - $10,000,000 per incident if the facility produces over 5,000 barrels per day of oil;
  - $5,000,000 per incident if the facility produces over 2,500 barrels per day but not more than 5,000 barrels per day of oil; and,
  - $1,000,000 per incident if the facility produces 2,500 barrels per day or less of oil.
- Onshore exploration facilities: $1,000,000 per incident.
- Crude oil vessels and barges: $300 per incident, for each barrel of storage capacity or $100,000,000, whichever is greater
- Non-crude oil vessels and barges: $100 per barrel per incident or $1,000,000, whichever is greater, with a ceiling of $35,000,000

- The coverage amounts are adjusted every third year based on the Consumer Price Index (AS 46.04.045),

e. Government Contingency Plans

In accordance with AS 46.04.200, ADEC must prepare, annually review, and revise the statewide master oil and hazardous substance discharge prevention and contingency plan. The plan must identify and specify the responsibilities of state and federal agencies, municipalities, facility operators, and private parties whose property may be affected by an oil or hazardous substance discharge. The plan must incorporate the incident command system, identify actions to be taken to reduce the likelihood of occurrence of catastrophic oil discharges and significant discharges of hazardous substances (not oil), and designate the locations of storage depots for spill response material, equipment, and personnel.

ADEC must also prepare and annually review and revise a regional master oil and hazardous substance discharge prevention and contingency plan (AS 46.04.210). The regional master plans must contain the same elements and conditions as the state master plan but are applicable to a specific geographic area.

6. Mitigation Measures and Other Regulatory Protections

Recognition of the difficulties of containment and clean up of oil spills has encouraged innovative and effective methods of preventing possible problems and handling them if they arise. Oil spill prevention, response, and cleanup and remediation techniques are continually being researched by state and federal agencies and the oil industry. Risk of effects from a spill can be avoided, minimized, and mitigated through preventive measures, monitoring, and rigorous response capability. Mitigation measures addressing the possibility of oil spills are included in this best interest finding (see Chapter 9). Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

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Chapter Seven: Governmental Powers to Regulate Oil and Gas

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Chapter Seven: Governmental Powers to Regulate Oil and Gas

All oil and gas activities (exploration, development, production, and transportation) are subject to numerous federal, state, and local laws, regulations, policies, and ordinances, with which the lessee is obligated to comply. This chapter does not provide a comprehensive description of the multitude of laws and regulations that may be applicable to such activities, but it does illustrate the broad spectrum of authority various government agencies have to prohibit, regulate, and condition activities related to oil and gas. Important laws and regulations applicable to oil and gas activities are included in Appendix B. Each of the regulatory agencies (state, federal, and local) has a different role in the oversight and regulation of oil and gas activities, although some agencies may have overlapping authorities.

An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances. However, as discussed previously, except for activities that would not require a land use permit or operations undertaken under an approved unit plan of operations, a plan of operations must be approved before any operations may be undertaken on or in the leased area.

Each agency requires various permits and approvals, which are discussed below along with additional information on the review process (Figure 7.1). However, there is no “typical” project. Actual processes, terms and conditions will vary with time-certain, site-specific operations. Therefore, each agency has field monitors assigned to ensure that operations are conducted as approved. The appropriate statutes and regulations should be consulted when specifics are required.

A. Alaska Department of Natural Resources

ADNR, through the Division of Oil and Gas, Division of Mining, Land and Water, Division of Coastal and Ocean Management, the Office of Project Management and Permitting, and the State Historic Preservation Office reviews, coordinates, conditions, and approves plans of operation or development and other permits as required before on-site activities can take place. The department monitors activities through field inspection once they have begun. Each plan of operation is site-specific and must be tailored to the activity requiring the permit. A plan of operation is required to identify the specific measures, design criteria, and construction methods and standards to be employed so as to comply with the terms of the lease. Applications for other state or federal agency authorizations or permits must be submitted with the plan of operation.

1. Alaska Coastal Management Plan (ACMP) Review

Under the Alaska Coastal Management Program, wetlands and tidelands must be managed to avoid, minimize, or mitigate significant adverse impacts to water flow and natural drainage patterns. Tideland must also be managed to avoid, minimize, or mitigate significant adverse impacts to competing uses such as commercial, recreational, or subsistence uses, to the extent that those uses are determined to be in competition with the proposed use. Rivers, streams, and lakes must be managed to avoid, minimize, or mitigate significant adverse impacts to natural water flow; active floodplains; and natural vegetation within riparian management areas (11 AAC 112.300).

The Cook Inlet Areawide lease sale area encompasses the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough. Therefore, lease related activities are subject to review under the Alaska Coastal Management Plan (ACMP; AS 46.40, 6 AAC 80, 6 AAC 85) and the local coastal district plans. An ACMP consistency analysis was issued concurrently

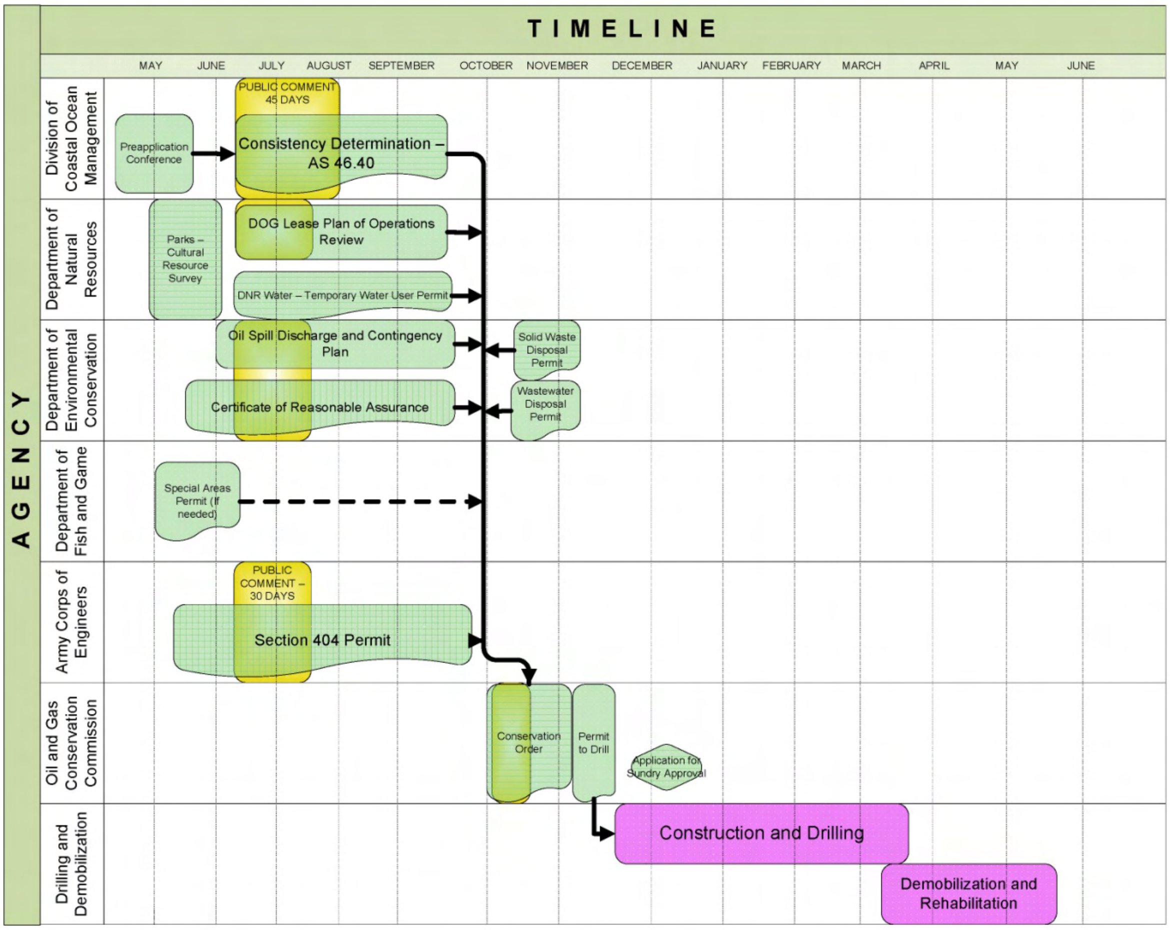

Figure 7.1. Generalized permit process.

with the preliminary best interest finding, and will be followed by a proposed consistency determination and a final consistency determination.

Permit applications for activities under the lease must be as detailed as necessary for a comprehensive agency review. If a project affects or occurs within the coastal zone, a review of the permit application will be conducted to determine whether the proposed activity is consistent with the standards of the ACMP. Following the review, each agency will approve or deny the permit and determine whether any alternative measures (changes in the project description) or permit terms are required before approval.

Most permits needed for exploration well drilling require public notice. The ACMP permitting process goes through a 30- or 50-day review and, if other agencies or offices within ADNR require approval, the review is coordinated by the Division of Coastal and Ocean Management. This process provides for coordinated agency reviews, public input, and ensures that proposed activities are consistent with the ACMP and local coastal plans.

The 50-day ACMP review process is initiated when the lessee, designated operator, or Division of Coastal and Ocean Management distributes an application package to affected coastal resource districts and permitting agencies. The various agencies initiate their internal consistency reviews and must send any requests for additional information to the coordinating agency within 25 days. Public and agency review comments are due on or before Day 34, and a proposed consistency finding is issued on or before Day 44. A request for additional time to complete the review must be received on or before Day 49, and the final consistency determination is issued on Day 50. However, if a reviewing agency objects to the proposed determination, it may elevate the decision to the director. If the determination is elevated, a director's determination is issued by Day 65. The 30-day review process has shorter time periods between action points.

The consistency determination process has been streamlined through the development of A, B, and C list activities.

"A list" activities are considered "categorically consistent," do not result in significant impacts to coastal resources, and do not require a consistency review. On-pad placement of light poles, railings, electrical towers/poles, modules, and associated oil and gas buildings are examples of A list activities. A Coastal Project Questionnaire (CPQ) application is required for projects on the A list unless the A list says that a CPQ is not required.

"B list" reviews are classified as General Concurrences, and the activities are considered routine with standard alternative measures. B list activities adopting the alternative measures are consistent with the ACMP. Individual ACMP consistency reviews are not necessary for activities on the B list. However, a CPQ application is required for all projects on the B list.

The resource agency(s) will check the CPQ and plan of operations to ensure that the project qualifies for the A or B list. The coordinating agency will also review the standard alternative measures and any applicable procedures against the plan of operations submitted.

"C list" activities are activities not covered by the A or B lists, and reviews are classified as Individual Project Reviews. C list activities are subject to the 50- or 30-day review process described in this section.

2. Plan of Operation Approval

Land use activities within oil and gas leases are regulated under 11 AAC 83.158 and paragraph 10 of the lease. These require the lessee to prepare plans of operation and development that must be approved by DO&G and by any other interest holder, if ownership is shared, before the lessee may commence any activities within the leased area. Except for uses and activities appearing on the list in 11 AAC 96.020, the lessee must prepare a plan of operation and obtain all required approvals and permits for each phase of exploration, development, or production before implementation of that activity. All permit applications and plans are available for public review and public notice will be given for all development plans of operation.

An application for approval of a plan of operation must contain sufficient information, based on data reasonably available at the time the plan is submitted for approval, for the commissioner to determine the surface use requirements and impacts directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

(1) the sequence and schedule of the operations to be conducted on or in the leased area, including the date operations are proposed to begin and their proposed duration;
(2) projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations;
(3) plans for rehabilitation of the affected leased area after completion of operations or phases of those operations; and

(4) a description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas (11 AAC 83.158(d).)

When it considers a plan of operation, ADNR often requires stipulations, in addition to the mitigation measures developed through the best interest finding. These additional stipulations address site-specific concerns directly associated with the proposed project. The lease stipulations and the terms and conditions of the lease are attached to the plan of operation approval and are binding on the lessee. The lease also requires that the lessee keep the lease area open for inspection by authorized state officials. Activities are field-monitored by ADNR, ADEC, ADF&G, and AOGCC to ensure compliance with each agency's respective permit terms. In addition, each permittee must post a $500,000 statewide bond to cover a drill site. Lease operation approvals are generally granted for three years.

3. Geophysical Exploration Permit

The geophysical exploration permit is a specific type of land use permit issued by DO&G under 11 AAC 96.010. Seismic surveys are the most common activity authorized by this permit. The purpose of the permit is to minimize adverse effects on the land and its resources while making important geological information available to the state (11 AAC 96.210). Under AS 38.05.035(a)(8)(C), the geological and geophysical data that are made available to the state are held confidential at the request of the permittee. If the seismic survey is part of an exploration well program, the permit will be reviewed as part of the exploration well permit package. The application must contain the following information in sufficient detail to allow evaluation of the planned activities' effects on the land:

(1) a map at a sufficient scale showing the general location of all activities and routes of travel of all equipment for which a permit is required;
(2) a description of the proposed activity, any associated structures, and the type of equipment that will be used. (11 AAC 96.030(a).)

Maps showing the precise location of the survey lines must also be provided, though this information is usually held confidential. A $100,000 bond is required to conduct seismic work. The bond amount for other geophysical surveys is determined when the activity is proposed.

A geophysical exploration permit contains measures to protect the land and resources of the area. The permit is usually issued for a single survey season, but may be extended. If the permit is extended, the director may modify existing terms or add new ones. The permit is revocable for cause for violation of a permit provision or of 11 AAC 96, and is revocable at will if the department determines that revocation is in the state's interest. A permit remains in effect for the term issued, unless revoked sooner. The department will give 30 days' notice before revoking a permit at will. A revocation for cause is effective immediately. (11 AAC 96.040(a).)

4. Pipeline Rights-of-Way

Most transportation facilities within the lease area or beyond the boundaries of the lease area must be authorized by ADNR under the Right-of-Way Leasing Act (AS 38.35). This act gives the commissioner broad authority to oversee and regulate the transportation of oil and gas by pipelines that are located in whole or in part on state land, to ensure the state's interests are protected. The Right-of-Way Leasing Act process is administered by the State Pipeline Coordinator's Office.

5. Temporary Water Use Authorization

Exploration activities may require a temporary water use authorization issued by DMLW. A temporary water use authorization is required before the temporary use of a significant amount of water under 11 AAC 93.035, if the use continues for less than five consecutive years and the water applied for is not otherwise appropriated. The authorization may be extended one time for good cause for a period of time not to exceed five years. An application must include: (1) the application fee; (2) a map indicating the section, township, range, and meridian, and indicating the location, of the property, the point of withdrawal, diversion, or impoundment, and the point of use; (3) the quantity of water to be used; (4) the nature of the water use; (5) the time period during which the water is to be used; and (6) the type and size of equipment used to withdraw the water. DMLW may issue an authorization for the temporary use of water subject to conditions, including suspension or termination, considered necessary to protect the water rights of other persons or the public interest. Information on lake bathymetry, fish presence, and fish species may be required when winter water withdrawal is proposed to calculate the appropriate withdrawal limits.

6. Permit and Certificate to Appropriate Water

Industrial or commercial use of water requires a Permit to Appropriate Water under 11 AAC 93.120. The permit is issued for a period of time consistent with the public interest and adequate to finish construction and establish full use of water. The maximum time period for which a permit will be issued for industrial of commercial use is five years, unless the applicant proves or the commissioner independently determines that a longer period is required. The commissioner may issue a permit subject to terms, conditions, restrictions, and limitations necessary to protect the rights of others, and the public interest. Under 11 AAC 93.120(e), permits are subject to conditions such as requirements: that no certificate will be issued until evidence is presented of adequate easements or other means necessary to complete the appropriation; that the permittee measure the water use and report water use information to ADNR; and to maintain, or restrictions from withdrawing, a specific quantity, rate of flow or volume of water to protect fish and wildlife habitat, recreation purposes, navigation, sanitation, water quality, prior appropriators, or any other purpose the department determines is in the public interest.

A Certificate of Appropriation will be issued under 11 AAC 93.130 if the permit holder: (1) submits a statement of beneficial use stating that the means necessary for the taking of water have been developed and the permit holder is beneficially using the quantity of water to be certified; the fee required must accompany the statement of beneficial use; and (2) has substantially complied with all permit conditions. Again, the commissioner will, in his or her discretion, issue a certificate subject to conditions necessary to protect the public interest. For example, conditions to maintain a specific quantity of water at a given point on a stream or water body, or in a specified stretch of stream, throughout the year or for specified times of the year, to achieve any of the following purposes: protection of fish and wildlife habitat, protection of recreation, protection of navigation, protection of sanitation and water quality, protection of prior appropriators, or any other purpose the commissioner determines is in the public interest. (11 AAC 93.130(c)(1).)

7. Land Use Permits

Land use permits are issued by DMLW and may be required for exploration, development, and production activities. Land use permits can be issued for periods up to five years depending on the activity, but ADNR anticipates permits issued in conjunction with the lease will likely be for a period of one year.

In accordance with 11 AAC 96.025, a generally allowed use listed in 11 AAC 96.020 is subject to the following conditions:

(1) activities employing wheeled or tracked vehicles must be conducted in a manner that minimizes surface damage;

(2) vehicles must use existing roads and trails whenever possible;

(3) activities must be conducted in a manner that minimizes

(A) disturbance of vegetation, soil stability, or drainage systems;

(B) changing the character of, polluting, or introducing silt and sediment into streams, lakes, ponds, water holes, seeps, and marshes; and

(C) disturbance of fish and wildlife resources;

(4) cuts, fills, and other activities causing a disturbance listed in (3)(A) - (C) of this section must be repaired immediately, and corrective action must be undertaken as may be required by the department;

(5) trails and campsites must be kept clean; garbage and foreign debris must be removed; combustibles may be burned on site unless the department has closed the area to fires during the fire season;

(6) survey monuments, witness corners, reference monuments, mining location posts, homestead entry corner posts, and bearing trees must be protected against destruction, obliteration, and damage; any damaged or obliterated markers must be reestablished as required by the department under AS 34.65.020 and AS 34.65.040;

(7) every reasonable effort must be made to prevent, control, and suppress any fire in the operating area; uncontrolled fires must be immediately reported;

(8) holes, pits, and excavations must be repaired as soon as possible; holes, pits, and excavations necessary to verify discovery on prospecting sites, mining claims, or mining leasehold locations may be left open but must be maintained in a manner that protects public safety;

(9) on lands subject to a mineral or land estate property interest, entry by a person other than the holder of a property interest, or the holder's authorized representative, must be made in a manner that prevents unnecessary or unreasonable interference with the rights of the holder of the property interest.

8. Material Sale Contract

If the operator proposes to use state-owned gravel or other materials for construction of pads and roads, a DMLW material sale contract must include, if applicable, but is not limited to: a description of the sale area, the volume of material to be removed from the sale area, the method of payment by the purchaser, the method of removal of the material, the bonds and deposits required of the purchaser, the method of scaling to be used by the purchaser, the purchaser's liability under the contract, the improvements to and occupancy of the sale area required of the purchaser, and the reservation of material within the sale area to DMLW. A material sale contract must also include the purchaser's site-specific operating requirements, including requirements relating to boundary markers and survey monument protection; erosion control and protection of water; fire prevention and control; roads; sale area supervision; protection of fish, wildlife and recreational values; sale area access; and public safety. A contract must state the date upon which the severance or extraction of material under the contract is to be completed. A contract may be extended before its expiration if the director determines that the delay in completing the contract is due to unforeseen events beyond the purchaser's control, or the extension is in the best interests of the state.

In connection with a material sale, the DMLW director may require the purchaser to provide a performance bond that guarantees performance of the terms of the contract. If the director requires a performance bond, the bond amount will be based on the total value of the sale. The performance bond must remain in effect for the duration of the contract unless released in writing by the director.

9. Office of History and Archaeology

The Alaska Heritage Resources Survey (AHRS) is an inventory of all reported historic and prehistoric sites within the state and is maintained by ADNR’s Office of History and Archaeology. This inventory of cultural resources includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. To date, over 22,000 sites have been reported within Alaska (however, this is probably only a small percentage of the sites that may actually exist but are as yet unreported). The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction. Before beginning a project, information regarding important cultural and historic sites can be obtained by contacting the Office of History and Archaeology.

AS 41.35.010, the Alaska Historic Preservation Act says that “It is the policy of the state to preserve and protect the historic, prehistoric, and archaeological resources of Alaska from loss, desecration, and destruction so that the scientific, historic, and cultural heritage embodied in those resources may pass undiminished to future generations.” Existing statutes, which apply to both known sites and newly discovered sites, include:

- **AS 41.35.200**. Unlawful acts. (a) A person may not appropriate, excavate, remove, injure, or destroy, without a permit from the commissioner, any historic, prehistoric, or archaeological resources of the state. “Historic, prehistoric, or archaeological resources” includes deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistorical culture of people in the state as well as to the natural history of the state (AS 41.35.230(2)).
- **AS 41.35.210**. Criminal penalties. A person who is convicted of violating a provision of AS 41-35.010 – 41.35.240 is guilty of a class A misdemeanor.
- **AS 41.35.215**. Civil penalties. In addition to other penalties and remedies provided by law, a person who violates a provision of AS 41.35.010 – 41.35.240 is subject to a maximum civil penalty of $100,000 for each violation.

B. Alaska Department of Environmental Conservation

ADEC has statutory responsibility for controlling air, land, and water pollution, and oil spill prevention and response. ADEC implements and coordinates several federal regulatory programs in addition to state laws.

1. Air Quality Permits

ADEC administers an air quality program under a federally-approved State Implementation Plan. Through this plan, federal requirements of the Clean Air Act are met including National Ambient Air Quality Standards, New Source Review (NSR), New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants, and Prevention of Significant Deterioration. ADEC also monitors air quality and compliance.

The National Ambient Air Quality Standards set limits on pollutants considered harmful to public health and the environment (EPA 2008b). Limits have been defined for six principal pollutants, or criteria pollutants: carbon monoxide, lead, nitrogen dioxide, particulate matter (PM_{10}), particulate matter ($PM_{2.5}$), ozone, and sulfur dioxide. NSR, a permitting program required for new construction projects, ensures that air quality is not degraded by the new project, and that large new or modified industrial sources will be as clean as possible (EPA 2008e). New Source Performance Standards are intended to promote use of the best air pollution control technologies available, and they take into account the cost of the technology and any other non-air quality, health, and environmental impact and energy requirements (EPA 2008d). The National Emissions Standards for Hazardous Air Pollutants are set for air pollutants that are not covered by National Ambient Air Quality Standards, but that may be harmful (EPA 2008c). The standards are categorized by type of source, and require the maximum degree of reduction in emissions that is achievable, as determined by the EPA. The purpose of the Prevention of Significant Deterioration program is:

> …to protect public health and welfare; preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value; insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources; and assure that any decision to permit increased air pollution…is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision making process. (EPA 2008e.)

The two primary types of permits issued to meet these requirements are Title I Construction Permits and Title V Operation Permits (EPA 2008a). Permits are legal documents that the applicant must follow. Permits specify what activities are allowed, what emission limits must be met, and may specify how the facility must be operated. Permits may contain monitoring, recordkeeping, and reporting requirements to ensure that the applicant meets the permit requirements (EPA 2008e).

a. <u>Title I (NSR) Construction Permits</u>

i. Permit Description

Title I permits incorporate air quality requirements for the Prevention of Significant Deterioration as well as other requirements of the Clean Air Act. This permit must be obtained before onsite construction can begin. Title I permits are required for projects that are new major sources for pollutants, or major modifications at existing sources. Prevention of Significant Deterioration requires installation of the "Best Available Control Technology (BACT)"; an air quality analysis; an additional impacts analysis; and public involvement (EPA 2008e).

BACT is determined on a case-by-case basis and takes into account energy, environmental, and economic impacts. BACT includes add-on control equipment, or modifications to production processes or methods. Examples include fuel cleaning or treatment, innovative fuel combustion techniques; and design, equipment, work practice, or operational standards (EPA 2008e).

An air quality analysis is required to show that new emissions will not violate air quality standards. In general, an assessment of existing air quality, and predictions of future air quality that will result from the project are required (EPA 2008e).

ii. Review Process

The permitting process includes a pre-application meeting between the applicant and ADEC, several ADEC reviews and a Technical Analysis Report, and a 30-day public comment period, after which ADEC may issue a final permit. The final permit includes a final Technical Analysis Report and response to comments. The process for a Title I process can take up to three years, depending on the amount of meteorological data collection required. The permit must be obtained before construction may begin.

b. Title V Operation Permits

i. Permit Description

The federal Clean Air Act of 1970, and its subsequent 1990 revision and expansions (42 U.S.C. §§ 7401-7642), give EPA the authority to limit emissions from point sources (EPA 2007b). EPA regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit to operate the facility, known as a Title V permit. In Alaska, ADEC is responsible for issuing Title V permits and making compliance inspections (DEC 2008; 18 AAC 50, and AS 46.14). Permits are legally binding and include enforceable conditions with which the operator must comply. The permit establishes limits on the type and amount of emissions allowed, requirements for pollution control devices and prevention activities, and monitoring and record keeping requirements (EPA 2008f).

ii. Review Process

Operators have 12 months to submit their completed Title V permit after commencing their operations, which can continue while ADEC processes the application. However, significant revisions to an existing permitted facility cannot be made until the permit revision is approved by ADEC. Processing time for permit revisions can be up to 6 months. Title V permits and revisions can be processed concurrently with Title I permits.

2. Solid Waste Disposal Permit

ADEC regulates solid waste storage, treatment, transportation, and disposal under 18 AAC 60. EPA regulates RCRA hazardous wastes and UIC Class I injection wells, and the AOGCC regulates UIC Class II oil and gas wells.

For all solid waste disposal facilities regulated by ADEC, a comprehensive disposal plan is required, which must include engineering design criteria and drawings, specifications, calculations, and a discussion demonstrating how the various design features (liners, berms, dikes) will ensure compliance with regulations. Before approval, solid waste disposal permit applications are reviewed for compliance with air and water quality standards, wastewater disposal, and drinking water standards, as well as for their consistency with the Alaska Historic Preservation Act. The application for a waste disposal permit must include a map or aerial photograph (indicating relevant topographical, geological, hydrological, biological, and archeological features) with a cover letter describing type, estimated quantity, and source of the waste, as well as the type of facility proposed. Roads, drinking water systems, and airports within a two-mile radius of the site must be identified, along with all residential drinking water wells within one-half mile. There must also be a site plan with cross-sectional drawings that indicate the location of existing and proposed containment structures, material storage areas, monitoring devices, area improvements, and on-site equipment. An evaluation of the potential for generating leachate must be presented as well. For above-grade disposal options, baseline water-quality data may be needed to establish the physical and chemical characteristics of the site before installing a containment cell.

Non-drilling-related solid waste must be disposed of in an approved municipal solid waste landfill (MSWLF). MSWLFs are regulated under 18 AAC 60.300-.397. All other solid waste (except for hazardous materials) must be disposed of in an approved monofill (18 AAC 60.400-.495). A monofill is a landfill or drilling waste disposal facility that receives primarily one type of solid waste and that is not an inactive reserve pit (18 AAC 60.990(80)). An inactive reserve pit is a drilling waste disposal area, containment structure, or group of containment structures where drilling waste has not been disposed of after January 26, 1996, and at which the owner or operator does not plan to continue disposing of drilling waste (18 AAC 60.990(62)). Closure of inactive reserve pits is regulated under 18 AAC 60.440.

Drilling waste disposal is specifically regulated under 18 AAC 60.430. Design and monitoring requirements for drilling waste disposal facilities are identified in 18 AAC 60.430(c) and (d), respectively. Under 18 AAC 60.430(c)(1), "the design must take into account the location of the seasonal high groundwater table, surface water, and continuous permafrost, as well as proximity to human population and to public water systems, with the goal of avoiding any adverse effect on these resources." The facility must be designed to prevent the escape of drilling waste and leachate, prevent contamination of groundwater, and be of sufficient volume and integrity to prevent leakage due to erosion, precipitation, wind and wave action, and changing permafrost conditions. The plans for the proposed design and construction of the drilling waste disposal facility and the fluid management plan must be approved, signed, and sealed by a registered engineer per 18 AAC 60.430(c)(5).

Presently, the preferred practice is to dispose of drilling fluids by reinjection deep into the ground; however, EPA and ADEC may authorize limited discharge of waste streams under the NPDES permit system. All produced waters must be re-injected or treated to meet Alaska Water Quality Standards before discharge. Before a well may be permitted under 20 AAC 25.005, a proper and appropriate reserve pit, also known as a solid waste disposal cell, must be constructed or appropriate tankage installed for the reception and confinement of drilling fluids and cuttings, to facilitate the safety of the drilling operation, and to prevent contamination of freshwater and damage to the surface environment (20 AAC 25.047).

Typically, a reserve pit is a containment cell lined with an impermeable barrier compatible with both hydrocarbons and drilling mud. Average dimensions are approximately 130 feet wide by 150 feet long by 12 feet deep, although specific configurations vary by site. The cell may receive only drilling and production wastes associated with the exploration, development, or production of crude oil, natural gas or hydrocarbon-contaminated solids. The disposal of hazardous or other waste in a containment cell is prohibited. After the well is deepened, the residue in the reserve pit is often dewatered and the fluids are injected into the well annulus. An inventory of injection operations including volume, date, type and source of material injected is maintained by requirement. Following completion of well activities, the material remaining in the pit is permanently encapsulated in the impermeable liner. Fill and organic soil is placed over it and proper drainage is re-established. Surface impoundments within 1,500 feet are sampled on a periodic basis and analyzed. In addition, groundwater-monitoring wells are drilled and sampled on a regular basis. If there are uncontained releases during operations, or if water samples indicate an increase in the compounds being monitored, additional observation may be required.

Substances proposed for disposal that are classified as "hazardous" undergo a more rigorous and thorough permitting and review process by both ADEC, per 18 AAC 62 and 63, and the EPA.

3. Wastewater Disposal Permit

Domestic graywater must be disposed of properly at the surface and requires a Wastewater Disposal Permit per 18 AAC 72. Typically, waste is processed through an on-site plant and disinfected before discharge. ADEC sets fluid volume limitations and threshold concentrations for biochemical oxygen demand (BOD), suspended solids, pH, oil and grease, fecal coliform, and chlorine residual. Monitoring records must be available for inspection, and a written report may be required upon completion of operations.

4. NPDES Certification

ADEC participates in the federal National Pollution Discharge Elimination System (NPDES) program that is administered by EPA (see EPA Section F1 below). ADEC certifies that discharges permitted under NPDES meet state and federal water quality standards. When an application for an NPDES permit is made to EPA, a duplicate must also be filed with ADEC for certification. The permit may impose stipulations and conditions on the facility and operations, such as monitoring and/or mixing zone requirements. Once operations begin, both EPA and ADEC have the responsibility to monitor the project for compliance with the terms of the permit.

Both EPA's process for reviewing and issuing NPDES permits, and ADEC's process for certifying the permits include requirements for public notices, receiving, considering, and addressing public input (40 C.F.R. 125.32; 18 AAC 15.140; 18 AAC 15.150).

EPA administered the NPDES program in Alaska, but on October 31, 2008, EPA approved the state's application to assume issuing and enforcing permits for wastewater discharges issued under the Clean Water Act. Transfer of authority for the program will be phased in over three years, from November 2008 – November 2011 (ADEC 2008; SOA 2008).

5. U.S. Army Corps of Engineers Section 10 and Section 404 Permit Certification

ADEC participates in the permit review process for U.S. Army Corps of Engineers Section 10 and Section 404 permits (see U.S. Army Corps of Engineers Section G1 below) by reviewing permit applications to ensure that proposed projects will comply with Alaska water quality standards. If it is determined that the project will comply, ADEC issues a Clean Water Act Section 401 Certification for the project.

6. Oil Discharge Prevention and Contingency Plan

Lessees must comply with the requirements of AS 46.04.010 - .900, Oil and Hazardous Substance Pollution Control. This requirement includes the preparation and approval by ADEC of an Oil Discharge Prevention and Contingency Plan (C-Plan) (AS 46.04.030; 18 AAC 75.445). Details on the contents of the plan are in Chapter Six.

Before receiving a permit to drill, the lessee must demonstrate in each plan of operation the ability to promptly detect, contain, and clean up any hydrocarbon spill before the spill affects fish and wildlife populations or their habitats. ADEC has authority under AS 46.04 for the purpose of preventing and cleaning up oil spills.

If transportation by water is planned, AS 46.04.030 requires that the lessee obtain the approval of ADEC for detailed oil spill contingency plans before the commencement of each aspect of the operation, including individual wells, drilling pads or platforms, pipelines, storage facilities, loading facilities, and individual tankers or barges.

C. Alaska Department of Fish and Game

ADF&G, Division of Habitat, evaluates the potential effect of any activity on fish and wildlife, their habitat, and the users of those resources.

1. ADF&G Special Areas

ADF&G requires permits for any oil and gas related activity in state game refuges, sanctuaries and critical habitat areas (AS 16.20 and 5 AAC 95). Special Area management plans provide guidelines for certain activities within many legislatively designated areas. The lease sale area includes five state game refuges (Trading Bay State Game Refuge, Susitna Flats State Game Refuge, Anchorage Coastal Wildlife Refuge, Goose Bay State Game Refuge, and Palmer Hay Flats State Game Refuge) and four critical habitat areas (Kalgin Island, Redoubt Bay, Clam Gulch, Anchor River/Fritz Creek). Four additional critical habitat areas are located in the vicinity of the lease sale area (Willow Mountain, Kachemak Bay, Homer Airport, and Fox River Flats).

By statute, these areas are jointly managed with ADNR. Permits are conditioned to mitigate impacts. For example, timing restrictions may be used to limit the impact on wildlife during sensitive life-cycle periods. Decisions are based upon recommendations provided by area staff, the commenting agencies and coastal districts. For permits issued for activities in anadromous streams, an applicant may appeal a rejection or stipulation through procedures described in the Administrative Procedures Act.

Applications must include plans, specifications and any other detail necessary to describe a proposed project fully by including a narrative addressing how activities might disturb fish and wildlife, habitat and public use. The application requests details concerning the method of construction, type of equipment, planned water use (including method and rate of withdrawal and consumption), any proposed excavation and fill, the type and location of material sources, how access will be accomplished and the number of people involved. Detailed maps with plan and cross-sectional views (drawn to scale) showing project features and the location of proposed facilities are required as well. As a condition of approval, applicants are required to agree to compensate the state fully for damage to fish and wildlife populations or the destruction of habitat. A mitigation plan may be required.

Each project is considered in relation to the purposes for which the area was established and permit conditions are often imposed to mitigate adverse impacts. Timing restrictions that limit activity to winter are common. A project may be allowed if the protection of fish and game and important habitat is not precluded.

2. Waters Important to Anadromous Fish and Fish Passage

Beginning July 1, 2008, permitting authority for activities that may affect anadromous fish streams was transferred back to ADF&G, Division of Habitat, which now administers the permitting process. Under this program, a Fish Habitat Permit is required before using, diverting, obstructing, polluting, or changing the natural flow or bed of an anadromous fish water body as required in AS 16.05.871)(b). A Fish Habitat Permit is likewise required for any activity that may affect the efficient passage of resident fish as per AS 16.05.841.

D. Alaska Oil and Gas Conservation Commission

AS 31.05, the Alaska Oil and Gas Conservation Act, created the Alaska Oil and Gas Conservation Commission (AOGCC). AOGCC acts to prohibit the physical waste of crude oil and natural gas, ensure a greater ultimate resource recovery, and protect the correlative rights of persons owning oil and gas interest in lands subject to Alaska's police powers. It also administers the Underground Injection Control (UIC) program for oil and gas wells in Alaska, and oversees metering operations to determine the quality and quantity of oil and gas produced in the state. AOGCC holds hearings and adjudicates decisions, which require the combined expertise of petroleum geology and petroleum engineering (AOGCC 2008).

1. Permit to Drill

a. Permit Description

In order to drill a well for oil or gas in Alaska, a person must obtain a Permit to Drill from AOGCC. This requirement applies not only to exploratory, stratigraphic test, and development wells, but also to injection and other service wells related to oil and gas activities. AOGCC is not in the business of managing or deciding whether to develop state owned resources. Rather, it regulates certain oil and gas operations anywhere in Alaska, whether on state owned, federally owned, or privately owned land.

AOGCC’s oversight of drilling operations focuses on ensuring that appropriate equipment is used and appropriate practices are followed to maintain well control, protect groundwater, avoid waste of oil or gas, and promote efficient reservoir development. AOGCC is not authorized to deny a Permit to Drill on the basis of land use concerns or conflicts between surface and subsurface interests.

AOGCC is one of several state agencies that has a role in reviewing and approving oil and gas activities. AOGCC's issuance of a Permit to Drill does not relieve the applicant of any obligations to comply with the permit or regulatory requirements of other state, local, or federal agencies before drilling (AOGCC 2008).

b. Review Process

A Permit to Drill from AOGCC is often the last step in the overall approval process, and usually all of the other concerned agencies have given their go-ahead. The application must be accompanied by the items set out in 20 AAC 25.005(c). A geologist and a drilling engineer review the entire application in detail using a multi-question checklist to ensure the application is complete, accurate, and conforms to all applicable regulations.

AOGCC will notify the operator if there are any deficiencies in the application. The operator will either supplement the original application with revised or additional information, or, in the event that substantive changes are needed, resubmit the entire application. If unanticipated exceptions to regulations or AOGCC orders are needed, such as a well spacing exception, the operator will be notified. Usually such exceptions are handled through a public notice process , with an opportunity for a hearing. If the permit is approved, it will include any operational or environmental safety stipulations identified by AOGCC (AOGCC 2008).

2. Disposal of Wastes

AOGCC must also review and take appropriate action on proposals for the underground disposal of Class II oil field wastes (20 AAC 25.252). Before receiving an approval, an operator must demonstrate that the movement of injected fluids into freshwater sources will not occur. Disposal must be into a well with equipment designed to ensure injected fluids are confined to the intended injection zone.

Along with a plat showing the location of other wells within one-quarter mile that penetrate the same disposal zone, the disposal injection order application must include information about surface owners located within one-quarter mile of the injection well(s). The disposal injection order application must also contain the name, description, depth, thickness, lithologic description, and geological data of the disposal formation and adjacent confining zones. A description of the fluid to be injected, including composition, source, daily amount, and disposal pressures, and sufficient information and analysis, must be presented demonstrating that the disposal well will not initiate or propagate fractures through the confining zones that allow fluids to migrate. Under certain circumstances a freshwater aquifer exemption may be granted (20 AAC 25.440).

Following approval, liquid waste from drilling operations may be injected through a dedicated tubing string into the approved subsurface zone. The pumping of drilling wastes through the annular space of a well is an operation incidental to drilling of the well, and is not a disposal operation subject to regulation as a Class II well. AOGCC approval of annular disposal operations is required before commencing pumping operations (20 AAC 25.080).

3. Annular Injection

An AOGCC permit is required if fluid is to be injected into a well annulus. The material must be incidental to the drilling of a well (muds and cuttings). AOGCC may take all actions necessary to allow the state to acquire the primary enforcement responsibility for the control of underground disposal related to the recovery and production of oil and natural gas. ADEC considers the volume, depth and other physical and chemical characteristics of the formation designated to receive the waste. Annular disposal is not permitted into water-bearing zones where dissolved solids or salinity concentrations fall below predetermined threshold limits. Waste not generated from a hydrocarbon reservoir cannot be injected into a reservoir.

4. Review Process

AOGCC actions that have statewide application, such as adopting regulations, are conducted in accordance with the Administrative Procedures Act. Major actions that result in conservation orders that apply to a single well or field receive public notice by publication in a newspaper (20 AAC 25.540). In addition, a public mailing list is maintained for the purpose of sending appropriate notices, orders, and publications to persons who request to be put on these lists.

E. State and Local Fire and Building Safety Offices

The Division of Fire and Life Safety, within the Alaska Department of Public Safety, is the State Building Official (ADPS 2008). Before construction, repair, remodel, addition, or change of occupancy of any building/structure, or installation or change of fuel tanks can occur, approval must be obtained from the Division of Fire and Life Safety. This division has responsibility for enforcing fire codes and reviewing plans for most of the state, except for specific cities which have been authorized to handle these responsibilities. In the Cook Inlet area, Anchorage, Kenai, and Soldotna have authority for the building permit process. The Division of Fire and Life Safety must examine and approve plans and specifications regarding the location of the building or structure on the property, area, height, number of stories, occupancy, type of construction, interior finish, exit facilities, electrical systems, mechanical systems, fuel storage tanks and their appurtenances, automatic fire-extinguishing systems, and fire alarm systems. However, structural considerations and accessibility are not reviewed, and review of mechanical and electrical systems only covers compliance with fire and life safety requirements (ADPS 2008). The cities of Anchorage, Kenai, and Soldotna have local regulations and building permits that must be followed in those communities.

F. U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) protects human health and the environment by implementing, administering, or overseeing programs and regulations promulgated in federal environmental legislation. These programs, some of which are delegated to the states, safeguard the air, land, and water environments.

1. Air Quality Permits

The federal Clean Air Act includes a number of air quality standards and requirements, including National Ambient Air Quality Standards, New Source Review (NSR), New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants, and Prevention of Significant Deterioration. The two primary types of permits are issued to meet these requirements: Title I Construction Permits, which must be obtained before onsite construction can begin, and Title V Operation Permits, which regulate facilities that emit certain pollutants or hazardous substances.

ADEC administers an air quality program under a federally-approved State Implementation Plan that applies these standards. See ADEC Section B1 above for further details.

2. Hazardous Waste (RCRA) Permits

The federal Resource Conservation and Recovery Act (RCRA) established a program for managing hazardous wastes to ensure the protection of human health and the environment, with the EPA as the regulatory authority. Regulations established by the EPA direct procedures for transporting, storing, and disposing of hazardous wastes, and for designing and operating treatment, storage, and disposal facilities safely. A corrective action program guides investigations and cleanups of contaminated air, groundwater, surface water, or soil. Regulations are enforced through inspections, monitoring of waste handlers, taking legal action for noncompliance, and providing compliance incentives and assistance (EPA 2008h).

States may receive authorization to implement the program, which requires that the state standards be at least as strict as the federal standards. Alaska is not authorized for this program, and therefore it is implemented by the EPA in Alaska.

3. NPDES Permit

a. Permit Description

Effluents discharged by the oil and gas industry into waters and wetlands of Cook Inlet are regulated through EPA's NPDES program as required by the federal Clean Water Act. The NPDES program, which covers other industries and waters as well, ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into the nation's waters (EPA 2008j). NPDES permits specify the type and amount of pollutant, and include monitoring and reporting requirements, to ensure that discharges are not harmful to water quality and human health (EPA 2008f). Some permits may be subject to procedures of the National Environmental Policy Act (EPA 2008g). Alaska is in the process of gaining implementation authority for the program. EPA is scheduled to transfer authority for the program in phases over three years, from November 2008 – November 2011 (ADEC 2008).

NPDES covers a broad range of pollutants, which are defined as "any type of industrial, municipal, and agricultural waste discharged into water" (EPA 2008j). Examples of oil and gas industry effluents regulated by NPDES include drilling muds, cuttings and wash water, deck drainage, sanitary and domestic wastes, desalination unit waste, blow-out preventer fluids, boiler blowdown, fire control system test water, non-contact cooling water, uncontaminated ballast and bilge waters, excess cement slurry, water flooding discharges, produced waters, well treatment fluids and produced solids.

There are two basic types of NPDES permits: general permits and individual permits. General permits cover multiple facilities that are similar, for example, oil and gas facilities in Cook Inlet. General permits are efficient and cost effective because they eliminate redundancy of multiple permits for the same type of facility and discharges (EPA 2008j). They also ensure consistency among similar facilities. Individual permits apply to a specific facility and are tailored to that facility's characteristics. Individual permits are issued for a defined time period, not exceeding five years, and the facility must reapply for the permit before it expires (EPA 2008j).

b. Review Process

The process for issuing a general permit begins when it is determined that there is a group of facilities in an area that share similar characteristics and discharges. The permitting authority develops a draft permit and fact sheet, which documents the decision-making process for developing effluent limits (EPA 2008j). The permitting authority then issues a public notice, providing opportunity for interested parties to submit comments on the draft permit. After considering public input, the permitting authority issues the final permit. The process for an individual permit is similar.

After a general permit is issued, facilities wishing to be included under the general permit submit a "Notice of Intent" to the permitting authority. Additional information describing the facility may be required. The facility may be notified that it is covered by the general permit or the facility may be required to apply for an individual permit (EPA 2008j).

c. NPDES General Permit for Cook Inlet

NPDES general permit AKG-31-5000 (EPA 2007a), issued in 2006, covers oil and gas exploration, development, and production facilities located in state and federal waters of Cook Inlet through June 2012. At the time AKG-31-5000 was issued, 19 existing facilities and 20 different waste streams were covered under the general permit (Table 7.1; Table 7.2). The permit also includes specific monitoring and reporting requirements for Cook Inlet oil and gas activities. The permit prohibits or restricts discharges in some specific areas, including intertidal and nearshore areas, state game refuges, state game sanctuaries, critical habitat areas, national parks, and all or parts of Kamishak Bay, Chinitna Bay, and Tuxedni Bay (EPA 2007a).

Table 7.1. Existing facilities in Cook Inlet covered under NPDES permit AKG-31-5000 at the time of issuance in 2006.

Facility Name	Facility Name	Facility Name
Granite Point Production Facility	King Salmon Platform	Spurr Platform
Trading Bay Treatment Facility	Dolly Varden Platform	Granite Point Platform
East Foreland Treatment Facility	Spark Platform	Grayling Platform
Platform Anna	Tyonek Platform A	Monopod Platform
Platform Baker	Cross Timbers Platform A	Steelhead Platform
Platform Bruce	Cross Timbers Platform C	North Forelands Platform
Platform Dillon		

Source: EPA 2006.

Table 7.2. Waste streams from which discharges are authorized in Cook Inlet by NPDES general permit AKG-31-5000.

Waste Stream	Waste Stream
Drilling Fluids and Drill Cuttings	Bilge Water
Deck Drainage	Excess Cement Slurry
Sanitary Wastes	Mud, Cuttings, Cement at Seafloor
Domestic Wastes	Water Flooding Discharges
Desalination Unit Wastes	Produced Water and Produced Sand
Blowout Preventer Fluid	Completion Fluids
Boiler Blowdown	Workover Fluids
Fire Control System Test Water	Well Treatment Fluids
Non-Contact Cooling Water	Test Fluids
Uncontaminated Ballast Water	Storm Water Runoff from Onshore Facilities

Source: EPA 2006.

4. UIC Class I and II Injection Well Permits

EPA is responsible for regulating injection wells, which are used to dispose of fluid wastes by injecting the waste underground (EPA 2008i). Authorized as part of the federal Safe Drinking Water Act of 1974, EPA's Underground Injection Control (UIC) program protects underground sources of drinking water from contamination by injection wells. Injection wells are categorized into five classes; Class I and II are most common in the oil and gas industry. EPA may delegate authority for implementing the program to states that meet federal standards. Authority for Class II oil and gas wells has been delegated to AOGCC in Alaska (see AOGCC Section D2 above); EPA implements the program in Alaska for Class I wells.

All injections falling into Class I must be authorized through EPA's UIC Class I program. Class I wells must operate under a permit that is valid for up to 10 years. Permits stipulate requirements such as siting, construction, operation, monitoring and testing, reporting and record keeping, and closure. Requirements differ for wells depending on whether they accept hazardous or non-hazardous wastes (EPA 2008i).

5. Spill Response Plan (C-Plan)

Owners or operators of non-transportation-related onshore and offshore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, or consuming oil and oil products must prepare a spill prevention control and countermeasures plan (C-Plan) in accordance with 40 C.F.R. § 112. Drilling rigs are included in this facility definition. The purpose of the C-Plan is to prevent discharges of oil into navigable waters of the U.S. and the adjoining shorelines. The plan must address three areas:

- operating procedures installed by the facility to prevent oil spills;
- control measures installed to prevent a spill from entering navigable waters; and
- countermeasures to contain, cleanup, and mitigate the effects of an oil spill that impacts navigable waters.

The C-Plan is facility-specific and is part of the required documentation that must be present at the facility for inspection. The owner or operator must have the plan certified by a registered engineer but does not submit it to EPA for approval before the beginning of operations. If the facility discharges more than 1,000 gallons or harmful quantities of oil in one event or experiences more than two discharges in a twelve-month period, the operator must submit the C-Plan to the EPA and ADEC for review. The C-Plan differs from the facility response plans (FRP) required by the federal Oil Pollution Act of 1990 in that the C-Plan focuses on prevention and the FRP focuses on response.

G. U.S. Army Corps of Engineers

1. Section 10 and Section 404 Permits

a. Permit Description

The U.S. Army Corps of Engineers (Corps) has regulatory authority over construction, excavation, or deposition of materials in, over, or under navigable waters of the United States, or any work which would affect the course, location, condition, or capacity of those waters (Rivers and Harbors Acts of 1890 [superseded] and 1899 [33 U.S.C. 401, et seq.; Section 10 [33 U.S.C. 403]; USACOE 2008b). Termed Section 10 permits, oil and gas activities requiring this type of authorization include exploration drilling from jack-up drill rigs and installation of production platforms.

Section 404 of the Clean Water Act established a program to regulate the discharge of dredged and fill material into waters and wetlands of the United States. This program is administered by the Corps, which is authorized to issue Section 404 permits for discharging dredge and fill materials.

Individual permits (issued for specific projects) are the basic type of permit issued. General permits (including programmatic, nationwide, and regional general permits) authorize activities that are minor and will result in minimal individual and cumulative adverse effects. General permits carry a standard set of stipulations and mitigation measures. Letters of permission, another type of project authorization, are used when the proposed project is minor, will not have significant individual or cumulative environmental impact, and appreciable opposition is not expected. The process for these authorizations is similar (USACOE 2008a, b).

b. Review Process

Section 404 and Section 10 permits follow a similar three-step review process: pre-application consultation (for major projects), formal project review, and decision making.

During the pre-application consultation, the applicant meets with Corps staff from the local district, interested resource agencies (federal, state, or local), and at times, interested public. These meetings provide informal discussions about the proposal before the applicant commits resources such as funds and detailed designs to the project; provide the applicant with possible alternatives and measures for reducing project impacts; and provide the applicant with information about factors the Corps considers in the permitting process (USACOE 2008a, b).

After receiving a formal application, the first step in the Corps' project review is to obtain public input, which is central to the permitting process. The project is public noticed, and comments and information are requested that will assist with evaluating the positive and negative effects on the public interest. Public hearings may be held if substantial issues are raised that warrant additional public input. USFWS, NMFS, ADNR, and ADF&G may also submit comments to the Corps (USACOE 2008a, b).

Next, the Corps evaluates the project's impacts, considers all comments received, negotiates changes to the project as required, and drafts documentation supporting a recommended permit decision including environmental impacts of the project, findings of public input, and other special evaluations depending on the type of project (USACOE 2008a, b).

In making a final decision on whether to issue a permit, the Corps weighs all relevant factors, which can include conservation, economics, aesthetics, wetlands, cultural values, navigation, fish and wildlife values, water supply, water quality, and other factors judged important to the needs and welfare of the people (USACOE 2008a, b).

The process for Letters of Permission is abbreviated. In this situation, the proposal is coordinated with fish and wildlife agencies and adjacent property owners who might be affected by the project, but the public at large is not notified (USACOE 2008a, b).

ADEC participates in the permit review process by reviewing the permit application to ensure that the proposed project will comply with Alaska water quality standards. ADEC then approves of the permit through a Clean Water Act Section 401 Certification. Permits may also receive review by other agencies, such as the USFWS and NMFS, to ensure compliance with other laws such as the Endangered Species Act, the National Environmental Policy Act, and Essential Fish Habitat Provisions of the Magnuson-Stevens Act.

H. Pipeline and Hazardous Materials Safety Administration

The federal Pipeline and Hazardous Materials Safety Administration (PHMSA), an agency of the U.S. Department of Transportation, is responsible for regulating movement of hazardous materials by all modes of transportation, including pipelines, under its jurisdiction (PHMSA 2008). Within PHMSA, the Office of Pipeline Safety is responsible for ensuring safety in the design, construction, operation and maintenance, and spill response planning of natural gas and hazardous liquid transportation pipelines under its jurisdiction. The Office of Pipeline Safety also administers a national pipeline inspection and enforcement program, implementation of risk management by pipeline operators, and provides assistance to state pipeline safety programs to ensure oversight of intrastate pipeline systems (PHMSA 2008); however, Alaska is not a member of this national pipeline inspection and enforcement program.

I. Other Requirements

1. Native Allotments

Lessees must comply with applicable federal law concerning Native allotments. Activities proposed in a plan of operations must not unreasonably diminish the use and enjoyment of lands within a Native allotment. Before entering onto lands subject to a pending or approved Native allotment, lessees must contact the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM) and obtain approval to enter.

2. U.S. Coast Guard

The U.S. Coast Guard has authority to regulate offshore oil pollution under 33 C.F.R. §§ 153-157 and to make a determination of a hazard to navigation under 33 C.F.R. §§ 64.31.

3. Rehabilitation Following Lease Expiration

Upon expiration or termination of the lease, paragraph 21 of the lease contract requires the lessee to rehabilitate the lease area to the satisfaction of the state. The lessee is granted one year from the date of expiration or termination to remove all equipment from the lease area and deliver up the lease area in good condition.

4. Applicable Laws and Regulations

In addition to existing laws and regulations applicable to oil and gas activities, DO&G requires, under paragraph 26 of the state's standard lease contract, that leases be subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases will also be subject to all future laws and regulations placed in effect after the effective date of the leases to the full extent constitutionally permissible and will be affected by any changes to the responsibilities of oversight agencies.

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Chapter Eight: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

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Chapter Eight: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

Until leases are sold and discoveries are made, DO&G cannot predict whether and when any oil and gas activity might occur, or the type, location, duration, or level of those potential activities. In addition, methods to explore for, develop, produce, and transport petroleum resources will vary depending on the area, lessee, operator, and discovery. Best interest findings are not required to speculate about such possible future effects (AS 38.05.035).

However, AS 38.05.035(g) specifies that the following shall be considered and discussed in a best interest finding: reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas on the lease sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources; reasonably foreseeable fiscal effects of the lease sale on the state and affected municipalities and communities; and reasonably foreseeable effects of exploration, development, production, and transportation for oil and gas on municipalities and communities within or adjacent to the lease sale area. This chapter discusses these potential effects.

Potential effects of oil and gas lease sales can be both positive and negative. Most potentially negative effects on fish and wildlife species, habitats, and their uses, on subsistence uses, and on local communities and residents can be avoided, minimized, or mitigated through mitigation measures. A full listing of mitigation measures can be found in Chapter 9.

This final best interest finding does not speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use is more specifically defined (AS 38.05.035). The effects of future exploration, development, or production will be considered at each subsequent phase, when various government agencies and the public review permit applications for the specific activities proposed at specific locations in the lease sale area.

It is important to note that all post-leasing activities are also subject to local, state, and federal statutes, regulations, and ordinances, many of which are listed as other regulatory requirements (lessee advisories) in Chapter 9 (see also Chapter 7 and Appendix B). Additional project-specific and site-specific mitigation measures will be required by permitting agencies as appropriate if exploration and development proposals are submitted.

Leasing activities alone are not expected to have any effects, other than initial revenue to the state. Post-lease activities could affect the terrestrial, freshwater, and marine habitats, and fish and wildlife of the lease sale area. These activities could include seismic surveys related to exploration, development, and production; environmental and other studies; excavation of material sites; construction and use of support facilities such gravel pads, staging areas, roads, airstrips, pipelines, and housing; transportation of machinery and labor to the site; and construction of drill sites and ongoing production activities. Unintended occurrences such as oil spills could have effects as well.

A. Terrestrial and Freshwater Habitats, Fish, Wildlife, and Birds

1. Potential Activities and Cumulative Effects

Potential post-lease activities that could have cumulative effects on terrestrial and freshwater habitats, fish, wildlife and birds of the Cook Inlet lease sale area include seismic surveys, construction of support facilities, and drilling and production activities. Some potential effects of these activities include physical disturbances that could alter the landscape, lakes, rivers, and wetlands; habitat change; behavior changes of fish, wildlife and birds; drawdowns and contamination of groundwater; and contamination of terrestrial or freshwater habitats from discharges from well drilling and production, gas blowouts, or oil spills.

BLM conducted an environmental impact statement in 2006 that included potential oil and gas exploration, development, and production. The EIS concluded that these activities would have negligible effects, or that potential significant effects could be mitigated through appropriate measures and permitting procedures (BLM 2006).

a. Seismic Surveys, Construction, and Other Activities

In Arctic environments, the largest effects of oil and gas activities are from physical disturbances (Huntington 2007). Activities such as seismic surveys, construction activities, and ongoing vehicle and human movements may alter landscapes and habitat; and disturb and contribute to behavior changes in fish, wildlife and birds. However, there is little information on these effects specific to the Cook Inlet lease sale area. There are studies on effects of oil and gas activities on Arctic habitats and wildlife, but the habitats of the forested Cook Inlet area differ in many respects from those of the Arctic tundra. Some studies are also available of industrial development in boreal forests of Canada that may be applicable to the Cook Inlet lease sale area.

Below is a discussion of potential effects from activities such as seismic surveys, construction activities, and similar development, on terrestrial and freshwater habitats, fish, wildlife, and birds of the Cook Inlet area. Section A2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

Activities such as seismic surveys that require creation of linear corridors may affect habitat and behavior of wildlife. Traditional seismic lines leave a long-lasting footprint in boreal forests. Plant communities on seismic lines are significantly different from adjoining forests, and seismic lines show little change for up to 30 years (MacFarlane 2003). The slow recovery rate may be due to factors such as damage to root systems by bulldozers and competition from grass species (Schneider 2002). Heavy equipment may result in soil compaction and erosion, and cratering may occur from improperly filled shot holes (Schneider 2002). Increased access for all-terrain vehicles, snow machines, and off-road trucks, and continued use of the lines by these vehicles may also contribute to extended recovery times (Schneider 2002). Studies have shown that low impact lines do not recover any faster, and the length of time for natural plant communities to be restored on low impact lines is unknown (MacFarlane 2003). Regeneration of alpine tundra, found at higher elevations in the Cook Inlet area, is slow following mechanical disturbance, and can take up to 60 years for full recovery for some lichen species (UAA-ISER 2008). Bog habitats that have been disturbed may take many years to return to their pre-disturbance state naturally (ADF&G 2006).

Loss of forest habitat that occurs when seismic lines are cleared is magnified by fragmentation, which reduces the usefulness of the habitat, and by avoidance of intact habitat in the area of the seismic lines by some species such as caribou (Schneider 2002). For example, use of habitat within 100 m of seismic lines during late winter by woodland caribou (*Rangifer tarandus caribou*) was about half the expected use, and use was also less than expected during calving, summer, rut, and early winter (Dyer et al. 2001). Habitat fragmentation, which could create "island populations", displacement, reduction of habitat quality, and potential increased frequency of high energy-cost flight responses are also concerns for brown bear populations of the Kenai Peninsula (ADF&G 2002; ADF&G 2007).

Several species of landbirds that have been identified by ADF&G as species of conservation concern may be negatively affected by habitat alterations to boreal forests and wetlands of the Cook Inlet lease sale area (ADF&G 2007). These species include olive-sided flycatcher, rusty blackbird, blackpole warbler, gray-cheeked thrush, and Townsend's warbler. Bald eagle populations could be affected by disturbance or removal of their nesting habitat, and by disturbances to their nests (ADF&G 2003). Disturbances by floatplanes, sport anglers, and other recreationists could force loons to abandon their nests, allowing the chicks to chill and die (ADF&G 1994). There is little direct research concerning effects of oil and gas development activities on these or other similar bird species. However, one study found that, with the exception of ovenbirds, abundance of 41 species of songbirds, and location and size of their territories, were unaffected by seismic lines in boreal forests of the Northwest Territories (Machtans 2006).

Seismic lines may alter predator-prey interactions. In boreal forests, tracked radio-collared wolves were significantly closer to linear corridors, and they traveled faster along linear seismic corridors than in the forest (James 1999). Travel speed was unrelated to whether the seismic line was packed or unpacked, so it is suspected that the visual stimulus of a long distance influences wolves to stay and follow the corridor when they intersect it. Caribou mortalities from wolf predation were closer to linear corridors relative to locations of live caribou, but the sample size of tracked caribou was only 5 animals (James 1999). Researchers speculate that creation of linear corridors may increase caribou mortality by facilitating wolf movement, but this has not been proven conclusively through research (James 1999).

Clearing operations to prepare seismic lines, and explosions that occur during seismic surveys, may disturb wildlife. Birds and wildlife are particularly sensitive during nesting and calving periods (Schneider 2002). Repeated disturbances can result in increased movement rates of wildlife and subsequent significant energy losses, which can be particularly problematic during winter when food supplies may be scarce (Schneider 2002).

A study of the effects of seismic airgun use on the hearing of fish in freshwaters of the Mackenzie River Delta concluded that substantial impacts on several freshwater species not likely (Popper et al. 2005).

Development and production may require the construction and continued use of support facilities such as roads, production pads, pipelines, and other facilities. In addition to clearing of trees, these may also require gravel infilling, and impoundment and diversion of water. Support facilities may result in many of the same effects as seismic lines, except that human activity, vehicle traffic, and aircraft activity associated with support facilities continue for the life of the field. On the other hand, activity on seismic lines may be limited to the duration of the seismic survey, although other recreational uses may continue, including use of snow machines, all-terrain vehicles, and hunting.

B. Havelock, DO&G

Lewis River C-Pad.

S. Schmitz, DO&G

Caribou cows and calves crossing road, North Slope.

Some limited information is available concerning effects of support facilities. For example, in one study, caribou used habitat near roads less than habitat farther away, ranging from 0 percent of expected use in closed coniferous wetlands in late winter to about 34 percent during summer in open coniferous wetlands (Dyer et al. 2001). Caribou also avoided well sites at some distances and seasons, although expected use was greater than 100 percent for others (Dyer et al. 2001). Cumulative effect of avoidance of all industrial development was a potential loss of 48 percent of the 617,204 ha study area (Dyer et al. 2001). However, studies of caribou in northern Alaska before and after construction of a road showed no significant differences in densities of caribou near the road (Noel et al. 2004), and pipelines elevated ≥1.5 m were found to not cause changes in caribou use or delay migrations (Noel et al. 2006). In addition, despite concerns that oil and gas development and infrastructure such as roads may displace caribou, sizes of caribou herds in northern Alaskan oilfields have increased from 5,000 to 32,000 animals since oilfield development began, and recent studies indicate that negative effects from displacement are absent or negligible (Noel et al. 2004; Haskell et al. 2006).

Extension of development into brown bear habitat is of concern to wildlife managers (ADF&G 2007) but little direct research is available on the effects of industrial development on brown bear populations of the Cook Inlet lease sale area. However, a study of frequency and distribution of highway crossings by brown bears on the Kenai Peninsula found that highways affected brown bear travel patterns (Graves et al. 2006). A study of the effects of roads on brown bears in British Columbia and Montana found that bears used areas within 100 m of roads significantly less than areas farther from the roads, but this behavior change did not translate into a demonstrable effect on the population (McLellan and Shackleton 1988). However, of greater concern to wildlife managers in the Cook Inlet area is the potential for increased bear-human interactions and potential subsequent high non-hunting mortality of bears resulting from those interactions (ADF&G 2007; Suring and Gino 2002).

ADF&G

Incorrectly positioned culvert, Tyonek Creek.

If activities associated with oil and gas exploration and development, such as gravel removal, heavy equipment operations, and siting of support facilities, are unregulated, they could increase stream sedimentation and erosion, impede fish passage, alter drainage patterns, and have other negative effects on freshwater habitats, fish, and other aquatic organisms (Schneider 2002). Erosion can increase sedimentation and turbidity of aquatic habitats, which can cause decreased primary production, resulting in depleted food for zooplankton, insects, freshwater mollusks, and fish. This can lead to direct mortality, reduced physiological function, and depressed growth rates and reproduction in aquatic organisms (Henley et al. 2000). Excess turbidity and sedimentation can also decrease recreation value (USGS 2008).

Secondary effects of new road construction and use could include dust deposition, which may reduce photosynthesis and plant growth, and downstream siltation and sedimentation, which can affect plant viability. Road construction and vehicular traffic can alter surface albedo (reflectivity of sunlight off the earth's surface) or water drainage patterns, resulting in thaw and subsidence or inundation. Such changes can affect regeneration and revegetation of certain species, and species composition may also change after disturbance from construction activities (Linkins et al. 1984).

Section A2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

b. Discharges from Exploration, Development, and Production

Discharges from well drilling and production may be intentional, such as permitted discharges regulated by the NPDES, or unintentional, such as gas blowouts, leakages, and spills. However, in the circumpolar Arctic, 80-90 percent of petroleum hydrocarbons entering the environment originate from natural seeps (Huntington 2007). Excluding oil spills, activities related to oil and gas exploration, development, and production are minor contributors of petroleum hydrocarbons to the environment (Huntington 2007).

Below is a discussion of possible effects from potential activities such as well drilling and production on terrestrial and freshwater habitats, fish, wildlife, and birds of the Cook Inlet area. Section A2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

Discharges from oil and gas activities could affect freshwaters of the area, including surface waters and groundwater. Some water bodies in the Cook Inlet do not meet water quality standards but none of the identified waters showed impairments from oil and gas exploration, development or production activities. Fourteen waters in the Anchorage area have high fecal coliform levels from urban runoff, and Eagle River Flats has high white phosphorous levels caused by munitions from military base operations (DEC 2008a). The Kenai River does not meet water quality standards because of high total aromatic hydrocarbons from motorized watercraft. Four additional waters in the Cook Inlet area are listed as impaired waters under Section 305(b) of the Clean Water Act, but not from oil and gas industry activities: Big Lake, for total aromatic hydrocarbons from motorized watercraft; Cottonwood Creek, for foam and debris from urban runoff and urban development; the Matanuska River, for debris from a landfill; and Ship Creek, for petroleum products from urban runoff (DEC 2008a).

USGS monitors water quality at eight fixed sites in the Cook Inlet area (Brabets and Whitman 2004). Sites studied included the Ninilchik River, two sites on the Kenai River, South Fork of Campbell Creek, Chester Creek, the Deshka River, Moose Creek near Palmer, and Johnson River near Tuxedni Bay. Of the sites that had human activities, only urbanization affected water quality. The Chester Creek basin was found to have volatile organic compounds, pesticides, an increased number of tolerant species, and changes in physical habitat, all related to urbanization (Brabets and Whitman 2004). Some sites near leaking fuel-storage tanks, fuel-storage facilities, and petroleum refineries have been documented to contain organic-compound contaminants (Glass 1999).

Source: USGS 2005

Chester Creek in Anchorage, monitored by USGS.

Potential effects of oil spills on terrestrial habitats depends on size of the spill, type of oil spilled, time of year, type of vegetation, and terrain. Spilled oil spreads both horizontally and vertically depending on the volume spilled, type of ground cover (plant or snow), slope, presence of cracks or troughs in the ground, moisture content of the soil, temperature, wind direction and velocity, thickness of the oil, discharge point, and ability of the ground to absorb the oil (Linkins et al. 1984). Oil spreads less when it is thicker, cooler, or is exposed to chemical weathering. If the ground temperature is less than the pour point of the oil, it pools and is easier to contain. Because dry soils are more porous, the potential for spilled oil to seep downward into the soil is greater (Linkins et al. 1984, citing to Everett 1978). If oil penetrates the soil layers and remains in the plant root zone, longer-term effects, such as mortality or reduced regeneration could occur in following summers. Under the right conditions involving oxygen, temperature, moisture in the soil, and the composition of the spilled oil, bacteria may assist in the breakdown of hydrocarbons in soils.

Oil leaks or spills in boreal forests can have a range of potential effects, including killing plants directly, slowing growth of plants, inhibiting seed germination, and creating conditions in which plants cannot receive adequate nutrition (Robertson et al. 2007). Although a single addition of PHCs does not appear to limit microbial communities in the long term, species richness often decreases. Oil spills and leaks can create changes in the physical and chemical properties of soil that disturb supplies of water, nutrients, and oxygen (Robertson et al. 2007). The persistence of chemicals in the soil depends on several factors, including the type and quality of clay particles, type and concentration of solutes, organic content and composition, pH, and temperature (Robertson et al. 2007).

At low concentrations, petroleum hydrocarbons can actually stimulate plant growth (Robertson et al. 2007). Heterotrophic bacteria and fungi in most natural microbial communities apparently have an inherent ability to degrade organic pollutants, and usually, biological processes eventually degrade or transform most organic compounds. Although mycorrhizal ecosystems may be harmed by oil spills or leaks, they are also used for bioremediation (Robertson et al. 2007).

The reproductive success of bald eagles can be affected by pesticides in its prey, and although bald eagles in Alaska appear to be reproductively healthy, contaminants have been recorded in some fish populations and in bald eagles (ADF&G 2003).

Section A2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

c. Groundwater Uses

Industrial use of groundwater could draw down the elevation of the water table in the vicinity of the industrial well or wells, and could affect nearby domestic well water depths. These effects are usually insignificant and temporary as other hydraulically connected groundwater sources replace pumped volume. In streams that are hydraulically connected to groundwater systems, industrial pumping may cause a reduction in surface flow or alteration of drainage pattern. This disruption in stream flow may be more pronounced during winter months when surface-flow is minimal (Zenone and Anderson 1978). Declines in lake levels are also associated with fluctuations in precipitation, making it difficult to discriminate effects of industrial pumping from natural causes (Nelson 1981).

Section A2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate potential effects to groundwater uses.

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on terrestrial and freshwater habitats, fish, and wildlife, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

For example, standard ADNR land use permit conditions serve to protect habitat and water quality from potential negative effects of facility construction and operation. Work areas must be kept clean. Trash, survey markers, and other debris that may accumulate in camps or along seismic lines and travel routes that are not recovered during the initial cleanup must be picked up and properly disposed of. All solid wastes, including incinerator residue, must be backhauled to a solid waste disposal site approved by ADEC. Vehicle maintenance, campsites, and the storage or stockpiling of material must be consistent with the ACMP. In addition, permits may include measures to ensure that activities are consistent with the ACMP and local district plans. Permit stipulations include setbacks for lakes and rivers, and permit applicants must seek permission from landowners to enter private property.

Permits may contain stipulations on the use and quantity drawn of water in order to meet water quality standards including protection of recreation activities; navigation; water rights; or any other substantial public interest. Water use permits may also be subject to conditions, including suspension and termination of exploration activities, in order to protect fish and wildlife habitat, the public health or to protect the water rights of other persons. Before a permit to appropriate water is issued, ADNR considers local demand and may require applicants to conduct aquifer yield studies. Generally, water table declines associated with the upper unconfined aquifer can be best mitigated by industrial users tapping confined (lower) layers or searching for alternate water sources.

Mitigation measures included in this best interest finding address habitat loss avoidance; protection of wetland, riparian, and aquatic habitats; prohibitions and restrictions on surface entry into designated state game refuges and critical habitat areas, as well as restrictions on other important habitat areas; disturbance avoidance; and free passage and movement of fish and wildlife. Specific mitigation measures also protect trumpeter swan nesting areas and bald eagles. Sets of comprehensive measures protect brown bears and their habitat, and the Kenai Lowlands caribou herd. Other measures and regulatory protections address drinking water, and address seismic activities, siting of facilities, pipelines, drilling waste, oil spill prevention and control, and rehabilitation. A complete listing of mitigation measures is found in Chapter 9.

DO&G

Revegetation plantings at the Theodore River.

B. Marine Habitats, Fish, Mammals, Birds, and Other Organisms

Potential post-lease activities that could have cumulative effects on marine habitats of the Cook Inlet lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as boat and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. Potential effects of oil and gas development have been discussed previously for the federal Cook Inlet Outer Continental Shelf Area located in lower Cook Inlet. In that 2003 environmental impact statement, MMS found that lease sales, and potential subsequent exploration and development, would have no measurable negative effects on the Cook Inlet area (MMS 2003).

1. Potential Activities and Cumulative Effects

a. Seismic Surveys, Construction, and Other Activities

i. Noise

One of the primary concerns about oil and gas development in marine waters is the potential effects that noise from seismic surveys, construction activities, and ongoing boat, drilling, and aircraft activities could have on marine mammals and other marine animals (Hofman 2003).

Below is a discussion of potential effects from activities such as seismic surveys, construction activities, and similar development, on marine habitats, fish, mammals, birds and other organisms of the Cook Inlet area. Section B2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

In 2005, MMS found that a proposed geophysical (seismic) survey would have no significant effect on the lower Cook Inlet area (MMS 2005). Other attempts have been made by scientists, the oil and gas industry, and by environmental groups to compile and draw conclusions about the effects of these activities from existing research, but these reports draw on few experimental studies, relying rather on anecdotal observations, unpublished reports, and non-peer reviewed research (OGP/IAGC 2004; WDCS 2004; Gordon et al. 2003). The lack of experimental research on the effects on marine animals of noise from oil and gas development, and the lack of conclusive results, particularly at the population level, is frequently highlighted by scientific, industry, and environmental organizations alike (Jasny et al. 2005; Gordon et al. 2003; OGP/IAGC 2004; WDCS 2004).

Hofman (2003) reviewed available studies of the effects of industrial noise on whales, finding that some effects on activity patterns of some whales were documented, but that research was insufficient for understanding which species are affected, how many animals are affected, distances at which various species are affected, and the biological significance of the effects. Although some studies found distribution and behavior changes for some whales, the changes were negligible and no harmful effects were documented (Hofman 2003). Research is also lacking on whether or not some species may become habituated to, and stop being affected by, certain kinds of sounds, or on whether certain species may become more sensitive to sounds with increased exposure (Hofman 2003).

Researching these effects on marine mammals and other marine animals is a difficult undertaking. Hofman (2003) explained the many variables that influence the effects of noise on animals in the marine environment:

> The nature and significance of acoustic effects are dependent on a number of variables. They include the intensity, frequency, and duration of the sound; the location of the sound source relative to the potentially affected animals; water depth, bottom reflectivity and other features of the environment; the distance between the animal and the sound source; whether the sound source is stationary or moving; the species, age, sex, reproductive status, activity and hearing ability of the animals exposed to the sound; whether the animals use similar sounds for communicating, locating and capturing prey, etc.; and whether and how frequently the animals in question are exposed to the sound.

However, there are a few published, peer-reviewed studies of the effects of noise from oil and gas activities on marine animals, although not specific to the Cook Inlet lease sale area. For example, a study in the Beaufort Sea found that ringed seals were not affected by noise from pipe-driving and construction sounds, except for helicopters, concluding that seals were likely habituated to the industrial sounds and visual activity (Blackwell et al. 2004). Another study in the Beaufort Sea found that the proportion of long-tailed ducks detected in areas with seismic surveys was not significantly different from control areas without the surveys; the study also found that there was no difference in diving behavior of ducks in the seismic and non-seismic areas (Lacroix et al. 2003). Several additional studies measured sound levels from drilling and operations in the Beaufort Sea, but these studies did not measure the effects of the sounds on marine life (Blackwell and Greene 2004, 2006). An experimental study of the effects of seismic surveys on cod and haddock in the Barents Sea, located north of Norway and Russia, found that fish distribution, abundance, and catch rates were significantly affected, decreasing by up to 50 percent during and after seismic shooting, compared to rates just previous to commencement of the seismic survey (Engas et al. 1996). In one of the few controlled experiments on the response of whales to noise, a four-year study examined responses of whales to airguns used in seismic surveys in the Gulf of Mexico. This study found no horizontal avoidance to seismic airgun sounds by sperm whales (Jochens et al. 2008).

In Cook Inlet, beluga whales appear to exhibit site fidelity, returning to estuary areas even after a disturbance, including adults with calves (Moore et al. 2000). They continue to occupy upper Cook Inlet despite oil and gas development, vessel and aircraft traffic, and dredging operations, and based on a review of available information, Moore et al. (2000) concluded that belugas appear to have become habituated to offshore oil and gas activities in central Cook Inlet. There is no evidence that routine oil and gas development and transport activities have a direct impact on the sea otter stock of Southcentral Alaska (Angliss and Outlaw 2008).

Section B2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

ii. Other Disturbances

The ocean substrate (ocean bottom) may be physically disturbed from activities such as anchoring or from sedimentation from discharges, potentially resulting in destruction of the organisms living there (Lissner et al. 1991). Below is a discussion of potential effects from disturbances such as these on marine habitats and animals of the Cook Inlet area. Section B2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

Research is lacking on the specifics of these potential effects, especially for the Cook Inlet lease sale area. Recovery time for substrate disturbances can vary from a few days or months to decades, depends on the type and frequency of the disturbance, and the type of organisms inhabiting the substrate (Lissner et al. 1991). Eelgrass beds are vulnerable to increased turbidity, sediment disturbances, and eutrophication that could occur as a result of development activities; these could, in turn, promote growth of epiphytic algae on eelgrass, decrease eelgrass photosynthesis and growth, and smother or uproot eelgrass (ADF&G 2006).

Oil and gas activities such as exploration, transportation and support vessels, production, product and waste removal could potentially damage important Steller’s eider habitat, force birds to relocate to alternate habitats of lower quality, or cause loss of birds directly. Awareness and avoidance of Steller’s eider concentration areas and times when birds tend to congregate in those areas may prevent or reduce these potential negative effects (ADF&G 2007.) Disturbances during critical periods of use are also a concern for shorebirds (DO&G 2000).

Human intrusions into seabird colonies can result in reduced reproductive success. Eggs, hatchlings, and fledglings are particularly vulnerable to activities that may result in loss of eggs or young, dispersion from the nesting site or rookery, and disruption of vital parent-offspring bonds (Boesch et al. 1987).

Section B2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate the potential effects discussed above.

b. Discharges from Exploration, Development, and Production

In addition to noise and physical disturbances, discharges into the water may result from activities associated with exploration, development, and production of oil and gas. Below is a discussion of potential effects from discharges such as these on marine habitats and animals of the Cook Inlet area. Section B2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

In the Arctic, oil spills pose the greatest environmental effect (Huntington 2007). Drilling muds, cuttings, produced waters, and other effluents from oil and gas exploration, development, and production, as well as oil spills, can have short- and long-term negative effects on aquatic life, including fish and benthic organisms (Olsgard and Gray 1995). Lethal or sub-lethal effects may subtly reduce or impair physiological and reproductive fitness (Davis et al. 1984). Sedentary animals, such as oysters, clams, and mussels, are more susceptible to releases of petroleum products than fish and shellfish such as crabs and shrimp, which are capable of active avoidance (Davis et al. 1984). Oil spills or impairments to water quality could have detrimental effects on mariculture industries (ADF&G 2007). Type and extent of effects depends on a myriad of factors including habitat involved, species, life history stage, migration patterns, nursery areas, season, type of chemical, amount and rate of release, time of release, duration of exposure, measures used for retaining of the chemical, and use of counteracting or dispersing agents (Davis et al. 1984).

Comprehensive water quality data for the entire Cook Inlet area are not available, but data that are available for several specific sites have not indicated water quality effects from oil and gas development. An assessment of water quality for a proposed Knik Arm crossing project found that dissolved oxygen and pH levels were well within water quality standards, and that levels of most substances were well below water quality limits and some were even below detection limits (Kinnetic Laboratories 2004). Substances below the water quality limits included dissolved metals, overall total metal concentrations, cyanide concentrations, total aromatic hydrocarbons, and total aqueous hydrocarbons (Kinnetic Laboratories 2004). Turbidity and suspended sediments exceeded water quality criteria because of naturally occurring, high suspended sediment concentrations from glacial runoff flowing into Cook Inlet from the Knik, Matanuska, Susitna, and other smaller rivers (Kinnetic Laboratories 2004). For other sites that do not meet water quality standards, the causes have been identified as urban runoff, military base operations, motorized watercraft, and a landfill (DEC 2008a; Brabets and Whitman 2004).

Oil spills as well as low-level exposure to toxins could have deleterious effects on populations of birds such as rock sandpipers (ADF&G 2007, citing to Stenhouse and Senner 2005) as well as populations of other shorebirds (Gill and Tibbitts 1999) and other marine animals. However, despite the relatively high level of development in the Cook Inlet area, including the oil and gas industry, Becker et al. (2000) found that concentrations of PCBs and other contaminants were much lower in belugas of Cook Inlet than in belugas of other Alaskan and circumpolar populations, and that there was no evidence to indicate that the low levels found in Cook Inlet belugas pose a health risk to the population or for human consumption.


Courtesy Exxon Valdez Oil Spill Trustee Council

Oil slick from the *Exxon Valdez*, Prince William Sound, 1989.

A study of sediments in Cook Inlet detected no contamination that might have originated from oil and gas production activities in upper Cook Inlet (MMS 2000). The study also found that concentrations of metals and organics in sediments have not increased since oil and gas development began in Cook Inlet, that the composition of hydrocarbons has changed subtly over time but uncorrelated to petroleum production activities or spills, and that concentrations of metals and PAHs were not linked to either oil and gas development in Cook Inlet or to the *Exxon Valdez* oil spill (MMS 2000). In addition, there is no evidence that routine oil and gas activities have affected the Southcentral sea otter stock (Angliss and Outlaw 2008).

A catastrophic oil spill would probably result in high mortalities of sea otters (Angliss and Outlaw 2008). Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (<10 percent of body surface) but that high levels (>25 percent) will lead to death (Angliss and Outlaw 2008). Direct contamination of shorebirds is also a concern, as is direct or indirect contamination and elimination of benthic food supplies (DO&G 2000).

Section B2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate the potential effects discussed above.

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on marine habitats, fish, and wildlife, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

For example, because of the potential effects discussed above, effluents discharged by the oil and gas industry into marine waters of Cook Inlet are regulated through EPA's NPDES program (see Chapter 7, Section F3). This program, which covers a broad range of pollutants, ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into the nation's waters (EPA 2008b). NPDES permits specify the type and amount of pollutant, and include monitoring and reporting requirements, to ensure that discharges are not harmful to water quality and human health (EPA 2008a). NPDES general permit AKG-31-5000 (EPA 2007a), issued in 2006, covers oil and gas exploration, development, and production facilities located in state and federal waters of Cook Inlet through June 2012. Therefore, marine fish, mammals, and other aquatic organisms are not expected to be impacted by drilling muds, cuttings, produced waters, and other effluents associated with oil and gas exploration, development, and production.

In addition, mitigation measures specifically address beluga whales and Steller's eiders. Mitigation measures also address disturbance avoidance, particularly in several state game refuges and critical habitat areas; seismic activities; siting of facilities; pipelines; oil spill prevention and control; and discharges and waste from drilling and production. Steller's eiders, Steller sea lions, and fin, beluga, and humpback whales are provided additional protection under the Endangered Species Act. A complete listing of mitigation measures and other regulatory protections is found in Chapter 9.

C. Air Quality

1. Potential Activities and Effects

Oil and gas exploration, development, and production activities may produce emissions that have the potential to affect air quality. Equipment that could produce pollutants includes boilers, diesel engines, drilling equipment, flares, glycol dehydrators, natural gas engines and turbines, and fugitive emissions which are leaks from sealed surfaces associated with process equipment (MMS 2004a, b).

Loading operations may also result in emissions caused when vapor space in the receiving cargo hold is displaced by the liquid product. Emissions may include carbon monoxide (CO); nitrogen oxides (NO_x); sulfur dioxide (SO_2); particulate matter-10 (PM_{10}), $PM_{2.5;}$ volatile organic compounds (VOC); ozone; and greenhouse gases including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_20) (MMS 2004b).

Oil and natural gas industries emitted an estimated 3.0 million metric tons of greenhouse gases throughout Alaska in 2005, which was about 6 percent of the total greenhouse gas emissions in Alaska (Roe et al. 2007). This is a decrease from 1990 and 2000, and continued decreases are expected through 2020. There are significant uncertainties with these estimates. These estimates are for fugitive emissions, which are released during the production, processing, transmission, and distribution of oil and gas. Fugitive emissions include methane and carbon dioxide released from leakage and venting at oil and gas fields, processing facilities, and pipelines. Estimates of emissions resulting from fuel combustion are only available for residential, commercial, and all industries combined, and are not available for the oil and gas industry separately (Roe et al. 2007). In Cook Inlet, 1.07 bcf of gas was flared or vented during 2004, a decrease of 11.3% from 2003 (AOGCC 2004).

MMS modeled possible effects of Outer Continental Shelf oil and gas exploration and development activities in Cook Inlet and concluded that for most emissions and scenarios, effects would be minor (MMS 2003).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially affect air quality, federal and state air quality regulations, particularly the Clean Air Act (42 U.S.C. §§ 7401-7642), 18 AAC 50, and AS 46.14, are expected to avoid, minimize, and mitigate those potential effects. Therefore, additional mitigation measures are not included.

Because industrial emissions such as those listed above can have negative environmental effects, the federal Clean Air Act of 1970, and its subsequent 1990 revision and expansions, regulates air quality across the U.S., including Alaska (EPA 2007b). Although the EPA is the primary federal agency responsible for controlling air pollution, monitoring air quality, and inspecting facilities (EPA 2007b), many of these authorities in Alaska have been delegated to ADEC under a federally-approved State Implementation Plan (DEC 2008b). State and federal regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit: new facilities are required to obtain a permit before construction (Title I, NSR permit); existing facilities must have an operating (Title V) permit. Permits are legally binding and include enforceable conditions with which the operator must comply. The permit establishes limits on the type and amount of emissions allowed, requirements for pollution control devices and prevention activities, and monitoring and record keeping requirements (EPA 2008a).

ADEC also operates ambient air quality monitoring networks to assess compliance with the National Ambient Air Quality Standards (NAAQS) for carbon monoxide, particulates, nitrogen dioxide, sulfur oxide, and lead; assesses ambient air quality for ambient air toxics level; provides technical assistance in developing monitoring plans for air monitoring projects; and issues air advisories to inform the public of hazardous air conditions (DEC 2008b).

Operators in Alaska are required to minimize the volume of gas released, burned, or permitted to escape into the air (20 AAC 23.235(c)). Operators must report monthly to AOGCC any flaring event lasting over an hour. AOGCC investigates these incidents to determine if there was unnecessary waste (AOGCC 2004).

Additional information about air quality regulations and permits is found in Chapter 7, Section B1.

D. Subsistence Uses

1. Potential Activities and Cumulative Effects

Potential post-lease activities that could have cumulative effects on subsistence uses of the Cook Inlet lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. A 2003 MMS environmental impact statement found that federal lease sales on the Outer Continental Shelf of lower Cook Inlet would have no measurable negative effects on the Cook Inlet area (MMS 2003).

Subsistence uses of the Cook Inlet area depend on the area's fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area's fish, wildlife, and habitats could also affect subsistence uses. Potential cumulative effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on subsistence uses are discussed below.

Oil and gas exploration, development, and production could result in increased access to hunting and fishing areas. For example, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for Tyonek and Beluga residents, who travel to subsistence areas primarily by truck (Braund 2007). However, increased public access to hunting, fishing, and trapping areas due to construction of new roads could also increase competition between user groups for fish and wildlife resources. Roads can also raise concerns among subsistence users that increased traffic is affecting distribution of wildlife (Braund 2007).

Oil and gas activities can raise other concerns among subsistence users. For example, Tyonek and Beluga residents have expressed concerns that disturbance from oil rigs has contributed to decline in beluga and seals; that pollution from oil rigs has resulted in fish diseases and declines in clam abundance; and that oil development has changed bear distribution and waterfowl habitat (Braund 2007). However, as discussed in the preceding sections, research about these effects on fish and game is lacking.

One study conducted by EPA is available (EPA 2003). The study analyzed concentrations of 161 chemicals in seven fish species, eight invertebrates, and three plant species traditionally used by members of four Alaskan tribal villages, Tyonek, Seldovia, Port Graham and Nanwalek. Only Tyonek is within the Cook Inlet Areawide sale area. Comparisons were made to published contaminant data for market basket food, and to Columbia River (in Washington, Oregon) Chinook salmon. The study concluded that, with few exceptions, contaminant concentrations in Cook Inlet area species were similar or lower than comparison samples (EPA 2003). Although this study provides important baseline information about contaminants in wild food sources of the Cook Inlet area, its usefulness in discussing potential effects of oil and gas development on wild foods is limited. The study compared Cook Inlet samples to contaminated samples from elsewhere, which only allowed a conclusion of whether the Cook Inlet samples were more or less contaminated than contaminated samples from elsewhere; and more importantly, the study did not attempt to determine the source of contaminants in the Cook Inlet samples. This is an important weakness of this study relative to potential effects from oil and gas development in Cook Inlet, because there are many other potential sources of contaminants in the Cook Inlet area in addition to oil and gas development, and also because many of the chemical compounds analyzed in the study occur naturally (EPA 2003). Another limitation of the EPA study is that contaminants found in salmon harvested in Cook Inlet may reflect conditions on the high seas where they spend a large portion of their life span, rather than conditions in Cook Inlet through which they migrate en route to and from spawning grounds.

Although the oil and gas industry has the potential to provide jobs and income to subsistence users, work in the oil and gas industry may reduce the time available for subsistence activities (Stanek et al. 2007).

Courtesy Exxon Valdez Oil Spill Trustee Council

Clam covered in oil from the *Exxon Valdez* oil spill, Prince William Sound, 1989.

A major oil spill could decrease resource availability and accessibility, and create or increase concerns about food safety which could result in significant effects on subsistence users, effects which could linger for many years. For example, subsistence harvests of fish and wildlife by residents of fifteen predominately Alaska Native communities, as well as by residents in larger rural communities, declined by as much as 70 percent after the 1989 *Exxon Valdez* oil spill (Fall 1999). Within two years of the spill, subsistence harvests and participation had returned to pre-spill levels, although communities closest to the spill lagged behind. However, concerns remained about food safety, availability of many species was reduced, efficiency was reduced, and opportunities to teach subsistence skills to young people were lost (Fall 1999). By 2003, harvest levels were higher than pre-spill levels, or were within the range of other rural communities. However, harvest composition remained different from the pre-spill composition, and concerns about the safety of some shellfish species remained (Fall 2006). Additional complex factors may confound effects of an oil spill, including demographic changes in communities, ocean warming, increased competition for fish and wildlife resources by other user groups, predators, and increased awareness about paralytic shellfish poisoning and other contaminants (Fall 2006). Because many subsistence resources affected by the spill had not fully recovered, subsistence in areas affected by the *Exxon Valdez* oil spill was still not considered to have fully recovered in 2006 (EVOSTC 2006).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially affect subsistence uses, primarily as secondary effects from effects on habitat, fish, or wildlife, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. In addition to mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address harvest interference avoidance, public access, road construction, and oil spill prevention. A complete listing of mitigation measures is found in Chapter 9.

E. Fish and Wildlife Populations and Their Uses

1. Potential Activities and Cumulative Effects

In addition to subsistence uses, other important uses of fish and wildlife populations in the Cook Inlet include sport hunting and sport, commercial, personal use, and educational fishing. Potential post-lease activities that could have cumulative effects on these uses of the Cook Inlet lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. A 2003 MMS environmental impact statement found that federal lease sales on the Outer Continental Shelf of lower Cook Inlet would have no measurable negative effects on the Cook Inlet area (MMS 2003).

Sport hunting and sport, commercial, personal use, and educational fishing in the Cook Inlet area depend on the area's fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area's fish, wildlife, and habitats could also affect these uses. Potential effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on hunting and fishing uses are discussed below.


K. Lingofelt

Sport hunter with moose taken on Ft. Richardson.

Oil and gas exploration, development, and production could result in increased access to hunting and fishing areas. For example, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for Tyonek and Beluga residents (Braund 2007), which would likely be true for user groups in other areas as well. However, increased public access to hunting and fishing areas due to construction of new roads could also increase competition between user groups for fish and wildlife resources.

Interference with commercial fishing operations is a potential effect of oil and gas exploration, development and production in Cook Inlet. A 2004 study of the drift gillnet fishery in Cook Inlet found that subsurface obstructions were generally not of concern as a hazard to fishing gear because most oil and gas infrastructure is quite deep and generally out of the range of fishing gear (Petterson and Glazier 2004). Areas with infrastructure in shallower locations are generally avoided by gillnet fishers to prevent grounding. Surface obstructions, such as platforms, are a concern, because unobstructed waters maximize navigational safety and time for harvest, but reports of actual interactions between infrastructure and gillnet operations appear rare. Non-permanent structures pose more of a hazard for fishers than permanent ones because permanent structures are predictable and fishing strategies can be adapted to account for them (Petterson and Glazier 2004).

Oil pollution could result in harmful effects to fisheries through direct lethal or sub-lethal effects to fish stocks (Davis et al. 1984). In addition, fishing operations may be directly affected by the presence of oil, and fisheries products may be unacceptable to the consumer. In the case of blowouts, fishers could be forced to change fishing locations (Davis et al. 1984).

An oil spill could result in decreased sport fishing. The number of anglers fishing in areas affected by the *Exxon Valdez* oil spill decreased by 13 percent in the year after the oil spill and harvest decreased by 10 percent, while the number of anglers had been increasing by 10 percent per year and harvest by 14 percent per year in the previous five years; increasing trends continued in areas outside the spill area (Mills 1992). The economic loss from this decrease in sport fishing for the two years following the oil spill was estimated to be $31 million (Carson and Hanemann 1992). Similar information is unavailable for personal use and educational fisheries, but oil spills or other pollution would likely create similar effects as with sport and subsistence fisheries.

The 1989 *Exxon Valdez* oil spill injured commercial fishing through direct impacts to commercial fish species and because of emergency closures of fisheries that led to dramatic declines in income of commercial fishers (EVOSTC 2006). Disruptions to the commercial fishing industry in the area of the oil spill continued many years after the spill in the form of changes in average earnings, ex-vessel prices, and values of fishing permits (EVOSTC 2006). Although pink salmon and sockeye salmon were considered recovered from the spill by 2002, Pacific herring were still listed as "not recovering" in 2006 and therefore the fisheries that depend on them were considered to be in the process of recovery but not fully recovered (EVOSTC 2006). Closures of commercial fisheries can result in over-escapements of salmon stocks. In sockeye salmon systems, this may lead to changes in abundance, size, and age structure of juveniles, and may adversely affect productivity in subsequent years (Schmidt et al. 1995). Direct cause-effect relationships between oil spills and negative changes in fisheries are difficult to demonstrate because many other complex factors also affect commercial fishing, including world supply of fishery products, regulatory and allocation changes, effects of management of other species such as sea lions, and increased competition with other user groups (EVOSTC 2006).

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on uses of fish and wildlife populations such as sport hunting and sport, commercial, personal use, and educational fishing. Most of these potential effects would likely occur as secondary effects from effects on habitat, fish, or wildlife. Measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. In addition to mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address harvest interference avoidance. A complete listing of mitigation measures is found in Chapter 9.

F. Historic and Cultural Resources

1. Potential Activities and Cumulative Effects

Historic and cultural resources could be affected by oil and gas exploration, development, and production activities. For example, historic and cultural resources may be encountered during field-based activities, and these resources could be affected by accidents such as an oil spill. Following the *Exxon Valdez* oil spill, 24 archaeological sites experienced adverse effects including oiling of the sites, disturbance by clean-up activities, and looting and vandalism (EVOSTC 2006; Reger et al. 2000). Monitoring of the sites over a seven-year period indicated that vandalism continued to be a minor problem, and that although some sites were initially badly damaged by oiling, residual oil does not appear to be contaminating known sites, and sites are now considered to be recovered (EVOSTC 2006).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on historic and cultural resources, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

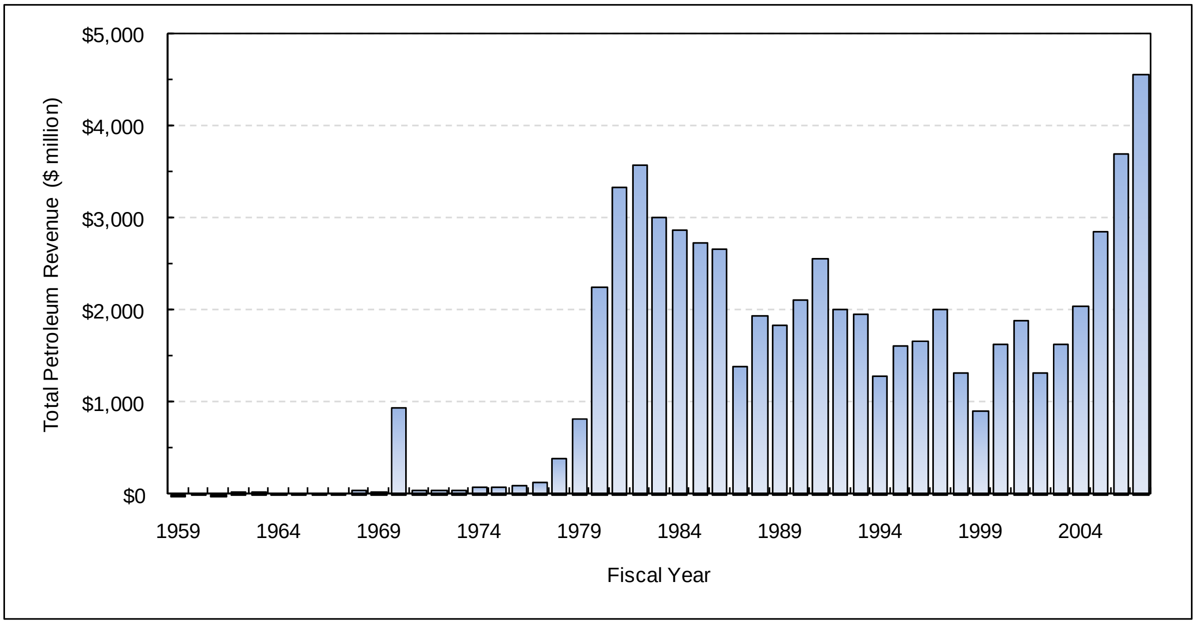
Because historic and cultural resources are irreplaceable, caution is necessary if these resources are encountered in order to not disturb or impact them. AS 41.35.200 addresses unlawful acts concerning cultural and historical resources. In addition, all field-based response workers are required to adhere to historic properties protection policies that reinforce that it is unlawful to collect or disturb, remove, or destroy any historic property or suspected historic property and to immediately report any historic property that they see or encounter (AHRS 2008).

Mitigation measures address education and protection of historic and archeological sites. A complete listing of mitigation measures is found in Chapter 9.

G. Fiscal Effects on the State, Municipalities, and Communities

1. Fiscal Effects on the State

Alaska's economy depends heavily on revenues related to oil and gas production and the government spending resulting from those revenues. Oil and gas lease sales generate income to state government through bonus payments, rentals, royalties, production taxes, income taxes, and oil and gas property taxes. Petroleum revenues totaled $4.57 billion in FY 2007 (ADOR 2007b; Figure 8.1).



Source: ADOR 2007b.

Notes: Includes petroleum corporate income tax; production tax; petroleum property tax; oil and gas royalties (net); bonuses, rents and interest (net); and petroleum special settlements. Does not include Permanent Fund contributions and Constitutional Budget Reserve Fund.

Figure 8.1. Historical petroleum revenue to the State of Alaska, 1959-2007.

a. Revenue

Bonus payments are the amounts paid by winning bidders for the individual tracts leased. Since 1959, 6,710 tracts have been leased, generating more than $2 billion in bonus income and interest to the state (ADNR 2008a).

Each lease requires an annual ***rental payment***. The first year rent is $1 per acre or fraction of an acre, and the rent increases in 50-cent increments to $3 per acre or fraction of an acre in the fifth and all subsequent years of the lease. The lessee must pay the rent in advance and receives a credit on the royalty due under the lease for that year equal to the rental amount. Rental income from state leases for FY 2007 (July 2006 through June 2007) was approximately $7.4 million. Rentals from federal leases were approximately $2 million (ADNR 2008b).

Royalties represent the state's share of the production as the mineral interest owner. Royalties, including bonuses, rents, and interest provided more than $2.0 billion in revenue to the state in FY

2007. Royalty rates can vary depending on the area. For the most recent Cook Inlet Areawide Oil and Gas Lease Sale held in May 2008, the royalty rate was 12.5 percent (ADNR 2008c).

Production taxes. In 2007, the state replaced the Petroleum Profits Tax (PPT) with the Alaska's Clear and Equitable Share (ACES). The revision increased overall rates and narrowed allowances for cost deductions and investment credits. For FY 2007 statewide production taxes were $2.29 billion; for FY 2008 they are forecast to be $3.40 billion (ADOR 2007b).

Corporate income taxes must be paid by all corporations in the state for all taxable income derived from sources within the state. Special provisions apply to apportioning total income worldwide for corporations involved in producing or transporting oil and gas. Most, if not all, producers and transporters of oil and gas in Alaska are corporations. For FY 2007, oil and gas corporation taxes were $594.4 million (ADOR 2007b).

Petroleum property taxes are annual taxes levied each year on the full and true value of property taxable under AS 43.56. This includes exploration property, production property, and pipeline transportation property. Property taxes amounted to $65.6 million in FY 2007 (ADOR 2007b).

In addition, tax settlements to the Constitutional Budget Reserve Fund amounted to approximately $560 million and National Petroleum Reserve-Alaska (NPR-A) royalties, rents, and bonuses amounted to $12.8 million, for total oil revenue of $5.2 billion (ADOR 2007b).

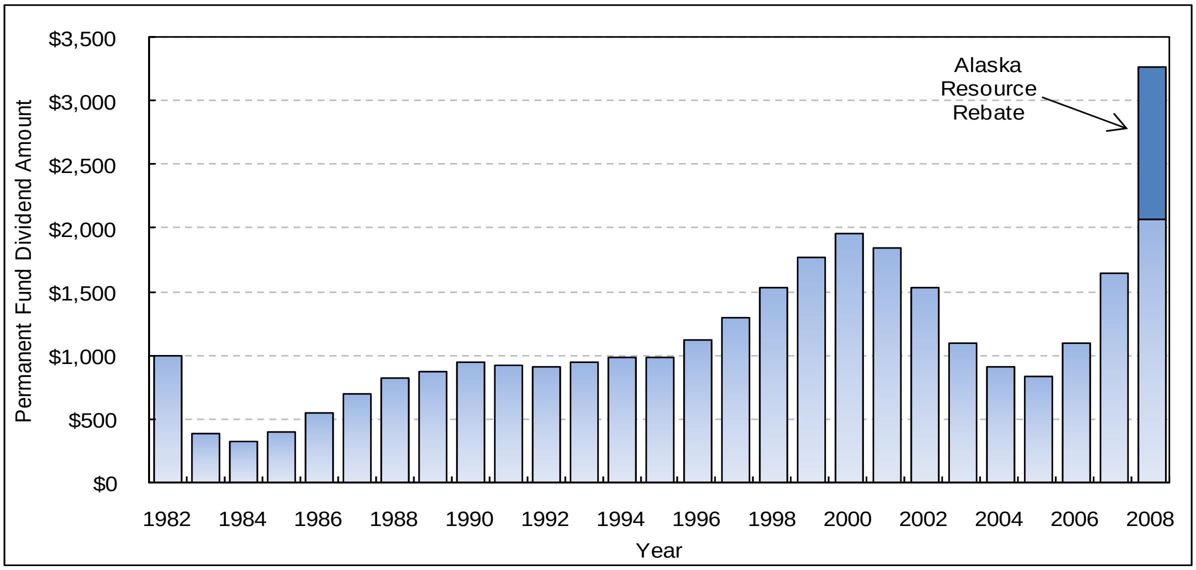
Together these revenues comprised approximately 87 percent of the state's general fund unrestricted revenue in FY 2007 (ADOR 2007b). Such revenues finance the state's education funding, operating budget, and capital budget. State spending supports nearly one out of every three jobs, and $3 of every $10 of personal income result from state spending. Nearly one of every two local government jobs (including school district jobs) in Alaska relies on state funding (Goldsmith 1991). Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund, which pays significant dividends each year to eligible state residents.

b. Alaska Permanent Fund

The Alaska Permanent Fund, established by ballot proposition in 1976, is also funded with oil and gas revenues. Twenty-five percent of all revenue generated by oil and gas activities is placed in the fund, which is forecast to exceed $40 billion in FY 2008 (APFC 2008). All eligible Alaskans who apply receive an annual Permanent Fund Dividend (PFD) from the earnings of the fund. In 2008, the PFD was $2,069 per person, and 610,768 dividends were paid totaling $1.2 billion (ADOR 2008; Figure 8.2). The PFD is an equitable benefit transfer because it reaches every eligible individual regardless of income or socio-economic status. The PFD, with its large annual infusion of cash, has contributed to the growth of the state economy like any other basic industry.

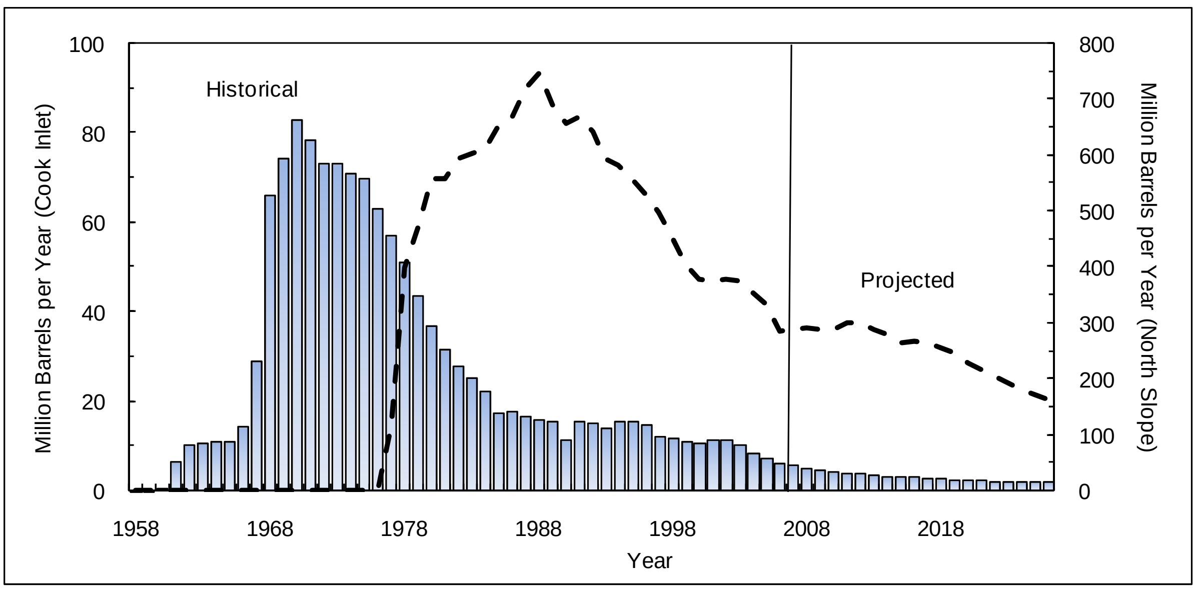
c. Current and Projected Production

Cook Inlet oil production peaked in 1970 at 82.9 million barrels, and declined to about 5.7 million barrels in FY 2007. Alaska North Slope production peaked at 2.006 million barrels per day in FY 1988 and has also declined steadily since then (Figure 8.3). ADOR projects Alaska North Slope oil prices will average $72.64 per barrel for the fiscal year ending June 30, 2008, and $66.32 for FY 2009. Alaska North Slope crude production is forecast to be 731,000 barrels per day for the fiscal year ending June 30, 2008, a 1.2 percent decrease over FY 2007. Production for FY 2009 is projected to decrease to 701,000 barrels per day.



Source: ADOR 2007a; ADOR 2008.

Figure 8.2. Amount of the Alaska Permanent Fund Dividend, 1982-2008; includes Alaska Resource Rebate in 2008.



Source: ADNR 2007.

Notes: Note different scales for Cook Inlet (gray bars) and North Slope (dashed line).

Figure 8.3. Historical and projected oil production in Cook Inlet (blue bars) and the North Slope (dashed line), 1958-2026.

2. Fiscal Effects on Municipalities and Communities

Local municipalities and communities benefit directly from the oil and gas industry through property taxes. The Kenai Peninsula Borough collected over $7 million in oil and gas property taxes in 2007; the Municipality of Anchorage collected over $4 million, and the Matanuska-Susitna Borough collected about $27,000 (ADOL 2008a, b, c).

Alaska's petroleum industry also has significant indirect impacts on local communities through state and local government spending of oil and gas revenues. In 1999, $1.5 billion was spent throughout the state, including capital projects, support of basic government operations (including payroll for state government employees), revenue sharing and municipal assistance, education funding, and Permanent Fund dividends (Information Insights and McDowell Group 2001). Furthermore, the total economic effect of any spending, including state government spending and salaries paid to private oil and gas industry employees, is always greater than the direct effect. When money is re-spent in the economy, its original value multiplies. For example, this "income multiplier" is calculated at 1.35 for state spending. This means that for every dollar of income Alaskans receive directly from state spending, an additional 35 cents of income is generated when that dollar is re-spent in the local economy (Goldsmith 1991).

The energy industry is Alaska's largest industry, spending $2.1 billion annually in the state. The industry directly spends $422 million on payroll in Alaska and $1.7 billion on goods and services in the state. Overall, this spending generates 33,600 jobs, $1.4 billion in payroll, and value added to the Alaska economy of $1.8 billion for total output of $3.1 billion. Oil and gas accounts for 12 percent of private sector jobs and 20 percent of private sector payroll. The oil and gas industry has the highest average wage in Alaska. The average producer company pays a monthly wage of $7,754, which is 2.8 times higher than the statewide average of $2,798 (Information Insights and McDowell Group 2001).

Statewide, 14,597 workers were employed in the oil and gas or oilfield services industries in 2006, with wages totaling $1,141.6 million (ADOL 2008d). The number of workers employed increased by 2,969 workers and wages increased 27.7 percent during 2005 (ADOL 2008d).

In 2008, the state legislature passed, and Governor Palin signed into law, Senate Bill 4002, a $910.1 million energy package addressing the state's high revenue from record high oil prices. The bill gave each PFD recipient a one-time Alaska Resource Rebate of $1,200 (Figure 8.2); increased the maximum loan amount for bulk fuel bridge and bulk fuel revolving loan funds to communities and cooperatives to $750,000; suspended the state's motor fuel tax on gasoline, marine fuel, and aviation fuel for a year, and strengthened the Power Cost Equalization Program. An additional $60 million was allocated to the Home Energy Rebate Program operated by the Alaska Housing Finance Corporation, and $50 million in supplemental funds was allocated to the Renewable Energy Fund bringing the total available for renewable energy projects in FY 2009 to $100 million (SOA 2008).

H. Effects of Oil and Gas on Municipalities and Communities

1. Oil and Gas Industry Expenditures and Employment

Although only limited oil and gas exploration and production occur in the Matanuska-Susitna Borough (Wells and Hanson 2006), 353 Mat-Su residents were employed by the oil and gas industry with an average monthly wage of $8,382 in 1999, the most recent estimates available (Information Insights and McDowell Group 2001). The economic impact of the oil and gas industry in the Mat-Su Borough was an additional 2,105 jobs for Mat-Su residents who commuted to Anchorage or other locations, with a payroll of $84 million; the induced impacts were 1,558 jobs and $38 million in payroll. Total economic impact was estimated to be 4,016 jobs and $158 million for the Mat-Su Borough in 1999 (Information Insights and McDowell Group 2001). It is important to note that these statistics are for oil and gas activity statewide, including the North Slope, and not just the Cook Inlet lease sale area; for example, the 353 Mat-Su residents employed by the oil and gas industry include residents working in jobs connected with the North Slope as well as the Cook Inlet area.

Anchorage is the primary headquarters for Alaska's oil and gas industry. In 2007, 2,400 workers were employed by the oil and gas industry in Anchorage, an increase of 9 percent over 2006 (AEDC 2008). In 1999, the most recent year for which economic impact estimates are available, a total of $239 million was spent on payroll and an additional $845 million in goods and services in the Anchorage economy (Information Insights and McDowell Group 2001). Indirect impact of the oil and gas industry was estimated to be 11,600 jobs and $431 million in payroll, and the induced impact was estimated to be 2,320 jobs and $69 million in payroll.

The oil and gas industry has been important to the economy of the Kenai Peninsula for over 40 years, and five of the top 10 employers are connected to the oil industry (Information Insights and McDowell Group 2001). In addition to the support service industry, several important processing facilities are also located on the Kenai Peninsula. Direct impact of the oil and gas industry was 674 jobs with a payroll of $63 million in 1999. The indirect economic impact was an additional 2,822 jobs and $94 million in payroll; and the induced impacts were 777 jobs and $20 million in payroll. Total economic impact on the Kenai Peninsula was 4,273 jobs and $177 million in payroll, which was 26 percent of the area's employment and 36 percent of the area's payroll (Information Insights and McDowell Group 2001). Additional current statistics are available for the Kenai Peninsula Borough. In 2006, oil and gas extraction, production, and manufacturing industries employed 1,334 workers who earned $659 million; this accounted for 7.4 percent of total Kenai Peninsula Borough employment and 18.3 percent of earnings (KPB 2008). Taxable properties for the oil and gas industry were reported at $607 million (KPB 2008), and 8 of the top 10 property tax payers in the borough were oil and gas industry companies (KPB 2006).

In 2006, nonresidents accounted for 30.8 percent of the statewide oil industry's workforce (major oil companies and oilfield services), an increase of 1.2 percentage points over 2005 (ADOL 2008d). Earnings paid to nonresidents working in the oil industry increased from $242.9 million in 2005 to $327.6 million in 2006. The nonresident share of earnings in the oil industry was 28.7 percent, a figure much higher than the statewide private sector average of 12.9 percent. By comparison, Alaska's seafood processing industry employed the highest percentage of nonresident workers of any industry sector in 2006; 76.4 percent of workers were nonresidents (ADOL 2008d).

2. Natural Gas Needs in Southcentral Alaska

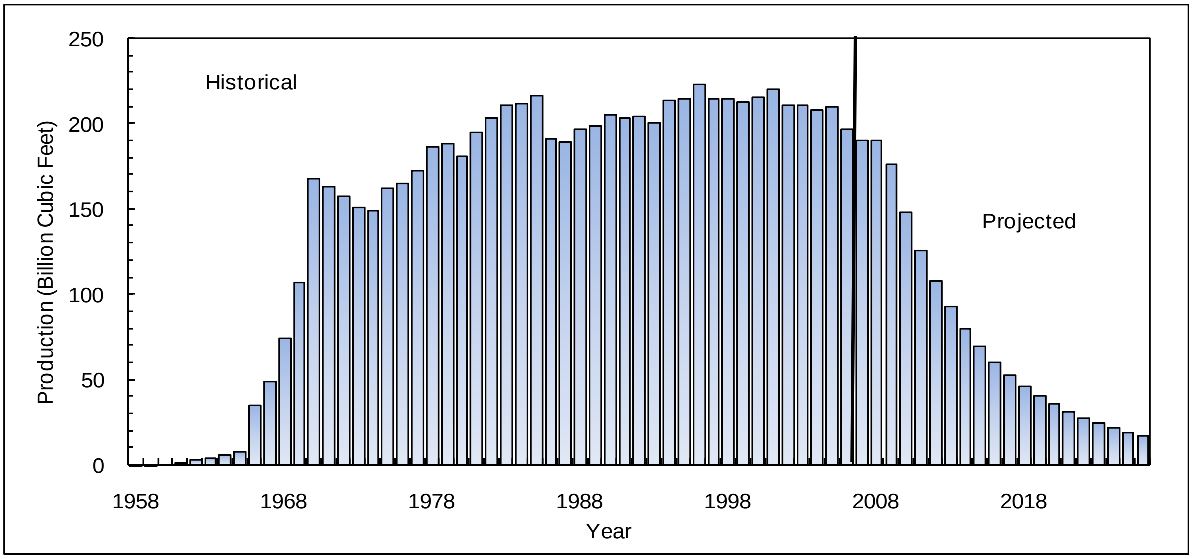
B. Havelock, DO&G

Agrium fertilizer plant, Nikiski (closed in 2007).

Natural gas is a major source of energy for Southcentral Alaska, and all natural gas used in the area comes from Cook Inlet. This includes residential and commercial uses, and industrial facilities which include the ConocoPhillips/ Marathon LNG plant in Nikiski, and until September 2007, Agrium's fertilizer plant that is also located in Nikiski. Electricity for Southcentral is generated primarily from natural gas.

Historically, the supply of natural gas exceeded demand, resulting in an abundant supply of low-cost gas that was consistently below prices in the Lower 48 and benefited residential gas customers and electric utilities along the railbelt from Homer to Fairbanks (Thomas et al. 2004). Abundant, low-priced local natural gas also enabled the industrial developments of the LNG and fertilizer plants on the Kenai Peninsula.

In 2006, the National Energy Technology Laboratory forecast dry gas consumption and Cook Inlet supply (NETL 2006). Taking into account proposed new industrial projects, they projected that demand for natural gas would exceed proven supplies by 110 MMcf/d (million cubic feet per day) by 2015, 250 MMcf/d by 2025, and 300 MMcf/d by 2035 unless new reserves are discovered and developed, natural gas is transported to the area by a spur line from the proposed North Slope pipeline, or LNG is imported (NETL 2006). Decreasing supply of Cook Inlet natural gas and resulting wholesale price increases (Figure 8.4) led to the closure of the Agrium plant in 2007, resulting in the loss of 250 jobs in the Kenai Peninsula Borough. The LNG export license and supply contract with Tokyo Electric and Tokyo Gas was extended to 2011, but continued operation of the LNG plant may be jeopardized without long-term proven supplies of natural gas (Thomas et al. 2004). Without increased Cook Inlet natural gas supplies, prices for residential and commercial natural gas and for electricity will continue to increase (Thomas et al. 2004). In fact, between 2000 and 2006, the price of natural gas increased 91 percent for Anchorage households and the cost of electricity increased 28 percent (Saylor and Haley 2006). Further, in September 2008, Enstar Natural Gas Co., which serves about 128,000 homes and businesses in the Anchorage area, announced plans to raise rates for home heating by at least 22 percent in January 2009 (Holland 2008).



Notes: Projected production represents the DO&G's current estimate of proved producing and probable reserves. Actual produced volumes may be greater than those projected if new reserves are discovered, developed, and produced to meet demand.

Figure 8.4. Historical and projected production of natural gas in Cook Inlet, 1958-2026.

3. Access

If platforms were constructed offshore, some recreational marine boaters may have to avoid or navigate around them. Temporary roads for exploration drilling may be built, and some permanent roads may be constructed as a result of proposed activities. Roads could increase access to previously inaccessible areas, which could improve recreational opportunities, but could also create community development, land use planning, or fish and game management problems. If a development project were proposed and a plan of operations approved, detours could affect some roads or trails during construction.

4. Recreation and Tourism

Recreation and tourism are important to the culture and economies of Cook Inlet communities. They are closely tied to fish and wildlife populations and the habitats that support them through activities such as fishing, hunting, wildlife viewing, hiking, camping, boating, and other outdoor activities. Therefore, effects from oil and gas development on fish, wildlife, and their habitats could have direct effects on recreation and tourism. Possible effects from oil and gas exploration, development, and production on fish and wildlife population and habitats are discussed in the preceding sections. Other potential effects on recreation and tourism are discussed below.

Oil and gas exploration, development, and production could affect recreation and tourism in the lease sale area if the aesthetics of the area were changed. However opinions regarding aesthetic quality vary widely, and the sight of a production platform in Cook Inlet, for example, could be distasteful to some, add to the appeal of the area for some, and be unnoticed by others.

An oil spill could result in significant negative effects to recreation and tourism. Recreation and tourism declined dramatically in Prince William Sound, Cook Inlet, and the Kenai Peninsula following that 1989 *Exxon Valdez* oil spill (EVOSTC 2006). Access to hunting and fishing areas was limited, and oiled areas were closed to kayakers. Some unoiled areas were used more heavily because activities were displaced from oiled areas. Because some species had not completely recovered from the spill and oil remained in some localized areas, tourism and recreation were considered to be recovering, but not yet recovered, in 2006 (EVOSTC 2006).

If oil and gas activities reduced access to towns, fishing grounds, campgrounds, and other tourist or recreational areas, users' enjoyment of the area could be negatively affected. If users' perceptions, travel, and spending were negatively affected, decreased revenues to local businesses could result. If oil and gas activities reduced access to services such as gas stations, hotels, restaurants, shops, supply stores, grocery stores, and guides, adverse consequences on businesses and local economies could result. However, oil and gas activities could provide a source of business for local vendors during the slow season, and could attract new businesses.

5. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have effects on municipalities and communities in the Cook Inlet area, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, or mitigate potentially negative effects. Positive effects are expected on local governments and economies, employment, personal income, reasonable energy costs, and opportunities for industrial development.

Mitigation measures encourage lessees to employ local Alaska residents and contractors, to the extent they are available and qualified. Lessees must submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the measure. The proposal must include a description of the operator's plans for partnering with local communities to recruit, hire, and train local and Alaska residents and contractors. Mitigation measures also address critical habitat areas and state game refuges, protection of streams, siting of facilities, public access, navigable waters, and public water supplies. A complete listing of mitigation measures is found in Chapter 9.

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Chapter Nine: Mitigation Measures and Other Regulatory Requirements

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Chapter Nine: Mitigation Measures and Other Regulatory Requirements (Lessee Advisories)

AS 38.05.035(e) and the departmental delegation of authority provide the director of the Division of Oil and Gas ("director"), with the authority to impose conditions or limitations, in addition to those imposed by statute, to ensure that a resource disposal is in the state's best interests. Consequently, to mitigate the potential adverse social and environmental effects of specific lease related activities, DO&G has developed mitigation measures and will condition plans of operation, exploration, or development and other permits based on these mitigation measures.

Lessees must obtain approval of a detailed plan of operations from the director before conducting exploration, development, or production activities. A plan of operations must identify the sites for planned activities and the specific measures, design criteria, construction methods and operational standards to be employed to comply with the restrictions listed below. It must also address any potential geologic hazards that may exist at the site.

These measures were developed after considering terms imposed in earlier competitive lease sales and comments and information submitted by the public, local governments, environmental organizations, and other federal, state, and local agencies. Additional measures will likely be imposed when lessees submit a proposed plan of operations.

Lessees must comply with all applicable local, state and federal codes, statutes and regulations, as amended, as well as all current or future ADNR area plans and recreation rivers plans; and ADF&G game refuge plans, critical habitat area plans, and sanctuary area plans within which a lease area is located. Lease activities must be consistent with the enforceable policies of the Alaska Coastal Management Program, including statewide standards and the enforceable policies of an affected coastal district, as amended.

The director may grant exceptions to these mitigation measures. Exceptions will only be granted upon a showing by the lessee that compliance with the mitigation measure is not practicable or that the lessee will undertake an equal or better alternative to satisfy the intent of the mitigation measure. Requests and justifications for exceptions must be included in the plan of operations. The decision whether to grant an exception will be made during the public review of the plan of operations.

Except as indicated, the mitigation measures do not apply to geophysical exploration on state lands; geophysical exploration activities are governed by 11 AAC 96.

Agency abbreviations are:

Abbreviation	Agency Name
ADF&G	Alaska Department of Fish and Game
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
DMLW	Division of Mining, Land, and Water (ADNR)
DO&G	Division of Oil and Gas (ADNR)
NMFS	National Marine Fisheries Service
SHPO	State Historic Preservation Office (ADNR)
USFWS	U.S. Fish and Wildlife Service

A. Mitigation Measures

1. Facilities and Operations

a) A plan of operations must be submitted and approved before conducting exploration, development or production activities, and must describe the lessee's efforts to minimize impacts on residential, commercial, and recreational areas, Native allotments and subsistence use areas, and adjacent private lands. At the time of application, lessee must submit a copy of the proposed plan of operations to all surface owners whose property will be entered.

b) Facilities must be designed and operated to minimize sight and sound impacts in areas of high residential, commercial, recreational, and subsistence use and important wildlife habitat. Methods may include providing natural buffers and screening to conceal facilities, sound insulation of facilities, or by using alternative means approved by the director, in consultation with ADF&G.

c) The siting of onshore facilities, other than roads, docks, utility or pipeline corridors, or terminal facilities will be prohibited within one-half mile of the mean high water of Cook Inlet, except where land use plans classify an area for development, or established usage and use history show development. The siting of facilities other than docks, roads, utility, and pipeline crossings will also be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet of all current surface drinking water sources. Additionally, to the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Harriet, Alexander, Lake, Deep, and Stariski creeks, and the Drift, Big, Kustatan, McArthur, Chuitna, Lewis, Theodore, Beluga, Susitna, Little Susitna, Kenai, Kasilof, Ninilchik, and Anchor rivers. Facilities may be sited within these buffers if the lessee demonstrates to the satisfaction of the director, in consultation with ADF&G, that site locations outside these buffers are not practicable or that a location inside the buffer is environmentally preferred. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses.

d) Impacts to identified wetlands must be minimized to the satisfaction of the director, in consultation with ADF&G and ADEC. The director will consider whether facilities are sited in the least sensitive areas. Further, all activities within wetlands require permission from the U.S. Army Corps of Engineers (see Lessee Advisories).

e) Exploration activities must be supported by air service, an existing road system or port facility, ice roads, or by off-road vehicles that do not cause significant damage to the vegetation or ground surface. Construction of temporary drill pads, airstrips, and roads may be allowed. Construction of permanent roads may be allowed upon approval by the director. Unrestricted surface travel may be permitted by the director and DMLW, if an emergency condition exists.

f) With the exception of drill pads, airstrips, and roads permitted under A1e, exploration facilities must be consolidated, temporary, and must not be constructed of gravel. Use of abandoned gravel structures may be permitted on a case-by-case basis.

g) Pipelines must utilize existing transportation corridors and be buried where conditions permit. Pipelines and gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Pipelines, flowlines, and gathering lines must be designed and constructed to assure integrity against climatic conditions and geologic hazards.

   In areas with above ground placement, pipelines must be designed, sited, and constructed to allow for the free movement of wildlife. Where practicable, pipelines must be located on the upslope side of roadways and construction pads, unless DMLW determines that an alternative site is environmentally acceptable.

h) Pipelines that must cross marine waters will be constructed beneath the marine waters using directional drilling techniques, unless the director, in consultation with ADF&G and the local borough and Coastal Resource Service Areas, approves an alternative method based on technical, environmental, and economic justification. Offshore pipelines must be located and constructed to prevent obstruction to marine navigation and fishing operations.

i) Gravel mining sites required for exploration and development activities will be restricted to the minimum necessary to develop the field efficiently and to minimize environmental damage. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless DMLW, after consultation with ADF&G, determines that there is no practicable alternative, or that a floodplain site would be compatible with fish and wildlife habitat after mining operations are completed and the site is closed.

2. Habitat, Fish, and Wildlife

a) Detonation of explosives will be prohibited in open water areas of fish bearing streams and lakes. Explosives must not be detonated beneath, or in close proximity to, fish-bearing streams and lakes if the detonation of the explosive produces a pressure rise in the water body of greater than 2.7 pounds per-square-inch, or unless the water body, including its substrate, is solidly frozen. Detonation of explosives within or in close proximity to a fish spawning bed during the early stages of egg incubation must not produce a peak particle velocity greater than 0.5 inches per second. Blasting criteria have been developed by ADF&G and are available from ADF&G upon request. The location of known fish bearing waters within the project area can be obtained from ADF&G.

b) Compaction or removal of snow cover overlying fish bearing water bodies is prohibited except for approved crossings. If ice thickness is not sufficient to facilitate a crossing, ice and/or snow bridges may be required.

c) Removal of water from fishbearing rivers, streams and natural lakes shall be subject to prior written approval by DMLW and ADF&G. Water intake pipes used to remove water from fish bearing waterbodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Screen mesh size shall be no greater than 1 mm (0.04 inches), unless another size has been approved by ADF&G. The maximum water velocity at the surface of the screen enclosure may be no greater than 0.4 feet per second, unless an alternative velocity has been approved by ADF&G. Screen material must be corrosion resistant, and must be adequately supported to prevent excessive sagging which could result in unusable intake surface. The intake structure must be designed and installed to avoid excessive fouling from floating debris, and a minimum of eight square feet of effective wetted screen surface must be provided for each multiple of a 450-gallon per minute (one cubic foot per second) pumping rate. The pump intake opening must be placed equidistant from all effective wetted screen surfaces.

d) Surface entry will be prohibited in parcels that are within the Kenai River Special Management Area.

Surface entry, other than access, will be prohibited on state lands within the Kenai National Wildlife refuge.

Lessees are prohibited from placing drilling rigs and lease-related facilities and structures within an area near the Kenai River composed of: all land within Section 36 in T6N, R11W that is located south of a line drawn from the protracted NE corner to the protracted SW corner of the section; all land within the western half of Section 31 in T6N, R10W and Section 6 in T5N, R10W; and all land within Section 1 in T5N, R11W.

e) Surface entry into the critical waterfowl habitat along the Kasilof River is prohibited. Directional drilling from adjacent sites may be allowed.

f) Surface entry will be prohibited within one-quarter mile of trumpeter swan nesting sites between April 1 and August 31. The siting of permanent facilities, including roads, material sites, storage areas, powerlines, and above ground pipelines will be prohibited within one-quarter mile of known nesting sites. Trumpeter swan nesting sites will be identified by ADF&G at the request of the lessee.

g) The director, in consultation with ADF&G, shall restrict or modify lease related activities if scientific evidence documents the presence of Steller's eiders from the Alaska breeding population in the lease area and it is determined that oil and gas exploration and development will impact them or their over-wintering habitat in the near-shore waters of Cook Inlet.

h) The director, in consultation with ADF&G, may impose seasonal restrictions on activities located in and adjacent to important waterfowl and shorebird habitat during the plan of operations approval stage.

Bears

i) Lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between bears and humans. The plan shall include measures to:

   i. minimize attraction of bears to facility sites, including garbage and food waste;
   ii. organize layout of buildings and work areas to minimize interactions between humans and bears such as including the use of electric fencing;
   iii. warn personnel of bears near or on facilities and the proper actions to take;
   iv. if authorized, deter bears from the drill site;
   v. provide contingencies in the event bears do not leave the site;
   vi. provide for proper storage and disposal of materials that may be toxic to bears; and
   vii. document and communicate the sighting of bears onsite or in the immediate area to all shift employees.

j) Before commencement of any activities, lessees shall consult with ADF&G to identify the locations of known bear den sites that are occupied in the season of proposed activities. Exploration and development activities started between November 15 and March 31 may not be conducted within one-half mile of known occupied brown bear dens, unless alternative mitigation measures are approved by the ADF&G. A lessee who encounters an occupied den not previously identified by ADF&G must report it to the Division of Wildlife Conservation, ADF&G, within 24 hours. Mobile activities shall avoid such discovered occupied dens by one-half mile unless alternative mitigation measures are approved by DO&G with concurrence from ADF&G. Non-mobile facilities will not be required to be relocated.

k) Recognizing the importance of sufficient vegetative cover and access by Kenai Peninsula brown bears feeding at streams, the director, in consultation with ADF&G, may require lessees to locate exploration and development facilities beyond the 500-foot buffer along anadromous streams during the plan of operations approval stage, except as provided in A1c.

Caribou

l) Surface entry within the core calving area of the Kenai Lowlands Caribou Herd is prohibited, except that surface entry for seismic exploration will be allowed from October 16 to March 31.

m) Exploration and development activities will be restricted or prohibited between April 1 and October 15 within the core summer habitat of the Kenai Lowlands Caribou Herd, except that maintenance and operation of production wells will be allowed year-round. Permanent roads, or facilities other than production wells, will also be restricted or prohibited within this area.

Facilities within the core summer habitat of the Kenai Lowlands Caribou Herd that require year-round access must be located in forested areas, where practical.

n) Pipelines must be buried within the core summer habitat of the Kenai Lowlands Caribou Herd.

o) The director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important moose or caribou calving and wintering areas during the plan of operations approval stage.

Beluga Whales

p) No permanent or temporary oil and gas exploration or development may occur within High Value/High Sensitivity (Type 1) beluga whale habitat areas, unless it occurs on upland areas (above Mean Higher Water datum). Type 1 habitat areas include the following tracts: 320-334, 391-409, 410, 462, 464-475, 476-481, 483, 484, 485, 486, 493, 494, 497, 498, 522, 524-537, 538, 539, 540, 541, 542, 543, 544, 547-552, 559, 575-577, 579, 581, 582, 585, 586, 590, 593, 594, 598, 616-618, 620-623, 627, 655-658, and 662.

q) The director will assess oil and gas-related activities within all High Value (Type 2) beluga whale habitat areas on a case-by-case basis. No permanent surface entry or structures are allowed, and temporary activities and structures, for example exploration drilling, will only be allowed between November 1 and April 1 of each year, unless it occurs on upland areas, within the following tracts: 021, 022, 126, 127, 129-132, 161, 162, 175, 177, 211, 218, 257, 301, 302, 373, 376, 377, and 384.

r) The director will assess oil and gas-related activities within the remaining tracts (Type 3 habitat areas) on a case-by-case basis.

3. Subsistence, and Other Fish and Wildlife Uses

a) Lease-related use will be restricted when DO&G determines it is necessary to prevent unreasonable conflicts between lease-related activities and subsistence, and commercial, sport, personal use, and educational harvest activities. In enforcing this term DO&G, during review of plans of operation, will consult with other agencies, the affected local borough(s) and the public to identify and avoid potential conflicts. In order to avoid conflicts with subsistence, commercial, sport and educational harvest activities, restrictions may include alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by DO&G.

4. Fuel, Hazardous Substances, and Waste

a) Secondary containment (see definitions) shall be provided for the storage of fuel or hazardous substances.

b) Containers with an aggregate storage capacity of greater than 55 gallons which contain fuel or hazardous substances shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

c) During equipment storage or maintenance, the site shall be protected from leaking or dripping fuel and hazardous substances by the placement of drip pans or other surface liners designed to catch and hold fluids under the equipment, or by creating an area for storage or maintenance using an impermeable liner or other suitable containment mechanism.

d) During fuel or hazardous substance transfer, secondary containment or a surface liner must be placed under all container or vehicle fuel tank inlet and outlet points, hose connections, and hose ends. Appropriate spill response equipment, sufficient to respond to a spill of up to 5 gallons, must be on hand during any transfer or handling of fuel or hazardous substances. Trained personnel shall attend transfer operations at all times.

e) Vehicle refueling shall not occur within the annual floodplain, except as addressed and approved in the plan of operations. This measure does not apply to water-borne vessels.

f) All independent fuel and hazardous substance containers shall be marked with the contents and the lessee’s or contractor’s name using paint or a permanent label.

g) A freshwater aquifer monitoring well, and quarterly water quality monitoring, may be required down gradient of a permanent above-ground liquid hydrocarbon storage facility.

h) Waste from operations must be reduced, reused, or recycled to the maximum extent practicable. Garbage and domestic combustibles must be incinerated or disposed of at an approved site in accordance with 18 AAC 60. (See also Section B2, below.)

i) New solid waste disposal sites will not be approved or located on state property during the exploratory phase. Exceptions may be provided for drilling waste if the facility will comply with the applicable provisions of 18 AAC 60.

j) Wherever practicable, the preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Other methods of disposal shall be allowed only upon approval by the director, in consultation with ADEC and ADF&G.

5. Access

a) Public access to, or use of, the lease area may not be restricted except within the immediate vicinity of drill sites, buildings, and other related facilities. Areas of restricted access must be identified in the plan of operations. Lease facilities and operations shall not be located so as to block access to or along navigable or public waters as defined in AS 38.05.965.

6. Prehistoric, Historic, and Archeological Sites

a) Before the construction or placement of any gravel, or other structure, road, or facility resulting from exploration, development, or production activities, the lessee must conduct an inventory of prehistoric, historic, and archeological sites within the area affected by an activity. The inventory must include consideration of literature provided by the affected borough and local residents; documentation of oral history regarding prehistoric and historic uses of such sites; evidence of consultation with the Alaska Heritage Resources Survey and the National Register of Historic Places; and site surveys. The inventory must also include a detailed analysis of the effects that might result from the activity.

b) The inventory of prehistoric, historic, and archeological sites must be submitted to the director, and to DPOR Office of History and Archaeology, who will coordinate with the affected borough for review and comment. If a prehistoric, historic, or archeological site or area could be adversely affected by a lease activity, the director, after consultation with DPOR Office of History and Archaeology and the affected borough, will direct the lessee as to the course of action to take to avoid or minimize adverse effects.

c) If a site, structure, or object of prehistoric, historic, or archaeological significance is discovered during lease operations, the lessee must report the discovery to the director as soon as possible. The lessee must make reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the director, after consultation with DPOR Office of History and Archaeology and the affected borough, has directed the lessee as to the course of action to take for its preservation.

7. Local Hire, Communication, and Training

a) Lessees are encouraged to employ local and Alaska residents and contractors, to the extent they are available and qualified, for work performed in the lease area. Lessees shall submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the measure. The proposal must include a description of the operator's plans for partnering with local communities to recruit, hire, and train local and Alaska residents and contractors. The lessee is encouraged, in formulating this proposal, to coordinate with employment and training services offered by the State of Alaska and local communities to train and recruit employees from local communities.

b) A plan of operations application must describe the lessee's past and prospective efforts to communicate with local communities and interested local community groups.

c) A plan of operations application must include a training program for all personnel including contractors and subcontractors. The program must be designed to inform each person working on the project of environmental, social, and cultural concerns that relate to that person's job. The program must use methods to ensure that personnel understand and use techniques necessary to preserve geological, archeological, and biological resources. In addition, the program must be designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating.

8. Definitions

Facilities means any structure, equipment, or improvement to the surface, whether temporary or permanent, including, but not limited to, roads, pads, pits, pipelines, power lines, generators, utilities, airstrips, wells, compressors, drill rigs, camps and buildings.

Hazardous substance means: (A) an element or compound that, when it enters into or on the surface or subsurface land or water of the state, presents an imminent and substantial danger to the public health or welfare, or to fish, animals, vegetation, or any part of the natural habitat in which fish, animals, or wildlife may be found; or (B) a substance defined as a hazardous substance under 42 U.S.C. 9601 - 9657 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980); "hazardous substance" does not include uncontaminated crude oil or uncontaminated refined oil; (AS 46.09.900).

Identified wetlands are those areas that have been identified as wetlands by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act.[1]

Minimize means to reduce adverse impacts to the smallest amount, extent, duration, size, or degree reasonable in light of the environmental, social, or economic costs of further reduction.

Plan of operations means a lease Plan of operations under 11 AAC 83.158 and a unit Plan of operations under 11 AAC 83.346.

Practicable means feasible in light of overall project purposes after considering cost, existing technology, and logistics of compliance with the standard.

Secondary containment means an impermeable diked area or portable impermeable containment structure capable of containing 110 percent of the volume of the largest independent container.

[1] *Wetlands* means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (40 CFR Parts 122.2, 230.3, and 232.2).

Double walled tanks do not qualify as Secondary Containment unless an exception is granted for a particular tank.

Temporary means no more than 12 months.

B. Other Regulatory Requirements (Lessee Advisories)

Lessees must comply with all applicable local, state and federal codes, statutes and regulations, as amended. Lessee advisories alert lessees to additional restrictions that may be imposed at the permitting stage of a proposed project or activity where entities other than DO&G have regulatory, permitting, or management authority.

1. Alaska Department of Natural Resources,

a) Pursuant to AS 46.40, projects are required to comply with all policies and enforceable standards of the Alaska Coastal Management Program, including the District Coastal Management Plans.

b) Lessees must include in their seismic permit applications a plan for notifying the public of their activities (11 AAC 96).

c) Forest clearing for seismic exploration must have prior approval by DO&G in consultation with the Division of Forestry and ADF&G.

d) Removal of gravel from state land must have prior approval from DMLW. Lessees must submit a material sale application (AS 38.05.110-120, AS 38.05.810, 11 AAC 71.045) as well as a development plan, environmental risk questionnaire, and Alaska Coastal Management Plan questionnaire. Applicants are required on state, federal, municipal, and private land to submit a reclamation plan or letter of intent per AS 27.19.030-050.

2. Alaska Department of Environmental Conservation

a) Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) before commencing operations. The plan must include a response action plan to describe how a spill response would occur, a prevention plan to describe the spill prevention measures taken at the facility, and supplemental information to provide background and verification information.

b) Pursuant to state regulations administered by ADEC and the Clean Air Act administered by EPA, lessees are required to obtain air quality permits before construction and operation. The permits will include air quality monitoring, modeling, and emission control obligations.

c) Unless authorized by an ADEC permit, surface discharge of reserve pit fluids and produced waters is prohibited.

d) Unless authorized by National Pollutant Discharge Elimination System or state permits, disposal of wastewater into freshwater bodies is prohibited.

3. Alaska Department of Fish and Game

a) Under the provisions of Title 16 of the Alaska Statutes, the measures listed below may be imposed by ADF&G below the ordinary high water mark to protect designated anadromous waterbodies and to ensure the free and efficient passage of fish in all fish-bearing waterbodies. Specific information on the location of anadromous water bodies in and near the area may be obtained from ADF&G.

i) Alteration of riverbanks may be prohibited.
ii) The operation of equipment, excluding boats, in open water areas of rivers and streams may be prohibited.
iii) Bridges or non-bottom founded structures may be required for crossing fish spawning and important rearing habitats.
iv) Culverts or other stream crossing structures must be designed, installed, and maintained to provide free and efficient passage of fish.

b) Removal of water from fish-bearing water bodies is subject to the provisions of Regulations for Appropriation and Use of Water (11 AAC 93.035 - 11 AAC 93.147).

c) The use of explosives for seismic activities with a velocity of greater than 3000 feet-per-second in marine waters is prohibited.

Game Refuges and Critical Habitat Areas

d) Management of legislatively designated state game refuges and critical habitat areas is the co-responsibility of ADF&G, per AS 16.20.050-060 and AS 16.20.500-530, and ADNR, per AS 38.05.027. For activities occurring within a refuge or critical habitat area, the lessee will be required to obtain permits from both ADNR and ADF&G. The following requirements are established by, and exceptions may only be granted by, ADF&G.

e) Five state game refuges (SGR) and four critical habitat areas (CHA) are located within or partially within the Cook Inlet lease sale area: Goose Bay SGR, Palmer Hay Flats SGR, Anchorage Coastal Wildlife Refuge, Susitna Flats SGR, Trading Bay SGR, Redoubt Bay CHA, Kalgin Island CHA, Clam Gulch CHA, and Anchor River and Fritz Creek CHA.

Operations within these refuges and critical habitat areas must comply with the terms and conditions of the lease sale, the regulations contained within 5 AAC 95, and the measures listed below.

i. Surface entry for drilling and above ground lease-related facilities and structures will be prohibited within the Palmer Hay Flats SGR, Anchorage Coastal Wildlife Refuge, Clam Gulch CHA, Anchor River and Fritz Creek CHA, within the core Tule goose and trumpeter swan nesting and molting corridors along the Big, Kustatan, and McArthur rivers in the Trading Bay SGR and Redoubt Bay CHA, on tidelands and wetlands in the Goose Bay SGR and Kalgin Island CHA and within the primary shorebird area in Susitna Flats SGR, Trading Bay SGR, and Redoubt Bay CHA.

Surface entry may be allowed on uplands within the Goose Bay SGR and Kalgin Island CHA; and surface entry for seismic surveys and similar temporary activities may be allowed in all of these areas, consistent with the Special Area regulations and applicable Special Area management plans. Directional drilling from adjacent sites may be allowed. Similar provisions will be imposed by the DO&G to protect primary shorebird habitat in Redoubt Bay south of the CHA.

ii) Exploration, development, and major maintenance within important Tule goose and trumpeter swan habitat in Trading Bay SGR, Redoubt Bay CHA, and Susitna Flats SGR, and the primary waterfowl area above mean high tide within the Susitna Flats SGR and Trading Bay SGR will be allowed only between November 1 and March 31, unless an extension is approved by ADF&G and DO&G.

Routine maintenance and emergency repairs will be permitted on a year-round basis during the production phase. A detailed plan describing routine maintenance activities to be conducted between April 1 and October 31 must be submitted to ADF&G and DO&G for review and approval.

iii) Gravel pads and wellheads are the only above ground structures that will be allowed within the primary waterfowl area above mean high tide in the Susitna Flats SGR and the Trading Bay SGR and important Tule goose and trumpeter swan habitat in the Trading Bay SGR, Redoubt Bay CHA and Susitna Flats SGR. Gravel roads will not be allowed in a SGR or CHA during exploration.

iv) (a) aircraft flying over the primary shorebird habitat within Susitna Flats SGR, Trading Bay SGR and Redoubt Bay CHA should maintain a minimum altitude of 1,500 feet above ground level or a horizontal distance of 1 mile.

(b) Aircraft flying over Goose Bay SGR and Palmer Hay Flats SGR, the primary waterfowl habitat above mean high tide within Susitna Flats and Trading Bay SGR, and the core Tule goose and trumpeter swan molting and nesting corridors in Trading Bay SGR and Redoubt Bay CHA should maintain a minimum altitude of 1,500 feet above ground level or a horizontal distance of 1 mile from April 1 to October 31. Human safety will take precedence over this provision.

v) Construction, operation, and maintenance activities shall minimize the visual, biological, and physical impacts to the SGR or CHA.

vi) Surface discharge of produced waters will be prohibited.

vii) Disposal of drilling mud and cuttings will be allowed only at upland sites approved by the DO&G and ADF&G, after consultation with DMLW and ADEC.

viii) Facilities must be designed to minimize the risk of spills or fires resulting from vandalism or accidents.

4. Alaska Department of Labor and Workforce Development

a) The lessee shall facilitate Alaska resident hire monitoring by reporting project wages on a quarterly basis for each individual employed by the lessee in the lease area, through electronic unemployment insurance reporting, and by requiring the same of the lessee’s contractors and subcontractors

5. U.S. Army Corps of Engineers

a) A U.S. Army Corp of Engineers permit is required when work is anticipated on, in, or affects navigable waters or involves wetland-related dredge or fill activities. A Section 10 Permit is required for construction, excavation, or deposition of materials in, over, or under navigable waters, or for any work which would affect the course, location, condition, or capacity of navigable waters (U.S.C. 403). Oil and gas activities requiring this type of permit include, but are not limited to, exploration drilling from a jackup drill rig and installation of a production platform. A Section 404 Permit is required for the discharge of dredged and fill material into waters and wetlands of the United States (33 U.S.C. 1344). The process and concerns are similar for both permits and, at times, both may be required.

6. U.S. Fish and Wildlife Service and National Marine Fisheries Service

a) The lessee is advised that the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.) protects the following endangered or threatened species and candidate species for listing that may occur in the lease sale area:

Common Name	Status
Fin whale	Endangered
Steller sea lion (western stock)	Endangered
Humpback whale	Endangered
Beluga whale (Cook Inlet stock)	Endangered
Steller's eider (Alaska breeding population)	Threatened

Migratory birds, sea otters, polar bears, and Pacific walrus are managed by the U.S. Fish and Wildlife Service. The National Oceanic and Atmospheric Administration, National Marine Fisheries Service is responsible for management of all other marine mammals.

b) NMFS, USFWS, and ADF&G will continue annual monitoring efforts to further delineate the presence and distribution of species administered under the ESA and Marine Mammal Protection Act (MMPA). The lessee is advised to annually acquire updated information from these agencies.

c) The USFWS has determined that oil and gas exploration and development activities within 3 miles seaward or within one-half mile landward of the eastern shore of Cook Inlet, from Clam Gulch to the southern bounds of the lease sale area, are likely to adversely affect (take) Steller's eiders. Each operator is advised to consult with the USFWS well in advance of any activities in this area.

d) The lessee is advised that off-shore activity (particularly seismic geophysical surveys) may result in the taking of beluga whales and other marine mammals. Such taking is prohibited by the federal MMPA unless otherwise authorized. The incidental taking of marine mammals may be authorized under the MMPA, and each operator should be advised to discuss this matter with NMFS well in advance of any geophysical survey activity.

e) The lessee is advised that the Cook Inlet beluga whale is listed as a depleted stock under the MMPA. In October 2008, NMFS listed the whale population as endangered under the ESA; critical habitat designations are pending. The lessee is advised to review the Federal Register and contact NMFS for additional information.

f) The lessee is advised that the Magnuson-Stevens Fishery Conservation and Management Act requires identification of Essential Fish Habitat (EFH) for all species managed under a federal Fisheries Management Plan. Subsequent exploration and/or development activities associated with the lease sale may be subject to consultation under EFH. EFH information, consultation, guidance, and species life history information are available on the NMFS website at http://www.fakr.noaa.gov/habitat.

g) The lessee is advised that the description of the techniques used to drill and conduct seismic operations should be thorough and assess potential effects of fish and their spawning substrate, migratory corridors, and over-wintering areas.

h) The lessee is advised that the response technologies and geographic response strategies have been prepared for Cook Inlet by state and federal planning teams in which NMFS has participated. However, the application of these plans in fast-moving Cook Inlet waters, especially during ice-laden times, could prove difficult. Further, mechanical recovery in estuaries, anadromous streams, and adjacent continuous wetlands can potentially disrupt these habitats and degrade water quality conditions. Thus, recovery and containment plans will need to address habitat effects within the site and areas where tidal currents may deposit or entrain spilled product. These assessments are needed before development.

i) Lessees are advised of the need to comply with the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703) which is administered by the USFWS. Under the MBTA, it is illegal to "take" migratory birds, their eggs, feathers or nests. “Take” is defined (50 CFR 10.12) to include “pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting.” The MBTA does not distinguish between “intentional” and “unintentional” take. Migratory birds include songbirds, waterfowl, shorebirds, and raptors. In Alaska, all native birds except grouse and ptarmigan (which are protected by the State of Alaska) are protected under the MBTA.

j) In order to ensure compliance with the MBTA, it is recommended that the lessees survey the project area before construction, vegetation clearing, excavation, discharging fill, or other activities which create disturbance, and confirm there are no active migratory bird nests. It is recommended that lessees contact the USFWS for assistance and guidance on survey needs, and other compliance issues under the MBTA. While the Service can recommend methods (such as surveys and timing windows) to avoid unintentional take, responsibility for compliance with the MBTA rests with lessees. In the lease sale area, the USFWS normally recommends that to prevent impacts to nesting migratory birds, no vegetation clearing, fill placement, excavation, or other construction activities be conducted between May 1 and July 15.

k) Bald eagles are protected under the Bald Eagle Protection Act (16 U.S.C. 668-668c) and the MBTA. Lessees are responsible to ensure their actions do not take bald eagles. The Bald Eagle Protection Act defines “take” to include disturbing birds. A survey for bald eagle nests is necessary before beginning exploration or development activities during the nesting period (March 1 through August 31). Any nests located within one-half mile of the project site must be mapped, and destruction of nest trees or locations is prohibited. If any nests are located within one-half mile of a project site, lessees shall meet with the USFWS before construction to review any site-specific concerns regarding the subject nest. USFWS generally recommends no clearing of vegetation within 330 feet of any nest. No activity should occur within 660 feet of any nests between March 1 and June 1. Between June 1 and August 31, no activity should occur within 660 feet of active eagle nests until after juvenile birds have fledged, unless specifically authorized by the USFWS. While the USFWS can recommend ways to avoid the take of eagles, final accountability lies with the party responsible for the action.

7. Matanuska-Susitna Borough

a) The lessee is advised that all development in the Point MacKenzie Port Special Use District must comply with Matanuska-Susitna Borough Code Chapter 17.23: Point MacKenzie Port Special Use District.

b) The lessee is advised that any exploration work on borough-owned tidelands or uplands in the area will require a land use permit from the borough’s land management division.

Chapter Ten: Bidding Method and Lease Terms

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Chapter Ten: Bidding Method and Lease Terms

Under AS 38.05.180(f) and 11 AAC 83.100(a), the leasing of oil and gas resources must be by competitive bidding. AS 38.05.180(f)(3) provides a number of leasing methods for competitive bidding that the commissioner may adopt for an oil and gas lease sale:

(1) a cash bonus bid with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease;

(2) a cash bonus bid with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease and a fixed share of the net profit derived from the lease of not less than 30 percent reserved to the state;

(3) a fixed cash bonus with a royalty share reserved to the state as the bid variable but no less than 12.5 percent in amount or value of the production removed or sold from the lease;

(4) a fixed cash bonus with the share of the net profit derived from the lease reserved to the state as the bid variable;

(5) a fixed cash bonus with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease with the share of the net profit derived from the lease reserved to the state as the bid variable;

(6) a cash bonus bid with a fixed royalty share reserved to the state based on a sliding scale according to the volume of production or other factor but in no event less than 12.5 percent in amount or value of the production removed or sold from the lease;

(7) a fixed cash bonus with a royalty share reserved to the state based on a sliding scale according to the volume of production or other factor as the bid variable but not less than 12.5 percent in amount or value of the production removed or sold from the lease.

For each lease sale under the 10-year Cook Inlet Areawide Best Interest Finding, the commissioner will adopt the bidding method or methods under AS 38.05.180(f) as the commissioner determines is in the best interests of the state. The bidding method or methods may not be the same for each lease sale over the 10-year term of this best interest finding, but the method for each sale will be adopted from the methods set out in AS 38.05.180(f)(3). The bidding method or methods adopted for a particular lease sale will be published in the pre-sale notice describing the interests to be offered, the location and time of the sale, and the terms and conditions of the sale. (AS 38.05.035(e)(6)(F)).

Chapter Eleven: Summary and Director's Final Finding

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Chapter Eleven: Summary and Director's Final Finding

A. Summary

DO&G is required by AS 38.05.035(e) and (g), to determine whether an oil and gas lease sale serves the state's best interests. It is the responsibility of the director of DO&G to make that determination for the Cook Inlet Areawide Oil and Gas Lease Sale. In making this decision, the reasonably foreseeable positive and negative effects were balanced to determine whether the potential benefits exceed the potential negative effects and whether holding this sale is in the best interests of the state.

In this final finding analysis, DO&G considered the reasonably foreseeable potential effects, both negative and positive, that this sale could have on fish, wildlife, and human users of these resources, on the local economy and well-being of Alaskans, and on state revenue. DO&G analyzed the available socioeconomic, environmental, geological and geophysical data, and information submitted by state and federal agencies. The discussion throughout this final finding reflects the analysis of these issues. Below is a summary of this analysis.

1. Reasonably Foreseeable Cumulative Effects of Leasing and Subsequent Activity

Potential post-lease activities that could have cumulative effects on the area's habitats, and fish and wildlife populations and their uses include seismic surveys, construction of support facilities, and drilling and production activities. Some potential effects of these activities include physical disturbances that could alter the landscape, lakes, rivers, and wetlands; habitat changes; behavior changes of fish, wildlife and birds; drawdowns and contamination of groundwater; and contamination of terrestrial or freshwater habitats from discharges from well drilling and production, gas blowouts, or oil spills.

Oil and gas exploration, development, and production activities may produce emissions that have the potential to affect air quality, including carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter-10 (PM_{10}), $PM_{2.5}$, volatile organic compounds (VOC), ozone, and greenhouse gases including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

Oil and gas related activities could result in increased access to hunting and fishing areas due to construction of new roads, but this could also increase competition between user groups for fish and wildlife resources. Interference with commercial fishing operations is a potential effect. A major oil spill could harm fisheries through direct lethal or sub-lethal effects to fish stocks, and could decrease resource availability and accessibility for users.

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially affect habitats, fish and wildlife and their uses, subsistence, air quality, and commercial fishing, measures proposed in this final best interest finding, along with regulations imposed by other state, federal, and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

Mitigation measures address habitat loss avoidance and protection; prohibitions and restrictions on surface entry into legislatively designated areas and other important habitat areas; disturbance avoidance; and free passage of fish and wildlife. Mitigation measures protect trumpeter swan nesting areas, bald eagles, and Steller's eiders. Sets of comprehensive measures protect the Kenai Lowlands caribou herd, brown bears and their habitat, and beluga whales. Measures to protect fish and wildlife uses address harvest interference avoidance, public access, and road construction. Other measures and regulations protect drinking water and clean air, and address seismic activities, design and construction of pipelines, discharges and waste from drilling and production, oil spill prevention and control, and site rehabilitation.

3. Fiscal Effects and Effects on Municipalities and Communities

Alaska's economy depends heavily on revenues related to petroleum development, which totaled $4.57 billion in fiscal year 2007. The petroleum industry is Alaska's largest industry, annually spending $2.1 billion, including $422 million on payroll and $1.7 billion on goods and services. Overall, this spending generates 33,600 jobs, $1.4 billion in payroll, and value added to the Alaska economy of $1.8 billion for total output of $3.1 billion. Oil and gas accounts for 12 percent of private sector jobs and 20 percent of private sector payroll. The oil and gas industry has the highest monthly wage in Alaska, averaging $7,754, which is 2.8 times higher than the statewide average of $2,798.

In the Matanuska-Susitna Borough, it is estimated that over 350 residents are employed by the oil and gas industry with an average monthly wage of $8,382. The economic impact of the oil and gas industry in the Matanuska-Susitna Borough was an additional 2,105 jobs for Matanuska-Susitna residents, with a payroll of $84 million. The induced impacts were 1,558 jobs and $38 million in payroll. Total economic impact was estimated to be 4,016 jobs and $158 million for the Matanuska-Susitna Borough.

In Anchorage, it is estimated that about 2,400 workers are employed by the oil and gas industry. Estimated total payroll is over $239 million with an additional $845 million in goods and services in the Anchorage economy. Indirect impact of the oil and gas industry is estimated to be 11,600 jobs and $431 million in payroll, with an induced impact of 2,320 jobs and $69 million in payroll.

The oil and gas industry has been important to the economy of the Kenai Peninsula for over 40 years, and five of the top 10 employers are connected to the oil industry. Direct impact of the oil and gas industry has been estimated at 674 jobs with a payroll of $63 million. Indirect economic impacts are estimated to be an additional 2,822 jobs and $94 million in payroll. The induced impacts were 777 jobs and $20 million in payroll. Total economic impact on the Kenai Peninsula was 4,273 jobs and $177 million in payroll, which was 26 percent of the area's employment and 36 percent of the area's payroll. Taxable properties for the oil and gas industry were reported at $607 million, and 8 of the top 10 property tax payers in the borough were oil and gas industry companies.

Demand for natural gas in the Cook Inlet area is projected to exceed supply by 2015 unless new reserves are discovered and developed. Decreasing supplies of Cook Inlet natural gas led to the closure of the Agrium plant in 2007, resulting in the loss of 250 jobs in the Kenai Peninsula Borough. The LNG export license and supply contracts will expire in 2011, and continued operation of the LNG plant may be jeopardized without long-term proven supplies of natural gas. Without increased Cook Inlet natural gas supplies, prices for residential and commercial natural gas and for electricity will continue to increase. Between 2000 and 2006, the price of natural gas increased 91 percent for Anchorage households, the cost of electricity increased 28 percent, and rates for home heating are expected to rise at least another 22 percent in January 2009.

B. Director's Final Finding and Signature

The director of the Division of Oil and Gas has made a final finding that holding annual Cook Inlet Areawide oil and gas lease sales from 2009-2018 is in the best interests of the state. State law AS 38.05.035(e) and (g) requires that before an oil and gas lease sale, the director determine whether the lease sale is in the best interests of the state; state law also specifies what must be considered in making that determination. Annually, DO&G issues a call for substantial new information that has become available since the most recent finding, and based on information received, the commissioner determines whether it is necessary to supplement the finding.

This final determination is based upon a review of all facts and issues known, or made known, to the director. The director has limited the scope of the finding to the lease sale phase of oil and gas activities and the reasonably foreseeable significant effects of a lease sale (AS 38.05.035(e)(1)(A)); conditions for phasing have also been met under AS 38.05.035(e)(1)(C). At the lease sale phase, the type, location, duration, timing, or level of any exploration or development activity that might subsequently occur cannot be predicted precisely. Therefore, the director has not considered possible specific effects of unknown future exploration, development and production activities that are outside the scope of the finding. The effects of future exploration, development, and production will be considered at each subsequent stage, when various government agencies and the public review permit applications for the specific activities proposed at specific locations in the area. However, the director did consider, in general terms, the potential effects that may occur subsequent to leasing.

In making this final finding, the director considered the petroleum potential of the lease sale area; the fish and wildlife and their habitats; current and projected uses in the area, including uses and value of fish and wildlife; the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the lease sale area, including effects on subsistence uses, fish and wildlife habitat, populations, and their uses, and historic and cultural resources; the methods most likely to be used to transport oil or gas from the lease sale area and the advantages, disadvantages, and relative risks of each; the reasonably foreseeable fiscal effects of the lease sale and subsequent activity on the state and affected municipalities and communities; and the reasonably foreseeable effects of exploration, development, production, and transportation involving oil and gas on municipalities and communities in the lease sale area (AS 38.05.035(g)).

Although the initial benefit to the state will be the primary effect of leasing itself, the director recognizes that oil and gas exploration, development, and production subsequent to leasing could result in effects such as habitat changes; behavior changes in fish, wildlife and birds; and contamination of terrestrial, freshwater, and marine habitats. Therefore, general mitigation measures are included that will avoid, minimize, and mitigate potential negative effects. These address facilities and operations; habitat, fish, and wildlife; harvest activities; fuel, hazardous substances, and waste; access; prehistoric, historic, and archeological sites; and local hire, communications, and training.

Lessees must also comply with all applicable local, state, and federal codes, statutes, and regulations. Lessee advisories notify lessees of many of these additional regulatory protections, including those that are administered by the Alaska Departments of Natural Resources, Environmental Conservation, Fish and Game, and Labor and Workforce Development; the U.S. Army Corp of Engineers; the U.S. Fish and Wildlife Service; the National Marine Fisheries Service; and the Matanuska-Susitna Borough. Additional project-specific and site-specific mitigation measures will be applied as appropriate to plans of operations and proposals when submitted.

The state has sufficient authority through general constitutional, statutory and regulatory empowerments, the terms of the lease sale, the lease contract, and plan of operations permit terms to ensure that lessees conduct their activities safely and in a manner that protects the integrity of the environment and maintains opportunities for subsistence and other concurrent uses.

No activity may occur without further review and proper authorization from the appropriate permitting agency, and all activities must comply with the ACMP. When lessees propose specific activities, more detailed information such as site, type, and size of facilities will be known. In most cases, permit applications are public information, and most permitting processes include public comment periods. The department may impose additional terms during the permitting process if additional issues are identified.

The director also weighed the potential positive effects to the state, and has concluded that developing the state's petroleum resources is vital to the economies of the state and Cook Inlet area communities and municipalities, and to the well-being of its citizens. Petroleum revenues, totaling $4.57 billion in fiscal year 2007, fund services, capital projects, revenue sharing and municipal assistance, education, and Permanent Fund dividends. As Alaska's largest industry, petroleum resources provide jobs with the highest average wage in Alaska, and direct and indirect positive economic effects of over $3 billion through spending on goods and services. Demand for natural gas in the Cook Inlet area is projected to exceed supply by 2015 unless new reserves are discovered and developed, natural gas is transported to the area by a spur line from the proposed North Slope pipeline, or LNG is imported. Decreasing supplies of Cook Inlet natural gas could jeopardize industrial development and result in continued increases in costs for electricity and for heating businesses and homes, all of which will have far-reaching negative effects on local and state economies.

After weighing the facts and issues known to him at this time, comments received during the public comment period, applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the director concludes that the potential benefits of the lease sale outweigh the possible negative effects, and that Cook Inlet Areawide oil and gas lease sales will best serve the interests of the state of Alaska.

A person affected by this decision who provided timely written comments or oral testimony may request reconsideration, in accordance with 11 AAC 02. Any reconsideration request must be received by February 9, 2009, and may be mailed or delivered to:

Thomas E. Irwin, Commissioner
Department of Natural Resources
550 W. 7th Avenue, Suite 1400
Anchorage, Alaska 99501

Fax: 1-907-269-8918
Email: dnr.appeals@alaska.gov.

If reconsideration is not requested by that date or if the commissioner does not order reconsideration on his own motion, this decision goes into effect as a final order and decision on February 20, 2009. Failure of the commissioner to act on a request for reconsideration within 30 days after issuance of this decision is a denial of reconsideration and is a final administrative order and decision for purposes of an appeal to Superior Court. The decision may then be appealed to Superior Court within a further 30 days in accordance with the rules of the court, and to the extent permitted by applicable law. An eligible person must first request reconsideration of this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. A copy of 11 AAC 02 may be obtained from any regional information office of the Department of Natural Resources.

Kevin Banks, Acting Director

January 20, 2009
Date

I concur with the director that Cook Inlet Areawide oil and gas lease sales are in the state's best interest.

Thomas E. Irwin, Commissioner

January 20, 2009
Date

Appendix A: Summary of Comments and Responses

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Appendix A: Summary of Comments and Responses

This appendix summarizes comments submitted during the public comment period, which was from September 30, 2008, through December 1, 2008. Comments could be submitted in writing or as oral testimony. Written comments could be submitted at public hearings, or by mail, email, or fax. Oral testimony was recorded at public hearings, which were held in Anchorage on October 27, 2008; in Wasilla on October 29, 2008; in Kenai on November 3, 2008; and in Homer on November 6, 2008. A total of 19 comments were received, including four through oral testimony and 15 written.

Section A provides summaries and responses to several common issues expressed by commenters. These include concerns about oil spills; information, data, and studies used in the finding; need for additional studies; use of federal environmental impact statements; discussion of effects; effectiveness of mitigation measures; beluga whales; use and lack of economic data; renewable energy; greenhouse gases, climate change, and global warming; and overall costs to the state and other regulatory agencies. Section B provides summaries of comments submitted and responses.

A. Common Issues

1. Oil Spills

Some commenters expressed that there was insufficient discussion of oil spills in the finding. Chapter 6 provides a lengthy discussion of oil spill risk, prevention, and response. Section F1 discusses the history of oil spills in the area; risks at the exploration and production phases; risks associated with pipelines, marine terminals, and tankers vessels; and an ongoing statewide risk assessment of oil and gas infrastructure. Section F2 discusses oil spill prevention, such as blowout prevention and leak detection. Section F3 provides a discussion of oil spill response, including the incident command system, response teams, training, response organizations, and Geographic Response Strategies. Section F4 discusses cleanup and remediation. Section F5 provides information on the federal and state regulation of oil spill prevention and response, a discussion of industry contingency plans, financial responsibilities, and government contingency plans. Finally, Section F6 discusses oil spill mitigation measures included in the finding for Cook Inlet.

Some commenters expressed that current oil spill prevention and response strategies are insufficient, or that mitigation measures are inadequate, particularly in the challenging northern environment of Cook Inlet. Some commenters suggested specific requirements, for example double-hulled tankers, tug escorts for tankers, or a leak detection system capable of detecting one percent loss of throughput. Others stated that specific cleanup plans for inclement weather are needed or that oil spills in icy waters cannot be avoided, minimized, or mitigated.

Chapter 6, Section F1c states that the Oil Pollution Act of 1990 (OPA), which was enacted after the *Exxon Valdez* oil spill, requires that all tank vessels greater than 5,000 gross tons that are constructed or that undergo major conversions under contracts awarded after June 30, 1990, must have double hulls to operate in U. S. navigable waters. Single-hulled tankers must be phased out by 2015. Double-hulled tankers currently transport the majority of oil in Cook Inlet. Information was added to Chapter 6, Section F1c concerning the Tesoro-funded tug stationed in Cook Inlet in 2008 to assist oil tankers docking at Nikiski.

At the lease sale phase, before exploration has been conducted and a commercially exploitable discovery has been made, it is impossible to discuss oil spill prevention, response, and cleanup plans for a specific site or activity. This level of discussion is not possible because it is unknown at this time at which specific sites activities will occur in the future, which activities will occur, and the specific geophysical and climatic conditions that might exist. In addition, response actions vary greatly with the nature, location, and size of the spill. Thus, it would be inappropriate for the Cook Inlet finding to speculate about future oil spill risks, prevention, and response specific to projects that have not yet been proposed for leases that have not yet been sold.

However, Chapter 6, Section F2 discusses techniques and operating procedures required for oil exploration, development, and production. These include use of existing facilities and roads; waterbody protection, including proper location of onshore oil storage and fuel transfer areas; use of proper fuel transfer procedures; use of secondary containment, such as impermeable liners and dikes; proper management of oils, waste oils, and other hazardous materials to prevent ingestion by bears and other wildlife; consolidation of facilities; placement of facilities away from fish-bearing streams and critical habitats; siting pipelines to facilitate spilled oil containment and cleanup; and installation of pipeline leak detection and shutoff devices. Section F2b provides a lengthy discussion of various methods used to detect leaks. Section F5 discusses in detail the state and federal regulatory requirements concerning oil spill prevention and response.

The finding includes other discussions specific to Cook Inlet oil spill response. For example, Chapter 6, Section F3d includes detailed information about Cook Inlet Spill Prevention and Response, Inc. (CISPRI) which provides personnel and equipment to respond to oil spills in Cook Inlet. It is also important to note that significant advances in oil spill response have been made in Cook Inlet since the previous 1999 best interest finding. Particularly important is the development of Geographic Response Strategies, which are spill response plans specific to individual environmentally sensitive areas. Within the northern Cook Inlet response zone, response strategies have been developed for 17 sites; 22 sites for central Cook Inlet; 18 sites for southwest Cook Inlet; 21 sites for Kachemak Bay; and 22 sites for southeast Cook Inlet. A discussion of Geographic Response Strategies is provided in the finding in Chapter 6, Section F3e, including a series of maps depicting locations for which Geographic Response Strategies have been developed, and an example of a Geographic Response Strategy for a specific site (the Kasilof River).

In addition to other state and federal regulations concerning oil spill prevention and response, mitigation measures included in the finding address facilities and operations, siting of activities, surface entry restrictions, and handling and disposal of fuel, hazardous substances, and waste.

Some commenters requested a risk or gap analysis, or other studies, concerning oil spills. See Section A3 response below. The finding does discuss the Alaska Risk Assessment project that is currently underway to evaluate Alaska's oil and gas infrastructure for its ability to operate safely for another generation (Chapter 6, Section F1d).

After considering the facts known or made known to him, the director believes that the mitigation measures in the Cook Inlet best interest finding, along with other state and federal regulatory protections, are sufficient to protect the habitat, fish, and wildlife of Cook Inlet; and that on balance, Cook Inlet Areawide oil and gas lease sales are in the best interest of the state.

2. Information, Data, and Studies Used in the Finding

Some commenters expressed that information, data, or studies considered and discussed in the finding concerning fish, wildlife, habitats, water quality, effects of oil and gas development, and oil spill risk is insufficient; or that studies included in the finding are inappropriate (for example, too old, from a different location, or inconclusive).

In making a preliminary finding concerning 2009-2018 Cook Inlet Areawide oil and gas lease sales, DO&G requested information from multiple agencies such as ADF&G and NMFS. DO&G dedicated over one year of staff time to gathering and updating information. Considered and discussed in the finding is information from over 50 sources describing the Cook Inlet area, over 120 sources describing the habitats, fish, and wildlife of the area, over 90 sources describing current and projected uses of the area, and over 90 sources concerning potential effects of oil and gas development.

Although much of the information available to, and considered and discussed by, the director was relatively current, other information was older, unavailable, inconclusive, contradictory, from locations outside the sale area, or for species closely related to those in the sale area but not actually found there. This information was included, with appropriate qualifiers, so that the director had as complete information as possible available to consider, discuss, and weigh in making a finding. In addition, when data are lacking, this is acknowledged frankly in the finding. Nevertheless, this is the large body of information that constituted the facts available to the director, that were considered and discussed by the director under AS 38.05.035(g)(1) to make a finding that on balance, Cook Inlet Areawide oil and gas lease sales are in the best interest of the state.

3. Need for Additional Studies

Some commenters expressed that the state should conduct baseline studies, gap analyses, or risk studies to get more information before proceeding with oil and gas lease sales. The director is not required to conduct studies to obtain new or complete information, nor is the director required to wait until additional research or studies are conducted to make a finding of whether oil and gas lease sales are in the best interest of the state. Rather, the director is required to "consider and discuss…facts that are known to the director…and within the scope of the administrative review…" (AS 38.05.035(g)(1).

Although some commenters expressed that the director should consider additional, new, or more relevant information, only a few additional sources of information were brought to the attention of the director during the public comment period. Two sources on greenhouse gases were noted by commenters. Roe et al. 2007 was added to the finding in Chapter 8, Section C because it is specific to Alaska. The source *IPCC Fourth Assessment Report: Climate Change 2007* was not included because it deals with worldwide issues which are beyond the scope of review of the best interest finding. One source on oil spill risk analysis for the Beaufort Sea was noted by commenters; it was not included because it is specific to the Beaufort Sea and had little applicability to Cook Inlet. A source for the most current listing of anadromous waterways was noted by ADF&G; it was added to the finding in Chapter 4, Section A2. Several studies concerning brown bears were noted by ADF&G; they were added to Chapter 4, Section B3a. A study of limited utility concerning contaminants in wild foods was noted, which was added to Chapter 8, Section D1.

Therefore, the requirement that the director "consider and discuss…facts that are known to the director…and within the scope of the administrative review…" (AS 38.05.035(g)(1)) has been met.

4. Use of Federal Environmental Impact Statements

Some commenters expressed that federal environmental impact statements (EIS) cited in the finding are faulty and/or that they should not be used in the finding. The finding does cite several federal environmental impact statements. In most cases, these are cited because they do exist and they do come to one conclusion or another, which are facts that were known to the director to consider and discuss. It is appropriate that the director consider and discuss information that other natural resource agencies have compiled, the decisions that those agencies have reached concerning oil and gas development, and the rationale used to reach those decisions. However, it should not be construed that because the director considered and discussed the studies or findings of other agencies that he simply adopted the decisions of those other agencies. As noted directly above in Section A2, DO&G compiled a large and comprehensive body of information that included many sources not found in the federal environmental impact statements. After weighing all the facts known or made known to him that were within the scope of review, the director has made an independent finding that on balance, Cook Inlet Areawide lease sales are in the state's best interests.

5. Insufficiently Proven or Disproven Effects

Some commenters expressed that effects considered and discussed in the finding were insufficiently proven or disproven, or that effects from specific projects were not considered and discussed. However, the director is not required to prove or disprove effects. Rather, as discussed in the preceding Sections A3 and A4, the director is required to "consider and discuss…facts that are known to the director…and within the scope of the administrative review…" (AS 38.05.035(g)(1)).

Further, DO&G is not required to produce an environmental impact statement with a determination that effects are significant or not, which is a federal requirement relating to federal projects. Environmental impact statements are not required by state law. In fact, the legislative intent language for SB 308 (Eighteenth Legislature) Section 1(7) (Ch. 38 SLA 1994) states:

> Analysis comparable to those generally required 42 U.S.C. 4321 – 4370a (National Environmental Policy Act of 1969, as amended) for the preparation of an environmental impact statement under 42 U.S.C. 4332(2)(C) are not required by the state for support of best interest findings issued under AS 38.05 or conclusive coastal zone consistency determinations issued under AS 46.40.

In addition, the director is not required to speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use for which a written best interest finding is required is more specifically defined, including speculation about the exact location and size of an ultimate use and related facilities, the economic feasibility of ultimate development, and future environmental laws that may apply at the time of any future development (AS 38.05.035(h)). Many of the analyses and models used in federal environmental impact statements are highly speculative, and although some of these analyses and models are considered and discussed in the state's Cook Inlet finding, the director and DO&G are neither required to use this speculative information nor to develop such speculative analyses and models.

Therefore, Chapter 8 of the finding considers and discusses relevant information and studies concerning, in general, potential reasonably foreseeable effects of oil and gas development in the Cook Inlet area. As noted above in Section A2, although much of the information concerning potential effects that was available to the director was current, other information was older, unavailable, inconclusive, contradictory, from locations outside the sale area, or for species closely related to those in the sale area but not actually found there. These were the facts available to the director concerning potential effects that were considered and discussed.

The analysis of effects presented is comprehensive and adequate enough for the director to determine whether this sale, as conditioned with mitigation measures and lessee advisories, is in the best interests of the state of Alaska. DO&G has followed the statutory requirements concerning considering and discussing potential effects of oil and gas lease sales. After weighing the facts, including reasonably foreseeable effects, the director has found that on balance, Cook Inlet Areawide lease sales are in the state's best interests.

6. Effectiveness of Mitigation Measures is not Proven

Some commenters expressed that the effectiveness of mitigation measures was not proven, and therefore the finding was flawed, and/or that lease sales should not proceed. As is the case with effects discussed in the preceding Section A5, the director is not required to conduct studies concerning the effectiveness of mitigation measures. However, mitigation measures included in this finding were developed over decades of lease offerings with consultation with ADF&G and other resource agencies, and provide environmental protections beyond what is required by law. These measures balance environmental concerns, social and economic considerations, and public benefits.

Annually, DO&G is required to call for comments from the public requesting new information that has become available since the most recent best interest finding for that lease sale area was issued. Based on information received, the commissioner determines whether it is necessary to supplement the finding. Thus, there is an annual process for adding or modifying mitigation measures if new information becomes available concerning their effectiveness.

7. Beluga Whales

Some commenters noted that beluga whales are listed as endangered under the Endangered Species Act. The preliminary finding for Cook Inlet was issued on September 29, 2008, before beluga whales were listed as endangered. The preliminary finding states that a final determination on endangered status was scheduled for October 20, 2008. On October 22, 2008, a final determination to list Cook Inlet beluga whales as endangered was issued, with an effective date of December 22, 2008, for the listing. This final best interest finding has been updated to reflect that Cook Inlet beluga whales were listed as endangered under the Endangered Species Act.

8. Economic Data

Some commenters expressed that economic information concerning the tourism and fishing industries is lacking, resulting in misrepresentation of the importance of fishing and tourism to the area. Economic data known to the director are included in Chapter 3, Sections C1b, C2b, and C3b. Statistics for Figures 3.3, 3.4, 3.6, 3.7, 3.8 and 3.9 come from the U.S. Department of Labor, a standard source for information on employment and wages. The U.S. Department of Labor excludes self-employed individuals and fishers in these statistics, which is clearly footnoted on the figures. Additional statistics are provided on the number and value of commercial salmon permits in Chapter 5, Section B1a. Harvest, ex-vessel value, and price per pound by salmon species in lower and upper Cook Inlet are also discussed in Chapter 5, Section B1a. Harvest and value (if available) for other species such as Pacific halibut, Pacific herring, lingcod, Pacific cod, sablefish, rockfish, walleye pollock, clams, crab, shrimp, scallops, octopus, sea urchins, and sea cucumbers are presented in Chapter 5, Section B1b. Economic value of mariculture is discussed in Chapter 5, Section B1c. Participation, value, and harvest of sport fisheries, including angler effort, expenditures for sport fishing, wages and jobs related to sport fishing, and economic impact of sport fishing in Southcentral Alaska are included in Chapter 5, Section B2.

Potential economic costs of an oil spill to the fishing industry are addressed in Chapter 8, Section E1. Information on this topic comes primarily from the *Exxon Valdez* oil spill which occurred in Prince William Sound because similar information was not available for Cook Inlet.

In addition to statistics from the U.S. Department of Labor discussed above which included statistics for the leisure industry, information concerning economic value of tourism is found in Chapter 5, Section H.

Additional statistics, information, studies, or other sources of information concerning economic value of fishing and tourism, or information concerning potential effects of oil and gas development on fishing and tourism, were not made known to the director during the public comment period. The director believes that the information provided in the best interest finding concerning economic importance of fishing and tourism is sufficient to make a finding that on balance, Cook Inlet Areawide oil and gas lease sales are in the state's best interest.

9. Renewable Energy

Some commenters expressed that the state should pursue renewable energy. Renewable energy resources that hold the most potential in the Cook Inlet area include geothermal, wind, and hydropower. The state supports and funds significant renewable and alternative energy programs throughout Alaska. The Alternative Energy and Energy Efficiency (AEEE) program of the Alaska Energy Authority (AEA) promotes the use of renewable energy resources and local sources of coal and natural gas as alternatives to diesel-based power, heat, and fuel production. The AEA manages 33 programs and projects with state and federal funding totaling $31.5 million, including hydroelectric, wind, biomass, transmission and distribution, geothermal, diesel efficiency, and energy conservation. In 2008, the Alaska State Legislature passed House Bill 152 with the purpose of identifying and developing renewable energy resources in Alaska. The bill created the Renewable Energy Fund, administered by the AEA, to award up to $250 million in grants over 5 years for feasibility studies and other groundwork to support development of alternative and renewable energy. Up to $150 million was provided to the fund by the legislature in 2008 for renewable energy projects.

In addition to the Renewable Energy Fund, AEA funds and supports many alternative and renewable energy projects throughout Alaska. Current wind energy projects include a wind power plant in Sand Point that could displace up to 132,000 gallons of diesel annually, a wind power plant in Chevak that could displace up to 63,000 gallons of diesel annually, and 11 additional wind energy projects. A project is underway concerning the potential for in-stream energy conversion through a partnership with AEA, Electric Power Research Institute, Chugach Electric, and ML&P (Municipal Light and Power of Anchorage). AP&T (Alaska Power and Telephone) plans to install a 90 kW hydrokinetic project at Eagle on the Yukon River in 2009 with a $1.6 million grant from the Denali Commission. In addition, another company has received a preliminary FERC (Federal Energy Regulatory Commission) permit to install a horizontal tidal energy device in Knik Arm in 2009. Other AEA projects are in progress to assess fish oil-based bio-diesel at the University of Alaska Fairbanks, and to assess the feasibility of recovering fish oil for fuel and other uses. Using funding through AEA, the city of Craig has a new sawmill waste-fired heating system, and AEA is working with 30 other communities to develop clean-burning wood-fired community district heating systems. Nearly 40 hydropower projects are licensed in the state. In 2008, DO&G held a geothermal lease sale for the Mt. Spurr area which brought bids totaling $3.5 million. Sixteen tracts totaling 36,057 acres were sold.

Most renewable energy sources are not without drawbacks. Geothermal plants are relatively expensive to develop, and they may produce some byproduct sludges that require disposal at specially approved sites. Some wind farms may not be cost competitive with conventional energy sources because a higher investment is required than for fossil-fueled generators. In addition, the wind source may be intermittent so that it does not provide a reliable energy source. Wind sources are often found in remote areas far from where they are needed. They may compete with other land uses, produce unacceptable noise levels, and have aesthetic impacts. Birds can be killed by the rotors. During drought, water may not be available for hydropower systems dependant on freshwater sources. Hydropower associated with dams can have serious environmental issues, including impeding fish passage, fish mortality from turbines, impacts on water quality and flow, and impacts on habitat.

Although renewable and alternative energy holds much potential in Alaska and the Cook Inlet area, the director believes it would be premature and imprudent to cancel oil and gas lease sales in the Cook Inlet area at this time.

10. Greenhouse Gases, Climate Change, and Global Warming

Some commenters said that the finding should discuss greenhouse gases, climate change, and global warming. Climate change was discussed in the preliminary finding in Chapter 3, Section E. Global warming, the effects of the world-wide oil and gas industry, and the effects of the use of oil and gas products are beyond the scope of review for the Cook Inlet best interest finding. Effects concerning specific future projects are not included because speculation would be required about possible future effects subject to future permitting that cannot reasonably be determined until a project or proposed use is more specifically defined (AS 38.05.035). Details that are unknown at this time include numbers, sizes, and types of projects, and technology that may be available that could affect emissions. Some general information about fugitive emissions from oil and gas production, processing, transmission, and distribution of oil and gas are available and have been added to the final finding in Chapter 8, Sections C1 and C2. Information was added to Chapter 3, Section E concerning the Alaska Climate Impact Assessment Commission, Climate Sub-Cabinet, and Alaska Climate Change Strategy.

11. Cost to the State and Other Regulatory Agencies

Some commenters said that the state should analyze costs of monitoring and enforcing compliance, and for conducting studies to assess environmental impacts. An analysis of the costs of monitoring, enforcement, and environmental studies is beyond the scope of review of this best interest finding. However, fiscal effects are considered and discussed in Chapter 8, Section G of the finding. Oil and gas revenues to the state comprised approximately 87 percent of the state’s general fund in FY07, funding not just monitoring and enforcement activities, but also the state’s education, operating, and capital budgets. Net rate of return is available for some industries in the *Alaska Economic Performance Report 2007* (http://www.commerce.state.ak.us/oed/pub/AEPR_2007_Final.pdf), but was unavailable for the oil and gas industry.

B. Summaries of Comments

1. Darby, Lydia

Location: Anchorage **Format**: Written, submitted at Anchorage public hearing

a. Flaring

Comment Summary: *Comments were questions concerning flaring, including what is the historical practice, what is the impact on air quality, and what laws address flaring.*

DO&G Response: Flaring is “the controlled burning of natural gas at a well site or facility; venting is the release of uncombusted natural gas to the atmosphere” (Centre for Energy 2008). Natural gas is occasionally flared for safety reasons. However, operators in Alaska are required to minimize the volume of gas released, burned, or permitted to escape into the air (20 AAC 23.235(c)). Operators must report monthly to AOGCC any flaring event which lasts over an hour. AOGCC investigates these incidents to determine if there was unnecessary waste. In Cook Inlet, 1.07 bcf of gas was flared or vented during 2004, a decrease of 11.3 percent from 2003. This information was added to the finding in Chapter 6, Section C3.

2. Sundog Consultants, Inc. (Rob Lund, Judith Lund, Sharon Brooks, David Schnieder)

Location: Homer **Format**: Written

a. Tourism and fishing

Comment Summary: *That the effects of oil and gas development on tourism and fishing are underestimated; that tourism and fishing are vital to the lifestyle and economy of the Kenai Peninsula; that oil and gas development affect tourism and fishing by depressing their value because of negative effects on scenic values (such as visibility of oil rigs) and contamination.*

DO&G Response: The finding presents the facts concerning effects of oil and gas development on tourism and fishing that were available to the director to consider and discuss under AS 38.05.035(g)(1) in Chapter 8, Section E. This included information available from studies after the *Exxon Valdez* oil spill. No additional sources of data or studies on oil spill effects were provided during the public comment period.

The director agrees that tourism and fishing are vital to the lifestyle and economy of the Kenai Peninsula. In fact, the finding dedicates a whole chapter to discussing uses in the Cook Inlet area (Chapter 5), including 24 tables and figures of statistics on harvest and value of the area's fisheries. Section H of Chapter 5 discusses uses in the area related to recreation and tourism, including economic statistics that were available to the director.

There were few studies or data available to the director concerning whether or not oil and gas development affect tourism and fishing by depressing their value. Information available to the director was provided in Chapter 8, Sections E and H4. No additional data or studies were brought to the director's attention during the public comment period.

b. Spill prevention and response

Comment Summary: *That mitigation measures, legislation, and planning for accidents has been inadequate, such as requirements for double-hulled tankers, tug escorts, and spill response in challenging conditions (inclement weather, darkness, strong currents, sea ice).*

DO&G Response: See Section A1 response.

c. Residents will not benefit

Comment Summary: *That resource extraction companies, non-residents, and the state will benefit from oil and gas development, but that residents will not.*

DO&G Response: Chapter 8, Sections G and H consider and discuss many of the positive benefits that accrue to Alaskans from oil and gas development. These include fiscal benefits such as permanent fund dividends and the Alaska Resource Rebate which are distributed directly to residents, as well as revenue to the state that finances services such as education that benefit Alaskan residents. In addition, benefits such as industry expenditures within the state, employment of Alaskans, and providing affordable natural gas for the residents of the area are considered and discussed.

3. Lund, Rob and Judith Lund

Location: Homer **Format**: Written

a. Tourism and fishing

Comment Summary: *That the effects of oil and gas development on tourism and fishing are underestimated; that tourism and fishing are vital to the lifestyle and economy of the Kenai Peninsula; that oil and gas development affect tourism and fishing by depressing their value because of negative effects on scenic values (such as visibility of oil rigs) and contamination.*

DO&G Response: See response to previous commenter.

b. Spill prevention and response

Comment Summary: *That mitigation measures, legislation, and planning for accidents has been inadequate, such as requirements for double-hulled tankers, tug escorts, and spill response in challenging conditions (inclement weather, darkness, strong currents, sea ice).*

DO&G Response: See Section A1 response.

c. Residents will not benefit

Comment Summary: *That resource extraction companies, non-residents, and the state will benefit from oil and gas development, but that residents will not.*

DO&G Response: See response to previous commenter.

4. Faust, Nina and Edgar Bailey

Location: Homer **Format**: Written

a. Renewable energy

Comment Summary: *That the state should cancel oil and gas lease sales in Cook Inlet and instead should pursue renewable energy sources because they do not jeopardize fisheries, tourism, and wildlife habitat.*

DO&G Response: See Section A9 response.

b. Risks from oil and gas development

Comment Summary: *That oil and gas development contribute too much to the carbon footprint and have serious risks of pipeline leaks, tanker groundings, oil spills, effects on water quality, and damage to domestic water supplies.*

DO&G Response: Concerning carbon footprint, see Section A10 response. Section A1 response addresses pipelines, tankers, and oil spills. In addition, Chapter 6, Section F of the finding addresses oil spill risk, prevention and response. Chapter 8, Sections A1b and A1c address potential effects on water quality and groundwater uses.

5. Marathon Oil Company (Charles A. Underwood, Jr.)

Location: Anchorage **Format**: Written

a. General comments

Comment Summary: *That applying North Slope mitigation measures to Cook Inlet results in onerous and overly burdensome obligations that will limit future Cook Inlet development; and that local hire is a critical issue in Alaska, and that Marathon continues its efforts to hire local Kenai Peninsula residents.*

DO&G Response: These mitigation measures have been developed over the years with input from the state's resource agencies, local governments, the federal government, and industry. They seek to strike a balance between development and environmental protection. Some of these were then applied to other areas of Alaska (the North Slope, Beaufort Sea and Alaska Peninsula).

b. Changes to mitigation measures

Comment Summary – Mitigation Measure A1a: *That notifying affected surface owners is not unreasonable, but that property owners may submit comments back to ADNR; and that the operator and property owner should be allowed to come to independent resolution.*

DO&G Response: ADNR issues the Plan of Operations and owns the mineral estate. Therefore, it is appropriate for it to receive comments from property owners. Having ADNR receive comments from affected property owners will not preclude the comments from being addressed objectively or resolved.

Comment Summary – Mitigation Measure A1c: *That not allowing facilities within one-half mile of the coast is excessive and impractical for Cook Inlet and could result in more or larger pads which could have negative economic impacts on projects; that this mitigation measure could increase cumulative impacts; that there is no immediate pressing problem that this measure would correct; and that it is unclear whether cased wells are considered surface drinking water sources.*

DO&G Response: This mitigation measure has been revised to allow more flexibility in siting facilities in areas classified for or where established usage shows development. Furthermore, facilities may be sited within these buffers if the lessee demonstrates to the satisfaction of the director, in consultation with ADF&G, that site locations outside these buffers are not practicable or that a location inside the buffer is environmentally preferred. A cased water well is not a surface drinking water source.

Comment Summary – Mitigation Measure A1d: *That the U.S. Army Corps of Engineers has the sole authority to regulate and approve development in wetlands.*

DO&G Response: Mitigation Measure A1d states:

> Impacts to identified wetlands must be minimized to the satisfaction of the director, in consultation with ADF&G and ADEC. The director will consider whether facilities are sited in the least sensitive areas. Further, all activities within wetlands require permission from the U.S. Army Corps of Engineers.

Mitigation Measure A1d acknowledges the role of the U.S. Army Corps of Engineers in managing wetlands. However, as the land owner, ADNR has the authority to impose conditions or limitations on the use of its land, in addition to those imposed by the U.S. Army Corps of Engineers, to ensure that a resource disposal is in the state's best interests. Further the introduction to the mitigation measures states:

> Lessees must comply with all applicable local, state and federal codes, statutes and regulations, as amended, as well as all current or future ADNR area plans and recreation rivers plans; and ADF&G game refuge plans, critical habitat area plans, and sanctuary area plans within which a lease area is located. Lease activities must be consistent with the enforceable policies of the Alaska Coastal Management Program, including statewide standards and the enforceable policies of an affected coastal district, as amended.

<u>Comment Summary – Mitigation Measure A1e</u>: *That disallowing use of gravel for access and pads is not feasible in Cook Inlet; that lack of extended cold weather conditions and high cost of alternate materials preclude other means; that the high costs force operators to use the most effective means, such as previously disturbed locations and public roads.*

<u>DO&G Response</u>: Mitigation Measures A1e and A1f have been rewritten: Construction of temporary drill pads, airstrips, and roads may be allowed.

e) Exploration activities must be supported by air service, an existing road system or port facility, ice roads, or by off-road vehicles that do not cause significant damage to the vegetation or ground surface. Unrestricted surface travel may be permitted by the director and DMLW if an emergency condition exists. Construction of temporary drill pads, airstrips, and roads may be allowed. Construction of permanent roads may be allowed upon approval by the director.

f) With the exception of drill pads, airstrips, and roads permitted under A1e, exploration facilities must be consolidated, temporary, and must not be constructed of gravel. Use of abandoned gravel structures may be permitted on a case-by-case basis.

<u>Comment Summary – Mitigation Measure A1g</u>: *That the applicant should have the flexibility to conduct wildlife studies to determine presence of wildlife before having to build pipelines that accommodate wildlife movement.*

<u>DO&G Response</u>: Mitigation Measure A1g requires that pipelines must utilize existing transportation corridors and be buried where conditions permit. In areas with above ground placement, pipelines must be designed, sited, and constructed to allow for the free movement of wildlife. ADNR believes that these are reasonable requirements. There are very few areas in the Cook Inlet area, even urban areas, which have no wildlife present. This mitigation measure allows for flexibility. Whether conditions permit a pipeline to be buried will be determined on a site-specific, case-by-case basis, once a specific project is proposed.

<u>Comment Summary – Mitigation Measure A1i</u>: *That operators must have flexibility to expand gravel operations when necessary; that operators who purchase gravel from privately owned and permitted pits should not be subject to unnecessary or duplicative regulation.*

<u>DO&G Response</u>: Nothing in Mitigation Measure A1i prohibits the expansion of gravel operations where necessary. The mitigation measure only restricts gravel mining sites to the minimum necessary to develop the field efficiently and to minimize environmental damage. Furthermore, this mitigation measure does not subject operators to unnecessary or duplicative regulation if they purchase gravel from privately owned and permitted pits.

__Comment Summary – Mitigation Measure A2d__: *Marathon is aware of the presence of state lands within the Kenai National Wildlife Refuge and desires to make it known that access to inholdings held by Native corporations is a right specified in the Alaska National Interest Lands Conservation Act (ANILCA). This obligation may be invalid if access to inholdings through adjacent state land is necessary.*

__DO&G Response__: Mitigation Measure A2d prohibits surface entry on state lands within the Kenai National Wildlife Refuge but does not limit surface entry for access to other private lands within the refuge. The mitigation measure has been rewritten to clarify this.

__Comment Summary – Mitigation Measure A2g__: *That the USFWS should be involved in the process related to protection of Steller's eiders.*

__DO&G Response__: Lessee Advisories 6a and 6c alert operators that Steller's eiders are protected by the Endangered Species Act and each operator is advised to consult with the USFWS in advance of any activities.

__Comment Summary – Mitigation Measure A2i (vii)__: *That requiring recording of onsite bear activity is excessive.*

__DO&G Response__: Mitigation Measure A2i(vii) has been rewritten: Lessees are no longer required to provide a systematic record of bears on the site and in the immediate area. They are now required to document and communicate the sighting of bears on site or in the immediate area to all shift employees.

__Comment Summary – Mitigation Measure A2m__: *That relocating facilities to accommodate bear movement corridors may be uneconomic, and that options should be fully evaluated before requiring significant modifications.*

__DO&G Response__: Original Mitigation Measure A2m regarding bears has been deleted. Original Mitigation Measure A2l has been rewritten and renumbered. Mitigation Measure A2k now reads:

> Recognizing the importance of sufficient vegetative cover and access by Kenai Peninsula brown bears feeding at streams, the director, in consultation with ADF&G, may require lessees to locate exploration and development facilities beyond the 500-foot buffer along anadromous streams during the plan of operations approval stage, except as provided in A1c.

__Comment Summary – Mitigation Measure A4b__: *That it is assumed that the 1,500 foot setback for fuel does not apply to potable water wells.*

__DO&G Response__: A potable water well is not considered a surface drinking water source.

__Comment Summary – Mitigation Measure A4d__: *That the practicality of placing secondary containment under hose fittings should be evaluated by the operator; that weather conditions may prevent placement of liner material; that operators should have the flexibility to determine what protection is best during fuel transfers.*

__DO&G Response__: ADNR believes that secondary containment is a reasonable and practical precaution and does not pose an undue burden on the operator.

Comment Summary – Mitigation Measure A4g: *That it should be clarified that this requirement is for crude oil facilities.*

DO&G Response: This mitigation measure is intended to apply to both crude and refined oil.

Comment Summary – Mitigation Measure A4j: *That Marathon currently utilizes permitted Class II disposal wells for disposal of exempt drilling and production waste.*

DO&G Response: Comment noted.

Comment Summary – Mitigation Measure A5a: *That temporary restrictions on use by the public may be necessary and that closures may be required at distances greater than the immediate vicinity of the drilling location or operating pad.*

DO&G Response: Temporary restrictions outside the immediate vicinity of the drilling location or operating pad may be identified in the plan of operations.

Comment Summary – Mitigation Measure A6a: *That this measure is duplicative of A6b. That A6a and A6b should be combined.*

DO&G Response: Mitigation Measure A6a requires lessees to conduct an inventory of prehistoric, historic, and archeological sites within the area affected by an activity. Mitigation Measure A6b provides that the director will direct the lessee as to the course of action to take to avoid or minimize adverse effects to those sites.

Comment Summary – Mitigation Measure A7a: *That requiring a detailed local hire proposal is excessive; that Marathon has a long history of local hire and training.*

DO&G Response: ADNR does not believe that the mitigation measure is excessive.

Comment Summary – Mitigation Measure A7b: *That Marathon notifies affected individuals and communities.*

DO&G Response: Comment noted.

Comment Summary – Mitigation Measure A7c: *That the training required is excessive, overly restrictive, relevant to the North Slope, and is misapplied to Cook Inlet.*

DO&G Response: The training program must be designed to inform each person working on the project of environmental, social, and cultural concerns that relate to that person's job. Environmental, social, and cultural concerns are relevant to the Cook Inlet area as well as the North Slope. The training program is not misapplied to Cook Inlet.

Comment Summary – Lessee Advisory B2a: *That natural gas exploration and development project can be exempted from the Financial Responsibility and Oil Spill Contingency Plan requirements.*

DO&G Response: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) before commencing operations. The provisions of AS 46.04.030 and 46.04.040 do not apply to a natural gas exploration facility if the Alaska Oil and Gas Conservation Commission has determined under AS 31.05.030 (l) that evidence obtained through evaluation demonstrates with reasonable certainty that all of the wells at a natural gas exploration facility will not penetrate a formation capable of flowing oil to the ground surface. If the drilling of a well at an exploration facility exempted under this subsection does penetrate a formation capable of flowing oil to the surface, the owner or operator shall submit an oil discharge prevention and contingency plan and proof of financial responsibility to the department to meet the requirements of AS 46.04.030 and 46.04.040. For purposes of this subsection, "natural gas exploration facility" means a platform, facility, or structure that, except for storage of refined petroleum products in a quantity that does not exceed 10,000 barrels, is used solely for the exploration for natural gas.

Comment Summary – Lessee Advisory B2b: *That air permit needs must be evaluated and that a permit must be in place only if it is required.*

DO&G Response: Lessee Advisory B2b requires lessees to follow state and federal laws and regulations. If air permits are not required by ADEC and EPA, then the lessee will not have to obtain them.

Comment Summary – Lessee Advisory B4a: *That Marathon objects to reporting requirements for wages, which is unnecessarily burdensome and provides no direct benefit to the state.*

DO&G Response: Encouraging Alaska hire is a benefit to the state. Electronic unemployment insurance reporting does not pose an undue burden. Lessees are not required to disclose the names of individuals or any confidential information.

6. Aurora Gas, LLC (Bruce D. Webb)

Location: Anchorage **Format**: Written

a. General comments

Comments Summary: *That the proposed mitigation measures have ambiguities that need to be clarified so that interpretation is not left up to individual state employees who have obstructionist attitudes that will not encourage exploration and development.*

DO&G Response: Mitigation measures are written to give state permitters flexibility when approving development plans. This flexibility allows for consideration of the environmental effects on a case-by-case basis.

b. Changes to mitigation measures

Comment Summary – Mitigation Measure A1c: *That this mitigation measure does not take into consideration existing facilities, despite ADNR preferring that facilities be consolidated; that the following change is suggested: "Additionally, with the exception of proposed facilities on existing pads, to the extent practicable, the siting of facilities will be prohibited within one-half mile of…"*

DO&G Response: Mitigation Measure A1c has been rewritten as follows:

> The siting of onshore facilities, other than roads, docks, utility or pipeline corridors, or terminal facilities will be prohibited within one-half mile of the mean high water of Cook Inlet except where land use plans classify an area for development, or established usage and use history show development. Furthermore, facilities may be sited within these buffers if the lessee demonstrates to the satisfaction of the director, in consultation with ADF&G, that site locations outside these buffers are not practicable or that a location inside the buffer is environmentally preferred.

Comment Summary – Mitigation Measure A1f: *That this mitigation measure and Mitigation Measure A1e are ambiguous and subject to various interpretations; that measure A1f has been abused by ADF&G to restrict responsible exploration and development; that is was meant to prevent long, linear gravel roads that would have significant impacts during exploration, but that it was meant to allow gravel pads and airstrips; that the following change is suggested:*

> *Gravel drill pads, airstrips, and access roads between these drill pads and airstrips are allowed for exploration activities. Roads which are permitted under A1e above are allowed on a case-by-case basis. All other exploration facilities must be consolidated, temporary and not be constructed of gravel. Use of abandoned gravel structures, including those within one-half mile of the water bodies listed in A1c above, are also allowed to promote consolidation of facilities and minimize additional surface impacts.*

DO&G Response: Mitigation measures are written to give state permitters flexibility when approving development plans. This flexibility allows for consideration of the environmental effects on a case-by case basis.

Comment Summary – Chapter 7, Section 2, Plan of Operations Approval: *That the ability of DO&G to exercise its authority beyond the lease boundary contradicts the statute and its intent, resulting in unnecessary redundancy and burden on the applicant; that lease operation approvals should focus on the lease activity, not activities regulated by other governmental agencies.*

DO&G Response: The commenter appears to disagree with regulations concerning plans of operations approval, which is set out in state regulation 11 AAC 83.158. Amending regulations is beyond the scope of this finding.

7. ConocoPhillips (Michael Nelson)

Location: Anchorage **Format**: Written

a. Changes to mitigation measures

Comment Summary – Mitigation Measure A1b: *That a definition of "areas of high residential, commercial, recreational or subsistence use" should be added to Section 8 (e.g., in the form of population density, pre-identified areas of high subsistence use, etc.), or change language to "urban" and "rural" and refer to the definitions of the U.S. Census Bureau.*

DO&G Response: Areas of high residential, commercial, recreational, or subsistence use are constantly changing and will be determined at the plan of operations phase, on a case-by-case basis, when a specific project is proposed and will depend on the type of activity and its location.

Comment Summary – Mitigation Measure A1c: *That the measure should be reworded to: "The siting of onshore facilities, other than roads, docks, utility or pipeline corridors, or terminal facilities will be prohibited within 1/2 mile of the coast, barrier islands, reefs, and lagoons; 500 feet of all ~~fish bearing~~ catalogued streams and waterbodies; and..."; and that the reference to catalogued streams should be included in Section 8.*

DO&G Response: This mitigation measure is designed to protect all fish bearing streams not just catalogued streams.

Comment Summary – Mitigation Measure A1g: *That the first sentence of the 2nd paragraph, "Offshore pipelines must be located and constructed to prevent obstruction to marine navigation and fishing operations," should be moved to A1h which deals with offshore pipelines.*

DO&G Response: Adopted.

Comment Summary – Mitigation Measure A2i (vii): *That the purpose of "providing a systematic record" is unclear, as is to whom the record will be provided; and that the following change is suggested: "Develop a mechanism to communicate the siting or presence of bears on site or in the immediate area to all shift employees."*

DO&G Response: Adopted.

Comment Summary – Mitigation Measure A2n-q: *The commenter asks, "Are the seasonal habitats and calving areas of the Kenai Lowlands Caribou Herd mapped/documented," and states that if so, this area should be defined and referenced in Section 8.*

DO&G Response: The habitat use areas of moose and caribou on the Kenai Peninsula have been documented, including core calving and summer use areas. Core areas are used seasonally by a high concentration of moose or caribou. Disturbances in core areas can disrupt important life stages such as calving or winter feeding and can cause changes in population size. Documents delineating the core habitat areas are available from the Soldotna ADF&G office (phone 907-262-9368).

Comment Summary – Mitigation Measure A4: *That a definition of "hazardous substances" should be added by incorporating a reference to EPA or OSHA standards.*

DO&G Response: AS 46.09.900 defines hazardous substances as: (A) an element or compound that, when it enters into or on the surface or subsurface land or water of the state, presents an imminent and substantial danger to the public health or welfare, or to fish, animals, vegetation, or any part of the natural habitat in which fish, animals, or wildlife may be found; or (B) a substance defined as a hazardous substance under 42 U.S.C. 9601 - 9657 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980); "hazardous substance" does not include uncontaminated crude oil or uncontaminated refined oil; This definition has been added to Section 8.

Comment Summary – Mitigation Measure A4f: *That the measure should be revised as follows: "All independent fuel and hazardous substance containers shall be marked with the contents and the lessee's or contractor's name ~~using paint or a permanent label~~ at all times."*

DO&G Response: Permanent marking is a necessary and reasonable requirement to identify the owner and contents of fuel and hazardous substance containers.

Comment Summary – Mitigation Measure A4g: *That this measure should be remove or revised because it is too prescriptive and narrow to apply to general oil and gas operations; that not all "above-ground liquid hydrocarbon storage facilities" are regulated by ADEC, and that at a minimum, this measure should refer to the volume of the storage facility for which a monitoring well is required.*

DO&G Response: This mitigation measure was revised. A freshwater aquifer monitoring well, and quarterly water quality monitoring, may be required down gradient of a permanent above-ground liquid hydrocarbon storage facility.

Comment Summary – Mitigation Measure A4h: *That this measure is too prescriptive and narrow to apply to general oil and gas operations; that not all facilities are equipped with incinerators, and ADEC air permits for incinerators are difficult to obtain because they are heavily regulated at the federal level; that the measure should be revised as follows: "...Garbage and domestic combustibles must be ~~incinerated whenever possible or~~ disposed of at an approved site in accordance with 18 AAC 60."*

DO&G Response: This mitigation measure was revised. Garbage and domestic combustibles must be incinerated or disposed of at an approved site in accordance with 18 AAC 60.

Comment Summary – Mitigation Measure A4j: *That not all facilities own and operate underground injection disposal wells; that whether or not a well can be used for disposal of drilling muds and cuttings is determined by EPA or AOGCC, and is based on the formation into which a lessee proposes to inject; that some lessees may not have this alternative; and that EPA currently allows for discharge of drill cuttings and water-based drilling mud into Cook Inlet by NPDES permit. That the measure should be revised as follows:*

> *Drilling muds and cuttings may be disposed via underground injection in accordance with programs administered by the AOGCC or EPA, drilling waste monofills as permitted by ADEC, or in some cases discharged as permitted by EPA. Drilling muds and cuttings cannot be discharged into lakes, streams, rivers, or important wetlands.*

Also, that a definition of "hazardous substances" should be added by incorporating a reference to EPA or OSHA standards.

DO&G Response: This mitigation measure has been revised:

> Wherever practicable, the preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Other methods of disposal shall be allowed only upon approval by the director, in consultation with ADEC and ADF&G.

8. Pioneer Natural Resources Alaska, Inc. (John Hellén)

Location: Anchorage **Format**: Written

a. Support of the finding

Comment Summary: *That Pioneer Natural Resources Alaska supports the finding that Cook Inlet Areawide oil and gas lease sales will be in the best interest of the state.*

DO&G Response: Comment noted.

b. Changes to mitigation measures

Comment Summary – Mitigation Measure A1c: *That the one-half mile prohibition on facilities is excessive and would bias development away from extended reach drilling in favor of platforms.*

DO&G Response: This mitigation measure has been revised to allow more flexibility in siting facilities in areas established or classified for industrial development. Furthermore, facilities may be sited within these buffers if the lessee demonstrates to the satisfaction of the director, in consultation with ADF&G, that site locations outside these buffers are not practicable or that a location inside the buffer is environmentally preferred.

Comment Summary – Definition of Secondary Containment: *That the requirement for 12 inches of freeboard is unnecessary and potentially hazardous; that the definition be revised to be consistent with state or federal spill prevention regulations.*

DO&G Response: The requirement for 12 inches of freeboard has been removed from the definition of secondary containment.

Comment Summary – Lessee Advisory B4a: *That Pioneer Natural Resources Alaska supports local hire, but that they object to the requirement to report individual wages; that the language of the advisory gives the incorrect impression that it is a requirement.*

DO&G Response: Facilitating Alaska hire is a benefit to the state. Electronic unemployment insurance reporting does pose not an undue burden. Lessees are not required to disclose the names of individuals or any confidential information.

Comment Summary – Lessee Advisory B6c: *That the advisory needs to clarify that it applies to activities within 3 miles seaward of the coast, and that onshore activities would not have the potential to affect Steller's eiders.*

DO&G Response: Lessee advisory B6c has been rewritten to more clearly describe habitat used by Steller's eiders in Cook Inlet, which includes areas both onshore and offshore. It states:

> The USFWS has determined that oil and gas exploration and development activities **within three miles seaward or within one-half mile landward of the eastern shore of Cook Inlet**, from Clam Gulch to the southern bounds of the lease sale area, are likely to adversely affect (take) Steller's eiders. Each operator is advised to consult with the USFWS well in advance of any activities in this area.

9. Cook Inlet Regional Citizens Advisory Council (Steve Catalano)

Location: Anchorage **Format**: Written

a. Mitigation of oil spills

Comment Summary: *That the finding has significant deficiencies regarding up-to-date information about oil spill mitigation; that additional analysis of oil spill risk is needed such as one performed by MMS for the Beaufort Sea; that a gap analysis should be conducted; and that the state should require all undersea pipelines associated with oil production to have a leak-detection system capable of detecting one percent loss of throughput.*

DO&G Response: See Section A1 response.

b. Impacts on fish, wildlife, and habitats

Comment Summary: *That the sections describing Cook Inlet's physical and biological environments are lacking, particularly concerning middle and upper Cook Inlet, and appear to have been rewritten from earlier state and federal documents; that the state should support Cook Inlet water quality studies on oil and gas infrastructure; that Chapter 8 cites an MMS environmental* *impact study; and that the finding needs to reflect that beluga whales are listed as endangered under the Endangered Species Act.*

DO&G Response: See response A2 and A3 concerning lack of information and need for studies. Some information was retained from the previous 1999 best interest finding if no new or updated information was available. See response A2 concerning the large number of information sources used for the current finding. See response A4 concerning use of federal environmental impact statements. See response A7 concerning listing of beluga whales.

c. Funding for CIRCAC

Comment Summary: *That successful bidders should be required to provide funding to the Cook Inlet Regional Citizens Advisory Council to improve their capacity to prevent, mitigate, and respond to oil spills.*

DO&G Response: Cook Inlet Regional Citizens Advisory Council already receives its base annual funding from the operators in Cook Inlet. The director believes requiring companies to provide funding at the lease sale phase, before any exploration, development, or production has occurred, would pose an undue burden.

10. Trustees for Alaska (Michael J. Frank)

Location: Anchorage **Format**: Written

a. Phasing

Comment Summary: *That phasing is applied inappropriately to the lease sale phase; that there are concerns about the constitutionality of phasing; that there is insufficient review at later phases; and that ADNR should conduct a best interest finding process for all post-lease phases.*

DO&G Response: Phased review is discussed in detail in Chapter 2, Section G. Under AS 38.05.035(e)(1)(C), the director may, if the project for which the proposed disposal is sought is a multiphased development, limit the scope of an administrative review and finding for the proposed disposal to the applicable statutes and regulations, facts, and issues that pertain solely to the disposal phase of the project when:

(i) the only uses to be authorized by the proposed disposal are part of that phase;
(ii) the disposal is a disposal of oil and gas, or of gas only, and, before the next phase of the project may proceed, public notice and the opportunity to comment are provided unless the project is subject to a consistency review under AS 46.40 and public notice and the opportunity to comment are provided under AS 46.40.096(c);
(iii) the department's approval is required before the next phase may proceed; and
(iv) the department describes its reasons for a decision to phase.

The conditions under which phasing may occur have been met for Cook Inlet Areawide oil and gas lease sales addressed in this best interest finding.

Deciding on constitutionality of phasing is beyond the role of ADNR and beyond the scope of review of the best interest finding. ADNR is following the statutory framework established by the legislature.

Conducting a best interest process for post-lease phases is not required by statute. In addition, the legislative intent language for SB 156 (Twenty-second Legislature) Section 1(f)(1) states that "no other best interest finding is required after the disposal phase."

SB 156 Section 1 (c) and (d) discusses the legislature's purpose in amending AS 38.05.035 in 1994. In (c) it says "Although the legislature did intend that there would be a detailed review of the project at any later phase, the legislature did not intend that the Department of Natural Resources would have to issue another best interest finding as part of the review." In (d) it says, "When passing the 1994 amendments, the legislature was aware that the post-disposal phases, which are exploration, development , and transportation, would be subjected to numerous federal, state, and local laws, regulations, polices, and ordinances; reviewed by numerous agencies; and subjected to public review and comment." Applications for permits and plans of operation generally require public notice and opportunity for public input. Chapter 7 describes many of the other permits and approvals required by local, state, and federal agencies for oil and gas exploration, development, and production.

b. Discussion of impacts

Comment Summary: *That the finding's discussion of impacts is largely generic and uninformative; that ADNR is not obligated to engage in studies of potential impacts and is required only to analyze "known" information.*

DO&G Response: The director agrees with Trustees that ADNR is not required to engage in studies of potential impacts, and is required to consider and discuss facts known or made known to the director. The legislative intent language for SB 156 (Twenty-second Legislature) Section 1(f)(2) (Chapter 101, SLA 2001) states that "the best interest finding shall be based upon known information or information that is made available to the director, even if all potential cumulative impacts of the project are not known."

Chapter 8 discusses reasonably foreseeable effects of leasing and subsequent activity. Best interest finding are not required to speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use is more specifically defined (AS 38.05.035(h)). However, Chapter 8 discusses facts known or made known to the director concerning reasonably foreseeable effects of leasing and subsequent activity, as required by statute. This 23-page discussion includes references to over 90 sources concerning these effects. The director has taken a hard look at the facts presented, considered, and discussed in Chapter 8, and believes that they are sufficient for finding that oil and gas lease sales in Cook Inlet are in the best interest of the state.

c. Lease terms

Comment Summary: *That including the phrase "and insofar as is constitutionally permissible" in lease term #26 is unnecessary, does not protect the best interests of the state, and should be deleted from the lease.*

DO&G Response: Noting that state action is limited by the constitution is appropriate.

d. Use of the term "significant"

Comment Summary: *That ADNR must explain and justify its use of the term "significant".*

DO&G Response: The purpose of the term "significant" in Chapter 2, Section F is to assist interested parties with understanding the concept of reasonably foreseeable effects. This text represents an ongoing working explanation that has been used in various ADNR documents to provide examples of the types of effects that are discussed in best interest findings. The common definition of the term significant is the meaning intended: "having or likely to have influence or effect: important", "of a noticeably or measurably large amount" (Merriam-Webster 2008).

e. Citations for studies

Comment Summary: *That inadequate citations are provided for studies cited in the finding.*

DO&G Response: The Name Year format used for citing studies and other sources in the finding is a standard format. See for example:

CBE (Council of Biology Editors)
1994 Scientific style and format: the CBE manual for authors, editors, and publishers, *sixth edition*. Style Manual Committee, Cambridge University Press, New York.

A complete listing of sources cited is provided at the end of each chapter. In addition to standard bibliographic information included in the references section at the end of each chapter, DO&G provides URL addresses so that the reader can go directly to the source if it is available online. DO&G spent considerable effort to ensure that sources used in the finding were properly cited, including purchase and use of bibliographic software to keep track of sources and to link text citations to lists of sources at the end of each chapter.

f. Use of environmental impact statements

Comment Summary: *That a federal environmental impact statement cited to support ADNR's claim of no significant impacts should cite to specific pages, that the citation does not cover the area of the state's proposed Cook Inlet Areawide oil and gas lease sales, and that the areas cited in the environmental impact statement differ in kind, quality, and natural attributes from the state lease sale area. That ADNR should engage in a federal environmental impact statement-like process for best interest findings.*

DO&G Response: Concerning citing to specific pages, see preceding response. Concerning including references to federal environmental impact statements, DO&G makes no claim or determination that Cook Inlet lease sales will or will not have significant effects. Federal environmental impact statements may require such a determination, but the director is not required to prepare an environmental impact statement (see Section A5 above). Rather, the director is required to consider and discuss the available facts and to make a finding whether oil and gas lease sales are in the best interests of the state. Concerning the use of information that is from areas outside the Cook Inlet Areawide oil and gas lease sale area, or that may differ in various ways from the area, see Section A2 above.

DO&G is not required to produce an environmental impact statement with a determination that effects are significant or not, which is a federal requirement relating to federal projects. Environmental impact statements are not required by state law. In fact, the legislative intent language for SB 308 (Eighteenth Legislature) Section 1 (7) states:

> Analyses comparable to those generally required by 42 U.S.C. 4321 -4370a (National Environmental Policy Act of 1969, as amended) for the preparation of an environmental impact statement under 42 U.S.C. 4332(2)(C) are not required by the state for support of best interest findings issued under AS 38.05 or conclusive coastal zone consistency determinations issued under AS 46.40.

g. Beluga whale listing

Comment Summary: *That the finding needs to reflect the federal listing of beluga whales as endangered under the Endangered Species Act; that tracts designated as Type 1, 2, or 3 should be removed from the Cook Inlet Areawide lease sale area in anticipation of critical habitat area* *designations by NMFS, or by including a provision in the lease that prohibits any surface activity on any leased lands that NMFS designates as critical habitat before or after the sale.*

DO&G Response: See Section A7 concerning listing of beluga whales. The director believes it would be premature to remove tracts from the lease sale area and/or to add prohibitions on surface activity in anticipation of critical habitat designations by NMFS. NMFS has one year to make critical habitat designations, a process which includes analysis of economic impacts and public comment. NMFS did not submit requests for tract removals or additional mitigation measures during the public comment period for the Cook Inlet best interest finding. In Chapter 9, Section B6, potential lessees are advised of the beluga listing and their responsibility to comply with applicable laws and regulations of other agencies, including NMFS, the Endangered Species Act, and the Marine Mammal Protection Act.

h. Habituation of beluga whales

Comment Summary: *That faulty conclusions were reached concerning habituation of beluga whales to oil and gas activity; and that the definition of habituate is unclear.*

DO&G Response: The finding makes two statements about habituation of whales to anthropogenic activities. The purpose of both of these statements is to provide available information to the director that can be used in finding whether Cook Inlet oil and gas lease sales are in the best interest of the state. The purpose is not to make definitive conclusions on habituation of beluga whales to anthropogenic activities. The first statement brings to attention that research is lacking: "Research is also lacking on whether or not some species may become habituated to, and stop being affected by, certain kinds of sounds, or on whether certain species may become more sensitive to sounds with increased exposure (Hofman 2003)". The second statement provides a conclusion made not by the director, but by NMFS beluga whale experts in a published scientific journal article about beluga whales and disturbances: beluga whales "continue to occupy upper Cook Inlet despite oil and gas development, vessel and aircraft traffic, and dredging operations, and based on a review of available information, Moore et al. (2000) concluded that belugas appear to have become habituated to offshore oil and gas activities in central Cook Inlet."

Concerning the definition of "habituate", the standard definition is intended: "to make used to something ; accustom" (Merriam-Webster 2008). Therefore additional explanation is unnecessary.

i. Essential Fish Habitat

Comment Summary: *That federal recommendations for mitigation measures as listed in Essential Fish Habitat legislation should be used to guide mitigation measures for Cook Inlet Areawide oil and gas lease sales; that tracts containing kelp beds should not be included in lease sales; and that eulachon and other fish spawning areas should not be included in lease sales, or that surface activity in them should be prevented; that commercial eulachon harvest should be included at a minimum.*

DO&G Response: Essential Fish Habitat (EFH) is discussed briefly in Chapter 4, Section A3. However, EFH is a federal designation that is considered by federal agencies during the review process of federal projects. Chapter 9, Section B6f notifies potential lessees that their activities may be subject to federal consultation concerning EFH. Many of the mitigation measures provided in the Cook Inlet Areawide best interest finding were developed to ensure protection of important habitats. Mitigation measures that will provide protection to fish, wildlife, and habitat were developed in consultation with ADF&G, as well as with input from NMFS. These agencies did not request removing tracts with kelp beds or fish spawning areas. The director believes that the mitigation measures included in this finding are sufficient to protect fish, wildlife, and their habitats.

j. Legislatively Designated Areas

Comment Summary: *That legislatively designated areas should be removed from the lease sale; and that buffers should be added to legislatively designated areas and to federally-protected areas within and near the lease sale area.*

DO&G Response: The director believes that legislatively designated areas are adequately protected by mitigation measures and other regulatory requirements, and thus, it is unnecessary to remove the areas from the lease sale area or add buffers. The director believes that federally-protected areas near state tracts are adequately protected by mitigation measures in the Cook Inlet best interest finding, as well as by other state and federal regulatory requirements.

k. Steller's eiders

Comment Summary: *That areas used by Steller's eiders should be eliminated from the lease sale, or that lease-related surface activities should be prohibited in areas when Steller's eiders are present; and that Chapter 9 does not specify which measures are intended to target Steller's eiders.*

DO&G Response: Most identified Steller's eider habitat is outside the Cook Inlet lease sale area (see Figure 4.2). Mitigation Measure A2g, which was developed in consultation with ADF&G and USFWS, addresses Steller's eiders. It says:

> The director, in consultation with ADF&G, shall restrict or modify lease related activities if scientific evidence documents the presence of Steller's eiders from the Alaska breeding population in the lease area and it is determined that oil and gas exploration and development will impact them or their over-wintering habitat in the near-shore waters of Cook Inlet.

In addition, potential lessees are advised in Chapter 9, Section B6a and B6c that Steller's eiders are listed as threatened under the Endangered Species Act and that lessees need to contact the appropriate federal agency to ensure that their activities do not result in taking of Steller's eiders. The director believes that Steller's eider habitat is adequately protected by mitigation measures and other regulatory requirements, and thus, it is unnecessary to remove additional areas from the lease sale.

l. Steller sea lion

Comment Summary: *That habitats used by Steller sea lions should be eliminated from the lease sale area.*

DO&G Response: Most important Steller sea lion habitat is located outside the Cook Inlet lease sale area (see Figure 4.11). However, potential lessees are advised in Chapter 9, Section B6a and B6b that Steller sea lions are listed as endangered under the Endangered Species Act, and that potential lessees must comply with requirements of the Endangered Species Act and the Marine Mammal Protection Act. The director believes that Steller sea lions and their habitat are adequately protected by mitigation measures, the Endangered Species Act, the Marine Mammal Protection Act, and other regulatory requirements, and thus, it is unnecessary to remove additional areas from the lease sale.

m. Effectiveness of mitigation measures

Comment Summary: *That there is no analysis of the potential effectiveness of mitigation measures.*

DO&G Response: See Section A6 response.

n. Oil spills

Comment Summary: *That current oil spill prevention and response strategies are ineffective; that tankers in Cook Inlet should be required to be accompanied by a suitable escort tug; and that comments submitted by Cook Inlet Regional Citizens Advisory Council are incorporated by reference.*

DO&G Response: See Section A1 response.

o. Greenhouse gases and global warming

Comment Summary: *That the finding fails to estimate and discuss current and future greenhouse gas emissions from Cook Inlet oil and gas activities; and that the finding does not discuss adverse effects of global warming on oil and gas activities.*

DO&G Response: See Section A10 response.

11. Ground Truth Trekking (Erin McKittrick and Bretwood Higman)

Location: Seldovia **Format**: Written

a. Oil spill risk

Comment Summary: *That a statistical analysis of oil spill risk, similar to the MMS Beaufort Sea environmental impact statement, should be included; that performance of all proposed spill prevention and response plans should be analyzed; and that the state should conduct studies to determine impacts of previous oil spills.*

DO&G Response: See Section A1 response.

b. Oil spill cleanup

Comment Summary: *That plans for spill cleanup in inclement weather should be included.*

DO&G Response: See Section A1 response.

c. Fish, wildlife, and habitats

Comment Summary: *That past impacts of oil and gas development on Cook Inlet fish, wildlife, habitats, and industries are not adequately addressed, and that the state should study impacts of past oil and gas development on fish and wildlife.*

DO&G Response: Chapter 8 discusses potential effects of oil and gas development in Cook Inlet. The chapter includes over 90 sources concerning impacts of oil and gas development. Additional sources of information were not brought to the attention of the director during the public comment period. See also Section A2 and Section A3 responses above concerning additional studies.

d. MMS environmental impact statement

Comment Summary: *That an MMS environmental impact statement for the Outer Continental Shelf is cited frequently in the chapter on effects, but that findings of that impact statement are irrelevant to the state's Cook Inlet Areawide oil and gas lease sales.*

DO&G Response: See Section A2 and A4 responses.

e. Water quality

Comment Summary: *That water quality information provided in the finding is insufficient and does not prove a lack of water quality impacts from oil and gas development; and that the state should conduct studies to assess impacts of oil and gas development on Cook Inlet water quality.*

DO&G Response: See Section A3 and A4 responses, and Section B10l response.

f. Geologic hazards

Comment Summary: *That the finding does not adequately address geologic hazards, particularly earthquakes, floods, erosion, volcanoes, tsunamis, landslides, and climate change.*

DO&G Response: Chapter 3, Section G discusses these potential geologic hazards. This section was reviewed and updated by professional geologists. This is the information that was available to the director to be considered and discussed in weighing whether Cook Inlet Areawide oil and gas lease sales are in the best interest of the state. Additional information or sources were not made known to the director during the public comment period.

See Section A10 response concerning climate change.

g. Costs to regulatory agencies

Comment Summary: *That the state should analyze costs of monitoring and enforcing compliance, and for conducting studies to assess environmental impacts.*

DO&G Response: See Section A11 response

h. Effects of seismic surveys

Comment Summary: *That an analysis of impacts of seismic surveys on the fishing industry should be included.*

DO&G Response: Chapter 8, Section B1 addresses potential effects of seismic surveys and other noises. A discussion is included concerning an experimental study on cod and haddock, important commercial species in the Barents Sea. However, this section also discusses the lack of research concerning these effects, as well as the inconclusive and contradictory results of available studies. Additional studies were not made known to the director during the public comment period.

i. Fiscal effects on fishing industry

Comment Summary: *That fiscal costs to the fishing industry should be included in an analysis of oil spills, habitat loss, and other potential environmental costs.*

DO&G Response: Potential economic costs of an oil spill to the fishing industry are addressed in Chapter 8, Section E1. Information on this topic comes primarily from the *Exxon Valdez* oil spill that occurred in Prince William Sound, not Cook Inlet. Additional studies were not made known to the director during the public comment period.

j. Revenue to the state

Comment Summary: *That fiscal statistics provided are primarily for the North Slope; that an approximate estimate of expected production and expected revenue should be provided; that the finding should discuss how well the 1999 best interest finding for Cook Inlet did in predicting benefits; and that the standard economic benefit-cost and statistical decision theory used by the state to determine the value of hydrocarbon resources should be provided in the finding.*

DO&G Response: Most statistics available for fiscal effects are statewide statistics. For example, property taxes collected by the Municipality of Anchorage are not categorized by whether the oil and gas company operates on the North Slope or Cook Inlet. Statistics for spending by the oil and gas industry, payroll, and numbers of jobs are also available primarily for the whole state. See Chapter 8, Section G.

Projected oil production for Cook Inlet is provided in Figure 8.3; projected natural gas production is provided in Figure 8.4. Predictions of revenue were not made by DO&G because of the many variables and uncertainties required to make such predictions. The 1999 best interest finding for Cook Inlet did not attempt to predict benefits to the state in future years. The 1999 finding provided one graph from the Alaska Department of Revenue showing a forecast for oil and gas revenues, and the finding provided a general discussion of decreasing trends in revenue and production.

Chapter 10 has been changed to more accurately reflect the process for determining the bidding method and lease terms.

k. Natural gas supplies

Comment Summary: *That an approximate estimate of the expected increase in natural gas supplies from the lease sales should be provided; that how demand is forecast should be included in the finding; and that information should be included on how well the 1999 best interest finding did at predicting how much revenue and supplies would be generated from previous lease sales.*

DO&G Response: Providing estimates of increases in natural gas supply if the sale goes through would require speculation about possible future effects subject to future permitting that cannot reasonably be determined at this phase (AS 38.05.035). Information about future demand for natural gas came from four sources: Thomas et al. 2004; NETL 2006; Saylor and Haley 2006; and Holland 2008. See preceding response concerning the 1999 best interest finding.

l. Immediate versus future development

Comment Summary: *That consideration should be given to reserving some oil and gas resources for future leasing, when their value may be higher and when better technology for preventing negative impacts might be available.*

DO&G Response: Exploration and development is needed now to replace declining reserves and develop long-term supplies of natural gas. Although technology will probably continue to improve, measures provided in Chapter 9 of the finding, along with regulations imposed by other state, federal, and local agencies, are expected to avoid, minimize, and mitigate potential negative environmental effects.

12. Kachemak Bay Conservation Society (Roberta Highland and Elise Wolf)

Location: Homer **Format**: Written

a. Restrictions on leasing

Comment Summary: *That only minimal leasing should take place; that leasing should not occur on the eastern side of Cook Inlet, adjacent to any critical habitat or recognized areas, along salmon streams or creeks, or ecologically sensitive areas.*

DO&G Response: Chapter 9 provides comprehensive mitigation measures that were developed in consultation with ADF&G to protect habitat, fish, wildlife, and their uses in the Cook Inlet Areawide oil and gas lease sale area. The director believes that these mitigation measures, along with regulations imposed by other state, federal, and local agencies, will avoid, minimize, and mitigate potential negative effects of oil and gas lease sales.

b. Renewable energy

Comment Summary: *That the state should fund renewable energy and sustainable industries such as tourism and fishing.*

DO&G Response: See Section A9 response.

c. Phasing

Comment Summary: *That phased review does not allow for adequate assessment of cumulative impacts, and that phasing allows the state to commit to a lengthy and costly process that may or may not be in the best interest of the state.*

DO&G Response: See Section B10a response.

d. Economic data on fishing and tourism

Comment Summary: *That economic data (such as income and wages) about fishing and tourism are not included and/or are improperly used, that impacts of oil and gas development and oil spills on fishing and tourism are not adequately considered, and that this results in misrepresentation of the importance of fishing and tourism to the Kenai Peninsula and Matanuska-Susitna boroughs.*

DO&G Response: See Section A8 response.

e. Other costs and analysis of future scenarios

Comment Summary: *That the costs for oversight of the oil and gas industry are not included, and that costs for various scenarios of holding versus buying back leases are not analyzed.*

DO&G Response: See Section A11 response. Analysis of multiple scenarios concerning buying back leases is beyond the scope of review of the best interest finding.

f. Foreign corporations, GATT, and NAFTA

Comment Summary: *That oil and gas leases will probably be bought by foreign corporations that are not held to the same environmental standards as American companies; that there is not a* *discussion of state costs for cleanup when non-American companies refuse to abide by state and federal environmental laws; that a discussion of GATT and NAFTA should be included in the finding.*

DO&G Response: All lessees must comply with terms of the lease, including mitigation measures, as well as all other local, state, and federal regulatory requirements, whether they are U.S. or foreign companies. Financial responsibility requirements are discussed in Chapter 6, Section F5d. Operators must provide proof of financial responsibility ranging up to $100,000,000 for crude oil vessels and barges. Regardless of the required bond amount, and the bond amounts required by other state agencies, the lessee is still fully liable for cleanup and rehabilitation of any disturbed areas.

Discussions of GATT (General Agreement on Tariffs and Trade) and NAFTA (North American Free Trade Agreement) are outside the scope of review for the Cook Inlet Areawide best interest finding.

g. Use of Environmental Impact Statements

Comment Summary: *That the MMS environmental impact statement's finding of no significant impact is not reconciled with the finding's statement that there is a "lack of conclusive results"; that inadequate or insufficient evidence does not lead logically to "no impacts" or ability to "avoid" impacts.*

DO&G Response: See Section A4 and A5 responses.

h. Inappropriate use of science, poor logic

Comment Summary: *That the finding's use of science is selective and sometimes inappropriate; that the finding is not fair and impartial; that the finding does not use logical reasoning; that conclusions have no bearing in objective science or logical reasoning.*

DO&G Response: In this comment, the commenter did not provide specific examples. Specific instances identified by the commenter are addressed separately. In response to this general concern, the finding presents a wide range of information relevant to topics that AS 38.05.035(g)(1)(B) requires best interest findings to consider and discuss. The director has not limited that consideration and discussion to only studies or information that supports one point of view or another. Rather, some available information was inconclusive or contradictory. This information was included in the finding, with appropriate qualifiers, so that the director had as complete information as possible available to consider, discuss, and weigh in making a finding. Including such information does not make the finding unfair or illogical. See Section A2 response also.

i. Mitigation measures

Comment Summary: *That the finding does not explain how mitigation measures can be effective if basic data on populations is lacking and if state agencies do not conduct adequate studies of the area.*

DO&G Response: See Section A3 and A6 responses.

j. Use of studies from outside the sale area

Comment Summary: *That studies from outside the sale area are included in the finding.*

DO&G Response: See Section A2 response.

k. Impacts from the petroleum industry

Comment Summary: *That the statement "the petroleum industry has functioned in the Cook Inlet without significant environmental damage since its beginning in 1957" is untrue.*

DO&G Response: This statement is found in the finding in Chapter 1, Section A, and Chapter 3, Section G. The context is a conclusion made by a geologic expert concerning potential geologic hazards that exist in the area. The finding cites the expert's conclusion that despite the area's proximity to volcanoes, position in a highly seismically active region, and other potential geologic hazards oil and gas development has occurred "without significant environmental damage." Additional evidence for this conclusion include that most fish and wildlife populations in the area are healthy, PCBs and other contaminants are lower in Cook Inlet belugas than other Alaska beluga populations; and available water quality data do not indicate negative effects from oil and gas development.

l. MMS 2000 study

Comment Summary: *That this study is improperly applied to upper Cook Inlet; that before leasing, ADNR and other state agencies should conduct thorough studies of Cook Inlet sediments, animals and fish, waters, and subsistence foods.*

DO&G Response: This comment concerns the research study, "Sediment quality in depositional areas of Shelikof Strait and outermost Cook Inlet," which was funded by MMS (MMS 2000). The study, conducted in 1997 and 1998 and published in 2000, is discussed in Chapter 8, Section B1b. This study is highly applicable to the best interest finding for Cook Inlet Areawide oil and gas lease sales. According to the study, outermost Cook Inlet (including Kamishak and Kachemak bays) and Shelikof Strait are considered potential areas for long-term deposition of pollutants from oil and gas exploration, production, and transportation activities in upper Cook Inlet. The study states [italics added]:

> Interactions of tides and geostrophic, baroclinic, and wind-induced currents with the topography of outermost Cook Inlet and Shelikof Strait provide a complex hydrographic regime that determines the distribution and eventual deposition of particle-associated contaminants released from offshore production platforms in ***upper Cook Inlet***.

The purpose of the study was to: 1) evaluate the Shelikof Strait and outermost Cook Inlet as potential depositional areas or "traps" for oil industry contaminants; 2) determine whether contaminant concentrations in sediments of these areas pose an environmental risk; 3) determine whether contaminants in these areas have accumulated relative to pre-industry concentrations; 4) determine whether any increases can be correlated with specific discharge events or activities (e.g., the *Exxon Valdez* oil spill); and 5) determine the importance of other hydrocarbon and metal sources to the sediments.

The study noted that there are multiple sources of similar pollutants in the area: natural oil seepages, oil spillage, tremendous quantities of suspended material swept into the region from glacial runoff with associated metals and hydrocarbons, municipal discharges, and other permitted industrial (e.g., seafood processing) discharges. Therefore, the study was designed to identify the sources of contaminants deposited in outermost Cook Inlet and Shelikof Strait.

Source samples were collected from a wide range of potential contaminant sources which included oil and gas activities, oil seeps, coals, municipal discharges, boat harbors, and riverine and coastal input, to compare to concentrations and distributions in the sediments of the depositional areas of Shelikof Strait and outermost Cook Inlet. Of particular relevance to the Cook Inlet Areawide best interest finding, source samples were collected to represent oil and gas production activities in upper Cook Inlet, including crude oil source samples from the Unocal Trading Bay Production Facility and the Swanson River Field, and produced water from the Unocal Trading Bay Production Facility. Thus, contrary to the commenter's statement, this study directly involved upper Cook Inlet oil and gas activities and attempted to determine if contaminants from upper Cook Inlet oil and gas activities are a source of pollution that is deposited in outermost Cook Inlet or Shelikof Strait.

Following are the findings of the study [italics added]:

> …the surface sediments of outermost Cook Inlet and the Shelikof Strait are traps for fine-grained sediment and are potential traps for contaminants from oil and gas production activities in ***upper Cook Inlet***. However, based on evaluations of the organic and inorganic data, no contamination in the surface sediments from oil and gas production activities in upper Cook Inlet was identified. Elevated Hg concentrations were identified in Kachemak Bay. However, the present-day Hg levels are comparable to values observed throughout the twentieth century, suggesting that the results are typical for the region.
>
> …the concentrations of metals and organics(i.e., PAHs) in sediments in outermost Cook Inlet and Shelikof Strait have not increased significantly since offshore oil exploration and production began in Cook Inlet (circa1963).
>
> …the composition (source[s]) of metals in the sediments of outermost Cook Inlet and Shelikof Strait do not appear to have changed since offshore oil exploration and production began in Cook Inlet (circa 1963). The composition of hydrocarbons in sediment cores show subtle changes over the past 25 to 50 years, but these changes do not appear to be correlated with petroleum production activities or spills.
>
> …the comprehensive findings of this two-year investigation indicate that the current concentrations of metals and PAHs in the Shelikof Strait and outermost Cook Inlet are neither linked to oil and gas development in the upper Cook Inlet, nor to the Exxon Valdez oil spill. The residues that are present, from a combination of natural sources – river inputs, oil seepages, etc. – pose no significant risk to the biota and the benthic environment of outermost Cook Inlet and Shelikof Strait. The degree of current risk is indeed very low and is similar to non-impacted coastal regions in Alaska and elsewhere.

m. Need for studies

Comment Summary: *That ADNR and other state agencies should conduct thorough studies of Cook Inlet sediments, animals and fish, waters, and subsistence foods.*

DO&G Response: See Section A3 response.

n. Oil spills

Comment Summary: *That oil spills in Cook Inlet, particularly in icy conditions, cannot be avoided, minimized, or mitigated.*

DO&G Response: See Section A1 response.

o. Seismic studies

Comment Summary: *That there are many more studies on effects of seismic surveys than those cited in the finding; that anecdotal information should be used in the finding; that many studies are done but are not published by state and federal scientists, and that many studies conducted by industry contain proprietary information and so are not published; and that the finding should be logical, rational, and unbiased in making determinations about impacts.*

DO&G Response: Potential effects from seismic surveys, as well as from other noise sources, are discussed in Chapter 8, Section B1a(i). Although the commenter states that there are far more studies on seismic than those cited in the finding, no additional sources were made known to the director during the public comment period, either by this commenter or others. The finding discusses frankly the lack of research in this important area, including that attempts to draw conclusions about noise effects have been hampered because the available information consists primarily of anecdotal observations, unpublished reports, and non-peer reviewed research. These categories of information are considered to be less credible scientifically than research that has been formally published in peer-reviewed journals. Issues concerning scientists and industry not publishing research is beyond the scope of review of the best interest finding.

Information that was known to the director concerning seismic surveys and other noise sources was sometimes inconclusive, incomplete, or contradictory. However, it is appropriate that the director consider and discuss this information. Doing so does not make the finding itself illogical, irrational, or biased. See Section A5 above for additional response concerning potential effects.

p. State and federal oversight

Comment Summary: *That state and federal agencies lack the ability to adequately oversee oil and gas development.*

DO&G Response: Chapter 7 gives information on the wide range of state and federal agencies that are tasked with overseeing the oil and gas industry. The director believes that the state has sufficient authority through general constitutional, statutory, and regulatory empowerments, the terms of the lease sale, the lease contract, and plan of operations permit terms to ensure that lessees conduct their activities safely and in a manner that protects the integrity of the environment.

q. Phasing

Comment Summary: *That mitigation measures need to be based on a full understanding of all the cumulative impacts (environmental, social, and economic) which cannot be understood by using a phased approach.*

DO&G Response: See section B10a response.

13. Kachemak Bay Conservation Society (Roberta Highland)

Location: Homer **Format**: Oral Testimony

a. Renewable energy

Comment Summary: *That renewable energy is preferable to fossil fuels.*

DO&G Response: See Section A9 response.

b. Energy costs

Comment Summary: *What is the energy cost is to develop oil and gas?*

DO&G Response: ADNR is not required to produce an analysis of the total energy costs to develop oil and gas. There are a number of variables such as the size, location, technology used, and proximity to existing infrastructure of a potential development, as well as the cost of energy itself, which fluctuates greatly. Such an analysis would be speculative and is beyond the scope of this finding.

c. Urban development and pollution

Comment Summary: *That there are a lot of effects from urban development, as well as pollution from the oil and gas industry.*

DO&G Response: AS 38.05.035(g)(1)(B)(vi) specifies that reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas or for gas only on the sale area are to be considered and discussed. Therefore, urban development and pollution from urban sources are beyond the scope of review of the best interest finding. Potential effects of oil and gas lease sales and subsequent activities are discussed in Chapter 8.

d. General opposition

Comment Summary: *That she opposes Cook Inlet Areawide lease sales.*

DO&G Response: Comment noted.

14. Kenai Peninsula Borough (Marcus A. Mueller)

Location: Soldotna **Format**: Written

a. Description of lands and estates to be leased

Comment Summary: *That the language describing which lands and/or estates will be leased is confusing.*

DO&G Response: This language has been revised for clarity.

15. Archibald, Robert

Location: Homer **Format**: Oral Testimony

a. Exploration

Comment Summary: *That companies come in for exploration and then leave.*

DO&G Response: All lessees must comply with terms of the lease, including mitigation measures, as well as all other local, state, and federal regulatory requirements. Financial responsibility requirements are discussed in Chapter 6, Section F5d. Operators must provide proof of financial responsibility ranging up to $100,000,000 for crude oil vessels and barges. Regardless of the required bond amount, and the bond amounts required by other state agencies, the lessee is still fully liable for cleanup and rehabilitation of any disturbed areas.

b. Important biological areas

Comment Summary: *That the Cook Inlet basin has important biological resources, including habitat and whales.*

DO&G Response: The director agrees with this statement. Chapter 4 discusses habitat, fish, and wildlife of the area, including whales. Chapter 5 discusses current and projected uses in the area, including importance of habitat for fish and wildlife, value of fisheries, and participation in hunting. Chapter 8 discusses reasonably foreseeable effects on the area's biological resources. Chapter 9 is a listing of mitigation measures and other regulatory requirements that will ensure that potential negative effects will be avoided, minimized, or mitigated.

c. Oil and gas potential

Comment Summary: *That oil and gas potential is only moderate to low.*

DO&G Response: The finding states that the area considered "has low to moderate petroleum exploration potential", that "some portions of this area have higher potential…while other portions of the area may have lower potential", but that "areas with lower potential may still contain hydrocarbon accumulations." After considering the petroleum potential of the Cook Inlet basin, potential fiscal effects of oil and gas lease sales, and other information relevant to topics required by AS 38.05.035(g)(1)(B), the director made the finding that, on balance, Cook Inlet Areawide oil and gas lease sales are in the best interest of the state.

d. Technology

Comment Summary: *That better technology needs to be developed for exploration that does not use air guns and explosives.*

DO&G Response: Chapter 6, Section C2a discusses geophysical exploration. Many advances have occurred in the field of geophysical exploration. These include conducting surveys in winter to avoid potential effects to habitat, fish, and wildlife; use of GPS; use of heli-portable crews and backpack units; narrow tracked vehicles; and vibroseis. Permits are required that may place restrictions on the exploration including duration, location, and intensity. Technology continues to develop in this area.

16. Wolf, Elise

Location: Homer **Format**: Oral Testimony

a. Economic data

Comment Summary: *That economic data do not include self-employed individuals, which means that the tourism and fishing industries are not correctly represented.*

DO&G Response: See Section A8 response.

b. Oil spills

Comment Summary: *That there needs to be more discussion of the effects of an oil spill or contamination on fish and the consumer.*

DO&G Response: Chapter 8, Sections B1b, D1, and E1 discuss potential effects of an oil spill on fish and fisheries. Most information known to the director concerning this issue came from studies related to the *Exxon Valdez* oil spill. Additional information was not made known to the director during the public comment period.

c. Contaminants

Comment Summary: *That there was an EPA study that documented tainted salmon in subsistence harvests that should be included.*

DO&G Response: The commenter provided no details on the title, year, authorship, or other information that would assist DO&G in obtaining a copy of this study. In searching for the study mentioned by the commenter, DO&G found an EPA study entitled, "Survey of chemical contaminants in seafoods collected in the vicinity of Tyonek, Seldovia, Port Graham and Nanwalek in Cook Inlet, Alaska" (EPA 2003; study number EPA 910-R-01-003). This study analyzed concentrations of 161 chemicals in seven fish species, eight invertebrates, and three plant species traditionally used by members of four Alaskan tribal villages, Tyonek, Seldovia, Port Graham and Nanwalek. Only Tyonek is within the Cook Inlet Areawide sale area. Comparisons were made to published contaminant data for market basket food, and to Columbia River (in Washington, Oregon) Chinook salmon. The study concluded that, with few exceptions, contaminant concentrations in Cook Inlet area species were similar or lower than comparison samples.

Although this study provides important baseline information about contaminants in wild food sources of the Cook Inlet area, its usefulness in discussing potential effects of oil and gas development on wild foods is limited. The study compared Cook Inlet samples to contaminated samples from elsewhere, which only allows a conclusion of whether the Cook Inlet samples were more or less contaminated than the contaminated samples from elsewhere, and more importantly, the study did not attempt to determine the source of contaminants in the Cook Inlet samples. This is an important weakness of this study relative to the Cook Inlet best interest finding, because there are many other potential sources of contaminants in the Cook Inlet area in addition to oil and gas development, and also because many of the chemical compounds analyzed in the study occur naturally. Another limitation of the EPA study relative to the Cook Inlet finding is that contaminants found in salmon harvested in Cook Inlet may reflect conditions on the high seas where they spend a large portion of their life span, rather than conditions in Cook Inlet through which they migrate en route to and from spawning grounds. Although it has limited utility for the Cook Inlet best interest finding, it has been added to Chapter 8 as an additional fact that has been made known to the director for consideration and discussion.

d. <u>Cost analysis</u>

<u>Comment Summary</u>: *That an analysis of costs to the state should be included, for example how much has been spent on the Exxon Valdez oil spill.*

<u>DO&G Response</u>: See Section A11 response

e. <u>MMS evaluation of noise and seismic</u>

<u>Comment Summary</u>: *That there was a meeting that included MMS, NMFS, Fish and Wildlife, and all the industry companies; that they looked at research about seismic, including a study from the Mackenzie Delta in Canada, and ocean acidification; that the study cited in the finding concerning sperm whales in the Gulf of Mexico has important differences from Cook Inlet; that the MMS findings of no significant impact are faulty; and that the Cook Inlet finding says there are few published studies on the effects of noise so the finding cannot come to a conclusion of no significant effects.*

<u>DO&G Response</u>: The commenter provided no details that would assist DO&G in obtaining the proceedings or other information about the meeting. The commenter provided no details concerning the Mackenzie Delta study that would assist DO&G in obtaining a copy on the study, such as title, year, authorship, or other information. In searching for the study mentioned by the commenter, DO&G found a study entitled, "Effects of exposure to seismic airgun use on hearing of three fish species" (Popper et al. 2005) that was conducted on northern pike, broad whitefish, and lake chub in the Mackenzie River Delta. This experimental study exposed fish held in cages to two levels of airgun shots; a control group was held in cages but not exposed to airguns. The higher level of airgun exposure was considered to be a worst case scenario, an exposure level that it was highly unlikely that fish would actually experience. The study concluded that it is unlikely that the three species would be substantially impacted by exposure to an airgun array used in a seismic survey in a river. This study has been added to Chapter 8, Section A1a as an additional fact that has been made known to the director for consideration and discussion.

The commenter provided no details about the relevance of ocean acidification to the Cook Inlet finding, nor details about studies concerning ocean acidification, that would assist DO&G in addressing this concern.

Concerning the MMS study on sperm whales in the Gulf of Mexico (Jochens et al. 2008), the director agrees that there are differences between the MMS study and Cook Inlet. For example, the study was conducted in the Gulf of Mexico rather than Cook Inlet; and the study examined effects on sperm whales rather than beluga whales. However, the director does not agree that these differences make the study irrelevant to the finding. Sperm whales are related to beluga whales, seismic techniques used in one location are similar to techniques used in others, and this was important information available to the director to consider and discuss.

Concerning MMS determination of no significant impact (the commenter is probably referring to a federal environmental impact statement), see Section A4 response.

Concerning that it is unjustified that the Cook Inlet finding made a determination of no significant impact for seismic surveys, the Cook Inlet finding does not make such a determination. See Section A4 and A5 responses.

f. Cook Inlet water quality data

Comment Summary: *That comprehensive baseline data on water quality are needed before mitigation measures can be developed and implemented; that the MMS 2000 study about water quality that is cited is too old; that water quality data are used incorrectly.*

DO&G Response: See Section A2 and A3 responses.

g. Oil spills

Comment Summary: *That there is not enough oversight to prevent future issues such as the Exxon Valdez oil spill.*

DO&G Response: See Section A1 response.

17. Cook Inlet Keeper (Bob Shavelson)

Location: Homer **Format**: Oral Testimony

a. Public hearing attendance

Comment Summary: *That Cook Inlet Keeper could have filled the whole auditorium, but that the members do not believe that it is worth their effort to attend the public hearing because they believe the decision has already been made.*

DO&G Response: Comment noted.

b. Previous law suits

Comment Summary: *That Cook Inlet Keeper sued over a previous Cook Inlet finding.*

DO&G Response: Comment noted.

c. Climate change

Comment Summary: *That the finding should address climate change.*

DO&G Response: See Section A10 response.

18. Alaska Department of Fish and Game (Kimberly Klein, Sean Farley)

Location: Anchorage **Format**: Written

a. Corrections to statutes and OHMP

Comment Summary: *That there are several instances where statute numbers have changed; that OHMP has moved to ADF&G.*

DO&G Response: These corrections are reflected in the final finding.

b. Anadromous streams catalogue

Comment Summary: *That the catalogue has been updated and a new table and reference are provided.*

DO&G Response: The new citation and table are incorporated in the final finding.

c. Susitna River sockeye

Comment Summary: *That Susitna River sockeye salmon have been designated a stock of concern.*

DO&G Response: This information has been added to the final finding.

d. Beluga whales

Comment Summary: *That beluga whales are now listed as endangered under the Endangered Species Act; that references to the history of the listing and objections to the listing by the state should be deleted.*

DO&G Response: See Section A7 response. The history of the listing and objections of the listing by the state are recent, important facts that help to describe the controversy surrounding listing of beluga whales as endangered under the Endangered Species Act, and should remain in the finding.

e. Miscellaneous corrections

Comment Summary: *That there are several corrections needed to information about fish species, fin whales, and humpback whales.*

DO&G Response: When supported by available information sources, these corrections have been made to the final finding.

f. Legislatively designated areas

Comment Summary: *That additional information about these areas should be provided; that there are some corrections needed to the information in the finding.*

DO&G Response: Information about the background and purpose of legislatively designated areas is provided in Chapter 4, Section A4. Corrections to Chapter 5, as noted by ADF&G, were made to the final finding.

g. Changes to mitigation measures

Comment Summary – Mitigation Measure A1d: *That a definition of "identified" wetlands should be included; that additional requirements on development in wetlands should be included.*

DO&G Response: Wetlands are discussed in Chapter 4, Section A1d. The definition of "identified" has been added to the definitions section of the mitigation measures (Chapter 9, Section A8). This definition explains that "identified" refers to areas that have been identified as wetlands by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. A footnote has also been added giving the federal definition of wetlands. The director believes that protections provided for wetlands with this mitigation measure, as well as the many other protections provided through other state and federal regulatory requirements, are adequate.

Comment Summary – Mitigation Measure A1e: *That construction of roads during the exploration phase should not be allowed.*

DO&G Response: A blanket prohibition of road construction during the exploration phase is excessive for the Cook Inlet area. Allowing construction of temporary or permanent roads associated with oil and gas exploration may be in the best interest of the state in some cases.

Comment Summary – Mitigation Measure A1i: *That measures concerning gravel mining should be more restrictive, and should prohibit gravel mining in floodplains.*

DO&G Response: A blanket prohibition of gravel mining in floodplains is excessive for the Cook Inlet area. This mitigation measure offers adequate habitat protection by restricting gravel mining sites to the minimum necessary; and by allowing gravel mining in floodplains only if there is no practicable alternative or if the site would be compatible with fish and wildlife habitat after mining operations are completed and the site is closed.

Comment Summary – Other regulatory requirements: *That some corrections are needed to this section, including that beluga whales are now listed as endangered species, and that a definition of "take" under the Endangered Species Act should be added.*

DO&G Response: Corrections noted by ADF&G have been made to the final finding; information about "take" has been added.

Comment Summary – Brown bear movement corridors:*That thorough studies identifying all travel/movement corridors of brown bears in the Cook Inlet area have not been completed; that minor changes to Mitigation Measure A2i are needed; that major changes to Mitigation Measure A2l are needed; that and Mitigation Measures A2k and A2m should be removed.*

DO&G Response: Most requested changes to Mitigation Measures A2i and A2l have been made to the final finding. Original Mitigation Measures A2k and A2m regarding bears have been deleted. (Original Mitigation Measure A2l has been renumbered A2k in the final finding.) Map 4.8 of the preliminary finding, depicting brown bear movement corridors, and references to movement corridors in Chapter 4, Section B3a have been removed from the final finding.

Comment Summary – Brown bear information:*That a 2001 conservation assessment of Kenai Peninsula brown bears is now available, as well as several research studies.*

DO&G Response: Reference to the conservation assessment report and research studies have been added to the final finding.

C. References

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Appendix B: Laws and Regulations Pertaining to Oil and Gas Exploration, Development, Production, and Transportation

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Appendix B: Laws and Regulations Pertaining to Oil and Gas Exploration, Development, Production, and Transportation

A. Alaska Statutes (AS) and Administrative Code (AAC) Sections

1. Alaska Department of Natural Resources (ADNR)

AS 38.05.027	Management of legislatively designated state game refuges and critical habitat areas is joint responsibility of ADF&G (AS 16.20.050-060) and ADNR. Lessees are required to obtain permits from both ADNR and ADF&G.
AS 38.05.127	Provides for reservation of easements to ensure free access to navigable or public water.
AS 38.35.010 to AS 38.35.260	Right-of-way leasing for pipeline transportation of crude oil and natural gas is under control of commissioner of ADNR. Commissioner shall not delegate authority to execute leases.
11 AAC 51.045	Easements to and along navigable or public water.
11 AAC 83.158(a)	Plan of operations for all or part of leased area or area subject to oil and gas exploration license must be approved by ADNR commissioner before any operations may be undertaken on or in leased or licensed area.
11 AAC 96.010	Operations requiring permits, including use of explosives and explosive devices, except firearms.
11 AAC 96.025	Generally allowed land use activities are subject to general stipulations that will minimize surface damage or disturbance of drainage systems, vegetation, or fish and wildlife resources.

2. ADNR Division of Oil and Gas (DO&G)

AS 38.05.035(a)(8)(C)	Requires geological and geophysical data to be kept confidential upon request of supplier.
AS 38.05.130	Allows DO&G director to approve oil and gas exploration and development activities in cases where surface estate is not held by state or is otherwise subject to third-party interests, provided director determines that adequate compensation has been made to surface estate holder for any damages that may be caused by lease activities.
AS 38.05.132	Establishes exploration licensing program.
AS 38.05.180	Establishes oil and gas leasing and gas only leasing programs to provide for orderly exploration for and development of petroleum resources belonging to the State of Alaska.

11 AAC 96.010 to 11 AAC 96.145	Provides controls over activities on state lands in order to minimize adverse activities; applies to geophysical exploration permit

3. ADNR Division of Forestry

AS 41.17.082	Alaska Forest Resources Practices Act. Requires that all forest clearing operations and silvicultural systems be designed to reduce likelihood of increased insect infestation and disease infections that threaten forest resources.
11 AAC 95.195	Describes approved methods of disposal or treatment of downed spruce trees to minimize spread of bark beetles and reduce risk of wildfire.
11 AAC 95.220	Requires lessee to file detailed plan of operations with state forester.

4. ADNR Division of Mining, Land and Water

AS 38.05.075	Governs public auctions for leasing lands (including tidelands and submerged lands) — procedures, bidding qualifications, and competitive or noncompetitive bidding methods.
AS 38.05.850	Authorizes director to issue permits, rights-of-way, or easements on state land for recovery of minerals from adjacent land under valid lease.
11 AAC 80.005 to 11 AAC 80.085	Pipeline right-of-way leasing regulations.
11 AAC 93.040 to 11 AAC 93.130	Requires water rights permit for appropriation of state waters for beneficial uses.
11 AAC 93.210 to 11 AAC 93.220	Provides for temporary water use permits and application procedures.
11 AAC 96.010 to 11 AAC 96.110	Land use permit activities not permitted by multiple land use permit or lease operations approval.

5. ADNR Division of Coastal and Ocean Management

6 AAC 80.070(b)(3)	Requires that energy facilities in coastal areas be consolidated to extent feasible and prudent.
6 AAC 80.070(b)(10) to 6 AAC 80.070(b)(12)	Requires that energy facilities in coastal areas be sited to extent feasible and prudent where development will necessitate minimal site clearing, dredging, and construction in productive habitats, to minimize risk of oil spills in or other contamination of productive or vulnerable habitats, and to allow for free passage and movement of fish and wildlife.

6 AAC 80.130(c)(3)	Requires that wetlands and tide flats be managed to assure adequate water flow and to avoid adverse effects on natural drainage patterns, destruction of important habitat, and discharge of toxic substances.
11 AAC 110	Alaska Coastal Management Program Implementation

6. Alaska Department of Fish and Game (ADF&G)

AS 16.20	Management of legislatively designated game refuges, sanctuaries, and critical habitat areas.
AS 16.20.060, AS 16.20.094, and AS 16.20.530	Commissioner, ADF&G, may require submission and written approval of plans and specifications for anticipated use and construction work and plans for proper protection of fish and game (including birds) within legislatively designated game refuges, critical habitat areas, and sanctuaries.
AS 16.20.180 to AS 16.20.210	Require measures for continued conservation, protection, restoration, and propagation of endangered fish and wildlife.
AS 16.05.841	Requires permit from ADF&G prior to obstruction of fish passage.
AS 16.05.871	Provides for protection of anadromous fish and game in connection with construction or work in beds of specified water bodies and calls for approval of plans by ADF&G for construction of hydraulic project or any use, diversion, obstruction, change, or pollution of these water bodies.
5 AAC 195.010	Atlas and catalog of waters important for spawning, rearing, or migration of anadromous fish. Permit application procedures.

7. Alaska Oil and Gas Conservation Commission (AOGCC)

AS 31.05.005	Establishes and empowers AOGCC.
AS 31.05.030(d)(9)	Requires oil and gas operator to file and obtain approval of plan of development and operation.
AS 46.03.900(35)	Definition of waste.
AS 46.03.100	Standards and limitations for accumulation, storage, transportation, and disposal of solid or liquid waste.
20 AAC 25.005 to 20 AAC 25.570	Requires permit to drill, to help maintain regulatory control over drilling and completion activities in state.
20 AAC 25.140	Requires water-well authorization to allow abandoned oil and gas wells to be converted to freshwater wells and to assure freshwater source is not contaminated.

8. Alaska Department of Environmental Conservation (ADEC)

AS 26.23.900(1)	Defines State Emergency Response Commission.
AS 46.03	Provides for environmental conservation including water and air pollution control and radiation and hazardous waste protection.
AS 46.03.100	Requires solid waste disposal permits.
AS 46.03.759	Establishes maximum liability for discharge of crude oil at $500 million.
AS 46.03.900(35)	Definition of waste.
AS 46.04.010 to AS 46.04.900	Oil and Hazardous Substance Pollution Control Act. Prohibits discharge of oil or any other hazardous substances unless specifically authorized by permit; requires those responsible for spills to undertake cleanup operations; and holds violators liable for unlimited cleanup costs and damages as well as civil and criminal penalties.
AS 46.04.030	Requires lessees to provide oil discharge prevention and contingency plans (C-plans). Also provides regulation of aboveground storage facilities that have capacities of greater than 5,000 bbl of crude oil or greater than 10,000 bbl of noncrude oil.
AS 46.04.050	Exemptions for aboveground storage facilities that have capacities of less than 5,000 bbl of crude oil or less than 10,000 bbl of noncrude oil.
18 AAC 50	Provides for air quality control, including permit requirements, permit review criteria, and regulation compliance criteria.
18 AAC 50.316	Preconstruction review for construction or reconstruction of major source of hazardous air pollutants.
18 AAC 60.265	Requires proof of financial responsibility before permit for operation of hazardous waste disposal facility may be issued.
18 AAC 60.200	Requires solid waste disposal permit to control or eliminate detrimental health, environmental, and nuisance effects of improper solid waste disposal practices and to operate solid waste disposal facility.
18 AAC 60.430(a)(2)	General requirement for containment structures used for disposal of drilling wastes.
18 AAC 70	Requires Certificate of Reasonable Assurance (Water Quality Certification) in order to protect state waters from becoming polluted. Assures that issuance of federal permit will not conflict with Alaska’s water quality standards.

18 AAC 72	Requires wastewater disposal permit in order to prevent water pollution (and public health problems) due to unsafe wastewater disposal systems and practices.
18 AAC 75.305 to 18 AAC 75.395	Provides for oil and other hazardous substance pollution control, including oil discharge contingency plan.
18 AAC 75.005 to 18 AAC 75.025	Requirements for oil storage facilities for oil pollution prevention.
18 AAC 75.065 to 18 AAC 75.075	Requirements for oil storage tanks and surge tanks.
18 AAC 75.080	Facility piping requirements for oil terminal, crude oil transmission pipeline, exploration, and production facilities.

B. Federal Laws and Regulations

Notes: CFR is the Code of Federal Regulations; USC is the United States Code.

1. Clean Water Act

33 USC §§ 1251 to 1387	Water pollution controls
33 USC § 1344	Army Corps of Engineers permit required to excavate, fill, alter, or otherwise modify course or condition of navigable or U.S. coastal waters and to discharge dredge-and-fill material

2. Environmental Protection Agency (EPA)

Oil and other hazardous substance regulations.

40 CFR § 109	Criteria for oil removal contingency plans
40 CFR § 110	Discharge of oil
40 CFR § 112	Oil pollution prevention
40 CFR § 112.7	Guidelines for implementing spill prevention, control, and countermeasures plan
40 CFR § 113(A)	Liability limits for small onshore storage facilities (oil)

40 CFR § 116	Designation of hazardous substances
40 CFR § 117	Determination of reportable quantities for hazardous substances

Water quality regulations.

40 CFR § 121	State certification of activities requiring federal license or permit
40 CFR § 136	Test procedures for analysis of pollutants

National Pollutant Discharge Elimination System regulations.

40 CFR § 122	NPDES permit regulations
40 CFR § 125	Criteria and standards for NPDES permits
40 CFR § 129	Toxic pollutant effluent standards
40 CFR § 401	General provisions of effluent guidelines and standards
40 CFR § 435	Offshore oil and gas extraction point-source category

Ocean dumping regulations.

40 CFR §§ 220 to 228	Ocean dumping regulations, permits, and criteria

Materials discharge and disposal regulations.

40 CFR § 230	Discharge of dredged or fill material into navigable waters
40 CFR § 231	Disposal site determination

Oil and other hazardous substance pollution regulations.

40 CFR § 300	National Oil and Hazardous Substances Pollution Contingency Plan

Underground injection regulations.

40 CFR § 144	Permit regulations for underground injection control program
40 CFR § 146	Criteria and standards for underground injection control program
40 CFR § 147	State underground injection control program

3. Coast Guard, Department of Homeland Security

Regulations relevant to a determination of a hazard to navigation and oil spills in navigable waters.

33 CFR §§ 64.31	Determination of hazard to navigation
33 CFR §§ 153 to 158	Oil pollution prevention and control
33 CFR § 153	Reporting oil spills to Coast Guard, Department of Homeland Security
33 CFR §§ 155 to 156	Vessels in oil transfer operations

4. Army Corps of Engineers

Navigable waters regulations.

33 CFR § 209.200	Navigable waters
33 CFR §§ 320 to 327 and 330	Permit program regulations
33 CFR § 323	Discharge of dredge and fill
33 CFR §§ 328 and 329	Definitions of waters

5. Fish and Wildlife Coordination Act

Clean Water Act § 404	Permit applications
16 USC § 662(a)	Allows comments on permit applications by EPA, National Marine Fisheries Service, U.S. Fish and Wildlife Service (USF&WS), and state agency that administers wildlife resources.

6. Comprehensive Environmental Response, Compensation, and Liability Act

42 USC §§ 9601 to 9675	Environmental laws

7. Safe Drinking Water Act

42 USC § 300 (f) to (h)	Safety of public water systems

8. Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act

42 USC §§ 6901 to 6991	Solid waste disposal planning, management, and regulation

Clean Air Act

42 USC §§ 740l to 7661	Emission standards, noise pollution restrictions, and permit regulations

9. Toxic Substances Control Act

15 USC §§ 2601 to 2655	Control of toxic substances, including asbestos

10. National Environmental Policy Act (NEPA)

42 USC §§ 4321 to 4347	Administration of environmental policy

Council on Environmental Quality-administered NEPA-related regulations

40 CFR §§ 1500 to 1508	Implement NEPA procedures

11. Endangered Species Act

16 USC §§ 1531 to 1543	Interagency cooperation, prohibited acts, penalties, and enforcement

12. USF&WS

Threatened and endangered species regulations

50 CFR § 17	Threatened and endangered wildlife and plant species
50 CFR § 402	Interagency cooperation

13. Marine Protection, Research, and Sanctuaries Act

33 USC §§ 1401 to 1445	Ocean dumping regulation and research

14. Marine Mammal Protection Act

16 USC §§ 1361 to 1407	Conservation and protection of marine mammals

15. Migratory Bird Treaty Act

16 USC §§ 703 to 712 and 715	Migratory bird treaty and conservation

16. National Historic Preservation Act

16 USC § 469 and 470	Preservation of historical and archeological data

17. Leases and Permits on Restricted Properties

25 CFR § 162	Leasing and permitting on Native and restricted lands

Appendix C: Directional and Extended-Reach Drilling

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Appendix C: Directional and Extended-Reach Drilling

A. Directional and Extended-Reach Drilling

Directional drilling is a drilling technique whereby a well is deliberately deviated from the vertical in order to reach a particular part of the reservoir. Directional drilling technology enables the driller to steer the drill stem and bit to a desired bottom hole location. Directional wells initially are drilled straight down to a predetermined depth and then gradually curved at one or more different points to penetrate one or more given target reservoirs. This specialized drilling usually is accomplished with the use of a fluid-driven downhole motor, which turns the drill bit (Gerding 1986). Directional drilling also allows multiple production and injection wells to be drilled from a single surface location such as a gravel pad or offshore production platform, thus minimizing cost and the surface impact of oil and gas drilling, production, and transportation facilities (Figures C.1 and C.2). It can be used to reach a target located beneath an environmentally sensitive area and may offer the most economical way to develop offshore oil fields from onshore facilities.

The limitations of directional drilling are primarily dependent upon maximum hole angle, rate of angle change, and torque or friction considerations. In directional drilling, it is now common for the horizontal displacement of the bottom hole location to be twice the total vertical depth (TVD) of the well. That is, a well with a vertical depth of 7,000 ft could have a bottom hole horizontal displacement of 14,000 ft from the drill site. However, in a shallower well, such as one in which a potential target is two miles away from the drill site but only one mile deep, directional drilling would be much more difficult, risky, and costly (Schmidt 1994).

Direction drilling may be limited by the type of geology or rock through which drillers must drill in order to reach the desired target. Coal and shale deposits tend to expand or collapse the well bore and cause the drill string to get stuck. This is more likely to happen in wells that take longer to drill where the downhole formations are exposed to the drilling mud and drill string longer before well casing is cemented into the hole. Small subsurface faults are difficult to locate prior to drilling, and if the drill bit crosses a fault, the type of rock being drilled may suddenly change and a new geologic reference must be established. During this intermediate period in the drilling operation, the driller will not be sure if the desired geologic target is being drilled or could be intersected again (Schmidt 1994). Stuck pipe can also occur in directional wells when the borehole becomes oval shaped from the drill pipe constantly laying on the downside part of the well bore. The pipe gets lodged in the groove cut on the bottom of the hole. The most common cause of hole collapse is the chemical difference between in-formation saltwater and the water in drilling mud. This is especially common when drilling through shale. Ions in the water in the mud have a tendency to transfer to the shale, the shale expands, and small sheets slough off into the hole, causing the pipe to get stuck (Gerding 1986

Subsurface collisions with neighboring wells can be problematic when drilling multiple boreholes from one surface location. A collision with a producing well could result in a dangerous situation. Anti-collision planning begins with accurate surveys of the subject well and a complete set of plans for existing and proposed oil and gas wells (Schlumberger Anadrill 1993).

Perhaps the greatest limitation on directional drilling is cost. For certain reservoirs, directional drilling technically may be possible but is not always economically feasible. Factors that may prohibit the use of directional drilling, such as the position of oil or gas deposits in the geologic structure relative to the drilling rig, the size and depth of the deposit, and the geology of the area, are all important elements that determine whether directional drilling is cost effective (Winfree 1994).

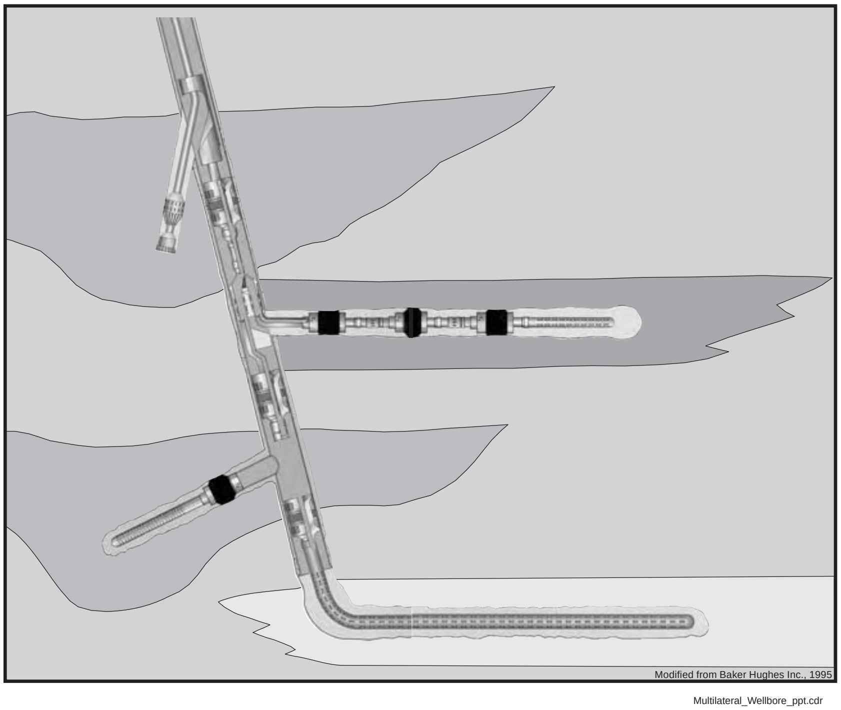

Figure C.1. Multilateral wellbore.

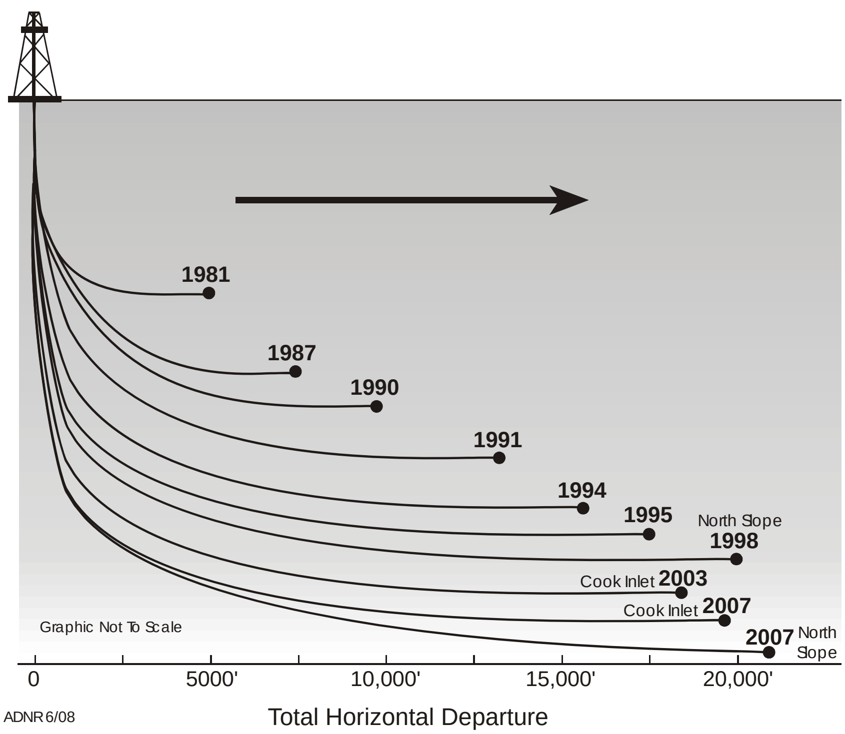

Figure C.2. Well reach versus time (in Alaska).

The environment and the cost of multiple pads or locations are also considerations in determining the cost-effectiveness of directional drilling.

Horizontal drilling, a more specialized type of directional drilling, allows a single well bore at the surface to penetrate oil- or gas-bearing reservoir strata at angles that parallel or nearly parallel the dip of the strata. The well bore is then open and in communication with the reservoir over much longer distances. In development wells, this can greatly increase production rates of oil and gas or volumes of injected fluids (Winfree 1994). Horizontal drilling may involve underbalanced drilling, coiled tubing, bit steering, continuous logging, multilateral horizontals, and horizontal completions. Lateral step-outs are directional wells that branch off a main borehole to access more of the subsurface. Conditions for successful horizontal wells include adequate pre-spud planning, reservoir descriptions, drillable strata that will not collapse, and careful cost control (PTTC 1996).

Extended-Reach Drilling (ERD) has evolved from simple directional drilling to horizontal, lateral, and multilateral step-outs (Figures C1 and C2). ERD employs both directional and horizontal drilling techniques and has the ability to achieve horizontal well departures and total vertical depth-to-deviation ratios beyond the conventional experience in a particular field (Gerding 1986). ERD can be defined in terms of reach/TVD (total vertical depth) ratios (Judzis et al. 1997). The definition of an ERD well depends on the results of existing drilling efforts in a particular oilfield (Gerding 1986). Local ERD capability depends on the extent of experience within specific fields and with specific rigs and mud systems. “ERD wells drilled in specific fields and with specific rigs, equipment, personnel, project teams, etc. do not necessarily imply what may be readily achieved in other areas” (Judzis et al. 1997).

Possible challenges to successful ERD include problematic movement of downhole drillstring and well casing, applying sufficient weight to the drill bit, buckling of well casing or drillstring, and running casing successfully to the bottom of the well. Drillstring tension may be a primary concern in vertical wells, but in ERD, drillstring torsion may be the limiting factor. Running normal-weight drill pipe to apply weight to the bit in ERD can lead to buckling of the drill pipe and rapid fatigue failure. Conventional drilling tools are prone to twist-off because of unanticipated failure under high torsional and tensile loads of an extended-reach well (JPT 1994). Torque can be significantly reduced with the use of nonrotating drill pipe protectors (Payne et al. 1995). Advanced equipment for an ERD well may include wider diameter drill pipe, additional mud pumps, enhanced solids control, higher capacity top-drive motors, more generated power, and oil-based drilling fluids (Judzis et al. 1997).

ERD requires longer hole sections, which require longer drilling times; the result is increased exposure of destabilizing fluids to the well bore (JPT 1994). Oil-based muds are superior to water-based muds in ERD (Payne et al. 1995). Water-based muds may not provide the inhibition, lubrication or confining support of oil-based muds (JPT 1994).

Drillstring design for ERD involves: (1) determining expected loads; (2) selecting drillstring components; (3) verifying each component’s condition; (4) setting operating limits for the rig team; and (5) monitoring condition during drilling. Economic and related issues in drillstring planning include cost, availability, and logistics. Rig and logistics issues include storage space, setback space, accuracy of load indicators, pump pressure and volume capacity, and top-drive output torque. Drill hole issues include hole cleaning, hole stability, hydraulics, casing wear, and directional objectives (Judzis et al. 1997).

The working relationship between various components of a drill string must be analyzed carefully. Conventional drill stems are about 30 ft long and are made up of a bit, stabilizer, motor, a measurement-while-drilling (logging) tool, drill collars, more stabilizers, and jars. Typically there are more than 1,600 parts to a drill string in a 24,000-foot well. A modern drill string can be made up of hundreds of components from more than a dozen vendors. These components may not always perform as anticipated and may not meet operational demands of drilling an extended-reach well (JPT 1994).

In a few cases, ERD technology has been used instead of platform installation off the coast of California, where wells are drilled from onshore locations to reach nearby offshore reserves. ERD has been instrumental in developing offshore reserves of the Sherwood reservoir under Poole Bay from shore at Wytch Farm, U.K. The original development plan called for the construction of a $260 million artificial island in the bay (JPT 1994). ERD also has been used successfully in the North Sea, in the Gulf of Mexico, in the South China Sea, and in Alaska (Milne Point, Badami, Point McIntyre, Alpine, and Niakuk fields) (Judzis et al. 1997). The longest ERD well on the North Slope was drilled in the Alpine Pool in 2007, well CD4-07, to a total length of 25,040 ft MD with horizontal displacement of 21,047 ft.

In the Cook Inlet Basin in 2003, ConocoPhillips drilled the Hansen 1 to 18,630 ft MD with horizontal displacement of 15,856 ft and then redrilled the Hansen 1A to 20,789 ft MD and 18,031 ft horizontal displacement. Both were part of an exploration program of the Cosmopolitan Field drilled from onshore to offshore locations with ERD methods. The Hansen 1 and 1A tests proved substantial oil in place in the Hemlock and Lower Tyonek Sands; however, productivity was less than expected due to low vertical permeability (Bond et al. 2006). In 2007, Pioneer Natural Resources drilled an ERD horizontal lateral from the Hansen 1A (Hansen 1AL1) to evaluate the Starichkof sands using an undulating horizontal technique to improve vertical permeability based on wellbore modeling (Bond 2008). The lateral bottomed at 22,650 ft MD with horizontal displacement of 19,907 ft. The Hansen 1AL1 lateral represents the longest horizontal displacement in the Cook Inlet Basin to date.

Although a 6.6-mile horizontal displacement was accomplished in 1999 at Cullen Norte 1 well in Argentina (Haliburton 1999), horizontal displacements (departure from vertical) of 0.5 to 2 miles are typical. In October 1998, BP set a long-reach record for horizontal directional wells in the U.S. with a displacement of 19,804 ft in the Niakuk field (Figures C.1 and C.2). Despite its $6 million price, the well represents a cost saving over the other drilling alternatives, such as construction of an offshore artificial gravel island (AJC 1996).

Exploration wells within the license area may be directionally drilled because of a lack of suitable surface locations directly overlying exploration targets. However, until specific sites and development scenarios are advanced and the specific conditions of drill sites are known, the applicability of directional drilling for oil and gas within the license area is unknown. It is anticipated that most development wells will be directionally drilled because of the cost savings realized in pad construction and required facilities.

Many surface use conflicts can be avoided through directional drilling and ERD. However, some reservoirs are located or sized such that directional drilling cannot eliminate all possible conflicts.

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Appendix D: Sample Competitive Oil and Gas Lease

Competitive Oil and Gas Lease

Form #DOG 200604

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

Competitive Oil and Gas Lease **ADL No.**

THIS LEASE is entered into , between the State of Alaska, "the state," and

"the lessee," whether one or more, whose sole address for purposes of notification is under Paragraph 25.

In consideration of the cash payment made by the lessee to the state, which payment includes the first year's rental and any required cash bonus, and subject to the provisions of this lease, including applicable stipulation(s) and mitigating measures attached to this lease and by this reference incorporated in this lease, the state and the lessee agree as follows:

1. GRANT. (a) Subject to the provisions in this lease, the state grants and leases to the lessee, without warranty, the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances in or under the following described tract of land:

containing approximately acres, more or less (referred to in this lease as the "leased area"); the nonexclusive right to conduct within the leased area geological and geophysical exploration for oil, gas, and associated substances; and the nonexclusive right to install pipelines and build structures on the leased area to find, produce, save, store, treat, process, transport, take care of, and market all oil, gas, and associated substances and to house and board employees in its operations on the leased area. The rights granted by this lease are to be exercised in a manner which will not unreasonably interfere with the rights of any permittee, lessee or grantee of the state consistent with the principle of reasonable concurrent uses as set out in Article VIII, Section 8 of the Alaska Constitution.

(b) For the purposes of this lease, the leased area contains the legal subdivisions as shown on the attached plat marked Exhibit A.

(c) If the leased area is described by protracted legal subdivisions and, after the effective date of this lease, the leased area is surveyed under the public land rectangular system, the boundaries of the leased area are those established by that survey, when approved, subject, however, to the provisions of applicable regulations relating to those surveys. If for any reason the leased area includes more acreage than the maximum permitted under applicable law (including the "rule of approximation" authorized in AS 38.05.145 and defined in AS 38.05.965 (18)), this lease is not void and the acreage included in the leased area must be reduced to the permitted maximum. If the state determines that the leased area exceeds the permitted acreage and notifies the lessee in writing of the amount of acreage that must be eliminated, the lessee has 60 days after that notice to surrender one or more legal subdivisions included in the leased area comprising at least the amount of acreage that must be eliminated. Any subdivision surrendered must be located on the perimeter of the leased area as originally described. If a surrender is not filed within 60 days, the state may terminate this lease as to the acreage that must be eliminated by mailing notice of the termination to the lessee describing the subdivision eliminated.

(d) If the State of Alaska's ownership interest in the oil, gas, and associated substances in the leased area is less than an entire and undivided interest, the grant under this lease is effective only as to the state's interest in that oil, gas, and associated substances, and the royalties and rentals provided in this lease must be paid to the state in the proportion that the state's interest bears to the entire undivided fee.

(e) The state makes no representations or warranties, express or implied, as to title, or access to, or quiet enjoyment of, the leased area. The state is not liable to the lessee for any deficiency in title to the leased area, nor is the lessee or any successor in interest to the lessee entitled to any refund due to deficiency in title for any rentals, bonuses, or royalties paid under this lease.

2. RESERVED RIGHTS. (a) The state, for itself and others, reserves all rights not expressly granted to the lessee by this lease. These reserved rights include, but are not limited to:

(1) the right to explore for oil, gas, and associated substances by geological and geophysical means;

(2) the right to explore for, develop, and remove natural resources other than oil, gas, and associated substances on or from the leased area;

(3) the right to establish or grant easements and rights-of-way for any lawful purpose, including without limitation for shafts and tunnels necessary or appropriate for the working of the leased area or other lands for natural resources other than oil, gas, and associated substances;

(4) the right to dispose of land within the leased area for well sites and well bores of wells drilled from or through the leased area to explore for or produce oil, gas, and associated substances in and from lands not within the leased area; and

(5) the right otherwise to manage and dispose of the surface of the leased area or interests in that land by grant, lease, permit, or otherwise to third parties.

(b) The rights reserved may be exercised by the state, or by any other person or entity acting under authority of the state, in any manner that does not unreasonably interfere with or endanger the lessee's operations under this lease.

3. TERM. This lease is issued for an initial primary term of 7 years from the effective date of this lease. The term may be extended as provided in Paragraph 4 below.

4. EXTENSION. (a) This lease will be extended automatically if and for so long as oil or gas is produced in paying quantities from the leased area.

(b) This lease will be extended automatically if it is committed to a unit agreement approved or prescribed by the state, and will remain in effect for so long as it remains committed to that unit agreement.

(c) (1) If the drilling of a well whose bottom hole location is in the leased area has commenced as of the date on which the lease otherwise would expire and is continued with reasonable diligence, this lease will continue in effect until 90 days after cessation of that drilling and for so long as oil or gas is produced in paying quantities from the leased area.

(2) If oil or gas in paying quantities is produced from the leased area, and if that production ceases at any time, this lease will not terminate if drilling or reworking operations are commenced on the leased area within six months after cessation of production and are prosecuted with reasonable diligence; if those drilling or reworking operations result in the production of oil or gas, this lease will remain in effect for so long as oil or gas is produced in paying quantities from the leased area.

(d) If there is a well capable of producing oil or gas in paying quantities on the leased area, this lease will not expire because the lessee fails to produce that oil or gas unless the state gives notice to the lessee, allowing a reasonable time, which will not be less than six months after notice, to place the well into production, and the lessee fails to do so. If production is established within the time allowed, this lease is extended only for so long as oil or gas is produced in paying quantities from the leased area.

(e) If the state directs or approves in writing a suspension of all operations on or production from the leased area (except for a suspension necessitated by the lessee's negligence), or if a suspension of all operations on or production from the leased area has been ordered under federal, state, or local law, the lessee's obligation to comply with any express or implied provision of this lease requiring operations or production will be suspended, but not voided, and the lessee shall not be liable for damages for failure to comply with that provision. If the suspension occurs before the expiration of the primary term, the primary term will be extended at the end of the period of the suspension by adding the period of time lost under the primary term because of the suspension. If the suspension occurs during an extension of the primary term under this paragraph, upon removal of that suspension, the lessee will have a reasonable time, which will not be less than six months after notice that the suspension has been removed, to resume operations or production. For the purposes of this subparagraph, any suspension of operations or production specifically required or imposed as a term of sale or by any stipulation made a part of this lease will not be considered a suspension ordered by law.

(f) If the state determines that the lessee has been prevented by force majeure, after efforts made in good faith, from performing any act that would extend the lease beyond the primary term, this lease will not expire during the period of force majeure. If the force majeure occurs before the expiration of the primary term, the primary term will be extended at the end of the period of force majeure by adding the period of time lost under the primary term because of the force majeure. If the force majeure occurs during an extension of the primary term under this paragraph, this lease will not expire during the period of force majeure plus a reasonable time after that period, which will not be less than 60 days, for the lessee to resume operations or production.

(g) Nothing in subparagraphs (e) or (f) suspends the obligation to pay royalties or other production or profit-based payments to the state from operations on the leased area that are not affected by any suspension or force majeure, or suspends the obligation to pay rentals.

5. RENTALS. (a) The lessee shall pay annual rental to the state in accordance with the following rental schedule:

(1) For the first year, $1.00 per acre or fraction of an acre;

(2) For the second year, $1.50 per acre or fraction of an acre;

(3) For the third year, $2.00 per acre or fraction of an acre;

(4) For the fourth year, $2.50 per acre or fraction of an acre;

(5) For the fifth year and following years, $3.00 per acre or fraction of an acre; provided that the state may increase the annual rental rate as provided by law upon extension of this lease beyond the primary term.

(b) Annual rental paid in advance is a credit on the royalty or net profit share due under this lease for that year.

(c) The lessee shall pay the annual rental to the State of Alaska (or any depository designated by the state with at least 60 days notice to the lessee) in advance, on or before the annual anniversary date of this lease. The state is not required to give notice that rentals are due by billing the lessee. If the state's (or depository's) office is not open for business on the annual anniversary date of this lease, the time for payment is extended to include the next day on which that office is open for business. If the annual rental is not paid timely, this lease automatically terminates as to both parties at 11:59 p.m., Alaska Standard Time, on the date by which the rental payment was to have been made.

6. RECORDS. The lessee shall keep and have in its possession books and records showing the development and production (including records of development and production expenses) and disposition (including records of sale prices, volumes, and purchasers) of all oil, gas, and associated substances produced from the leased area. The lessee shall permit the State of Alaska or its agents to examine these books and records at all reasonable times. Upon request by the state, the lessee's books and records shall be made available to the state at the state office designated by the state. These books and records of development, production, and disposition must employ methods and techniques that will ensure the most accurate figures reasonably available without requiring the lessee to provide separate tankage or meters for each well. The lessee shall use generally accepted accounting procedures consistently applied.

7. APPORTIONMENT OF ROYALTY FROM APPROVED UNIT. The landowners' royalty share of the unit production allocated to each separately owned tract shall be regarded as royalty to be distributed to and among, or the proceeds of it paid to, the landowners, free and clear of all unit expense and free of any lien for it. Under this provision, the state's royalty share of any unit production allocated to the leased area will be

regarded as royalty to be distributed to, or the proceeds of it paid to, the state, free and clear of all unit expenses (and any portion of those expenses incurred away from the unit area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing oil, gas, or associated substances for transportation off the unit area, and free of any lien for them.

8. PAYMENTS. All payments to the State of Alaska under this lease must be made payable to the state in the manner directed by the state, and unless otherwise specified, must be tendered to the state at:

DEPARTMENT OF NATURAL RESOURCES
550 WEST 7TH AVENUE, SUITE 1410
ANCHORAGE, ALASKA 99501-3561
ATTENTION: FINANCIAL SERVICES SECTION

or in person at either of the Department's Public Information Centers located at

550 W. 7th Ave., Suite 1260 Anchorage, Alaska	3700 Airport Way Fairbanks, Alaska

or to any depository designated by the state with at least 60 days notice to the lessee.

9. PLAN OF OPERATIONS. (a) Except as provided in (b) of this section, a plan of operations for all or part of the leased area must be approved by the commissioner before any operations may be undertaken on or in the leased area.

(b) A plan of operations is not required for:

(1) activities that would not require a land use permit; or

(2) operations undertaken under an approved unit plan of operations.

(c) Before undertaking operations on or in the leased area, the lessee shall provide for full payment of all damages sustained by the owner of the surface estate as well as by the surface owner's lessees and permittees, by reason of entering the land.

(d) An application for approval of a plan of operations must contain sufficient information, based on data reasonably available at the time the plan is submitted for approval, for the commissioner to determine the surface use requirements and impacts directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

(1) the sequence and schedule of the operations to be conducted on or in the leased area, including the date operations are proposed to begin and their proposed duration;

(2) projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations;

(3) plans for rehabilitation of the affected leased area after completion of operations or phases of those operations; and

(4) a description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas.

(e) In approving a lease plan of operations or an amendment of a plan, the commissioner will require amendments that the commissioner determines necessary to protect the state's interest. The commissioner will not require an amendment that would be inconsistent with the terms of sale under which the lease was obtained, or with the terms of the lease itself, or which would deprive the lessee of reasonable use of the leasehold interest.

(f) The lessee may, with the approval of the commissioner, amend an approved plan of operations.

(g) Upon completion of operations, the lessee shall inspect the area of operations and submit a report indicating the completion date of operations and stating any noncompliance of which the lessee knows, or should reasonably know, with requirements imposed as a condition of approval of the plan.

(h) In submitting a proposed plan of operations for approval, the lessee shall provide ten copies of the plan if activities proposed are within the coastal zone, and five copies if activities proposed are not within the coastal zone.

10. PLAN OF DEVELOPMENT. (a) Except as provided in subparagraph (d) below, within 12 months after completion of a well capable of producing oil, gas, or associated substances in paying quantities, the lessee shall file two copies of an application for approval by the state of an initial plan of development that must describe the lessee's plans for developing the leased area. No development of the leased area may occur until a plan of development has been approved by the state.

(b) The plan of development must be revised, updated, and submitted to the state for approval annually before or on the anniversary date of the previously approved plan. If no changes from an approved plan are contemplated for the following year, a statement to that effect must be filed for approval in lieu of the required revision and update.

(c) The lessee may, with the approval of the state, subsequently modify an approved plan of development.

(d) If the leased area is included in an approved unit, the lessee will not be required to submit a separate lease plan of development for unit activities.

11. INFORMATION ACQUIRED FROM OPERATIONS. (a) The lessee shall submit to the state all geological, geophysical and engineering data and analyses obtained from the lease within 30 days following the completion of a well. The lessee shall submit to the state data and analyses acquired subsequent to well completion within 30 days following acquisition of that data. The state may waive receipt of operational data from some development, service or injection wells. The state will inform the operator of the waiver prior to well completion. The lessee shall submit the data and analyses to the Division of Oil and Gas, Department of Natural Resources, at the location specified in paragraph 25 of this lease. The data and analyses shall include the following:

(1) a copy of the completion report (AOGCC form 10-407) with an attached well summary, including daily drilling reports, formation tops encountered, a full synopsis of drillstem and formation testing data, an identification of zones of abnormal pressure, oil and gas shows and cored intervals;

(2) latitudinal and longitudinal coordinates for the completed surface and bottom hole locations;

(3) a copy of the permit to drill (AOGCC form 10-401 only, additional documentation not required) and the survey plat of the well location;

(4) a paper copy (no sepia copies) of all final 2-inch open hole and cased hole logs, including measured depth and true-vertical depth versions, specialty logs (such as Schlumberger's cyberlook, formation microscanners and dipmeter logs), composite mud or lithology log and report, measured-while-drilling (MWD) and logged-while-drilling (LWD) logs, velocity and directional surveys;

(5) a digital version of well logs in LAS, LIS or ASCII format on IBM format floppy disks, a digital version of velocity surveys in SEG Y format, a digital version of directional surveys in ASCII format (other formats may be acceptable upon agreement with the Division of Oil and Gas); and

(6) a paper copy of all available well analyses, including geochemical analyses, core analyses (porosity, permeability, capillary pressure, photos, and descriptions), paleontologic and palynologic analyses, thermal maturation analyses, pressure build up analyses, and fluid PVT analyses (an ASCII format digital version of the above information shall also be submitted, if available). The state may require the lessee to submit additional information in accordance with the applicable statutes and regulations in effect at the time of the completion date of the well.

(b) Any information submitted to the state by the lessee in connection with this lease will be available at all times for use by the state and its agents. The state will keep information confidential as provided in AS 38.05.035(a)(9) and its applicable regulations. In accordance with AS 38.05.035(a)(9)(C), in order for geological, geophysical and engineering information submitted under paragraph 11(a) of this lease to be held confidential, the lessee must request confidentiality at the time the information is submitted. The information must be marked **CONFIDENTIAL.**

12. DIRECTIONAL DRILLING. This lease may be maintained in effect by directional wells whose bottom hole location is on the leased area but that are drilled from locations on other lands not covered by this lease. In those circumstances, drilling will be considered to have commenced on the leased area when actual

drilling is commenced on those other lands for the purpose of directionally drilling into the leased area. Production of oil or gas from the leased area through any directional well surfaced on those other lands, or drilling or reworking of that directional well, will be considered production or drilling or reworking operations on the leased area for all purposes of this lease. Nothing contained in this paragraph is intended or will be construed as granting to the lessee any interest, license, easement, or other right in or with respect to those lands in addition to any interest, license, easement, or other right that the lessee may have lawfully acquired from the state or from others.

13. DILIGENCE AND PREVENTION OF WASTE. (a) The lessee shall exercise reasonable diligence in drilling, producing, and operating wells on the leased area unless consent to suspend operations temporarily is granted by the state.

(b) Upon discovery of oil or gas on the leased area in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geologic structure at another location with a reasonable profit to the operator, the lessee must drill those wells as a reasonable and prudent operator would drill, having due regard for the interest of the state as well as the interest of the lessee.

(c) The lessee shall perform all operations under this lease in a good and workmanlike manner in accordance with the methods and practices set out in the approved plan of operations and plan of development, with due regard for the prevention of waste of oil, gas, and associated substances and the entrance of water to the oil and gas-bearing sands or strata to the destruction or injury of those sands or strata, and to the preservation and conservation of the property for future productive operations. The lessee shall carry out at the lessee's expense all orders and requirements of the State of Alaska relative to the prevention of waste and to the preservation of the leased area. If the lessee fails to carry out these orders, the state will have the right, together with any other available legal recourse, to enter the leased area to repair damage or prevent waste at the lessee's expense.

(d) The lessee shall securely plug in an approved manner any well before abandoning it.

14. OFFSET WELLS. The lessee shall drill such wells as a reasonable and prudent operator would drill to protect the state from loss by reason of drainage resulting from production on other land. Without limiting the generality of the foregoing sentence, if oil or gas is produced in a well on other land not owned by the State of Alaska or on which the State of Alaska receives a lower rate of royalty than under this lease, and that well is within 500 feet in the case of an oil well or 1,500 feet in the case of a gas well of lands then subject to this lease, and that well produces oil or gas for a period of 30 consecutive days in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geological structure at an offset location with a reasonable profit to the operator, and if, after notice to the lessee and an opportunity to be heard, the state finds that production from that well is draining lands then subject to this lease, the lessee shall within 30 days after written demand by the state begin in good faith and diligently prosecute drilling operations for an offset well on the leased area. In lieu of drilling any well required by this paragraph, the lessee may, with the state's consent, compensate the state in full each month for the estimated loss of royalty through drainage in the amount determined by the state.

15. UNITIZATION. (a) The lessee may unite with others, jointly or separately, in collectively adopting and operating under a cooperative or unit agreement for the exploration, development, or operation of the pool, field, or like area or part of the pool, field, or like area that includes or underlies the leased area or any part of the leased area whenever the state determines and certifies that the cooperative or unit agreement is in the public interest.

(b) The lessee agrees, within six months after demand by the state, to subscribe to a reasonable cooperative or unit agreement that will adequately protect all parties in interest, including the state. The state reserves the right to prescribe such an agreement.

(c) With the consent of the lessee, and if the leased area is committed to a unit agreement approved by the state, the state may establish, alter, change, or revoke drilling, producing, and royalty requirements of this lease as the state determines necessary or proper to secure the proper protection of the public interest.

(d) Except as otherwise provided in this subparagraph, where only a portion of the leased area is committed to a unit agreement approved or prescribed by the state, that commitment constitutes a severance of this lease as to the unitized and nonunitized portions of the leased area. The portion of the leased area not committed to the unit will be treated as a separate and distinct lease having the same effective date and term as this lease and may be maintained only in accordance with the terms and conditions of this lease, statutes, and regulations. Any portion of the leased area not committed to the unit agreement will not be affected by the unitization or pooling of any other portion of the leased area, by operations in the unit, or by suspension approved or ordered for the unit. If the leased area has a well certified, under 11 AAC 83.361, as capable of production in paying quantities as defined in 11 AAC 83.395(4) on it before commitment to a unit agreement, this lease will not be severed. If any portion of this lease is included in a participating area formed under a unit agreement, the entire leased area will remain committed to the unit and this lease will not be severed.

16. INSPECTION. The lessee shall keep open at all reasonable times, for inspection by any duly authorized representative of the State of Alaska, the leased area, all wells, improvements, machinery, and fixtures on the leased area, and all reports and records relative to operations and surveys or investigations on or with regard to the leased area or under this lease. Upon request, the lessee shall furnish the State of Alaska with copies of and extracts from any such reports and records.

17. SUSPENSION. The state may from time to time direct or approve in writing suspension of production or other operations under this lease.

18. ASSIGNMENT, PARTITION, AND CONVERSION. This lease, or an interest in this lease, may, with the approval of the state, be assigned, subleased, or otherwise transferred to any person or persons qualified to hold a lease. No assignment, sublease, or other transfer of an interest in this lease, including assignments of working or royalty interests and operating agreements and subleases, will be binding upon the state unless approved by the state. The lessee shall remain liable for all obligations under this lease accruing prior to the approval by the state of any assignment, sublease, or other transfer of an interest in this lease. All provisions of this lease will extend to and be binding upon the heirs, administrators, successors, and assigns of the state and the lessee. Applications for approval of an assignment, sublease, or other transfer must comply with all applicable regulations and must be filed within 90 days after the date of final execution of the instrument of transfer. The state will approve a transfer of an undivided interest in this lease unless the transfer would adversely affect the interests of Alaska or the application does not comply with applicable regulations. The state will disapprove a transfer of a divided interest in this lease if the transfer covers only a portion of the lease or a separate and distinct zone or geological horizon unless the lessee demonstrates that the proposed transfer of a divided interest is reasonably necessary to accomplish exploration or development of the lease, the lease is committed to an approved unit agreement, the lease is allocated production within an approved participating area, or the lease has a well capable of production in paying quantities. The state will make a written finding stating the reasons for disapproval of a transfer of a divided interest. Where an assignment, sublease, or other transfer is made of all or a part of the lessee's interest in a portion of the leased area, this lease may, at the option of the state or upon request of the transferee and with the approval of the state, be severed, and a separate and distinct lease will be issued to the transferee having the same effective date and terms as this lease.

19. SURRENDER. The lessee at any time may file with the state a written surrender of all rights under this lease or any portion of the leased area comprising one or more legal subdivisions or, with the consent of the state, any separate and distinct zone or geological horizon underlying the leased area or one or more legal subdivisions of the leased area. That surrender will be effective as of the date of filing, subject to the continued obligations of the lessee and its surety to make payment of all accrued royalties and to place all wells and surface facilities on the surrendered land or in the surrendered zones or horizons in condition satisfactory to the state for suspension or abandonment. After that, the lessee will be released from all obligations under this lease with respect to the surrendered lands, zones, or horizons.

20. DEFAULT AND TERMINATION; CANCELLATION. (a) The failure of the lessee to perform timely its obligations under this lease, or the failure of the lessee otherwise to abide by all express and implied provisions of this lease, is a default of the lessee's obligations under this lease. Whenever the lessee fails to comply with any of the provisions of this lease (other than a provision which, by its terms, provides for automatic termination), and fails within 60 days after written notice of that default to begin and diligently prosecute operations to remedy that default, the state may terminate this lease if at the time of termination there is no well on the leased area capable of producing oil or gas in paying quantities. If there is a well on the leased area capable of producing oil or gas in paying quantities, this lease may be terminated by an appropriate judicial proceeding. In the event of any termination under this subparagraph, the lessee shall have the right to retain under this lease any and all drilling or producing wells for which no default exists, together with a parcel of land surrounding each well or wells and rights-of-way through the leased area that are reasonably necessary to enable the lessee to drill, operate, and transport oil or gas from the retained well or wells.

(b) The state may cancel this lease at any time if the state determines, after the lessee has been given notice and a reasonable opportunity to be heard, that:

(1) continued operations pursuant to this lease probably will cause serious harm or damage to biological resources, to property, to mineral resources, or to the environment (including the human environment);

(2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and

(3) the advantages of cancellation outweigh the advantages of continuing this lease in effect. Any cancellation under this subparagraph will not occur unless and until operations under this lease have been under suspension or temporary prohibition by the state, with due extension of the term of this lease, continuously for a period of five years or for a lesser period upon request of the lessee.

(c) Any cancellation under subparagraph (b) will entitle the lessee to receive compensation as the lessee demonstrates to the state is equal to the lesser of:

(1) the value of the cancelled rights as of the date of cancellation, with due consideration being given to both anticipated revenues from this lease and anticipated costs, including costs of compliance with all applicable regulations and stipulations, liability for clean-up costs or damages, or both, in the case of an oil spill, and all other costs reasonably anticipated under this lease; or

(2) the excess, if any, over the lessee's revenues from this lease (plus interest on the excess from the date of receipt to date of reimbursement) of all consideration paid for this lease and all direct expenditures made by the lessee after the effective date of this lease and in connection with exploration or development, or both, under this lease, plus interest on that consideration and those expenditures from the date of payment to the date of reimbursement.

21. RIGHTS UPON TERMINATION. Upon the expiration or earlier termination of this lease as to all or any portion of the leased area, the lessee will be directed in writing by the state and will have the right at any time within a period of one year after the termination, or any extension of that period as may be granted by the state, to remove from the leased area or portion of the leased area all machinery, equipment, tools, and materials. Upon the expiration of that period or extension of that period and at the option of the state, any machinery, equipment, tools, and materials that the lessee has not removed from the leased area or portion of the leased area become the property of the state or may be removed by the state at the lessee's expense. At the option of the state, all improvements such as roads, pads, and wells must either be abandoned and the sites rehabilitated by the lessee to the satisfaction of the state, or be left intact and the lessee absolved of all further responsibility as to their maintenance, repair, and eventual abandonment and rehabilitation. Subject to the above conditions, the lessee shall deliver up the leased area or those portions of the leased area in good condition.

22. DAMAGES AND INDEMNIFICATION. (a) No rights under the AS 38.05.125 reservation may be exercised by the lessee until the lessee has provided to pay the owner of the land, his lessees and permittees, upon which the AS 38.05.125 reserved rights are sought to be exercised, full payment for all damage sustained by the owner by reason of entering the land. If the owner for any reason does not settle the damages, the lessee may enter the land after posting a surety bond determined by the state, after notice and an opportunity to be heard, to be sufficient as to form, amount, and security to secure to the owner, his lessees and permittees, payment for damages, and may institute legal proceedings in a court of competent jurisdiction where the land is located to determine the damages which the owner of the land may suffer. The lessee agrees to pay for any damages that may become payable under AS 38.05.130 and to indemnify the state and hold it harmless from and against any claims, demands, liabilities, and expenses arising from or in connection with such damages. The furnishing of a bond in compliance with this paragraph will be regarded by the state as sufficient provision for the payment of all damages that may become payable under AS 38.05.130 by virtue of this lease.

(b) The lessee shall indemnify the state for, and hold it harmless from, any claim, including claims for loss or damage to property or injury to any person caused by or resulting from any act or omission committed under this lease by or on behalf of the lessee. The lessee is not responsible to the state under this subparagraph for any loss, damage, or injury caused by or resulting from the sole negligence of the state.

(c) The lessee expressly waives any defense to an action for breach of a provision of this lease or for damages resulting from an oil spill or other harm to the environment that is based on an act or omission committed by an independent contractor in the lessee's employ. The lessee expressly agrees to assume responsibility for all actions of its independent contractors.

23. BONDS. (a) If required by the state, the lessee shall furnish a bond prior to the issuance of this lease in an amount equal to at least $5 per acre or fraction of an acre contained in the leased area, but no less than $10,000, and must maintain that bond as long as required by the state.

(b) The lessee may, in lieu of the bond required under (a) above, furnish and maintain a statewide bond in accordance with applicable regulations.

(c) The state may, after notice to the lessee and a reasonable opportunity to be heard, require a bond in a reasonable amount greater than the amount specified in (a) above where a greater amount is justified by the nature of the surface and its uses and the degree of risk involved in the types of operations being or to be carried out under this lease. A statewide bond will not satisfy any requirement of a bond imposed under this subparagraph, but will be considered by the state in determining the need for and the amount of any additional bond under this subparagraph.

(d) If the leased area is committed in whole or in part to a cooperative or unit agreement approved or prescribed by the state, and the unit operator furnishes a statewide bond, the lessee need not maintain any bond with respect to the portion of the leased area committed to the cooperative or unit agreement.

24. AUTHORIZED REPRESENTATIVES. The Director of the Division of Oil and Gas, Department of Natural Resources, State of Alaska, and the person executing this lease on behalf of the lessee shall be authorized representatives for their respective principals for the purposes of administering this lease. The state or the lessee may change the designation of its authorized representative or the address to which notices to that representative are to be sent by a notice given in accordance with Paragraph 25 below. Where activities pursuant to a plan of operations are underway, the lessee shall also designate, pursuant to a notice under Paragraph 25 below, by name, job title, and address, an agent who will be present in the state during all lease activities.

25. NOTICES; PROTEST. (a) Any notices required or permitted under this lease must be by electronic media producing a permanent record or in writing and must be given personally or by registered or certified mail, return receipt requested, addressed as follows:

TO THE STATE:

DIRECTOR, DIVISION OF OIL AND GAS
DEPARTMENT OF NATURAL RESOURCES
550 WEST 7TH AVENUE, SUITE 800
ANCHORAGE, ALASKA 99501-3560

TO THE LESSEE:

(b) Any notice given under this paragraph will be effective when delivered to the above authorized representative.

(c) A lessee who wishes to protest the amount of money due the state under the lease or any action of the state regarding a provision of this lease must file a written protest with the Division of Oil and Gas within 30 days after the mailing date of the state's notice or bill. A lessee who fails to file a protest within the required time waives any further right to protest. The state will establish the administrative appeal procedure to be followed and will inform the lessee of the procedure no later than 30 days after the filing of the written protest.

26. STATUTES AND REGULATIONS. This lease is subject to all applicable state and federal statutes and regulations in effect on the effective date of this lease, and insofar as is constitutionally permissible, to all statutes and regulations placed in effect after the effective date of this lease. A reference to a statute or regulation in this lease includes any change in that statute or regulation whether by amendment, repeal and

replacement, or other means. This lease does not limit the power of the State of Alaska or the United States of America to enact and enforce legislation or to promulgate and enforce regulations affecting, directly or indirectly, the activities of the lessee or its agents in connection with this lease or the value of the interest held under this lease. In case of conflicting provisions, statutes and regulations take precedence over this lease.

27. INTERPRETATION. This lease is to be interpreted in accordance with the rules applicable to the interpretation of contracts made in the State of Alaska. The paragraph headings are not part of this lease and are inserted only for convenience. The state and the lessee expressly agree that the law of the State of Alaska will apply in any judicial proceeding affecting this lease.

28. INTEREST IN REAL PROPERTY. It is the intention of the parties that the rights granted to the lessee by this lease constitute an interest in real property in the leased area.

29. WAIVER OF CONDITIONS. The state reserves the right to waive any breach of a provision of this lease, but any such waiver extends only to the particular breach so waived and does not limit the rights of the state with respect to any future breach; nor will the waiver of a particular breach prevent cancellation of this lease for any other cause or for the same cause occurring at another time. Notwithstanding the foregoing, the state will not be deemed to have waived a provision of this lease unless it does so in writing.

30. SEVERABILITY. If it is finally determined in any judicial proceeding that any provision of this lease is invalid, the state and the lessee may jointly agree by a written amendment to this lease that, in consideration of the provisions in that written amendment, the invalid portion will be treated as severed from this lease and that the remainder of this lease, as amended, will remain in effect.

31. LOCAL HIRE. The lessee is encouraged to hire and employ local and Alaska residents and companies, to the extent they are available and qualified, for work performed on the leased area. Lessees shall submit, with the plans of operations, a proposal detailing the means by which the lessee will comply with this measure. The lessee is encouraged, in formulating this proposal, to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

32. CONDITIONAL LEASE. If all or a part of the leased area is land that has been selected by the state under laws of the United States granting lands to the state, but the land has not been patented to the state by the United States, then this lease is a conditional lease as provided by law until the patent becomes effective. If for any reason the selection is not finally approved, or the patent does not become effective, any rental, royalty, or other production or profit-based payments made to the state under this lease will not be refunded.

33. NONDISCRIMINATION. The lessee and the lessee's contractors and subcontractors may not discriminate against any employee or applicant because of race, religion, marital status, change in marital status, pregnancy, parenthood, physical handicap, color, sex, age, or national origin as set out in AS 18.80.220. The lessee and its contractors and subcontractors must, on beginning any operations under this lease, post in a conspicuous place notices setting out this nondiscrimination provision.

34. DEFINITIONS. All words and phrases used in this lease are to be interpreted where possible in the manner required in respect to the interpretation of statutes by AS 01.10.040. However, the following words have the following meanings unless the context unavoidably requires otherwise:

(1) "oil" means crude petroleum oil and other hydrocarbons, regardless of gravity, that are produced in liquid form by ordinary production methods, including liquid hydrocarbons known as distillate or condensate recovered by separation from gas other than at a gas processing plant;

(2) "gas" means all natural gas (except helium gas) and all other hydrocarbons produced that are not defined in this lease as oil;

(3) "associated substances" means all substances except helium produced as an incident of production of oil or gas by ordinary production methods and not defined in this lease as oil or gas;

(4) "drilling" means the act of boring a hole to reach a proposed bottom hole location through which oil or gas may be produced if encountered in paying quantities, and includes redrilling, sidetracking, deepening, or other means necessary to reach the proposed bottom hole location, testing, logging, plugging, and other operations necessary and incidental to the actual boring of the hole;

(5) "reworking operations" means all operations designed to secure, restore, or improve production through some use of a hole previously drilled, including, but not limited to, mechanical or chemical treatment of any horizon, plugging back to test higher strata, etc.;

(6) "paying quantities" means production in quantities sufficient to yield a return in excess of operating costs, even though drilling and equipment costs may never be repaid and the undertaking considered as a whole may ultimately result in a loss; and

(7) "force majeure" means war, riots, acts of God, unusually severe weather, or any other cause beyond the lessee's reasonable ability to foresee or control and includes operational failure of existing transportation facilities and delays caused by judicial decisions or lack of them.

35. ROYALTY ON PRODUCTION. Except for oil, gas, and associated substances used on the leased area for development and production or unavoidably lost, the lessee shall pay to the state as a royalty 12.50 percent in amount or value of the oil, gas, and associated substances saved, removed, or sold from the leased area and of the gas from the leased area used on the leased area for extraction of natural gasoline or other products.

36. VALUE. (a) For the purposes of computing royalties due under this lease, the value of royalty oil, gas, or associated substances shall not be less than the highest of:

(1) the field price received by the lessee for the oil, gas, or associated substances;

(2) the volume-weighted average of the three highest field prices received by other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices reported by other producers, the volume-weighted average will be calculated using the lesser number of prices received by other producers in the field or area;

(3) the lessee's posted price in the field or area for the oil, gas, or associated substances; or

(4) the volume-weighted average of the three highest posted prices in the same field or area of the other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices posted by other producers, the volume-weighted average will be calculated using the lesser number of prices posted by other producers in the field or area.

(b) If oil, gas, or associated substances are sold away from the leased or unit area, the term "field price" in subparagraph (a) above will be the cash value of all consideration received by the lessee or other producer from the purchaser of the oil, gas, or associated substances, less the lessee’s actual and reasonable costs of transportation away from the leased or unit area to the point of sale. The "actual and reasonable costs of transportation" for marine transportation are as defined in 11 AAC 83.229(a), (b)(2), and (c) - l.

(c) In the event the lessee does not sell in an arm's-length transaction the oil, gas, or associated substances, the term "field price" in subparagraphs (a) and (b) above will mean the price the lessee would expect to receive for the oil, gas, or associated substances if the lessee did sell the oil, gas, or associated substances in an arm's-length transaction, minus reasonable costs of transportation away from the leased or unit area to the point of sale or other disposition. The lessee must determine this price in a consistent and logical manner using information available to the lessee and report that price to the state.

(d) The state may establish minimum values for the purposes of computing royalties on oil, gas, or associated substances obtained from this lease, with consideration being given to the price actually received by the lessee, to the price or prices paid in the same field or area for production of like quality, to posted prices, to prices received by the lessee and/or other producers from sales occurring away from the leased area, and/or to other relevant matters. In establishing minimum values, the state may use, but is not limited to, the methodology for determining "prevailing value" as defined in 11 AAC 83.227. Each minimum value determination will be made only after the lessee has been given notice and a reasonable opportunity to be heard. Under this provision, it is expressly agreed that the minimum value of royalty oil, gas, or associated substances under this lease may not necessarily equal, and may exceed, the price of the oil, gas, or associated substances.

37. ROYALTY IN VALUE. Except to the extent that the state elects to receive all or a portion of its royalty in kind as provided in Paragraph 38 below, the lessee shall pay to the state that value of all royalty oil, gas, and associated substances as determined under Paragraph 36 above. Royalty paid in value will be free

and clear of all lease expenses (and any portion of those expenses that is incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area. All royalty that may become payable in money to the State of Alaska must be paid on or before the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances are produced. The amount of all royalty in value payments which are not paid when due under this lease or the amount which is subsequently determined to be due to the state or the lessee as the result of a redetermination will bear interest from the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances were produced, until the obligation is paid in full. Interest shall accrue at the rate provided in AS 38.05.135(d) or as may later be amended. Royalty payments must be accompanied by such information relating to valuation of royalty as the state may require which may include, but is not limited to, run tickets, evidence of sales, shipments, and amounts of gross oil, gas, and associated substances produced.

38. ROYALTY IN KIND. (a) At the state's option, which may be exercised from time to time upon not less than 90 days' notice to the lessee, the lessee shall deliver all or a portion of the state's royalty oil, gas, or associated substances produced from the leased area in kind. Delivery will be on the leased area, unit area, or at a place mutually agreed to by the state and the lessee, and must be delivered to the State of Alaska or to any individual, firm, or corporation designated by the state.

(b) Royalty oil, gas, or associated substances delivered in kind must be delivered in good and merchantable condition, of pipeline quality, and free and clear of all lease expenses (and any portion of those expenses incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area.

(c) After having given notice of its intention to take, or after having taken its royalty oil, gas, or associated substances in kind, the state, at its option and upon 90 days' notice to the lessee, may elect to receive a different portion or none of its royalty in kind. If, under federal regulations, the taking of royalty oil, gas, or associated substances in value by the state creates a supplier-purchaser relationship, the lessee hereby waives its right to continue to receive royalty oil, gas, or associated substances under that relationship, and further agrees that it will require any purchasers of the royalty oil, gas, or associated substances likewise to waive any supplier-purchaser rights.

(d) The lessee shall furnish storage for royalty oil, gas, and associated substances produced from the leased or unit area to the same extent that the lessee provides storage for the lessee's share of oil, gas, and associated substances. The lessee shall not be liable for the loss or destruction of stored royalty oil, gas and associated substances from causes beyond the lessee's ability to control.

(e) If a state royalty purchaser refuses or for any reason fails to take delivery of oil, gas, or associated substances, or in an emergency, and with as much notice to the lessee as is practical or reasonable under the circumstances, the state may elect without penalty to underlift for up to six months all or a portion of the state's royalty on oil, gas, or associated substances produced from the leased or unit area and taken in kind. The state's right to underlift is limited to the portion of royalty oil, gas, or associated substances that the royalty purchaser refused or failed to take delivery of, or the portion necessary to meet the emergency condition. Underlifted oil, gas, or associated substances may be recovered by the state at a daily rate not to exceed 10 percent of its royalty interest share of daily production at the time of the underlift recovery.

39. REDUCTION OF ROYALTY. Lessee may request a reduction of royalty in accordance with the applicable statutes and regulations in effect on the date of application for the reduction.

40. EFFECTIVE DATE. This lease takes effect on .

BY SIGNING THIS LEASE, the state as lessor and the lessee agree to be bound by its provisions.

STATE OF ALASKA

By: ______________________________________

Director, Division of Oil and Gas

STATE OF ALASKA)
) ss.
Third Judicial District)

On , before me appeared Kevin R. Banks of the Division of Oil and Gas of the State of Alaska, Department of Natural Resources, and who executed this lease and acknowledged voluntarily signing it on behalf of the State of Alaska as lessor.

____

Notary public in and for the State of Alaska

My commission expires _______________

LESSEE: _______________________________________

Signature: _______________________________________

Printed Name/Title: ________________________________

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: _______________________________________

Signature: _______________________________________

Printed Name/Title: ________________________________

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: _______________________________________

Signature: _______________________________________

Printed Name/Title: ________________________________

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.