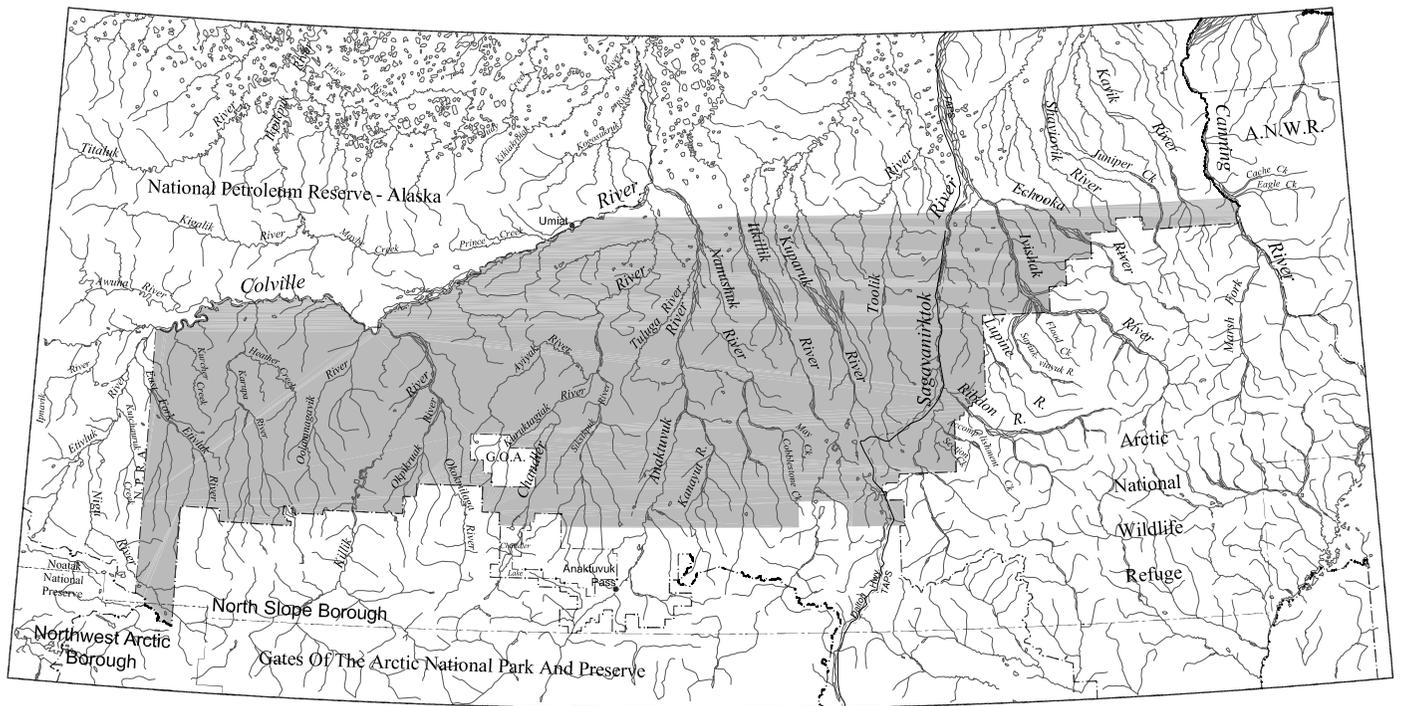


# Oil and Gas Lease Sale North Slope Foothills Areawide 2001

## Final Finding of the Director

February 7, 2001



Alaska Department of  
**NATURAL  
RESOURCES**  
DIVISION OF OIL & GAS

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

**Anchorage Alaska**  
**February 7, 2001**

**This publication was produced by the Department of Natural Resources, Division of Oil and Gas. It was printed at the cost of \$7.17 per copy. The purpose of the publication is to meet the mandate of AS 38.05.035(e). Printed in Anchorage Alaska.**



## Table of Contents

Chapter One: Introduction .....	1-1
A. Statutory Background .....	1-1
B. North Slope Foothills Areawide Oil and Gas Lease Sale .....	1-7
C. Governmental Powers to Regulate Oil and Gas Exploration, Development, Production, and Transportation.....	1-12
Chapter Two: Property Description and Petroleum Potential .....	2-1
A. Property Description .....	2-1
B. Geology .....	2-1
C. Exploration History .....	2-2
D. Petroleum Potential .....	2-4
Chapter Three: Habitat, Fish and Wildlife .....	3-1
A. Habitats.....	3-1
B. Fish and Bird Species.....	3-2
C. Terrestrial Mammals .....	3-10
Chapter Four: Current and Projected Uses of the Sale Area .....	4-1
A. Subsistence Hunting Fishing and Trapping.....	4-1
B. Other Uses .....	4-11
Chapter Five: Reasonably Foreseeable Effects .....	5-1
A. Post Sale Phases .....	5-3
B. Fiscal Effects .....	5-9
C. Effects on Municipalities and Communities.....	5-12
D. Cumulative Effects .....	5-14
Chapter Six: Issues Related to Oil and Gas Exploration, Development, Production, and Transportation.....	6-1
A. Geophysical Hazards.....	6-1
B. Likely Methods of Transportation .....	6-4
C. Oil Spill Risk .....	6-10
D. Oil Spill Prevention .....	6-11
Chapter Seven: Mitigation Measures and Lessee Advisories .....	7-1
A. Mitigation Measures.....	7-3
B. Lessee Advisories.....	7-10
Chapter Eight: Bidding Methods and Lease Terms.....	8-1
Chapter Nine: Conclusion.....	9-1
A. Reasonably Foreseeable Effects of the Sale and their Mitigation .....	9-1
B. Cumulative Effects and their Mitigation .....	9-3
C. Specific Issues Related To Oil And Gas Exploration, Development, Production, and Transportation.....	9-5
D. Bidding Method and lease Terms.....	9-6
E. Summary and Signature.....	9-6
Appendix A: Summary of Comments .....	A-1
Appendix B: Laws and Regulations Pertaining to Oil and Gas .....	B-1
Appendix C: Sample Lease Contract .....	C-1
Appendix D: Directional and Extended-Reach Drilling .....	D-1
Appendix E: References.....	E-1

## List of Figures

Figure 1.1 Sale Area and Alaska Coastal Zone Boundary .....	1-6
Figure 2.1 Generalized Stratigraphic Column .....	2-3
Figure 3.1 Anadromous Fish Species in and around the Sale Area .....	3-4
Figure 3.2 Areas Identified as Containing North Slope Dolly Varden Spawning/Overwintering Habitat.....	3-5
Figure 3.3 Geese Habitat in and around the Sale Area.....	3-9
Figure 3.4 Caribou Habitat in and around the Sale Area.....	3-11
Figure 3.5 Moose Habitat in and around the Sale Area .....	3-13
Figure 3.6 Duck and Brown Bear Habitat in and around the Sale Area .....	3-15
Figure 4.1 Seasonal Use Harvest Activities Anaktuvuk Pass and Nuiqsut .....	4-4
Figure 4.2 Seasonal Use Harvest Activities Barrow and Kaktovik .....	4-6
Figure 4.3 Subsistence Resource-Use Areas: Caribou and Furbearer.....	4-8
Figure 4.4 Subsistence Resource-Use Areas: Sheep and Grizzly .....	4-9
Figure 4.5 Subsistence Resource-Use Areas: Moose and Waterfowl .....	4-10
Figure 4.6 Game Management Units in the Arctic Region .....	4-12
Figure 5.1 Typical Production/Injection Well (North Slope, Alaska) .....	5-7
Figure 5.2 Evolving Consolidation of North Slope Production Pad Size.....	5-8
Figure 5.3 Alaska Permanent Fund Dividends, 1982-2000.....	5-10
Figure 5.4 Statewide Crude Oil Production Volumes, 1978-1999 .....	5-10
Figure 5-5 State Revenue from Oil and Gas Royalties .....	5-11
Figure 6.1 Seismicity in the North Slope Foothills Region.....	6-2
Figure 6.2 Ground Acceleration in the North Slope Foothills Region.....	6-2
Figure D.1 Drill Site Block Diagram .....	D-2
Figure D.2 Multi-Lateral Wellbore Completions.....	D-3
Figure D.3 Well "Reach" vs Time (in Alaska).....	D-5

## List of Tables

Table 1.1 Permit Process: North Slope Onshore Exploration Well .....	1-14
Table 2.1 Geologic Time .....	2-2
Table 3.1 Some Waterways and Typical Fish Species Within the Sale Area .....	3-3
Table 3.2 Birds Observed in the Vicinity of the Sale Area .....	3-7
Table 4.1 Berries Harvested on the North Slope.....	4-3
Table 5.1 Activities That May Be Found At Post Lease Sale Phases .....	5-3
Table 5-2 North Slope Borough Employment Profile .....	5-12
Table 6-1 Advantages and Disadvantages of Techniques for Cleaning Up Crude Oil in Terrestrial and Wetland Ecosystems.....	6-6

## List of Abbreviations

AAC	Alaska Administrative Code	DPOR	Division of Parks and Outdoor Recreation
ACMP	Alaska Coastal Management Plan	DW	Division of Water
ADCRA	Alaska Department of Community and Regional Affairs	EIS	Environmental Impact Statement
ADEC	Alaska Department of Environmental Conservation	gal	Gallon(s)
ADF&G	Alaska Department of Fish and Game	m	Meter
AOGCC	Alaska Oil and Gas Conservation Commission	MMS	Minerals Management Service
ADNR	Alaska Department of Natural Resources	NPDES	National Pollution Discharge Elimination System
AS	Alaska Statute	NSB	North Slope Borough
Bbl	Barrel (42 gallons)	NSBCMP	North Slope Borough Coastal Management Program
bpd	Barrels per day	NSBMC	North Slope Borough Municipal Code
BIA	U.S. Bureau of Indian Affairs	RCRA	Resource Conservation and Recovery Act
BLM	U.S. Bureau of Land Management	SPCC	Spill Prevention Control and Countermeasure
DF	Division of Forestry	SHPO	State Historic Preservation Officer
DGC	Division of Governmental Coordination	USACE	U.S. Army Corps of Engineers
DL	Division of Land	USC	United States Code
DMLW	Division of Mining, Land and Water	USDOI	United States Department of the Interior
DO&G	Division of Oil and Gas	USF&WS	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



# Chapter One: Introduction

## Contents

Introduction .....	1-1
A. Statutory Background .....	1-1
1. Public Participation .....	1-2
2. Best Interest Finding Scope of Review .....	1-3
3. Phased Review .....	1-4
B. North Slope Foothills Areawide Oil and Gas Lease Sale .....	1-7
1. North Slope Foothills Areawide Scope of Review .....	1-7
2. North Slope Foothills Areawide Process .....	1-8
C. Governmental Powers to Regulate Oil and Gas Exploration, Development, Production, and Transportation.....	1-12
1. Alaska Coastal Management Plan Review.....	1-12
2. Alaska Department of Natural Resources .....	1-13
3. Alaska Department of Environmental Conservation.....	1-17
4. Alaska Department of Fish and Game.....	1-21
5. Alaska Oil and Gas Conservation Commission.....	1-22
6. U.S. Environmental Protection Agency .....	1-24
7. U.S. Army Corps of Engineers.....	1-25
8. North Slope Borough .....	1-27
9. Other Requirements.....	1-27



# Chapter One: Introduction

The state of Alaska is offering for lease available state-owned acreage in its first North Slope Foothills Areawide Oil and Gas Lease Sale, scheduled for May 9, 2001. This sale consists of all unleased, state-owned lands lying between the National Petroleum Reserve-Alaska (NPR-A) and the Arctic National Wildlife Refuge (ANWR), south of the Umiat Baseline and north of the Gates of the Arctic National Park and Preserve. The gross sale area is in excess of 7.8 million acres (see Figure 1.1).

Areawide leasing provides an established time each year that the state offers for lease all available acreage within three geographical regions: Cook Inlet, the North Slope, and the Beaufort Sea. By conducting lease sales at a set time each year, the state will have a stable, predictable leasing program, which will allow companies to plan and develop their exploration strategies and budgets years in advance. The result will be more efficient exploration and earlier development, which will, in turn, benefit the state and its residents.

Areawide sales are also efficient for the public and the state. Previously, ADNR evaluated noncontiguous, patchwork portions of a region and then offered them for lease. For each subsequent 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. Areawide leasing allows a thorough, region-wide analysis, eliminates repeated confusing requests to the public and increases government efficiency as demanded by the public, and the legislature.

## A. Statutory Background

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, art. VIII, §§ 1, 2). To comply with this provision, the legislature enacted Title 38 of the Alaska Statutes (AS 38) and directed ADNR to implement the statutes.

Alaska Statute 38.05.035 governs the disposal of state owned subsurface interests and includes public notice requirements referred to in this document (AS 38.05.035(e)(5) and (AS 38.05.945). Under AS 38.05.035(e), ADNR may not dispose of state land, resources, property, or interests, unless the director first determines in a written finding that such action will serve the best interests of the state. This written finding is known as a best interest finding and is a written analysis which describes for the public the facts and applicable law which are relevant to the disposal and gives a decision based on these factors. The finding must also discuss material issues that were raised during the period allowed for receipt of public comment. Two documents are issued by DO&G: a Preliminary Best Interest Finding and subsequently, a Final Best Interest Finding.

AS 38.05.035(e) prescribes what, at minimum, must be in these findings, including a summary of comments on the sale received by the division, which can be found in Appendix A of this finding. In addition, AS 38.05.035(g) lists the topics that the Division of Oil & Gas (DO&G) must consider and discuss in the best interest finding analysis:

- 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 oil and gas exploration, development, production, and transportation;
- vi. the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation 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 and 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 oil and gas exploration, development, production, and transportation on the 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.

A compilation of other laws and regulations applicable to oil and gas activities in Alaska can be found in Appendix B. If the proposed activity occurs in a coastal area, 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.

## 1. Public Participation

The Alaska Constitution requires “prior public notice and other safeguards of the public interest as prescribed by law” prior to the leasing of state lands (Alaska Constitution, art. VIII, § 10).

Title 38 of the Alaska statutes requires DO&G to issue a preliminary best interest finding at least 180 days prior to an oil and gas lease sale. The division allows the public at least 60 days to review and comment on the preliminary finding analysis under AS 38.05.035(e)(5)(A). DO&G staff consider and research the comments and make appropriate changes for the subsequent final finding. The division issues a final best interest finding at least 90 days prior to the sale. See AS 38.05.035(e)(5)(B).

The public notice statute, AS 38.05.945, includes specific provisions for best interest findings for oil and gas lease sales. These include:

- publication of a legal notice in newspapers of statewide circulation and in newspapers of general circulation in the vicinity of the proposed action at least once a week for two consecutive weeks;
- for a preliminary finding, publication of a notice in display advertising form in the newspapers described above at least once a week for two consecutive weeks;
- 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 action; notification of parties known or likely to be affected by the action; or another method calculated to reach affected parties.

AS 38.05.946 provides that a municipality, an Alaska Native Claims Settlement Act (ANCSA) corporation, or nonprofit community organization entitled to receive a 30-day notice of issuance of a final best

interest finding, may hold a hearing which the commissioner shall attend. The commissioner has the discretion to hold a public hearing also. Although not required by statute or regulation, ADNR may:

- (a) contact legislators serving areas affected by a lease sale and local governing bodies early in the lease sale process so that informational meetings with concerned citizens and organizations can be arranged; and
- (b) conduct its own public hearings in one or more communities affected by a proposed lease sale at least once during the public comment period immediately following the issuance of the preliminary best interest finding.

Additional meetings and hearings are intended to provide information to the public about a proposed lease sale in the area and to encourage public comment. All findings under AS 38.05.035(e) must include a summary of agency and public comments regarding the proposed disposal and ADNR's responses to those comments.

After a final best interest finding is issued, an individual or organization may request reconsideration at the agency level in accordance with AS 38.05.035(i). A request for reconsideration of a best interest finding must be filed with the ADNR commissioner within 20 days after the issuance of the final best interest finding. In order to file a request for reconsideration, a person must have "meaningfully participated" in the administrative review process and must be affected<sup>1</sup> by the final decision. The term "meaningfully participated" means that the person (1) submitted written comment during a public comment period; or (2) presented oral testimony at a public hearing (AS 38.05.035(i)). An issue must be raised during a comment period, but not necessarily by the individual, in order to be the basis for a request for reconsideration.

A person may appeal to the superior court only if the person requested reconsideration at the agency level and may appeal only those points the person raised in the request for reconsideration (AS 38.05.035(l)). By requiring that a party exhaust the administrative review and reconsideration process before appealing to the superior court, the agency is given the fullest opportunity to review, analyze, and respond to the appealed concerns prior to litigation. For the purposes of review, the person appealing must state and prove the defect alleged to exist within the best interest finding (AS 38.05.035(m)).

## 2. Best Interest Finding Scope of Review

The scope of review and best interest finding are based on the facts and issues known, or made known, to the director and may address only reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(g), AS 38.05.035(e)(1)(A)). Legislative history indicates that for an effect to be "reasonably foreseeable": (1) there is 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. These practical constraints eliminate speculation about potential but improbable future effects and focuses the best interest finding on those effects which are most likely to occur as a result of the proposed lease sale disposal. For example, at the time ADNR prepares the best interest finding, it is impossible to predict whether, let alone when and where, development or production, or related facilities might result.<sup>2</sup> This concept is embraced in AS 38.05.035(h),

---

<sup>1</sup> Alaska case law defines "a person affected by a decision" as someone who has a personal stake in the results of the decision. *Sisters of Providence v. Dept. of Health & Social Services*, 648 P. 2d 970, 974 (Alaska 1982).

<sup>2</sup> The probability that commercial production will ever occur on a tract offered in an oil and gas lease sale is very low. Statistics compiled by ADNR indicate that about half of the tracts (51.6 percent) offered in state oil and gas lease sales have been leased. Of these leased tracts, slightly more than 10 percent have actually been drilled on. About 5 percent of the tracts leased have been commercially developed for oil and gas production. This means that only a small percentage (approximately 3 percent) of state lands offered for lease have been commercially developed for oil and gas

which states that “the director may not be required to speculate about 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 (1) the exact location and size of an ultimate use and related facilities.”

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. Public input 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 assist the director in:

- reviewing all of the facts and issues;
- determining which are material to the decision of whether to lease the area in question;
- establishing the scope of the review for that decision by determining the reasonably foreseeable, significant effects of leasing that arise from those material facts and issues; and
- balancing those effects to determine under what conditions, if any, leasing the area will serve the best interests of the state.

### 3. Phased Review

Phased review recognizes that leasing of state land may result in future projects that cannot be predicted or planned with any certainty or specificity at the initial lease sale stage and that will require future detailed site-specific review prior to approval. In oil and gas leasing, it cannot be determined with any specificity or definition at the leasing stage if, when, where, how, or what kind of production might ultimately occur, as the result of leasing. Advances or the lack of advances in technology, along with market changes, while they cannot be predicted, may determine the answers to some of these questions. The lease sale phase only authorizes the transfer of mineral interests. The only reasonably foreseeable effects of the sale are annual rental payments required by the state to keep the lease, and those effects resulting from exploration to evaluate the oil and gas potential of the lease. Thus, the analysis in the best interest finding is limited to a non site-specific discussion of the known or reasonably foreseeable effects of oil and gas activities on human and natural resources.

For example, Chapter Five discusses likely methods of oil and gas transportation, like pipelines, in a northern environment, with attention to the known physical and biological characteristics of the Foothills region. It does not and cannot discuss when, what kind, or where individual pipelines may be built. Such speculation concerning future development activities that will be subject to independent permitting requirements is not required by statute at the time a decision is made to lease.

Additional authorizations, such as plans of operation and permits, are required for exploration, development, and production phases. Phasing allows the analysis of proposed leasing to focus only on the issues pertaining to the lease sale stage and reasonably foreseeable significant effects of leasing and subsequent activities, such as exploration.

When a project is multiphased, review of issues which would require speculation about future factors may be deferred until permit authorization is sought at the exploration, development and production phases

---

production (Kornbrath, 1995). It is important to note that the 3 percent production success to tracts offered ratio is a statewide average for sales held over a 33+ year time period under the old leasing regime and not under areawide leasing. Considering changes in oil and gas recovery technology in recent decades, and that tracts continue to be offered and reoffered after they are relinquished, use of this average to estimate future effects of this sale, such as total surface impact, would be unreliable and misleading. For a discussion on surface impact as a result of oil and gas activities, see Chapter Five.

---

ADNR is allowed to review projects as "multi phased development," when three conditions are met (AS 38.05.035(e)(1)(C)):

- (a) the only uses to be authorized are part of the discrete phase being reviewed;
- (b) ADNR's approval is required before the next phase may proceed (i.e., a plan of operations or permit must be authorized before another phase or segment may begin); and
- (c) ADNR describes its reasons for allowing phased review and conditions the approval to ensure that any additional uses or activities proposed for that or any later phase will serve the best interests of the state.

Phased review is based in part on the fact that some multiphased projects are subject to continued review throughout the succeeding stages. Phased review is intended to allow for consideration of subsequent issues when sufficient data are available upon which to make reasonable decisions. Future phases cannot be reviewed with any accuracy when information regarding future activities is unknown, nonspecific, undefined, unavailable, or unreliable.



## B. North Slope Foothills Areawide Oil and Gas Lease Sale

This final best interest finding follows professional and technical review of social, economic, environmental, geological, and geophysical information about the North Slope Foothills Areawide sale area, as well as comments received. This document describes the sale area, and presents the department's review of the area's resources and history. It discusses the reasonably foreseeable, significant effects that may occur as a result of oil and gas exploration, development, production, and transportation within the sale area. It also proposes mitigation measures, including lessee advisories, to be imposed as plans of operation permit terms designed to reduce or eliminate any reasonably foreseeable, significant effects.

### 1. North Slope Foothills Areawide Scope of Review

The review of activities in the sale area is a multiphased development review. The Director, in making this final 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 this sale. The three conditions under which phasing may occur, are met here. See AS 38.05.035(e)(1)(C).

Condition (a) is met because the only authorizations in a lease sale are the granting of certain mineral rights under the lease. The lease merely gives the lessee, subject to the provisions of the lease, the non-exclusive right to conduct geological and geophysical exploration for oil, gas, and associated substances within the leased area; and the exclusive 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 (b) is met because state approval is required before the next phase (exploration) may proceed (see Chapter Six on the post-lease phases). Before exploration activities can occur on leased lands, the lessee must secure all applicable permits. Additional permits must also be prepared, and approved by the state, for any later development or production phase.

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 lease. Plans of operation are subject to extensive technical review by a number of local, state, and federal agencies. They are also subject to consistency with the Alaska Coastal Management Program (ACMP) standards, if the affected lands are within the coastal zone. The plans are available for public review upon submission to the state. Oil and gas exploration, development, or production-related activities will be permitted only if proposed future operations comply with all borough, state, and federal laws and the provisions of the lease.

Condition (c) is met because ADNR is conditioning this best interest determination and any leases ultimately issued with a number of mitigation measures designed to ensure that any future activities in the exploration, development, and production phases will serve the best interests of the state. These mitigation measures have been developed by ADNR through its review of the material facts and issues, including the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the sale area.

Therefore, the scope of review in this finding is limited to the applicable statutes and regulations; the material facts and issues that are known to the Director that pertain to the lease sale phase; and the reasonably foreseeable, significant effects of leasing. This includes all of the items referenced on the list in AS 38.05.035(g) and all material facts and issues raised by the public during the public comment period. These effects of specific future exploration, development and production will be considered at each phase, when permit applications for specific proposed activities at specific locations are reviewed by various government agencies and the public. This finding discusses the potential effects in general terms that may occur with oil and gas exploration, development, production, and transportation within the sale area, and the mitigation measures to be imposed as terms of the sale, as lease provisions, and as plans of operation permit terms to reduce or eliminate any possible adverse effects.

## **2. North Slope Foothills Areawide Process**

### **a. Calls for Comments**

ADNR added North Slope Foothills Areawide 2001 to the Five-Year Oil and Gas Program schedule of lease sales in January 1997 after a call for comments, issued on July 12, 1996. A second call for comments was issued on March 17, 1998 and ended on September 30, 1998. A call for agency information was issued on September 9, 1999 and ended on January 10, 2000. A Preliminary Best Interest Finding was issued on June 14, 2000 and included a 60-day comment period. The commissioner extended this comment period an additional 30 days, until September 15, 2000. Also, DNR held a public hearing in Anaktuvuk Pass on July 20, 2000. All comments contributed to the department's analysis of the sale's potential effects and selection of the mitigation measures. They are summarized and responded to in Appendix A.

### **b. Post-Sale Title Search**

The North Slope Foothills sale area has been divided into tracts that will remain fixed for future sales. The extent of the state's ownership interest in these lands will not be determined prior to the sale. Instead, following the sale, ADNR will verify title only for acreage that is leased. Therefore, should a potential bidder require title or land status information for a particular tract prior to the 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 sale may contain land that the state cannot legally lease (existing lease, federal, Native or private land, etc.). Following the sale, ADNR will complete the title work and issue all of the leases. The actual number of months between the sale date and issuance of leases will depend on the number of tracts leased and the complexity of the land holdings involved.

### **c. Future North Slope Foothills Sales**

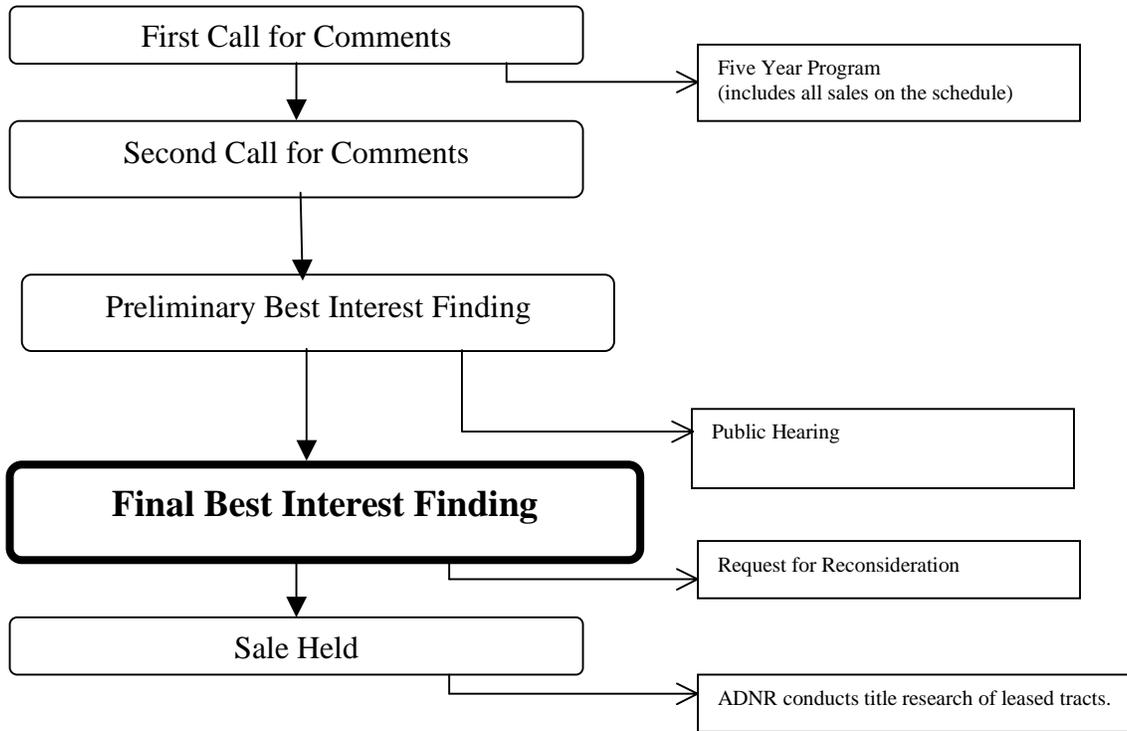
The state has not proposed any subsequent lease sales for this area in its current five-year leasing program. Instead, in accordance with AS 38.05.131, the North Slope Foothills area may be subject to exploration licensing, but only after first being offered in a competitive oil and gas lease sale.<sup>3</sup> However, the state may decide to competitively lease in this area at some time in the future. As a result of amendments to AS 38.05.035(e) and AS 38.05.180(w) by the legislature, once a finding has been written for an areawide sale, ADNR can then conduct a lease sale in that same area each year for up to ten years without repeating the entire finding process. However, a process similar to the following will be used. Annually, before holding a sale, DO&G will determine whether a supplement to the finding is required. Approximately nine months before a sale, ADNR will issue a call for comments requesting substantial new information that has become available since the most recent finding for that sale area was written. This request will be sent to agencies and

---

<sup>3</sup> The North Slope Foothills area was formerly part of proposed Sale 88.

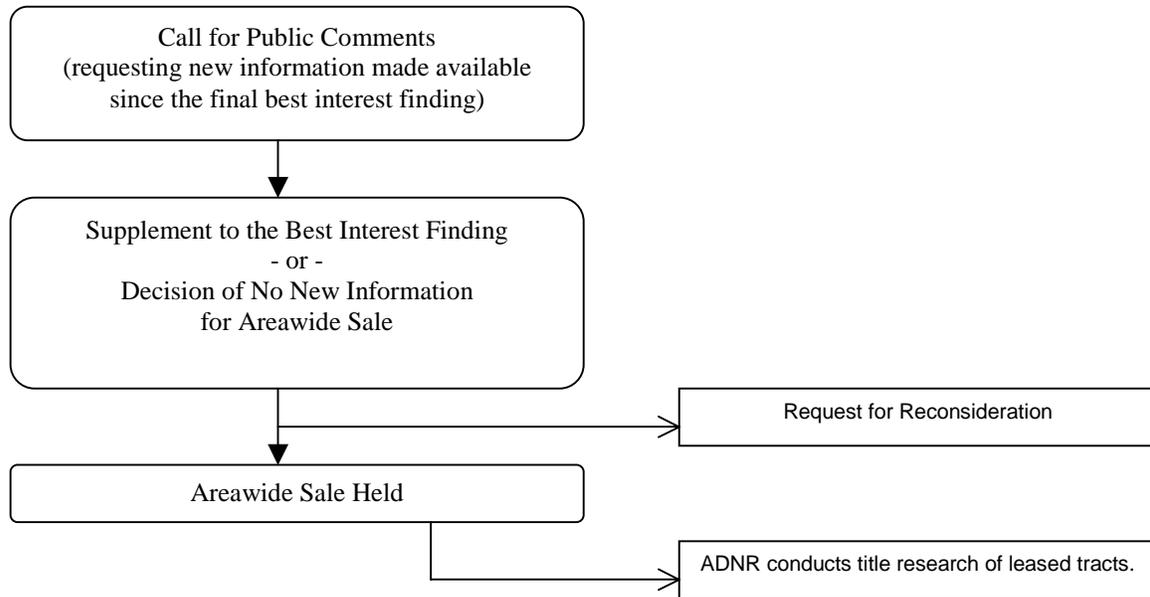
individuals on the division's mailing list. Agencies and the public will be given approximately two months in which to provide any new information. Based on information received, ADNR will determine whether or not it is necessary to revise the finding. Then, based on this determination, ADNR will either issue a supplement to the finding, or a Decision of No New Information 90 days prior to the sale. Any person that has commented during the prescribed time, will have the reconsideration and appeal rights as described in AS 38.05.035.

# Public Process



# Lease Sale Public Process

(During life of finding)



## C. Governmental Powers to Regulate Oil and Gas Exploration, Development, Production, and Transportation

All post-lease sale activities, exploration, development, production, and transportation are subject to numerous federal, state, and local laws, regulations, policies, and ordinances. Each successful bidder awarded a lease in a state oil and gas lease sale is obligated to comply with all federal, state, and local laws. A sample lease contract is contained in Appendix C. This section does not provide an exhaustive description of all laws and regulations that may be applicable to such activities. However, it does provide a sufficient illustration of the broad powers of various government agencies to prohibit, regulate, and condition any activities related to oil and gas which may ultimately occur on sale leases. A list of important laws and regulations applicable to oil and gas activities is included in Appendix B. Each of the regulatory agencies, (state, federal, and local) has a different role in the oversight and regulation of post-lease sale activities.

Each lease issued as a result of the sale will grant the lessee exclusive rights to subsurface mineral interests. However, as discussed in the previous section, a lease does not authorize subsequent activities. The lessee's rights are subject to the terms of the sale and the provisions of the lease (including the mitigation measures contained in Chapter Seven), all applicable state and federal laws and regulations, and may allow the lease holder 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.

Permits and approvals that each agency requires are presented below, with additional information on the review process (see Table 1.1). There is, however, no "typical" project. Actual processes, terms and conditions will vary with time-certain, site-specific operations. 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 as agency procedure will change from time to time.

### **1. Alaska Coastal Management Plan Review**

Permit applications for post-lease sale activities must be as detailed as necessary for a comprehensive agency review. If an activity affects or occurs within a coastal area, an ACMP review of the permit application will be conducted to determine whether the activity is consistent with the ACMP standards. Following the review, each agency will approve or disapprove the permit and determine whether any additional protective stipulations or permit terms are required prior to approval.

The public is provided the opportunity to participate in ACMP reviews. For example, most permits needed for exploratory wells require public notice. The ACMP permitting process goes through a 50-day agency review, and if approvals are needed by many agencies, the review is coordinated by Division of Governmental Coordination (DGC). This process provides for coordinated agency reviews, public input, and insures consistency with the ACMP and local coastal district plans. The coastal district plan applicable to this sale is the NSBCMP.

Application packages are distributed to affected coastal resource districts and permitting agencies by the lessee or designated operator, and DGC. Consistency review is initiated, and additional information must be requested within 25 days. Public and agency review of comments are due on or before day 34, and a consistency finding is issued on or before day 44. Requests for additional review must be received on or before

day 49, and the Final Consistency Determination is issued (unless elevated)<sup>4</sup> on day 50. If the determination is elevated, a director's determination is issued by day 65. A citizen may petition for Coastal Policy Council review of the consistency determination after the elevation of issues.

Agencies may authorize some activities using either the A or B lists.

"A list" activities are considered "categorically consistent" and do not result in significant impacts to coastal resources and they do not require a consistency determination 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 all projects on the A list.

"B list" reviews are classified as General Concurrences and the activities are considered routine with standard conditions. B list activities are consistent with the ACMP. Individual ACMP consistency reviews are not necessary for activities on the B list. However, a Coastal Project Questionnaire (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 stipulations and any applicable procedures against the plan of operations submitted.

Activities not on the A or B lists constitute the "C List." These reviews are classified as Individual Project Reviews and are subject to the review process described at the beginning of this section.

## **2. Alaska Department of Natural Resources**

ADNR, through the Divisions of Oil & Gas, and Mining, Land and Water Management, reviews, coordinates, conditions, and approves plans of operations or development and other permits as required before on-site activities take place. The department also monitors activities through field inspection once they have begun. Each plan of operations is site-specific and must be tailored to the activity requiring the permit. A plan of operations must identify the specific measures, design criteria, and construction methods and standards to be employed to comply with the terms of the lease. It must also comply with coastal zone consistency review standards and procedures established under 6 AAC 50 and 80. Applications for other state or federal agency authorizations or permits must be submitted with the plan of operations.

### **a. Lease Operations Plan of Approval**

Land use activities on state oil and gas leases are regulated under 11 AAC 83.158 and paragraphs 9 and 10 of the lease contract. These require the lessee to prepare plans of operations and development that must be approved by ADNR through DO&G and by any other interest holder, if ownership is shared, before the lessee may commence any activities on the lease. Except for equipment uses exempted under 11 AAC 96.020, the lessee must prepare a plan of operations and obtain all required approvals and permits for each phase of exploration, development, or production prior to implementation of that activity. All permit applications and plans are available for public review.

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 in order for the commissioner to determine the surface

---

<sup>4</sup> An elevation is an appeal process which allows further review by division directors and commissioners of the state resource agencies. A resource agency, local coastal district or the applicant can appeal a proposed consistency determination. The appeal goes first to the division directors. If the division directors are unable to resolve the conflict, it goes to the commissioners. A citizen may petition for Coastal Policy Council review of a proposed consistency determination if they commented on district policies.

**Table 1.1: Permit Process: North Slope Onshore Exploration Well**

ID	Task Name	J A S O N D J F M A M												
		J	A	S	O	N	D	J	F	M	A	M		
1	Exploration Well - Permitting and Drilling													
2	DNR Parks - Cultural Resource Survey													
3	North Slope Borough Development Permit													
4	ACMP Pre-application Conference													
5	Permits that may also be Subject to ACMP Coridnated Individual Project Review													
6	ACMP Consistency Determination - AS 46.40													
7	DNR DO&G - Plan of Operation Review													
8	DNR DO&G - Geophysical Exploration Permit													
9	DNR DL - Cross Country Travel or Ice Road Land Use Permit													
10	ADFG - Fish Habitat Permit, Water Sources and Stream Crossings													
11	DNR DW - Temporary Water Use Permit													
12	DEC - Authorization for Temporary Storage of Drilling Wastes													
13	DEC - Oil Spill Discharge and Contingency Plan													
14	DEC - Solid Waste Disposal Permit													
15	DEC - Air Quality Control Permit to Operate (Title V)													
16	DEC - Wastewater Disposal Permit													
17	<b>Other Permits</b>													
18	EPA - NPDES Coverage Under General North Slope Permit for Wastes													
19	USFWS - LOA for Incidental Take of Polar Bears													
20	AOGCC - Conservation Order													
21	AOGCC - Permit to Drill													
22	<b>Ice Construction - Drilling - Demobilization</b>													

Project: North Slope      Task:      Public Notice/Comment      ADNR, DO&G 1/01

use requirements and effects 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 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 but not limited to 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 lease 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).

ADNR may require other stipulations, in addition to the mitigation measures developed at the time of preparation of the best interest finding when it considers the plan of operations. These will 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 operations approval and are binding on the lessee. Lease activities are field-monitored by ADNR, ADEC, ADF&G, and AOGCC to ensure compliance with each agency's respective permit terms. Paragraph 16 of the lease contract requires that the lessee keep the lease area open for inspection by authorized state officials. The lessee must post a \$500,000 statewide bond to cover a drill site. Lease operations approvals are generally granted for three years.

## **b. Geophysical Exploration Permit**

The geophysical exploration permit is a specific type of land use permit issued by DO&G (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 lands and resources while making important geological information available to the state. Under AS 38.05.035(a)(9)(c), the geological and geophysical data that are made available to the state are held confidential at the request of the permittee.

Seismic surveys using Vibrosis vehicles on the North Slope during winter have been found to be consistent with the ACMP, provided certain conditions are adhered to. Seismic surveys in any other area of the state are subject to individual 30-day ACMP reviews. If the survey is part of an exploration program, the permit will be reviewed as part of the exploration well permit package.

The application must contain sufficient detail to allow evaluation of the activities' effects on the lands and resources. A map showing the general location and routes of travel, and a description of the activity and equipment that will be used must be included. 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.

The permit will contain measures to protect the land and resources of the area. The permit is usually issued for one year or less, but may be extended. If the permit is extended, the director may modify existing terms or add new ones. The permit is also revocable.

## **c. Pipeline Right-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, which are in whole or in part

located on state land, to ensure that the state's interests are protected. The Right-of-Way Leasing Act permits are administered by the Joint Pipeline Office.

#### **d. Temporary Water Use Permit**

Under 11 AAC 93.210-220, Temporary Water Use permits are issued by the Division of Mining, Land and Water Management and may be required for exploration activities. An application for a temporary water use permit must be made if the amount of water to be used is a significant amount as defined by 11 AAC 93.970(14), the use continues for less than five consecutive years, and the water applied for is not otherwise appropriated. The permit may be extended one time for good cause for a period of time not exceeding five years. The application must include: (1) the application fee; (2) a map indicating the location of the property, take point, and 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 to be used to withdraw the water. At the discretion of the commissioner, a temporary water use permit will be subject to conditions, including suspension and termination in order to protect the water rights of other persons or the public interest.

#### **e. Permit and Certificate to Appropriate Water**

Industrial or commercial use of water requires a Permit to Appropriate Water (11 AAC 93.120). The permit is issued for a period of time (not to exceed five years for industrial or commercial uses) consistent with the public interest and adequate to finish construction and establish full use of water. The commissioner will, in his discretion, issue a permit subject to conditions he considers necessary to protect the public interest. The conditions include, but are not limited to, conditions that reserve a sufficient quantity of water to achieve any of the following purposes: protection of fish and wildlife habitat, recreation, navigation, sanitation and water quality, protection of prior appropriations and for any other substantial public purpose.

A Certificate of Appropriation (11 AAC 93.130) will be issued if (1) the permit holder has shown that the means necessary for the taking of water have been developed; (2) the permit holder is beneficially using the amount of water to be certified; and (3) the permit holder 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, the applicant may be required to maintain a specific quantity of water at a given point on a stream or waterbody, or in a specified stretch of stream, throughout the year or for specified times of the year in order to protect fish and wildlife habitat, recreation, navigation or prior appropriations. 11 AAC 93.130(c)(1).

#### **f. Land Use Permits**

11 AAC 96.010-.140. Land use permits are issued by the Division of Mining, Land and Water Management and may be required for exploration, development and production activities. Permits have a term of one year. All land use activities are subject to the following provisions:

- (1) Activities employing wheeled or tracked vehicles shall be conducted in such a manner as to minimize surface damage;
- (2) Existing roads and trails shall be used whenever possible. Trail widths shall be kept to the minimum necessary. Trail surface may be cleared of timber, stumps, and snags. Due care shall be used to avoid excessive scarring or removal of ground vegetative cover;
- (3) All activities shall be conducted in a manner that will minimize disturbance of drainage systems, changing the character, polluting, or silting of streams, lakes, ponds, waterholes, seeps, and marshes, or disturbance of fish and wildlife resources. Cuts, fills, and other activities causing any of the above disturbances, if not repaired immediately, are subject to such corrective action as may be required by the director;

- (4) The director may prohibit the disturbance of vegetation within 300 feet of any waters located in specially designated areas as prescribed in 11 AAC 96.010(2) except at designated stream crossings;
- (5) The director may prohibit the use of explosives within one-fourth mile of designated fishery waters as prescribed in 11 AAC 96.010(2);
- (6) Trails and campsites shall be kept clean. All garbage and foreign debris shall be eliminated by removal, burning, or burial, unless otherwise authorized;
- (7) All survey monuments, witness corners, reference monuments, mining claim posts, and bearing trees shall be protected against destruction, obliteration, or damage. Any damaged or obliterated markers shall be reestablished in accordance with accepted survey practice of the division;
- (8) Every reasonable effort shall be made to prevent, control, or suppress any fire in the operating area. Uncontrolled fires shall be immediately reported;
- (9) Holes, pits, and excavations shall be filled, plugged, or repaired to the satisfaction of the director. Holes, pits, and excavations necessary to verify discovery on prospecting sites, mining claims, and mining leasehold locations may be left open but shall be maintained as required by the director;
- (10) No person may engage in mineral exploratory activity on land, the surface of which has been granted or leased by the state of Alaska, or on land for which the state has received the reserved interest of the United States until good faith attempts have been made to agree with the surface owner or lessee on settlement for damages which may be caused by such activity. If agreement cannot be reached, or lease or surface owner cannot be found within a reasonable time, operations may be commenced on the land only with specific approval of the director, and after making adequate provision for full payment of any damages which the owner may suffer;
- (11) Entry on all lands under mineral permit, lease, or claim, by other than the holder of the permit, lease, or claim or his authorized representative, shall be made in a manner which will prevent unnecessary or unreasonable interference with the rights of the permittee, lessee, or claimant. Additional stipulations may be imposed.

### **g. Material Sale Contract**

A material sale contract must include, if applicable, (1) a description of the sale area, (2) the volume of material to be removed, (3) the method of payment, (4) the method of removal of the material, (5) the bonds and deposits required of the purchaser, (6) the purchaser's liability under the contract, (7) the improvements to and occupancy of the sale area required of the purchaser, (8) and the reservation of material within the sale area to the division, (9) the purchaser's site-specific operation requirements including 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 is to be completed. The director at his discretion may grant an extension not to exceed one year. When determined by the director that a delay in completing the contract is due to causes beyond the purchaser's control, the contract will be extended for a time period equal to the delay.

The director, in his discretion, will require a purchaser to provide a performance bond 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.

## **3. Alaska Department of Environmental Conservation**

ADEC has statutory responsibility for preventing air, land, and water pollution. Oil and gas activities, such as the disposal of drilling mud and cuttings, the flaring of hydrocarbon gases, and the discharge of wastewater, are regulated by this agency as well as AOGCC if the activity involves a class II injection well. Several separate written permits are required before activity can begin. Before solid waste disposal, wastewater or air quality permits are issued, two public notices and an opportunity for public comment (and a public hearing, if requested) are required.

## **a. 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.

Prior to receiving a permit to drill, the lessee must demonstrate in the plan of operations the ability to promptly detect, contain, and cleanup any lease-related hydrocarbon spill before the spill affects fish and wildlife populations or their habitats. This includes the capability to drill a relief well in the event of a loss of well control. ADEC has authority under AS 46.04 over both onshore and offshore activities 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 prior to 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.

## **b. Wastewater Disposal**

Domestic greywater must be disposed of properly at the surface and a Wastewater Disposal Permit is required (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.

## **c. Annular Injection**

If fluid is to be injected into a well annulus, a permit is required. ADEC considers the volume, depth and other physical and chemical characteristics of the formation designated to receive the waste. Injection 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.

## **d. Solid Waste Disposal Permit**

Recent industry practice is to use methods other than surface reserve pits for disposal of drilling muds, such as injection wells, where possible. In addition, the majority of muds utilized today are water-based. When a well is drilled, muds and cuttings are initially either temporarily stored on a gravel pad or collected in a reserve pit pending final disposal by injection. Drilling muds and cuttings discharged into a reserve pit require pre-approval and a written permit. The permit addresses design, operation and closure concerns to ensure that unacceptable environmental effects are avoided.

Solid waste storage, treatment, transportation and disposal are regulated under 18 AAC 60. For all solid waste disposal facilities, 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 ACMP and Alaska Historic Preservation Act. 18 AAC 60.215. 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 1/2-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 (MSWL). MSWL's 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 is not an inactive reserve pit. 18 AAC 60.990(81). An inactive reserve pit is a drilling waste disposal area, containment structure, or group of containment structures where drilling waste has been disposed of which the owner or operator does not plan to continue disposing of drilling waste. 18 AAC 60.990(61). 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 and signed and sealed by a registered engineer. 18 AAC 60.430(c)(5).

Today, on the North Slope, drilling fluids are disposed of by reinjection deep into the ground, however, limited discharge of waste streams may be authorized by EPA and ADEC under the NPDES permit system. All produced waters must be re-injected or treated to meet Alaska Water Quality Standards prior to discharge. Discharge of muds and cuttings is prohibited between the shore and the 5-meter isobath. (EPA, 1995<sup>5</sup>). In the past, muds and cuttings were disposed of using surface disposal methods (reserve pits). Reserve pits must still be constructed for every well. Before a well may be permitted under 20 AAC 25.005, a proper and appropriate reserve pit 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 ground water 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. Typical dimensions may be 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

---

<sup>5</sup> EPA 1995, NPDES General Permit: Final Arctic Permit. U.S. EPA, Seattle, WA, Permit No. AKG 2 84200, April 12.

is reestablished. Surface impoundment's 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 classified as "hazardous" undergo a more rigorous and thorough permitting and review process by both ADEC (18 AAC 62 and 63) and EPA.

### **e. Air Quality Control Permit to Operate**

The federal Prevention of Significant Deterioration (PSD) program, which is administered by ADEC, establishes threshold amounts for the release of byproducts into the atmosphere. Oil and gas exploration and production operations with emissions below predetermined threshold amounts must still comply with state regulations designed to control emissions at these lower levels (18 AAC 50). Activities which exceed predetermined PSD threshold amounts are subject to a more rigorous application and review process. Such activities include the operation of turbines and gas flares.

For oil and gas activities, these requirements translate into the requirement for a permit to flare gas during well testing (a safety measure) or when operating smoke-generating equipment such as diesel-powered generators. Permit conditions will induce additional scrutiny if a black smoke incident exceeds 20 percent opacity for more than 3 minutes in any 1-hour period.

The burning of produced fluids is prohibited unless failures or seasonal constraints preclude storage in tanks, backhauling or reinjection. If liquids are to be incinerated, they must be burned in smokeless flares. The open burning of produced liquids is prohibited except under emergency conditions.

Gas produced as a by-product of oil production is usually re-injected into the producing formation to maintain pressure, which supports further production. Flaring is not an approved method of disposal, however, as a safety measure and backup for standard gas handling systems production facilities, which separate gas from oil, are capable of flaring large volumes of gas. Flaring occurs when the oil and gas separation process is interrupted, or when an unplanned event requires an immediate release from pressure increases. Pilot flares are an operational necessity; they are subject to permit requirements as well.

### **f. 401 Certification**

Under 18 AAC 15.120, a person who conducts an operation that results in the disposal of wastewater into the water of the state need not apply for a permit from ADEC if the disposal is permitted under an NPDES permit. When an NPDES permit is issued under Section 401 (33 U.S.C. § 1341) of the Clean Water Act, ADEC does not require a separate permit, but participates by certifying that the discharge meets state and federal water quality standards.

When an application is made, a duplicate must be filed with the department and public notice of the certification application is published jointly by EPA and ADEC. 18 AAC 15.140 and 40 C.F.R. § 125.32. As a result, the state and federal reviews run concurrently. Public comment is sought and a hearing can be requested.

Following an EPA determination, but within 30 days, the department must provide the applicant, EPA, and all persons who submitted timely comments with a copy of the certification. The decision may impose stipulations and conditions (such as monitoring and/or mixing zone requirements), and any person disagreeing with the decision may request an adjudicatory hearing. 18 AAC 15.200-.920. Once activity begins, both EPA and the department have the responsibility to monitor the project for compliance with the terms of the permit.

The Corps of Engineers 404 permit program (see Corps of Engineers) also requires certification under section 401 of the Clean Water Act and it is processed in a similar manner. The ADEC certification is termed a Certificate of Reasonable Assurance.

### **g. Review Process**

Following receipt of an application for a solid waste disposal, wastewater, or air quality permit, ADEC must publish two consecutive notices in a newspaper of general circulation in the area affected by the proposed operation, as well as through other appropriate media.

Comments must be submitted in writing within 30 days after the second publication and a public hearing may be requested. A hearing will be scheduled if good cause exists. Notice of a public hearing is handled in a manner similar to that of the initial application. Permits issued by the department may be subject to review for consistency with the Alaska Coastal Zone Management Program.

A decision on an application includes (1) the permit, (2) a summary of the basis for the decision and (3) provisions for an opportunity for an adjudicatory hearing. 18 AAC 15. The decision, as conditioned, is sent to the applicant as well as each person, or entity, who submitted timely comments or testified at a public hearing. Permits may be valid for up to five years. Renewals are treated the same as the original application, but they do not receive public notice.

## **4. Alaska Department of Fish and Game**

ADF&G analyzes the effect of any activity on fish and wildlife, the users of those resources, and the protection of habitat. ADF&G requires permits for any activity in state game refuges, sanctuaries, critical habitat areas, and streams that contain anadromous fish, as well as other areas the agency believes might be threatened by development. Management plans control activities within many legislatively designated areas. By statute these areas are jointly managed with ADNR. Permits are conditioned to mitigate impacts. For example, timing restrictions are used to limit the impact on transitory wildlife. Public notice of ADF&G permit actions is not required.

### **a. Fish Habitat Permit**

Title 16 gives ADF&G permitting authority over activities affecting anadromous fish streams that could block fish passage. A fish habitat permit must be obtained from ADF&G prior to using, diverting, obstructing, polluting, or changing the natural flow or bed of anadromous streams. AS 16.05.870. If the proposed activity obstructs fish passage, a fishway and device for the safe passage of downstream migrants may be required under AS 16.05.840.

Additionally under the ACMP, wetlands and tidelands must be managed to assure adequate water flow, avoid adverse effects on natural drainage patterns, and the destruction of important habitat. 6 AAC 80.130(c)(3). Rivers, streams, and lakes must be managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural water flow. 6 AAC 80.130(c)(7). To further protect fish and wildlife habitat, 6 AAC 80.070(b)(3) requires that facilities be consolidated, to the extent feasible and prudent.

### **b. ADF&G Special Area Permit**

For activities in a legislatively designated area (such as a game refuge, a game sanctuary or critical habitat area), a Special Area Permit is required. AS 16.20 and 5 AAC 95. Currently there are no such areas on the North Slope.

### **c. Review Process**

A fish habitat permit issued by the department is subject to the ACMP consistency review process. General permits, with standard stipulations, may be issued when it is determined that the impact of frequent and recurring activities meet pre-determined criteria. Applications, including the Coastal Zone Questionnaire, are submitted to the department's Habitat and Restoration Division.

Most permit actions subject to ADF&G require a 30-day review unless surface occupancy issues or other related permits require additional time. An informal review is conducted with the Departments of Natural Resources and Environmental Conservation as well as any affected coastal districts. Public notice of ADF&G permit actions is not required.

Decisions are based upon suggestions 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.

## **5. Alaska Oil and Gas Conservation Commission**

AOGCC administers the Alaska Oil and Gas Conservation Act under Title 31. The AOGCC may investigate to determine whether waste of oil and gas resources exists or is imminent. It is also responsible for ensuring that accurate metering and measuring of oil and gas production takes place.

The commission maintains programs to ensure that the drilling, casing and plugging of a well occurs in a manner that prevents (1) escapement from one stratum into another, (2) the intrusion of water into an oil or gas horizon, (3) the pollution of fresh water supplies, and (4) blowouts, cavings, seepage and fires. For conservation purposes, the commission regulates certain aspects of the drilling, production, and plugging of wells in addition to well spacing, the disposal of salt water and oil field waste and the contamination of underground water.

Reports, well logs, drilling logs and other information must be filed with the commission for each well drilled. The information is confidential for two years. However, if the data are considered especially important for the evaluation of nearby unleased land, they may be held confidential for an extended period.

### **a. Permit to Drill**

Before drilling, a Permit to Drill, valid for 24 months, must be obtained from the commission. AS 31.05; 20 AAC 25. The permit application informs the commission of a proposed operator's engineering and safety plans designed to ensure the structural and mechanical ability of the well to contain fluids and gases that could be encountered at various depths and under varying pressure.

With the application, a diagram of the proposed blowout prevention (BOP) equipment (used for secondary well control) must be included with an analysis of expected downhole pressures. A BOP, along with related well-control equipment, must be installed, used, maintained and tested as necessary to assure control over the well and conform to the latest technology and accepted industry practice.

Casing, cementing, and drilling fluid programs are also designed to ensure primary well control. A drilling fluid monitoring program must be in place to detect gases entrained in the drilling fluid and detect hydrogen sulfide, a poisonous gas.

For exploration wells, a well-site survey is conducted using seismic techniques. The data from the seismic survey are analyzed to detect shallow gas in near-surface strata to a depth of 2,000 feet and the depths

of suspected overpressured strata are predicted. For offshore wells, an analysis of seafloor conditions is required.

If climatic conditions and operational or environmental concerns become apparent, or if unplanned-for circumstances prevent the continuation of an approved program, an operator can secure a well and apply for an operational shut down. When a well is abandoned, plans for setting plugs, mudding, cementing, shooting, testing and removing the casing must be submitted to AOGCC for approval. Abandoned or suspended wells may remain that way for long periods of time. Until final plans are made, the commission seeks to prevent the movement of fluids into or between freshwater and/or hydrocarbon sources.

Before beginning to drill, an operator must post a bond for \$100,000 in favor of the state for a single well, or \$200,000 for a blanket bond covering more than one well. The purpose of the bond is to ensure that a well is properly completed or abandoned.

After abandonment, a location clearance is required. For onshore locations, materials, supplies, structures, and installations must be removed, debris properly disposed of, and the reserve pit filled and graded. The location must be left uncontaminated, in a clean condition acceptable to state inspectors. Off-shore locations must have all casing, wellhead equipment, pilings, and other structures removed to a depth of 15 feet below the mud line.

## **b. Disposal of Wastes**

AOGCC must also review and approve proposals for the underground disposal of water and oil field waste. 20 AAC 25.252. Before receiving an approval, an operator must demonstrate that the movement of fluids into freshwater sources will not occur. Disposal must be into a well with equipment designed to ensure a controlled release. A plat is required showing the location of other wells within a quarter-mile that penetrate the same disposal zone, and surface owners (located within one quarter-mile) must be provided with a copy of the application.

Included with a description of the fluid to be injected (with its composition, source, daily amount and disposal pressures), the application must contain the name, description, depth, thickness, lithologic description and geological data of the disposal formation and adjacent confining zones. There must be evidence presented that the disposal well will not initiate or propagate fractures through the confining zones that would allow fluids to migrate, a laboratory analysis is required. Under certain circumstances, however, a fresh water aquifer exemption may be granted. 20 AAC 25.440.

Following approval, liquid waste from drilling operations may be pumped into a well drill pipe, casing or annulus. The pumping of drilling mud from reserve pits (not runoff) into exploration or stratigraphic test wells or into the annuli of a well approved in accordance with 20 AAC 25.080 is an operation incidental to drilling of the well, and is not a disposal operation subject to regulation as a Class II well under EPA regulations.

## **c. Review Process**

Actions by the commission that have statewide application (such as adopting regulations) are conducted in accordance with the Administrative Procedures Act. Major actions, resulting 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 mailing list is maintained for the purpose of sending notices, orders or publications to those who request them. There are different lists for different purposes.

## 6. U.S. Environmental Protection Agency

### a. NPDES Permit

The federal Clean Water Act requires a NPDES permit to release pollutants into the waters and wetlands of Alaska. The permitting system is designed to ensure that discharges do not violate state and federal water quality standards by identifying control technologies, setting effluent limitations, and gathering information through reporting and inspection.

Typically, approved discharges are covered by a general permit developed through a public review process after the specific location of a proposed discharge has been identified by the EPA in an Authorization to Discharge. When a general permit for a specific geographical area does not exist, proposed discharges are subject to an individual approval process and NPDES permit.

A NPDES permit covers the discharge of drilling muds, cuttings and wash water, as well as 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.

### b. Review Process

Discharges needing authorization before a general permit is issued require individual permits. 40 C.F.R. § 122. Once EPA receives an application for a proposed discharge, a draft permit and fact sheet is prepared to address the proposal. Public notice solicits comments and provides notification of state certification under section 401 of the Clean Water Act. It also initiates a review for consistency with the ACMP.

There is a minimum period of 30-days for public comment and all comments received must be in writing. Public hearings, if scheduled in the original notice, will be canceled if there is no interest in holding them; however, anyone can request a hearing.

An individual permit will not take effect for 30 days, during which time an aggrieved party who earlier submitted written comments may request an evidentiary hearing. EPA will respond by issuing a finding identifying the qualifying issues to be decided before an adjudicatory law judge. For general permits, notice must be published in the Federal Register and issuance may be challenged for 120 days. 40 C.F.R. § 124.

A permit will not be issued unless ADEC certifies that the discharge will comply with the applicable provisions of the Clean Water Act. The certification process is addressed in an agreement between EPA and ADEC. In addition, the proposed activity must be consistent with the requirements of the Alaska Coastal Management Plan.

Persons wishing to comment on a state consistency determination or 401 certification must submit written comments within the 30 day comment period.

### c. Typical Permit Requirements

Only pre-approved discharges may be released and each must be emitted in accordance with an effluent limitation designed for that particular emission at that point of discharge. After it is issued, the permit will be modified or revoked if new information justifies different conditions, or if new standards are promulgated that are more stringent than those in the original approval. For example, existing permits prohibit

discharges within 1,000 m of coastal marshes, river mouths, and specially designed monitoring programs are required within 1,500 m of areas considered sensitive.

In all cases, mixing zones are established at the discharge point and produced waters are passed through at least one oil separator before discharge. Under certain conditions verification studies may be required of the mixing zone; discharge limitations are then applied as the emission passes through the mixing zone.

Only pre-approved drilling muds, specialty additives and mineral oil pills may be discharged; and maximum concentrations are specified. For each mud system, a precise chemical inventory of its constituents is maintained. Free oil or oil-based muds (those containing oil as the continuous phase, with water as the dispersed phase) may not be discharged at any time. The oil content of a discharge must be analyzed (1) at the time the fluid or additive is used, (2) when a drilling fluid could become contaminated with hydrocarbons from an underground formation, and (3) immediately when the static sheen test of a discharge indicates violation. Water-based drilling fluids that have contained diesel oil or cuttings associated with muds that contain diesel oil may not be discharged. In state waters, the discharge of cuttings with an oil volume greater than 5 percent by weight, or the discharge of free oil as a result of discharging drilling muds or cuttings is prohibited as well. A static sheen test is performed daily on emission samples as well as prior to any bulk discharge. Generally, the discharge of floating solids or visible foam is not allowed. Surfactant, dispersant and detergent discharges are minimized, but may be allowed to comply with occupational health and safety requirements. In all cases, deck drainage and wash water must go through an oil/water separator; the effluent is tested and any discharge that would cause a sheen on the receiving waters is prohibited.

#### **d. C-Plans**

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 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:

1. operating procedures installed by the facility to prevent oil spills;
2. control measures installed to prevent a spill from entering navigable waters; and
3. 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 prior to 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 OPA 90 in that the c-plan focuses on prevention and the FRP focuses on response.

## **7. U.S. Army Corps of Engineers**

The Department of the Army regulatory program is administered by the U.S. Army Corps of Engineers (Corps). The program is authorized by section 10 of the Rivers and Harbors Act of 1899, section 404 of the Clean Water Act, and section 103 of the Marine Protection, Research and Sanctuaries Act. The permit program authorizes activities in, on, or affecting, navigable waters as well as the discharge of dredge or fill into waters of the United States. For purposes of administration, waters of the United States includes wetlands. The most

common oil and gas activity requiring a Corps permit is the discharge or placement of fill, generally gravel or ice, on “wetlands.”

The EPA and the Corps jointly administer the 404 program. The Corps performs the day-to-day permitting and enforcement functions (including individual permit decisions) and jurisdictional determinations, while EPA develops and interprets environmental criteria to be used in the evaluation of permit applications. The 404(b)(1) guidelines are EPA regulations; as a result, they can (and have) exercise veto authority over permit decisions made by the Corps.

### **a. Section 10 of Rivers and Harbors Act of 1899 (33 U.S.C. § 403)**

If work is anticipated on or in (or affects) navigable waters, a Corps permit is required. A section 10 permit addresses activities that could obstruct navigation. Oil and gas activities requiring this type of permit would be exploration drilling from a backup drill rig, installation of a production platform, or construction of a causeway. The process and concerns are similar to those required for section 404 approval and, at times, both may be required.

### **b. Individual Permits, General Permits and Letters of Permission**

Some oil and gas activities undergo individual project reviews. Under this process, projects are evaluated on a case-by-case basis and a public interest determination is conducted. 33 C.F.R. § 320. The Corps issues general permits that carry a standard set of stipulations that cover frequent, repetitive and similar activities when, individually and cumulatively, there will be a minimal environmental effect. A general permit describes the activity covered and includes appropriate proposed stipulations and mitigation measures. This type of permit generally has a geographical limitation. There are 36 nationwide general permits, while the Alaska District has 21.

### **c. Letters of Permission (LOP)**

LOPs are a type of permit that, once approved for issuance after a public review process, undergo individual, but abbreviated reviews. These activities are routine and have been determined to have no significant environmental effect. In Alaska, LOPs are used only for activities that might have an affect on navigable waters under section 10.

### **d. Review Process**

Upon receipt of an application, the Corps solicits comments from the public, federal, state and local agencies as well as other interested parties. They seek comments to assess the impact of the proposed activity on aquatic resources, endangered species, historic properties, water quality, environmental effects and other public interest factors. Most public comment periods last 30-days and a public hearing can be requested.

The U.S. Fish and Wildlife Service, National Marine Fisheries Service and ADF&G submit comments to the Corps in accordance with the Fish and Wildlife Coordination Act. Their comments address compliance with section 404(b)(1) of the Clean Water Act as well as the measures they consider necessary for the protection of wildlife resources. Under the Endangered Species Act of 1973, endangered species that frequent the area are identified and the effect the proposed activity might have on them or their habitat is considered. In some cases, an environmental assessment or environmental impact statement may be required by the National Environmental Policy Act.

An application to the Corps serves as an application to ADEC for state water quality certification as required under section 401 of the Clean Water Act of 1977 (P.L. 95-217), and must be reviewed by EPA. The application is reviewed against the Act, the Alaska Water Quality Standards and other applicable state laws. For placing fill in wetlands, water quality stipulations included in the 401 Certification become part of the Corps permit (see ADEC 401 Certification).

The Corps will not issue a permit until consistency requirements for the Coastal Zone Management Act are met and a Coastal Zone Consistency Questionnaire is included with a Corps application. An applicant must certify consistency with the ACMP, and the state Division of Governmental Coordination must, based on the results of the ACMP review, concur. In addition, a review of cultural resources is coordinated with the state's Historic Preservation Office and the federal Minerals Management Service. Archeological or historical data that could be lost or destroyed by the proposed activity is considered and presented in the Corp's final assessment of the described project.

The public interest review (33 C.F.R. § 320.4) considers guidelines set forth under section 404(b) of the Clean Waters Act. The guidelines outline a mitigation sequence that must be followed in the decision-making process, which applies, to all waters, including wetlands. A permit will be denied if the contemplated discharge does not meet the required standards. For placement of fill, the mitigation sequence requires avoiding wetlands where practical, minimizing impact where avoidance is not practicable, and compensating for impact to the extent appropriate and practicable.

A decision to issue a permit, with proposed mitigation measures included, is based upon an evaluation of the probable impacts (including cumulative impacts) of a proposed activity. Benefits that can reasonably be expected to accrue are balanced against reasonably foreseeable costs. Factors relevant to the decision are conservation, economics, aesthetics, general environmental concerns, wetlands, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, property ownership, and in general, the needs and welfare of the people.

## **8. North Slope Borough**

The NSB has adopted a comprehensive plan and land management regulations under Title 29 of the Alaska Statutes. AS 29.40.020-.040. These regulations are Title 19 of the NSB Municipal Code and require borough approval for certain activities necessary for exploration and development of lease contracts. The Borough can assert its land management powers to the fullest extent permissible under law to address any outstanding concerns regarding impacts to the area's fish and wildlife species, and habitat and subsistence activities.

The NSBCMP has been incorporated into the ACMP. The program presents policies to regulate activities in the borough's coastal zone. Consistency with the ACMP standards and the policies of the NSBCMP is discussed in *Alaska Coastal Management Program Consistency Analysis Regarding Proposed Oil and Gas Lease Sale North Slope Foothills Areawide 2001*, dated June 14, 2000.

## **9. Other Requirements**

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 BIA and BLM and obtain approval to enter.

The U.S. Coast Guard has authority to regulate offshore oil pollution under 33 C.F.R. §§ 153-157.

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.

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. North Slope Foothills Areawide 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 agency responsibilities of oversight agencies.

# Chapter Two: Property Description and Petroleum Potential

## Contents

Property Description and Petroleum Potential .....	2-1
A. Property Description .....	2-1
B. Geology .....	2-1
C. Exploration History .....	2-2
D. Petroleum Potential .....	2-4



# Chapter Two: Property Description and Petroleum Potential

## A. Property Description

The North Slope Foothills Sale area lies between the National Petroleum Reserve-Alaska (NPR-A) on the west, the Arctic National Wildlife Refuge (ANWR) on the east, south of the Umiat Baseline and north of the Gates of the Arctic National Park and Preserve. The gross acreage is in excess of 7.8 million acres. However, approximately 3.2 million of these acres are either Native-owned or Native-selected, and will not be included in the lease sale.

The sale area is within the North Slope Borough (NSB), population 9,632 (ADCED 2000), a home rule borough incorporated in 1972. The borough encompasses an area of 88,281 square miles or approximately 15 percent of the state. It extends from the Chukchi Sea on the west to the Canadian border on the east, and 225 miles from Point Barrow on the north to the foothills of the Brooks Range on the south. The borough has the powers of taxation, education, planning, platting, and zoning.

Portions of the sale area are located within the coastal zone where activities are subject to the North Slope Borough Coastal Management Program (ADGC, 1985). The boundary of the coastal zone extends inland along certain river corridors, including the Colville, Chandler, Anaktuvuk, Nanushuk, Itkillik, and Sagavanirktok (See Figure 1.1).

## B. Geology

The Foothills Province is the part of Alaska's west-to-east-trending North Slope Petroleum Province that is nestled between the Brooks Range Province and the Coastal Plain Province (Houle, 2000 citing to Bird, 1991).

Regional geologic depositional history of the area is conventionally divided into four major sequences based on similar regional tectonic stresses, provenance source areas, depositional styles, and geological history. Geologic time periods are depicted in Table 2.1. A generalized stratigraphic column is shown in Figure 2.1.

The Franklinian sequence contains the oldest rocks and is collectively referred to as basement. It is considered unlikely to contain oil and gas accumulations. The lower Ellesmerian sequence includes the Endicott and Lisburne oil reservoirs, productive beneath the coastal plain. The upper Ellesmerian sequence contains the Sadlerochit (Ivishak), Shublik and Sag River Sandstone oil reservoirs so highly productive in the Prudhoe Bay area. The Ellesmerian section was subaerially uplifted and eroded prior to the deposition of the Beaufortian sequence. The Beaufortian sequence includes the Kingak, Pebble Shale, Nanushuk, Torok, Fortress Mountain and Kuparuk formations. The Brookian sequence contains the geologically youngest oil reservoirs in the area (the Meltwater, Tarn, Tabasco, Badami, Seabee, and Sourdough accumulations).

The primary petroleum source rocks in the foothills area appear to be the Kingak and Shublik formations. The thermal maturity of these primary source rocks places the deeper depths of the foothills area primarily within the gas window (Houle 2000, citing to Bird, 1994).

**Table 2.1. Geologic Time**

Eras	Periods	Epochs	Began Approximate Number of Years Ago
Cenozoic	Quaternary	Holocene (Recent)	10,000
		Pleistocene (Glacial)	1 million
	Tertiary	Pliocene	7 million
		Miocene	25 million
		Oligocene	40 million
		Eocene Paleocene	60 million 68-70 million
Mesozoic	Cretaceous	Late and Early	135 million
	Jurassic		180 million
	Triassic		225 million
Paleozoic	Permian		270 million
	Pennsylvanian		325 million
	Mississippian		350 million
	Devonian		400 million
	Silurian		440 million
	Ordovician		500 million
	Cambrian		600 million

Adapted from Webster's Ninth New Collegiate Dictionary, 1991:512 and AEIDC, 1975:37

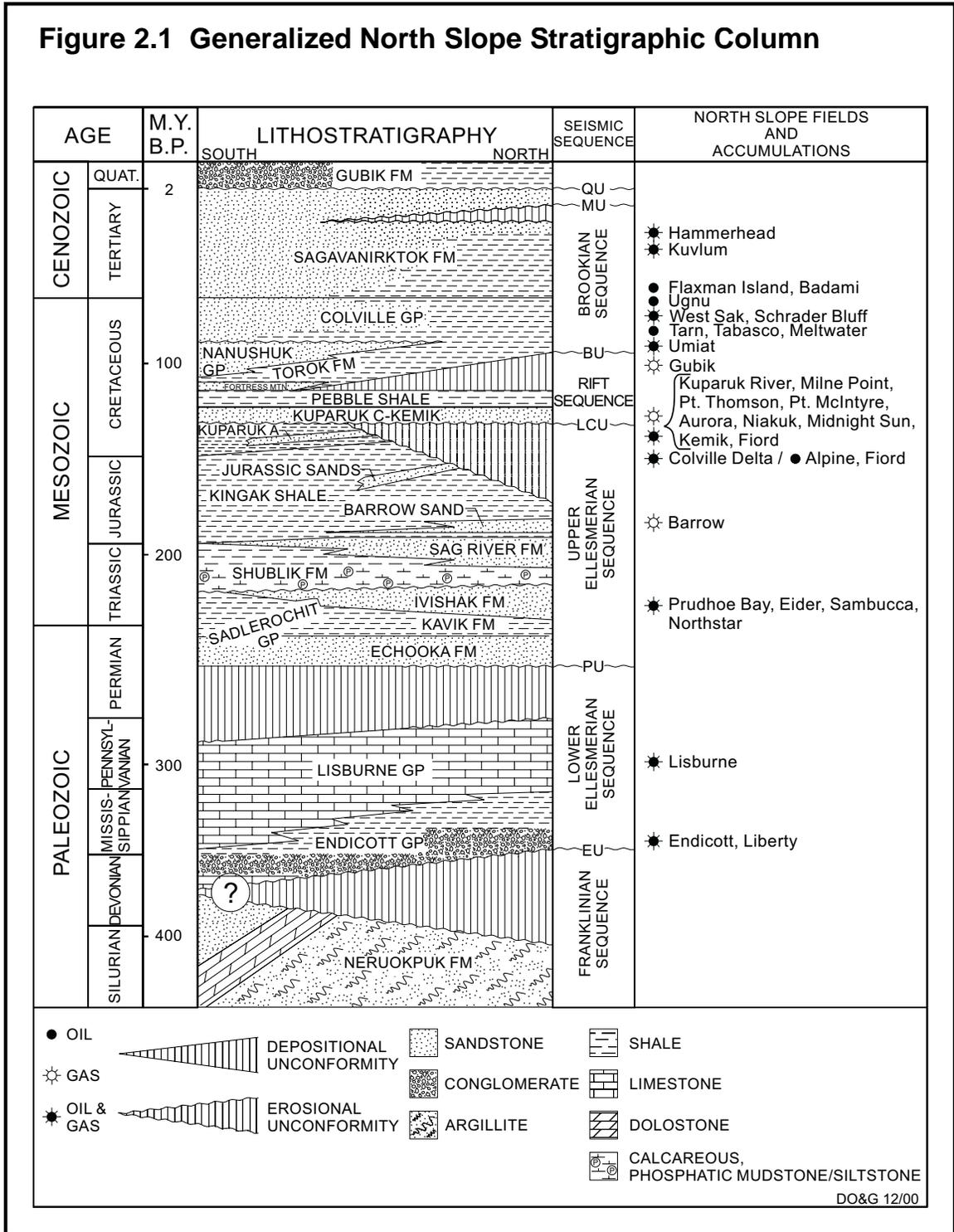
## C. Exploration History

The foothills area was one of the first areas of the North Slope to be considered prospective for hydrocarbon exploration because the area contains discernable surface anticlinal structures. The U.S.G.S spent four field seasons between 1923-1926 conducting reconnaissance surface mapping. The second phase of North Slope exploration occurred between 1943 and 1953 when the U.S. Navy, in conjunction with the U.S.G.S., undertook a major exploration drilling program in the Naval Petroleum Reserve No. 4 (NPR-4), known now as the National Petroleum Reserve – Alaska or NPR-A. (Houle, 2000 citing to Bird, 1991). The southern part of the area included a region of the northern foothills area. Over the ten-year period, the U.S. Navy drilled 37 test wells and found three oil accumulations at Fish Creek, Cape Simpson, and Umiat. The Umiat accumulation is located just outside of the northcentral part of the sale area, near the westward bend in the Colville River. Five gas fields were also discovered: South Barrow, Simpson, Meade, Wolf Creek, and Gubik. None of these gas finds are considered to be economic although the South Barrow gas field provides gas to the community of Barrow. Based on the drilling results of the original NPR-4 drilling program, private industry began North Slope exploration in the foothills area where there was surface expression of anticlinal structures. Various oil companies drilled eight wells between 1964 to 1967. Although hydrocarbon shows were present in every well, only one subcommercial gas field (East Umiat) was discovered.

Drilling activities in the foothills area were greatly curtailed following the success of the Prudhoe Bay State No. 1 discovery in 1967 and subsequent discoveries in the Colville Basin of the coastal plain province. There has been intermittent activity between 1967 and 1981. Chevron drilled three wells: Tiglukpuk No. 1 in 1978; Killik No. 1 in 1981; and Cobblestone No. 1 in 1981-1982 on Native-owned land. The last two wells drilled by Husky for the U.S.G.S. were the Seabee Well and the Lisburne Well, both completed in 1980. The Seabee Test Well No. 1 tested the south flank of the shallow east-west trending Umiat anticline. There were numerous hydrocarbon shows in the Nanushuk Group; several gas shows in the Torok and Fortress Mountain; and a significant show of gas in the Pebble Shale (Houle, 2000

citing to Husky Seabee No. 1 Geological Well Report, p. 1-2). The Lisburne No. 1 well tested the hydrocarbon potential of the Lisburne carbonates on a closed anticlinal structure in the overthrust belt at the

**Figure 2.1 Generalized North Slope Stratigraphic Column**



west end of the sale area. Minor gas shows were encountered in poor reservoir-quality rocks throughout the well (Houle, 2000, citing to Husky report). There was no further drilling activity in the foothills area until 1993. The last two foothills wells drilled were ARCO's Big Bend No. 1 well, drilled on native-owned land in 1993 and the Unocal Amethyst St. No. 1 well drilled in 1994.

## D. Petroleum Potential

ADNR has determined that sale area has low to moderate petroleum potential. This represents ADNR's general assessment of the oil and gas potential of the area and is based on its resource evaluation. This resource evaluation involves several factors including geology, seismic data, exploration history of the area, and proximity to known hydrocarbon accumulations. Some portions of this area have higher potential because of more favorable geology, while other portions of the area may have lower potential because the geology is less favorable or the exploration history is less encouraging. Areas with lower potential may still contain hydrocarbon accumulations.

Recent discoveries at Tarn and Meltwater, situated southwest of the Kuparuk River Field, coupled with the development of the Tabasco sandstones within the western Kuparuk River Unit are encouraging finds that should stimulate and encourage new exploration approaches and strategies within the foothills area. With the advent of 3-D seismic the play emphasis in the foothills area may shift from a search for structural traps to a search for shallower stratigraphic traps, where the rocks may have the potential to be in the oil window.

# Chapter Three: Habitat, Fish and Wildlife

## Contents

- Habitat, Fish and Wildlife..... 3-1
  - A. Habitats..... 3-1
  - B. Fish and Bird Species..... 3-2
    - 1. Fish ..... 3-2
    - 2. Birds ..... 3-6
  - C. Terrestrial Mammals..... 3-10
    - 1. Caribou ..... 3-10
    - 2. Moose ..... 3-12
    - 3. Brown Bears ..... 3-14
    - 4. Muskoxen..... 3-16
    - 5. Dall Sheep ..... 3-17
    - 6. Furbearers ..... 3-17



# Chapter Three: Habitat, Fish and Wildlife

## A. Habitats

The sale area is in the foothills of the Brooks Range, a series of high, rugged peaks that extend from the Canadian border across Alaska to the Chukchi Sea. The foothills comprise rolling uplands of moist tundra with outcrops of ridges, mesas, and bluffs such as Gunsight, Table Top, Itigaknit, and Imnavait mountains, Hatbox Mesa, and Tuktu Bluff. The elevation ranges from a low of 500 feet in the valleys of the northern section of the sale area, to a high of 6,000 feet near the boundary of the Gates of the Arctic National Park and Preserve. Permafrost in the foothills area is generally shallow and surface ice may be present (AEIDC, 1975:113). The central and eastern portions of the sale area contain several lakes.

Precipitation is low in the foothills with about six inches of precipitation per year. This includes snow, which has an average conversion rate of ten to one. Winds are generally lighter than at the coast, but can be stronger through the mountain passes. Cold winter temperatures combined with strong winds produce a chill factor that requires extreme caution in outdoor activities. February is the coldest month, except at Anaktuvuk Pass where January is recorded as the coldest. Average winter temperature is -35° F in the foothills. In July, the average temperature ranges from low to mid-60s F (AEIDC, 1975:11-15, 114).

The distribution of vegetation in the northern foothills of the sale area is affected by soil conditions, elevation, and drainage. Moist tundra is the dominant plant community of the foothills region. It is dissected locally by river drainages. Cottongrass tussocks 6 to 10 inches high, separated by narrow channels, cover large area of rolling terrain. Other plants growing with the cottongrass include small shrubs such as dwarf birch, willows, Labrador tea, cloudberry, and a few herbs like bistort and cloudberry (AEIDC, 1975:121).

The high brush plant community occurs along the floodplains of many large rivers of the Arctic Region, particularly in the mountains and foothills. Soils are usually well-drained gravel, sand, or silt, and the active layer is deeper than in the remainder of the Arctic. Spring floodwaters and floating ice may destroy some vegetation, so the community is constantly changing. Newly exposed gravel bars are invaded by a pioneer flora with such species as horsetail, alpine bluegrass, and dwarf fireweed. The high brush community, found in areas that have not been disturbed for several decades, includes willows, a few herbs, many mosses and lichens, and possibly alder and a few well-developed stands of cottonwood near springs in the eastern foothills of the Brooks Range (AEIDC, 1975:122).

Alpine tundra communities occur in mountainous areas and along well-drained, rocky ridges. The coarse soil is rocky and dry. A fell-field<sup>1</sup> community of low, mat-forming heather vegetation is characteristic of much of the area. Exposed outcrops and talus slopes sustain sparse islands of cushion plants and lichens among the rocks. The low growth form protects the vegetation from abrasion by blowing snow and sand in the exposed, windswept habitat. Important plants in the fell-field include mountain avens, willows, and heather. Lichens, especially reindeer moss and other mosses, are common. Grasses, sedges, and a few herbs are also evident. Cushion plants such as moss campion and saxifrages, as well as many lichens, occur in the dry talus communities (AEIDC, 1975:118).

---

<sup>1</sup> A Danish term meaning "rock desert." Dry exposed slopes and summits where vegetation is scarce.

## B. Fish and Bird Species

### 1. Fish

The sale area contains habitat critical to populations of anadromous and resident freshwater fish. Numerous oligotrophic lakes varying in size from a few to thousands of acres are located in the foothills area. These waters provide unique habitat needed by lake trout and lake resident Arctic char, and these species have very narrow environmental tolerances. The lakes also support significant populations of Arctic grayling, burbot, and five species of whitefish. Rivers and streams within the sale area support anadromous and resident fish populations. The streams provide necessary spawning, rearing, and overwintering habitat along with migratory pathways to seasonally critical areas (ADF&G, 2000a).

A lack of overwintering habitat is the primary factor limiting arctic fish populations. Most arctic lakes and rivers are shallow and freeze solid each winter. As a result, overwintering habitat is limited to deeper pools and lakes (Baker 1987:1-8). These are localized areas of adequate groundwater spring flow that do not freeze to the bottom, providing the conditions to allow eggs to incubate and hatch, and the other ages of fish to overwinter. These spring areas are unique and essential to the survival of Dolly Varden. The entire population, including all age classes from eggs to adults, are in these spring areas during the winter. The two largest general areas identified by ADF&G as containing overwintering and spawning areas are 12 to 15 miles long in the Anaktuvuk and Ivishak river drainages. Most of the other areas are around five miles long or less. Several of the areas straddle the Arctic National Wildlife Refuge boundary. General areas identified as containing overwintering and spawning areas within this sale area are located on the following rivers: Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayut, and Nanushuk Rivers; May, Cobblestone, Section, and Accomplishment Creeks (ADF&G, 2000:3).

Anadromous fish spawn and overwinter in rivers or lakes. Non-anadromous fish inhabit freshwater year-round, although one species, the arctic grayling, moves into river deltas and nearshore coastal waters after spring break-up. Arctic char, and broad and humpback whitefish remain in freshwater for several months or years, depending on the species, before migrating to coastal waters. After the initial migration, these anadromous species summer in coastal waters, returning to inland waters to spawn and overwinter.

Arctic char are dependent on spring-fed habitats for their spawning grounds, rearing areas for fry and juveniles, and overwintering areas. Their eggs are spawned in the fall and do not hatch until early spring. The young leave the spawning grounds at about age two (ADF&G 1986b, Vol. II:159).

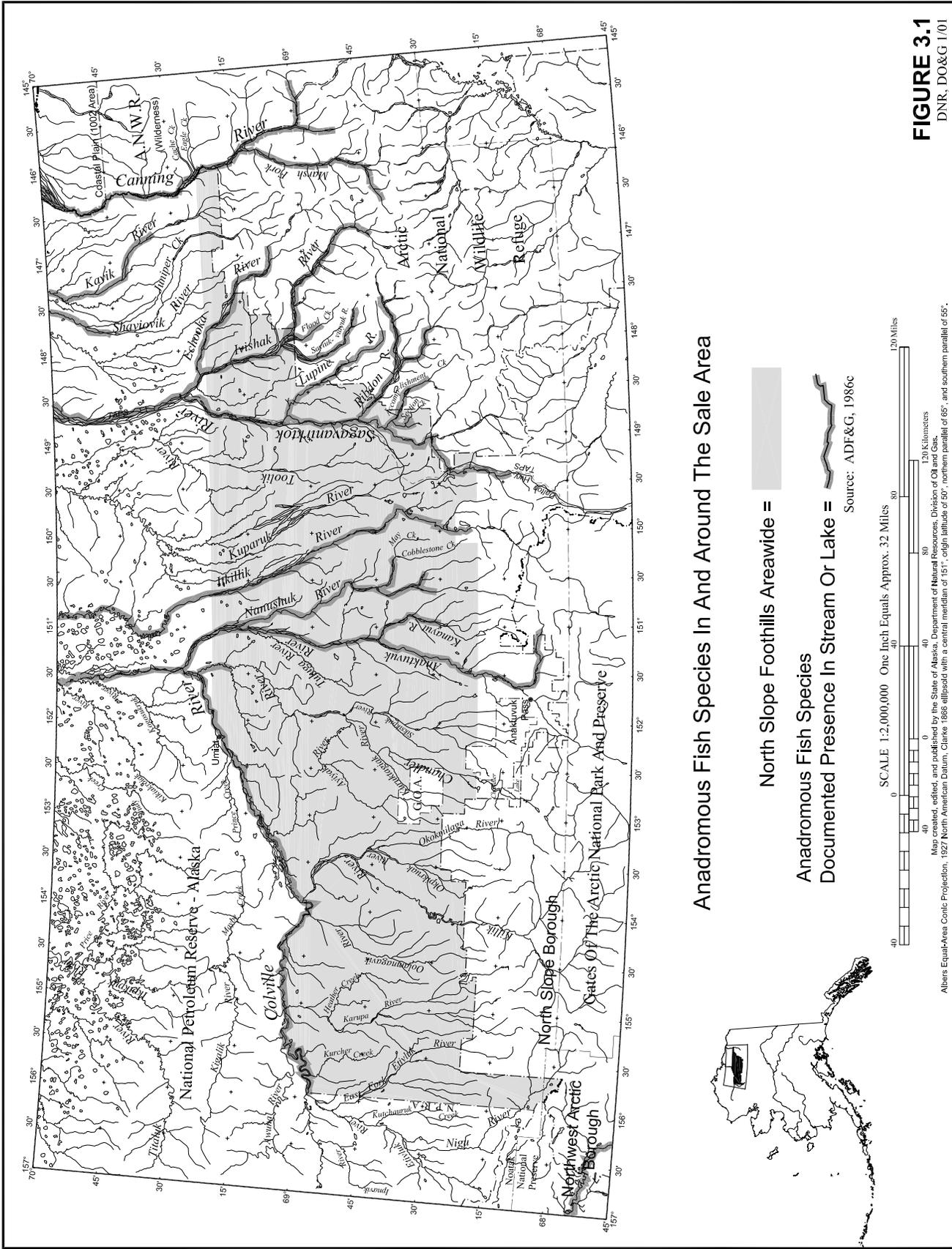
Grayling spawn in May and June in the foothill streams of the Brooks Range. Adults leave these smaller feeder streams shortly thereafter to spend their summer in the main streams and rivers. Juveniles remain in the foothill streams throughout the summer and leave for deeper water before freeze-up in September. Grayling are the most widely distributed fish species in the Sagavanirktok River and neighboring drainages ADF&G 1986b, Vol. II:173).

Broad whitefish migrate out of the larger rivers, such as the Sagavanirktok, during spring breakup in early June. After spending their summer feeding in shallow bays and lagoons along the coast, they re-enter the rivers in late July and August and swim to their spawning areas in the foothill streams. After spawning, they move back downstream during freeze-up to overwinter under the ice in deep freshwater pools (ADF&G 1986b, Vol. II:217).

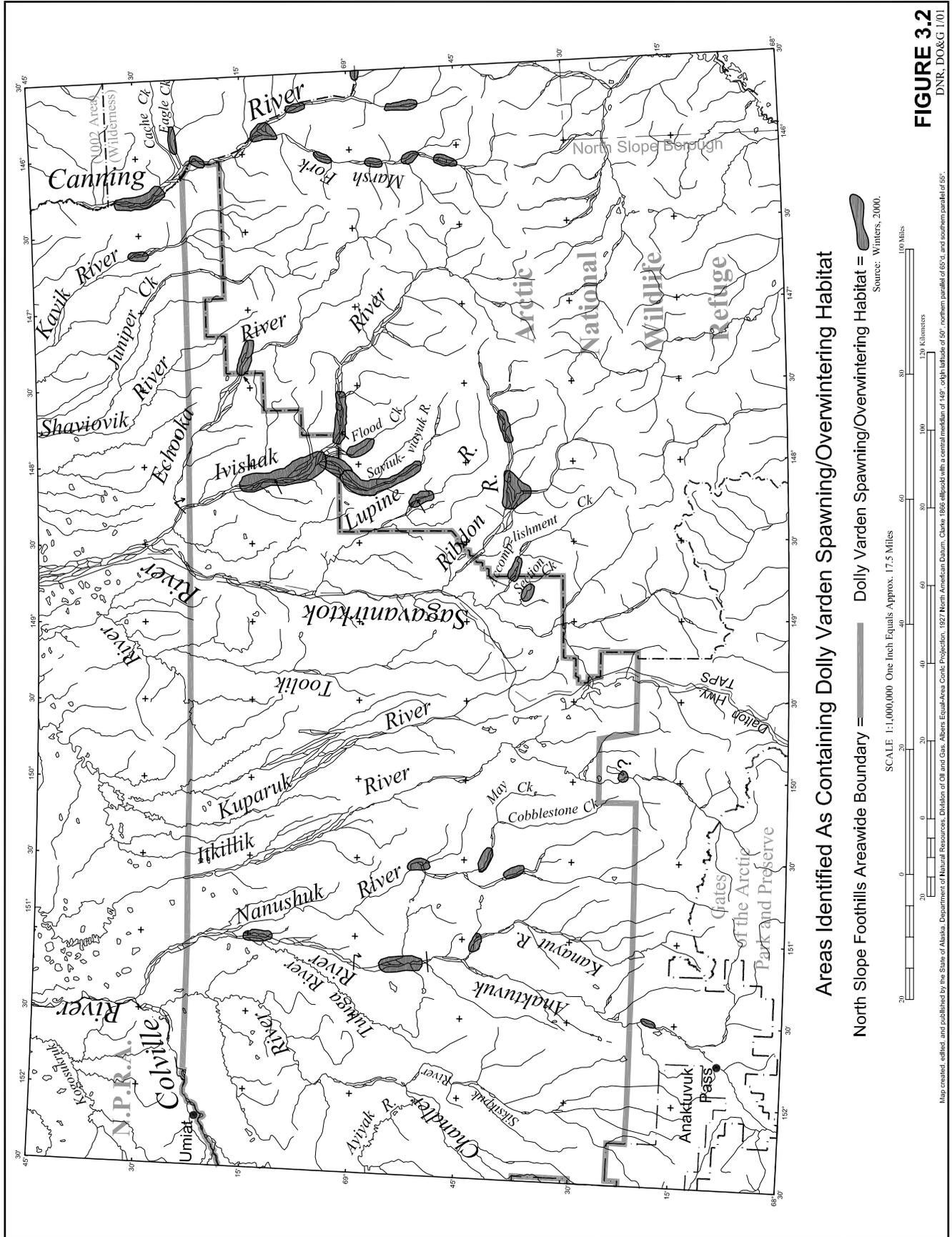
Pink and chum salmon are at their most northern range in these waters. A lack of suitable spawning areas not subject to freeze-up keep the population low. Spawning takes place in mid-August in the Colville River and its upper reaches, including the Itkillik River (Ott 1992), (ADF&G 1986b:217).

**TABLE 3.1: Some Waterways and Typical Fish Species Within the Sale Area**

Waterway	Anadromous Species	Resident Species
Accomplishment Creek	Arctic char	Arctic grayling
Anaktuvuk River	Arctic char, broad whitefish	Lake trout, Arctic grayling, round whitefish, burbot, longnose sucker, slimy sculpin, ninespine stickleback
Canning River	Arctic char, chum salmon, pink salmon, whitefish	Arctic grayling, burbot, round whitefish, ninespine stickleback
Chandler River	Arctic char, broad and humpback whitefish, Arctic cisco	Lake trout, Arctic grayling, round whitefish, burbot, longnose sucker, slimy sculpin, ninespine stickleback
Cobblestone Creek	Arctic char	Arctic grayling
Colville River	Arctic char, chum salmon, pink salmon, least cisco, Arctic cisco, broad whitefish, humpback whitefish, rainbow smelt	Lake trout, Arctic grayling, round whitefish, burbot, longnose sucker, slimy sculpin, ninespine stickleback, northern pike
Echooka River	Arctic char	Arctic grayling, round whitefish, slimy sculpin
Etivluk River		Arctic grayling, ninespine stickleback, round whitefish, broad whitefish, lake trout, burbot, longnose sucker, slimy sculpin
Itkillik River	Arctic char, pink and chum salmon, humpback whitefish, broad whitefish, least cisco, Arctic cisco	Arctic grayling, burbot, longnose sucker, slimy sculpin, ninespine stickleback
Ivishak River	Arctic char	Arctic grayling, round whitefish, slimy sculpin, burbot, ninespine stickleback
Kanayut River	Arctic char	Arctic grayling, round whitefish, slimy sculpin
Killik River		Arctic grayling, burbot, longnose sucker, slimy sculpin, ninespine stickleback, lake trout
Kuparuk River	whitefish	Arctic grayling, round whitefish, burbot, slimy sculpin, ninespine stickleback
Kurupa River		Arctic grayling, round whitefish, burbot, longnose sucker, slimy sculpin, ninespine stickleback
Lupine River	Arctic char	Arctic grayling, round whitefish, slimy sculpin, burbot
May Creek	Arctic char	Arctic grayling, slimy sculpin
Nanushuk River	Arctic char	Arctic grayling, round whitefish, slimy sculpin
Natvakruak Creek		Arctic grayling, lake trout, round whitefish, slimy sculpin
Okokmilaga River		Arctic grayling, slimy sculpin
Ribdon River	Arctic char	Arctic grayling, round whitefish, slimy sculpin
Sagavanirktok River	Arctic char, pink salmon, chum salmon, broad whitefish, humpback whitefish, least cisco, Arctic cisco	Lake trout, arctic grayling, round whitefish, burbot, slimy sculpin, ninespine stickleback
Saviukviayak River	Arctic char	Arctic grayling
Section Creek	Arctic char	Arctic grayling
Siksikpuk River		Arctic grayling, slimy sculpin
Toolik River		Arctic grayling, round whitefish, slimy sculpin
Various Lakes		Lake trout, grayling, round whitefish, arctic char, Dolly Varden, and whitefish, slimy sculpin, burbot,



**FIGURE 3.1**  
DNR, DO&G 1/01



**FIGURE 3.2**  
DNR, DOS&G 1/01

## 2. Birds

Many species of small birds use the thick, vegetated riverine areas for nesting sites and for cover from predators. These species include the savannah, fox, tree, and white-crowned sparrow; the gray-cheeked thrush; the arctic warbler; the redpoll; and the robin. Rock and willow ptarmigan may also be found along the high brush areas. Northern shrike and short-eared owls are also present in the sale area. Birds observed in the vicinity of the sale area are listed in Table 3.2. Geese habitat is depicted in Figure 3.3 and duck habitat is shown in Figure 3.6.

The ponds and sloughs associated with river floodplains provide nesting and brood-rearing areas for waterfowl, including tundra swans, northern pintail, green-winged teal, greater scaup, oldsquaw, harlequin duck, and red-breasted merganser. River gravel bars provide nesting habitat for mew gulls and arctic terns. Riverbanks and pond edges provide foraging and nesting habitat for shorebirds such as the lesser golden-plover, spotted sandpiper, ruddy turnstone, Baird's sandpiper, and buff-breasted sandpiper (Sousa 1992).

Tundra Swans begin nesting during the last week of May and the first two weeks of June. Nests are large (approximately 1 m high and up to 2 m in diameter) and widely scattered. The nests are generally located on sedge tundra. After hatching in late June or early July, broods are reared in nesting territory (Smith et. al. 1993:12). Adults molt from mid-July through August. Fall migration occurs from late September to early October. They winter along the east and west coasts of North America, from the Aleutian Islands to California and from Maryland to North Carolina (Johnson and Herter, 1989:17).

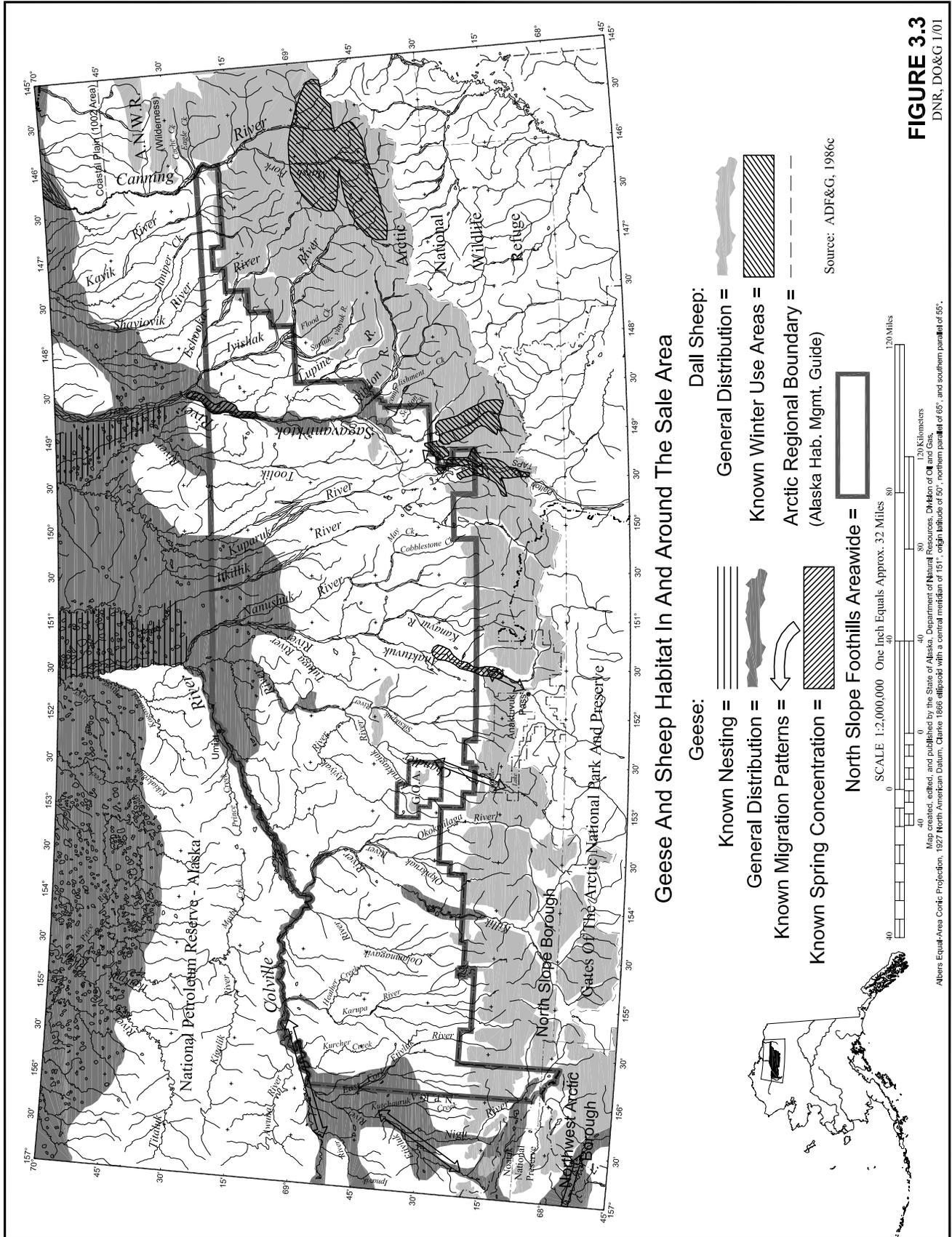
The moist tundra areas found mainly between the rivers in the sale area are home to snow buntings, snowy owls, ravens, and marsh hawks (AEIDC, 1975). Arctic peregrine falcons nest primarily on bluffs along the Colville River from Umiat to Ocean Point, and at Franklin and Sagwon Bluffs in the Sagavanirktok River drainage. Additional nest sites may occur at other locations (Ott, 1997). Arctic peregrine falcons are present from late April through September. Nesting begins by mid-May, and the young birds fledge from late July to late August. Immature peregrine falcons from the Colville to the Sagavanirktok River drainages move toward the Beaufort Sea coast in mid-to late August. Peregrine falcons generally have left the North Slope by late September (Ott, 1997).

A number of birds are closely associated with the high brush community. Many are small and inhabit thick vegetation which provides cover and nesting sites. These include the fox, white-crowned, savannah, and tree sparrows; gray-cheeked thrushes and robins; redpolls; yellow wagtails; and Arctic warblers. Several predator species are found in the high brush, especially the northern shrike and the short-eared owl. The willow ptarmigan is also found here (AEIDC, 1975:126). The alpine tundra and dry areas are used extensively by a wide variety of birds. Shorebirds are represented by the whimbrel, bar-tailed godwit, golden plover, black-bellied plover, ruddy turnstone, and the sernipalmated and Baird sandpiper. Some, such as the golden plover, nest nowhere else in the Arctic (AEIDC, 1975:136).

**Table 3.2 Birds Observed in the Vicinity of the Sale Area**

<b>Common Name</b>	<b>Scientific Name</b>
Red- throated Loon	<i>Gavia stellata</i>
Pacific Loon	<i>Gavia pacifica</i>
Yellow-billed Loon	<i>Gavia adamssi</i>
Tundra Swan	<i>Cygnus columbianus</i>
Greater White-fronted Goose	<i>Anser albifrons</i>
Snow Goose	<i>Chen caerulescens</i>
Brant	<i>Branta bernicla</i>
Canada Goose	<i>Branta canadensis</i>
Mallard	<i>Anas platyrhynchos</i>
Northern Pintail	<i>Anas acuta</i>
Green-winged Teal	<i>Anas crecca</i>
American Wigeon	<i>Anas americana</i>
Greater Scaup	<i>Aythya marila</i>
Harlequin Duck	<i>Histrionicus histrionicus</i>
Oldsquaw	<i>Clangula hyemalis</i>
White-winged Scoter	<i>Melanitta fusca</i>
Surf Scoter	<i>Melanitta perspicillata</i>
Red-breasted Merganser	<i>Mergus serrator</i>
Northern Harrier	<i>Circus cyaneus</i>
Rough-legged Hawk	<i>Buteo lagopus</i>
Golden Eagle	<i>Aquila chrysaetos</i>
American Kestrel	<i>Falco sparverius</i>
Merlin	<i>Falco columbarius</i>
Peregrine Falcon	<i>Falco peregrinus</i>
Gyrfalcon	<i>Falco rusticolus</i>
Willow Ptarmigan	<i>Lagopus lagopus</i>
Sandhill Crane	<i>Grus canadensis</i>
Rock Ptarmigan	<i>Lagopus mutus</i>
Black-bellied Plover	<i>Pluvialis squatarola</i>
Lesser golden Plover	<i>Pluvialis dominica</i>
Sernipalmated Plover	<i>Charadrius semipalmatus</i>
Lesser Yellowlegs	<i>Tringa flavips</i>
Wandering Tattler	<i>Heteroscelus incanus</i>
Spotted Sandpiper	<i>Actitis macularia</i>
Upland Sandpiper	<i>Bartramia longicauda</i>
Whimbrel	<i>Numenius phaeopus</i>
Bar-tailed Godwit	<i>Limosa lapponica</i>
Ruddy Turnstone	<i>Arenaria interpres</i>
Sanderling	<i>Calidris alba</i>
Semipalmated Sandpiper	<i>Calidris pusilla</i>
Least Sandpiper	<i>Calidris minutilla</i>
White-rumped Sandpiper	<i>Calidris fuscicollis</i>

Baird's Sandpiper	<i>Calidris bairdii</i> -
Pectoral Sandpiper	<i>Calidris nielanotos</i>
Dunlin	<i>Calidris melantos</i>
Stilt Sandpiper	<i>Calidris himantopus</i>
Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>
Common Snipe	<i>Gallinago gallinago</i>
Red-necked Phalarope	<i>Phalaropus lobatus</i>
Red Phalarope	<i>Phalaropus fulicaria</i>
Pomarine Jaeger	<i>Stercorarius pomarinus</i>
Parasitic Jaeger	<i>Stercorarius parasiticus</i>
Long-tailed Jaeger	<i>Stercorarius longicaudus</i>
Mew Gull	<i>Larus canus</i>
Herring Gull	<i>Larus argentatus</i>
Glaucous Gull	<i>Larus hyperboreus</i>
Sabine's Gull	<i>Xenia sabini</i>
Arctic Tern	<i>Sterna paradisaea</i>
Snowy Owl	<i>Nyctea scandiaca</i>
Short-eared Owl	<i>Asio flammeus</i>
Say's Phoebe	<i>Sayornis saya</i>
Honed Lark	<i>Eremophila alpestris</i>
Cliff Swallow	<i>Hirundo pyrrhonota</i>
Common Raven	<i>Corvus corax</i>
American Dipper	<i>Cinclus mexicanus</i>
Arctic Warbler	<i>Phylloscopus borealis</i>
Bluethroat	<i>Luscinia svecica</i>
Northern Wheatear	<i>Oenanthe oenanthe</i>
Gray-cheeked Thrush	<i>Catharus minimus</i>
American Robin	<i>Turdus migratorius</i>
Yellow Wagtail	<i>Motacilla flava</i>
American Pipit	<i>Anthus rubescens</i>
Northern Shrike	<i>Lanius excubitor</i>
Yellow Warbler	<i>Dendroica petechia</i>
American Tree Sparrow	<i>Spizella arborea</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Fox Sparrow	<i>Passerella iliaca</i>
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
Dark-eyed Junco	<i>Junco hyemalis</i>
Lapland Longspur	<i>Calcarius lapponicus</i>
Smith's Longspur	<i>Calcarius spictus</i>
Snow Bunting	<i>Plectrophenax nivalis</i>
Rosy Finch	<i>Leucosticte arctoa</i>
Redpoll	<i>Carduelis sp.</i>



## C. Terrestrial Mammals

### 1. Caribou

Caribou: (*Rangifer tarandus*) are present throughout the sale area. The range of the Central Arctic Caribou Herd, (CAH) which currently numbers about 27,128 animals (PNA, 2000), extends from the northern foothills of the Brooks Range to the Beaufort Sea and from the Colville River to the Canning River. Caribou from this herd generally use the sale area as winter range (Sousa 1992). Caribou from the Western Arctic Herd (WAH) and the Teshekpuk Lake Herd (TLH) may also be present, usually west of the Anaktuvuk River.

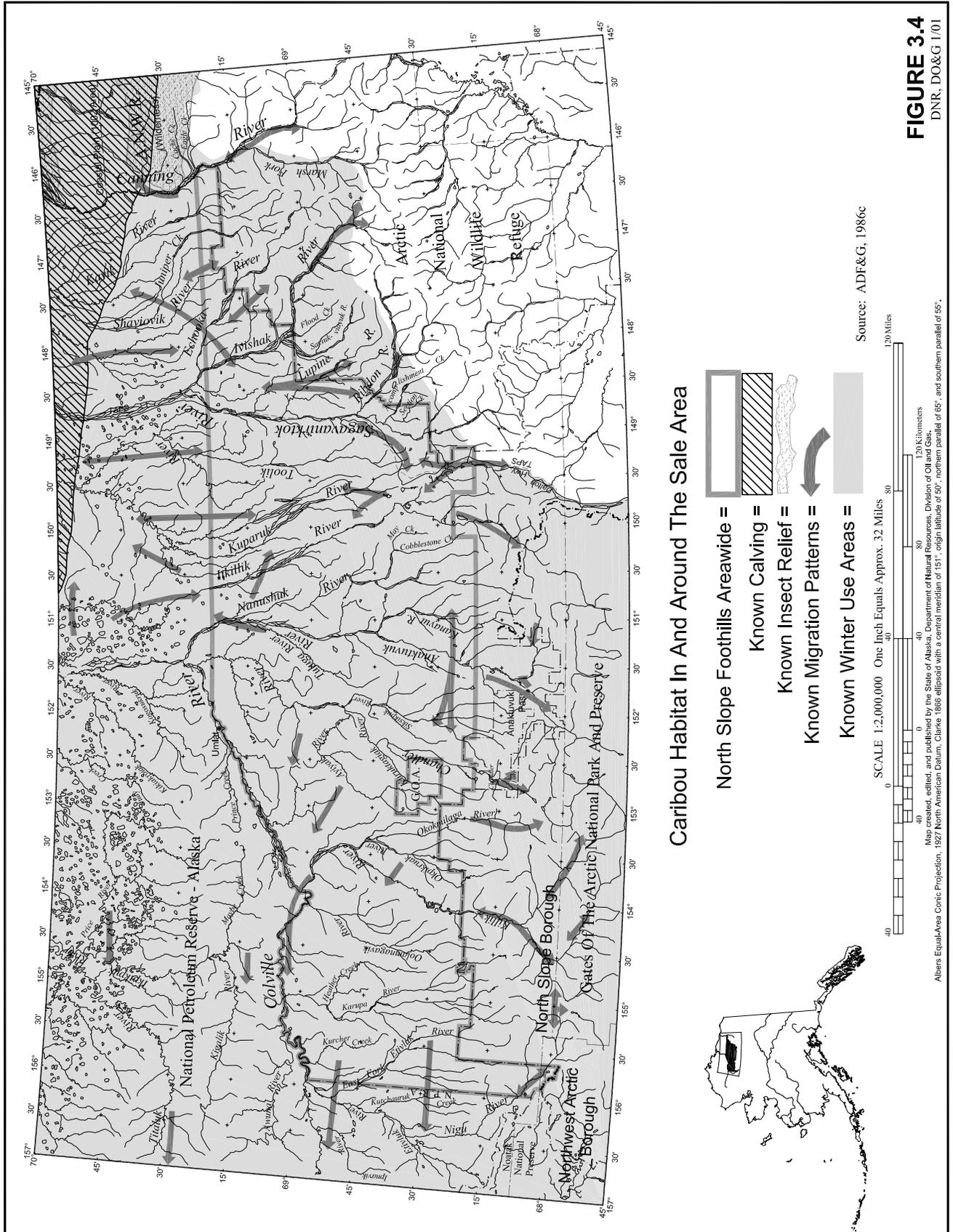
Movement between the summer and winter ranges is predominately north-south, whereas movement within the summer range is generally east-west along the coast and dependent in part on the intensity of insect harassment. Fall migration routes within or near the sale area are down the Itkillik, Nanushuk, Anaktuvuk, Kuparuk, and Chandler river valleys (Shideler 1986:ix).

Caribou use the river areas and mountain passes as migratory routes from their winter habitat to their summer calving and foraging areas along the Beaufort Sea coast and inland areas. The timing of their arrival appears to be closely correlated to the receding snow and appearance of the first Eriophorum (cotton grass) buds. In late May or June a single calf is born (twins are very rare) mostly within thirty miles of the coast, north of the sale area. ADF&G have identified no caribou calving areas in the sale area (Winters, 2000a).

Caribou generally summer on the arctic coastal plain, outside the sale area. The CAH spends June through mid-August near the arctic coast between the Colville and Canning Rivers (Whitten, 1995). In midsummer, from mid -to late June through July, caribou are often harassed by hordes of mosquitoes, warble flies, and nose flies. Movement during the summer is closely tied to insect harassment. In response, caribou move from inland feeding areas to windswept, vegetation-free coastal areas where the insects are limited. Sometimes the animals will run in a frenzy for long distances, stopping to rest only when exhausted or when wind offers relief from the insects (ADF&G, 1994). Most insect relief areas are found within two miles of the coast (ADF&G 1986b:71). However, caribou also tend to congregate on gravel drilling pads and roads which are generally raised above the tundra and more exposed to the elements (USACE 1984:141). Caribou that remain inland may move to river bars and bluffs to escape these insects. The frequency and duration of caribou movements to and from the coast depend on weather related changes that affect the number of mosquitoes. Caribou distribution on the coastal plain can change dramatically within a 24-hour period.

The fall migration south begins in September and ends by mid-November. During both the spring and fall migrations, the herd tends to move along or near major river drainages, such as the Itkillik, Kuparuk, Shaviovik, and Canning. Caribou generally winter in the northern foothills of the Brooks Range. Occasionally, some remain on the coastal plain during mild winters. (Ott, 1992).

Caribou must keep moving to find adequate food. This distributes feeding pressure and tends to prevent overgrazing. Caribou are great wanderers and very efficient at moving across both boggy and rugged terrain. They commonly travel vast distances to reach suitable foraging sites on widely separated season ranges. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases. In summer, caribou eat a wide variety of plants, apparently favoring the leaves of willows, grasses, and herbaceous and flowering plants. During winter, they use windswept upland areas, or areas of lighter snow



**FIGURE 3.4**  
 DNR, DO&G 1/01

cover where they can dig through the snow to feed on lichens, "reindeer moss," and dried sedges (ADF&G, 1994).

The CAH reached its highest level ever recorded in 2000 with an estimated 27,128 animals. That compares with 19,700 in 1997 and a previous high of 24,000 in 1992. In 1978 the herd numbered 6,000. The cause of caribou population fluctuations is a matter of debate among biologists. In North America some herds appear to go up and down on a 20-year cycle. Other herds fluctuate erratically. Caribou biologists agree that fluctuations in herd numbers are at least partially weather related. Also, predation, especially by wolves, plays a role (PNA, 2000). Another factor is carrying capacity, which is the maximum number of inhabitants that a given environment can support without detrimental effects. When herds grow too large they may overgraze their range and reduce their forage availability (Whitten, 1995:2).

Portions of the WAH occasionally winter in the sale area east of the Anaktuvuk River. Portions of the WAH also use the sale area west of the Anaktuvuk River for summer and winter range. In addition, WAH caribou use major river systems from the Anaktuvuk River west for fall migration to winter habitat outside of the sale area, and for spring migration to the traditional calving grounds in the Utukok Uplands. The Anaktuvuk and Chandler river valleys are particularly important spring migration corridors for pregnant females heading westward toward the Utukok calving area. The WAH was estimated in 1999 to number 430,000 animals (ADF&G, 2000b).

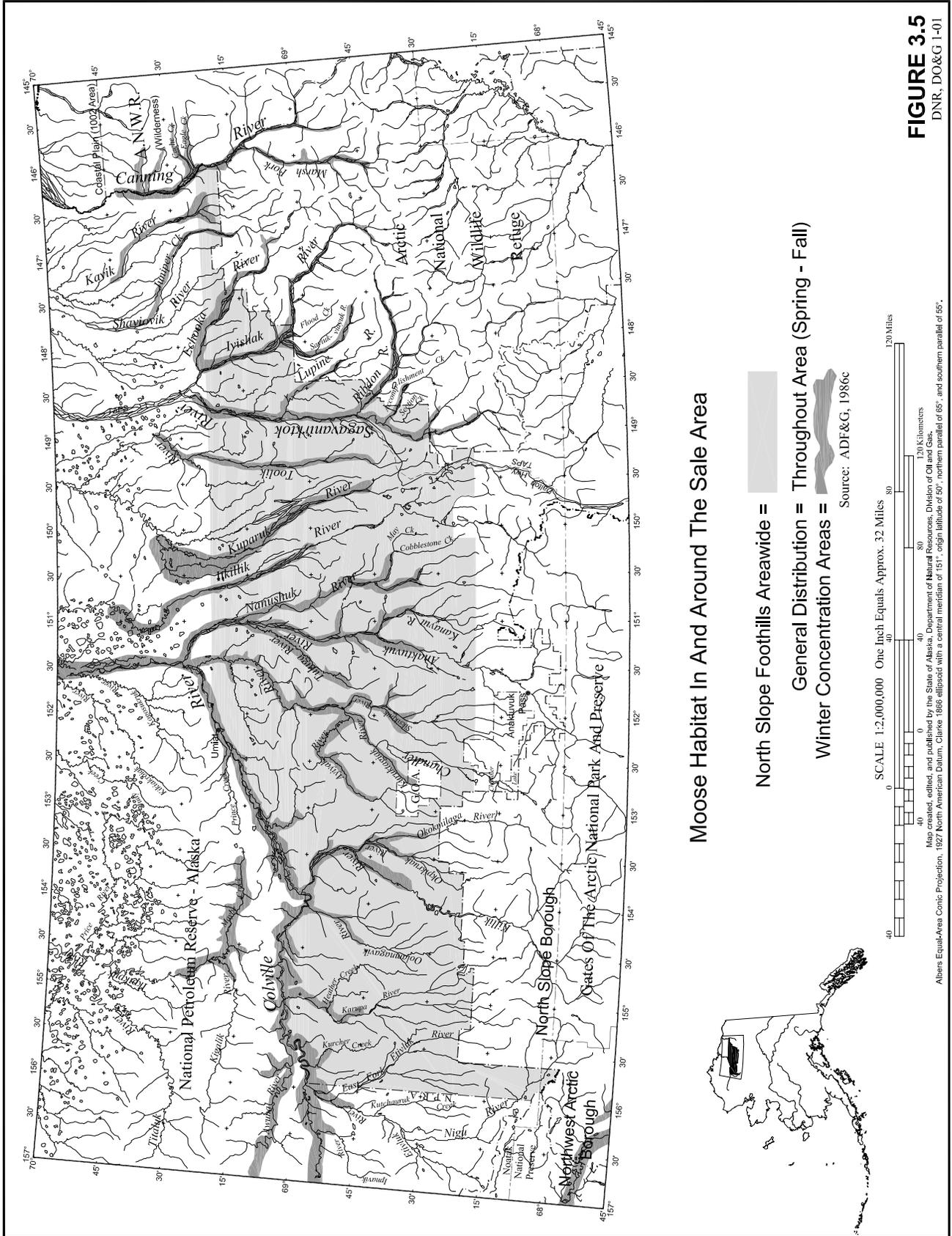
Portions of the TLH often use portions of the sale area for winter range in addition to its use as a potential migration route. Most of the herd spent the winter of 1993-1994 in the sale area between Umiat and Anaktuvuk Pass when most of the coastal plain was covered by a layer of ice, and access to habitat in the foothills was essential (ADF&G, 2000b, citing to Carroll, 1995, S&I report). The TLH currently numbers 28,000 animals.

## 2. Moose

The extensive riparian willow stands along river drainages, such as the Kuparuk and Toolik rivers, are valuable moose habitat (Sousa 1992). These riparian areas are especially important during the winter when forage is mainly confined to willow stands where shrubs will not be covered by drifting snow. Following the snow melt, usually around the beginning of May, moose occasionally disperse across the tundra, but are mainly found in varying elevations in the foothills. Calving also occurs at this time. Moose feed on aquatic vegetation, grasses, sedges, and willow during spring and summer. During winter they feed on deciduous shrubs and crater in the snow for ferns, willow, and foliose lichens. As snow depths increase, moose prefer to migrate to dense coniferous and deciduous forests where snow accumulation is less. Moose breed annually and both sexes may begin breeding at 16 to 18 months. Rutting occurs during the fall between late September and early October. During this period, moose may aggregate in groups of up to 30 bulls and cows with movement between the groups (ADF&G 1986a:139-146).

Moose are the world's largest members of the deer family and the Alaska moose (*Alces alces gigas*) is the largest of all the moose. Moose breed annually and both sexes may begin breeding at an age of 16 to 18 months. Calves are born any time from mid-May to early June after a gestation period of about 230 days. Calves begin taking solid food a few days after birth. Newborn calves weigh 28 to 35 pounds and within five months grow to over 300 pounds (ADF&G, 1994).

Rutting occurs during the fall between late September and early October. During this period, moose may aggregate in groups of up to 30 bulls and cows, with movement of individuals between the groups (ADF&G 1986a:139-146).



**FIGURE 3.5**  
DNR, DO&G 1-01

Moose eat a variety of foods, particularly sedges, equisetum (horsetail), pond weeds, and grasses. During summer, moose feed on vegetation in shallow ponds, forbs, and the leaves of birch, willow, and aspen. Willow stands along rivers and streams are important winter habitat for moose. These riparian areas are especially important during winter when forage is mainly confined along major drainages where shrubs will not be covered by drifting snow. (Sousa, 1992).

Moose have a high reproductive potential and can quickly fill a range to capacity if not limited by predation, hunting, and severe weather. Deep crusted snow can lead to malnutrition and subsequent death of hundreds of moose and decrease the survival of the succeeding year's calves. Predation by wolves and bear limits the growth of moose populations in Alaska (ADF&G, 1994).

General distribution occurs all across the North Slope, but this has not always been the case. In the mid-1940s there were few moose on the lower Colville River. Breeding populations migrated north and became established and the population grew to 1600 moose in the 1980s. In the early 1990s North Slope moose population experienced an alarming decline. The adult population declined by 50 percent and there was little if any calving success. Biologists are not sure of the cause. It could be a combination of factors, such as food availability and habitat limitation (population beyond carrying capacity of the habitat), disease, nutrition, predation, toxicity, and mosquito harassment. Food supply varies from year to year, and forage is limited. Moose populations along the Colville and Kavik Rivers are at the northern extent of the species' range, and they are susceptible to bad winters. Increasing populations of wolf and bear are also a likely factor contributing to the decline (Carroll, 1996). A lack of forage can lead to a mineral deficiency which may result in increased predation. Population surveys in 1997 and 1998 indicate moose in the Colville, Anaktuvuk and Chandler River drainages experienced low adult mortality and high calf survival, producing two years of population increase (ADF&G, 2000b). An ADF&G count in 1998 showed a total of 216 moose in the Colville, Anaktuvuk and Chandler River drainages. For a discussion of the potential effects this sale on moose from habitat loss, disturbance, oil spills and gas blowouts, see Chapter Five, "Cumulative Effects."

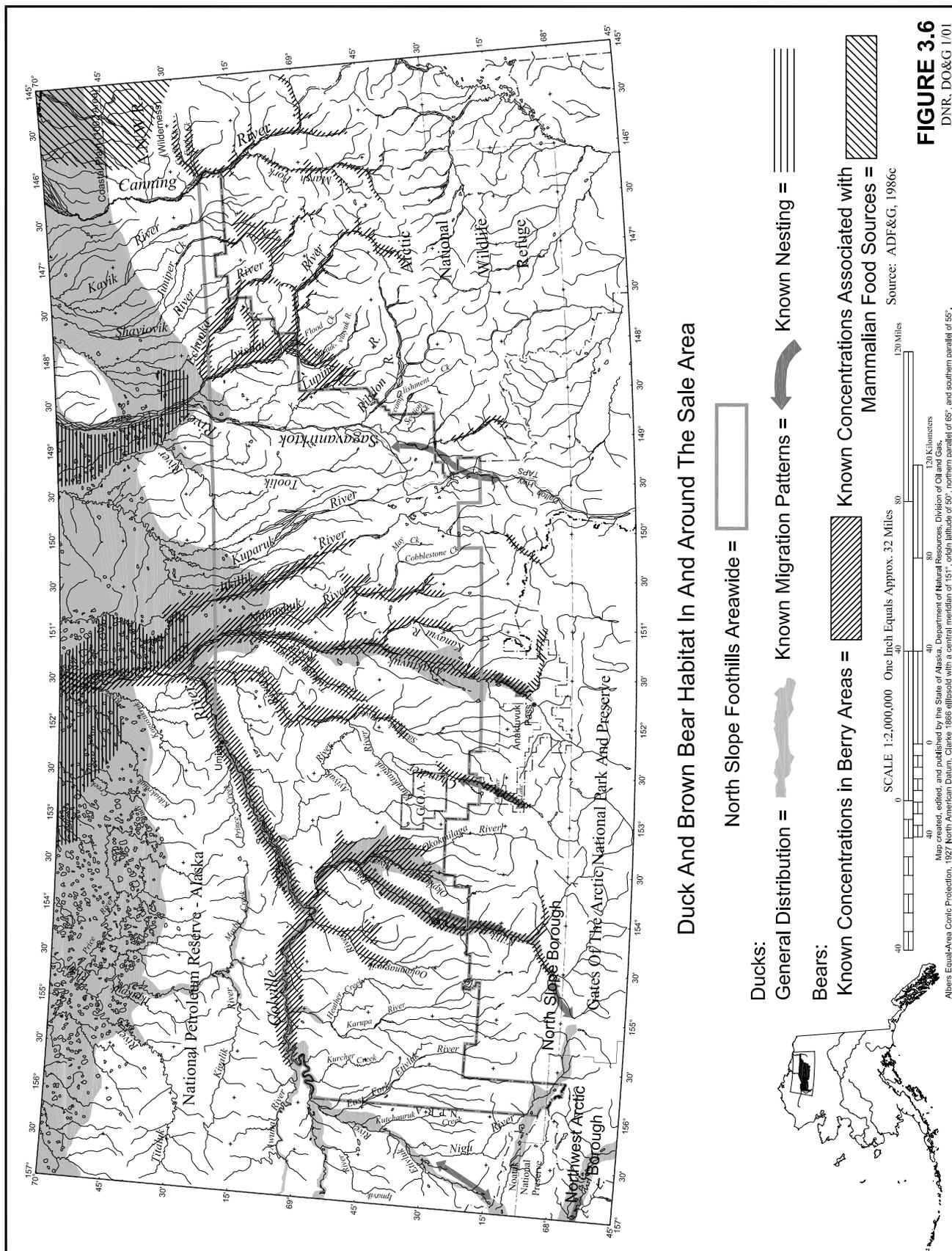
### 3. Brown Bears

Formerly, taxonomists listed brown and grizzly bears as separate species. Technically, brown and grizzly bears are classified as the same species, *Ursus arctos*. Generally the term brown bear is used for those found in coastal areas while bears found in the interior areas of Alaska are known as grizzlies (ADF&G, 1994).

Brown bears (also known as grizzly bears) may be found throughout the sale area. Highest concentrations are found each fall in berry-feeding areas along the Colville, Itkillik, Chandler, and Anaktuvuk rivers. ADF&G estimates the 1997-1998 brown bear population of GMU 26A of 900 to 1120 bears. Population estimates for GMU 26B are not available (ADF&G, 2000a). Grizzly bears den in a variety of terrain ranging from creek banks at low elevations of 886 feet to mountain slopes near the crest of the Brooks Range at 4,200 feet (ADF&G 1986a:106).

Grizzly bears hibernate during the winter months, entering their dens in late September or early October. They normally leave their dens in April or early May; adult males emerge first, followed by single females, then sows with young. Breeding takes place from May to early July. In the spring, grizzly bears are commonly found along major river valleys, such as the Colville and Itkillik. They later move to smaller tributaries and poorly drained areas to feed (ADF&G 1986a:103-108).

Except for females with offspring and breeding animals, bears are typically solitary creatures and avoid the company of other bears. Exceptions to this occur where food sources are concentrated, such as streams, where bears can catch salmon swimming upstream to spawn (ADF&G, 1994). In the spring, brown



bears are commonly found in major river valleys, such as the Colville and Itkillik. They later move to small tributaries and poorly drained areas to feed.

Mating takes place from May through July with the peak of activity in early June. Brown bears generally do not have strong mating ties. Individual bears are rarely seen with a mate for more than a week. Males may mate with more than one female during breeding season. The young are born the following January or February in a winter den. Litter size ranges from one to four cubs, but two is most common. Offspring typically separate from their mothers as two-year olds in May or June. In some areas where food is scarce, females may skip one to three years before producing new litters. Bear populations vary depending on the productivity of the environment. In areas of low productivity, such as on Alaska's North Slope, studies have revealed bear densities as low as one bear per 300 square miles (ADF&G, 1994).

During spring and summer, bears use east/west oriented ridges as important feeding areas (ADF&G, 2000b). Brown bears consume a wide variety of foods such as berries, grasses, sedges, horsetails, cow parsnips, fish, ground squirrels, and roots of many kinds of plants. In some parts of Alaska, brown bears have been known to prey on newborn moose and caribou. They can also kill healthy adults of these species. Bears also like all types of carrion as well as garbage in human dumps. Brown bears have an especially good sense of smell and under the right conditions may be able to detect odors more than a mile distant (ADF&G, 1994). During the summer, bears most frequently feed in wet sedge meadows, late snow bank areas, and tussock tundra, concentrating on grasses, sedges, the fruiting and vegetative stems of horsetails. In the fall, bears tend to use the floodplains of large creeks and rivers, dry ridge areas or mountain slopes and feed on roots, berries, and ground squirrels (ADF&G 1986a:103-109).

## 4. Muskoxen

The muskox (*Ovibos moschatus*) is a stocky, long-haired animal with cloven hooves, a slight shoulder hump and a very short tail. Taxonomists classify muskoxen with the sheep and goats. Muskoxen as a species have changed little since the ice age and are perfectly adapted to live in their harsh arctic environment (ADF&G, 1994).

Muskoxen from the Arctic National Wildlife Refuge (ANWR) population are dispersing westward into eastern GMU 26A. Small groups of bull muskoxen, presumably from the Cape Thompson herd, have been observed in western GMU 26A (ADF&G, 2000b). A June 1997 survey by ADF&G showed 247 muskoxen in GMU 26 B (ADF&G, 2000).

The original Alaska muskoxen disappeared in the mid- or late 1800s as a result of over-hunting. Muskoxen were re-introduced in the Arctic National Wildlife Refuge (ANWR) in 1969, and are continuing to expand westward into the area west of the Canning River (USDOI 1987:26).

Muskoxen are not migratory, but they may move in response to seasonal changes in snow cover, vegetation, and natural behavior. Many bull muskoxen move between mixed sex groups during the summer and form bull groups during the winter. Females calve from late April to mid-June, and the rutting season generally occurs during August. In summer and fall, both sexes may be found along major river drainages where they feed on willows and forbs. In winter and spring, muskoxen groups of 10 to 20 animals may be found in the uplands adjacent to river drainages which afford forage of tussock sedges and have less snow cover (USDOI, 1987:27).

Riparian habitat is preferred by muskoxen for virtually their entire annual cycle. River systems that provide diverse low shrub-forb and tall willow communities in proximity to relatively snow-free uplands, hillsides, and plateaus are important to muskoxen. Known wintering areas occur along riverside bluffs (Souza, 1992). Muskoxen are relatively sedentary in the winter (October-May), possibly as a strategy for conserving

energy. Limited data suggest that the majority of the population calves in the southern portion of the Arctic Coastal Plain on wind-blown, snow-free banks within riparian areas, and in upland sites in the foothills (Sousa, 1992).

Muskoxen eat a wide variety of plants, including grasses, sedges, forbs, and woody plants. In summer and fall, both sexes may be found along major river drainages where they feed on willows and forbs. In winter and spring, muskoxen groups of 10 to 20 animals may be found in the uplands adjacent to river drainages which afford forage of tussock sedges and have less snow cover (USDOI, 1987:27). Muskoxen are poorly adapted for digging through heavy snow for food, so winter habitat is generally restricted to areas with shallow snow accumulations or areas blown free of snow (ADF&G, 1994).

## 5. Dall Sheep

Dall Sheep (*Ovis dalli dalli*). Although sheep do not occupy the entire sale area, they are found in isolated mountain complexes such as Gunsight, Castle, Fortress, and Slope Mountains, in mountains around Galbraith Lake and the Atigun River, and in the more rugged terrain along the southern boundary of much of the sale area. Mineral licks and lambing areas are known to occur on Slope Mountain and in the Atigun River valley (ADF&G, 2000b).

Male Dall sheep (rams) are distinguished by massive curling horns. The females (ewes) have shorter, more slender, slightly curved horns. The young (lambs) are born in late May or early June. As lambing approaches, ewes seek solitude and protection from predators in the most rugged cliffs available on their spring ranges. Ewes bear a single lamb, and the ewe-lamb pairs remain in the lambing cliffs a few days until the lambs are strong enough to travel. Lambs begin feeding on vegetation within a week after birth and are usually weaned by October. Normally, ewes have their first lamb at age 3 and produce a lamb annually (ADF&G, 1994).

During summer, food is abundant, and a wide variety of plants is consumed. Winter diet is much more limited and consists primarily of dry, frozen grass and sedge stems available when snow is blown off the winter ranges. Some populations use significant amounts of lichen and moss during winter. Many Dall sheep populations visit mineral licks during the spring and often travel many miles to eat the soil at these unusual geological formations (ADF&G, 1994).

## 6. Furbearers

Other species that may be found in the sale area include arctic and red fox, wolf, and wolverine. Information on the abundance and distribution of these species is limited.

**Arctic fox.** The arctic fox (*Alopex lagopus*) is found within the sale area. Both blue and white color phases occur, with the white color phase more common in northern litters. Young of each color phase may occur in the same litter (ADF&G, 1994). Fully grown arctic foxes weigh from 6 to 10 pounds. They average 43 inches in length including the tail, which averages 15 inches in length (ADF&G, 1994).

Arctic fox pups are born in dens excavated by the adults in sandy, well-drained soils of low mounds and river cut backs. Most dens have southerly exposure. They extend from 6 to 12 feet underground. Enlarged ground squirrel burrows with several entrances are often used as dens (ADF&G, 1994).

Mating occurs in early March and early April. Gestation lasts 52 days. Litters average seven pups but may contain as many as 15 pups. Arctic foxes are monogamous in the wild. Both parents aid in bringing food to the den and in rearing the pups. Pups begin eating meat when about one month old and are fully weaned by 1-1/2 months. They emerge from the den when about three weeks old and begin to hunt and range away from

the den at about three months. Arctic foxes attain sexual maturity at nine to ten months, but many die in their first year (ADF&G, 1994).

Arctic foxes are omnivorous. In summer, they feed primarily on small mammals, including lemmings and tundra voles. They sometimes eat berries, eggs, and scavenged remains of other animals. In areas where lemmings and voles are the most important summer prey, numbers of foxes often rise and fall with cyclic changes of their prey. Fewer pups are successfully reared to maturity when food is scarce. There is evidence indicating that competition for food among young pups accounts for some of the heavy mortality in this age group (ADF&G, 1994).

**Wolf.** Wolves (*Canis lupus*) are adaptable and exist in a wide variety of habitats. They are highly social animals and usually live in packs averaging 6 to 7 animals (ADF&G, 1994).

Wolves normally breed in February and March, and litters are born in May or early June. Litters may include from 2 to 10 pups, but most often 4 to 7 pups are born. Most female wolves first breed when 22 months old but usually have fewer pups than older females. Pups are usually born in a den excavated as much as ten feet into well-drained soil, and most adult wolves center their activities around dens while traveling as far as 20 miles away in search of food, which is regularly brought back to the den. Wolf pups are weaned gradually during mid-summer. In mid- or late summer, pups are usually moved some distance away from the den and by early winter are capable of traveling and hunting with adult pack members. Wolves are great travelers, and packs often travel 10 to 30 or more miles in a day during winter. Dispersing wolves have been known to move from 100 to 700 miles from their original range (ADF&G, 1994).

In spite of a generally high birth rate, wolves rarely become abundant because mortality is high. In much of Alaska, hunting and trapping are the major sources of mortality, although diseases, malnutrition, accidents, and particularly preying by other wolves act to regulate wolf numbers (ADF&G, 1994). An ADF&G survey conducted in 1998 in GMU 26A indicated a population of 1.6 wolves per 1000 sq km (ADF&G, 2000).

Wolves are carnivores, with moose and caribou as their primary food. During summer, small mammals including voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish are supplements in the diet. Wolves are opportunistic feeders; very young, old, or diseased animals are preyed upon more heavily than other age classes. Under some circumstances, however, such as when snow is unusually deep, even animals in their prime may be vulnerable to wolves (ADF&G, 1994).

**Wolverine.** The wolverine, is the largest terrestrial member of the family *Mustelidae*. Its scientific name is *Gulo gulo*, meaning glutton. Wolverines are primarily found in the wilder and more remote areas of Alaska (ADF&G, 1994). They frequent all types of terrain and often utilize rivers as territorial boundaries (USDOI, 1987:339).

Wolverines become sexually mature in their second year. Breeding takes place between May and August. After wolverines mate, the embryo floats in the uterus until late fall or early winter. This type of reproduction is known as delayed implantation, and allows a female wolverine to become pregnant when food supplies are plentiful and when she is in good physical condition. The abundance of food determines whether a pregnancy will be maintained and the number of young that will be born (ADF&G, 1994).

Litters are born between January and April. In interior and northern Alaska, most young are born in snow caves. These caves usually consist of one or two tunnels that can be up to 60 yards long. Litters usually number between one to three. Baby wolverines (kits) develop rapidly and are weaned in about 8 weeks of age. They leave their mothers at approximately 5 or 6 months to forage for themselves (ADF&G, 1994).

Wolverines travel extensively in search of food. They are opportunistic, eating about anything they can find or kill. They are poor hunters but are well adapted for scavenging. Wolverines can survive for long periods on little food. Their diet varies from season to season depending on food availability. In the winter, wolverines rely primarily on remains of moose and caribou killed by wolves and hunters or animals that have died of natural causes. Throughout the year, wolverines feed on small and medium-sized animals such as voles, squirrels, snowshoe hares, and birds. In the right situations, wolverines can kill moose or caribou, but these occurrences are rare (ADF&G, 1994).

# Chapter Four: Current and Projected Uses of the Sale Area

## Contents

- Current and Projected Uses of the Sale Area .....4-1
  - A. Subsistence Hunting Fishing and Trapping.....4-1
    - 1. Anaktuvuk Pass .....4-1
    - 2. Nuiqsut .....4-3
    - 3. Kaktovik .....4-7
    - 4. Barrow.....4-7
    - 5. Subsistence Resource-Use Areas .....4-7
  - B. Other Uses.....4-11
    - 1. Commercial and Sport fishing.....4-11
    - 2. Sport Hunting, Guiding & Outfitting.....4-11
    - 3. Tourism and Recreation .....4-13



# Chapter Four: Current and Projected Uses of the Sale Area

## A. Subsistence Hunting Fishing and Trapping

The sale area encompasses lands traditionally and presently used for economic, cultural, and social purposes by residents of Barrow, Nuiqsut, Anaktuvuk Pass, and Kaktovik (ADF&G, 2000). Subsistence activities vary from season to season depending on the availability of food and the ability to travel. In summer, the primary mode of transportation is by small skiff, which can navigate the shallow river channels and by ATV for overland access. In winter, snow machines provide transportation to hunting and fishing camps. Historical subsistence access routes on the North Slope follow all major rivers and skirt the coast from the Canadian border to Wainwright and beyond. The Inupiat make use of virtually all local plant and animal resources for food and raw materials. The wide diet breadth is illustrated in Figure 4.1 and 4.2.

Factors affecting subsistence harvests include: the availability of fish and wildlife populations, weather, terrain, methods of harvest, availability of transportation, state and federal hunting and fishing regulations, local economic conditions, availability of cash for supplies and transportation (Jacobson and Wentworth 1982:30) (Pederson, Coffing, and Thompson, 1985:15), the changing condition of the meat, hide or fur (Jacobson and Wentworth, 1982:29), and community needs.

Subsistence food is the link that holds people together as members of a common social and economic community. Sharing is important in Inupiat society. A sense of community was essential in the past, when sharing was the best insurance against starvation. During times of shortage, food sharing maximized everyone's chances of survival. (Nelson, Mautner, and Bane, 1982:234).

Subsistence resources are utilized for much more than nutrition. Many non-edible parts of the animals harvested are used to make both functional items, and arts and crafts. Driftwood and willow brush are collected for firewood and building materials. Caribou hides are used for bedding, clothing, and masks. Ivory, caribou antler and bone, and whale bones are carved into miniature animals, umiaks, and hunting scenes or made into functional items, like knife or ulu handles and needle cases. Jewelry is made out of many things, including ivory, antler, feathers and imported beads. Wolverine, wolf, polar bear, seal, and fox fur are used to make parkas, slippers, mukluks, and hats, and are used in making dolls, Eskimo yo-yo's, and caribou skin masks. Feathers and skins are used to make drums and many other craft items, such as spirit masks.

It has been estimated that at least one in ten residents of the borough produces arts and crafts. These items may be traded, shared, given away, or sold. Prices of such items vary widely from ten or twenty dollars to thousands. These items are probably made for two basic reasons; for recreation and artistic expression, or to raise cash for a specific purpose, but they are not produced solely for the purpose of generating income in order to perpetuate the craft (Steihn & Hayes, 1996).

### 1. Anaktuvuk Pass

The most intensive users of the area are those from Anaktuvuk Pass, (population 314) the closest community to the sale area. It is located just south of the sale area in the central Brooks Range (ADCED, 2000). Subsistence harvest levels in this community are high and reliance on locally harvested resources is strong. Local residents know the best time to gather certain animals, fish, birds and vegetation. People depend

on subsistence when there is little or no income, which is the whole winter season. According to the City Council of Anaktuvuk Pass (2000), there is also a nutritional need for traditional food over store-bought food.

Caribou is an important community subsistence resource in Anaktuvuk Pass and provides sustenance to residents of communities surrounding the lease area. When the Killik and Tulgak people decided to come together and settle, they chose Anaktuvuk Pass because of nearby water sources, the abundance of willows, and the known fact that thousands of caribou migrated through the pass each year (City Council of Anaktuvuk Pass, 2000).

Anaktuvuk Pass residents mainly use the river corridors of the Colville, Itkilik, and Anaktuvuk rivers for subsistence activities within the sale area (Pederson, 1997). They also use the Killik and Chandler River corridors (City Council of Anaktuvuk Pass, 2000). The annual subsistence cycle of Anaktuvuk Pass revolves around the caribou. In a survey conducted by the North Slope Borough Department of Wildlife Management, caribou accounted for 82.5 percent of the harvest in edible pounds for a one-year period. The reported number of caribou harvested during the study period (July 1, 1994, to June 30, 1995) was 311. This is low when compared with previous years for which harvest data are available. For example, in 1990-91, the estimated harvest was 592; in 1993-94 it was 574 (NSB, 1996:13).

Surveys by ADF&G conducted in the 1993-1994 harvest-year show that 82 percent of Anaktuvuk Pass residents got more than half of their meat from local resources. Residents harvested 486 caribou that year, with August and September being the peak months for hunting. The sex composition of the harvest was 55 percent bulls and 45 percent cows (ADF&G, 2000).

Intensive caribou hunting occurs in April and May as animals move through the Brooks Range on spring migrations northward. Caribou hunting intensifies again in the fall as the animals begin to move southward. During the winter, caribou are occasionally hunted, but they are in less desirable condition at this time of year (ADF&G, 1986b:571).

Although caribou is more abundant and depended upon, residents of Anaktuvuk Pass believe that all animals, fish, birds, and vegetation are important. (City Council of Anaktuvuk Pass, 2000). Sheep, moose and brown bear each play an important role as supplemental sources of meat when caribou are scarce. Dall sheep are considered a secondary resource. Moose and brown bear are occasionally harvested by hunters, usually during a hunt for something else (NSB, 1996 citing to Hall, 1985).

Fish are crucial during times of other resource scarcity. Important fish species include grayling, Arctic Char, lake trout, and whitefish. Fish are primarily taken during the spring and summer. Grayling, lake trout and whitefish are harvested during July, August, and September. Spring fishing takes place in March, April, May, and June. The types of fish harvested are Arctic Char, grayling, and lake trout. Between October and February fishing activity is minimal (NSB, 1996).

Anaktuvuk Pass residents do not harvest many ducks or geese compared to hunters in other North Slope villages because waterfowl in the central Brooks Range are generally scarce. The types of birds harvested include Oldsquaw, pintail, and White-fronted geese. Ptarmigan are considered the most important species and are harvested year round (NSB, 1996:15).

Other subsistence activities include trapping and hunting wolf, wolverine, fox, and ground squirrels (NSB, 1996:13). The harvest of furbearers occurs during the months of November through March (except for ground squirrel, which are taken May through August). The Inupiat make use of virtually all local plant and animal resources for food and raw materials (see Figures 4.1 and 4.2.).

Berry picking is an important subsistence activity in Anaktuvuk Pass. Heavy summer rains ensure a good crop of berries. In late August berries are ready to be gathered and the season can extend into September, depending on weather conditions (Toopetlook, 2001). The year 2000 was a bad year for berry picking because deep snow made for a shorter growing season (Mekiana, 2001). Some residents of Anaktuvuk Pass will travel six hours or more on ATV to gather berries (Weber, 2001). Salmonberries (cloudberries) are highly valued as are cranberries, and blueberries (McConnell, 2001). In 1994, the NSB prepared a technical report that documented subsistence harvest data from July 1, 1994 to June 30, 1995 in Anaktuvuk Pass. In 1994, 7 gallons of blueberries, 12 gallons of salmon berries and 2 gallons of cranberries were harvested by Anaktuvuk Pass residents (NSB, 1996).

Berries are simply plucked by hand and put into a cloth bag or metal bucket then eaten raw or preserved. Before modern refrigeration berries were mixed with grease and meat and stored away for winter (Gubser, 1965:103). Today, they are packed in ziplock bags and frozen (Toopetlook, 2001; McConnell, 2001). Berries are traded with people living in coastal area and make a very special gift (McConnel, 2001). Cranberries are good for digestion and are baked into bread (Weber, 2001). Salmonberries are particularly prized because they grow in marshy areas and are the most difficult to pick (Toopetlook, 2001). Sometimes blueberries and salmonberries are mixed together to create a sweet and tart taste that is highly preferred by the elders (Weber, 2001). Berries are also mixed with fat and sugar to make "Eskimo ice cream" and are also made into pies and jams (Mekiana, 2001).

**Table 4.1: Berries Harvested on the North Slope**

Common Name	Iñupiaq Name
Blueberry	<i>Asiaq</i>
Salmonberry (Cloudberry)	<i>Aqpik</i>
Cranberry	<i>Kimmigñaq</i>
Crowberry	<i>Paungaq</i>
Source: NSB, 1996	

Hall et al., conducted interviews with 30 residents of Anaktuvuk Pass on the general topic of subsistence. Most of the females reported berry picking as a subsistence activity. None of the males surveyed reported berry picking as a subsistence activity, however, sometimes men will pick and eat berries while hunting (Hall, 1985:34; Toopetlook, 2001). In addition to berries, other food plants include sweet vetch, parsnip, wild rhubarb, mountain sorrel, current, and wild spinach (Sour Dock) (Campbell, 1962:63).

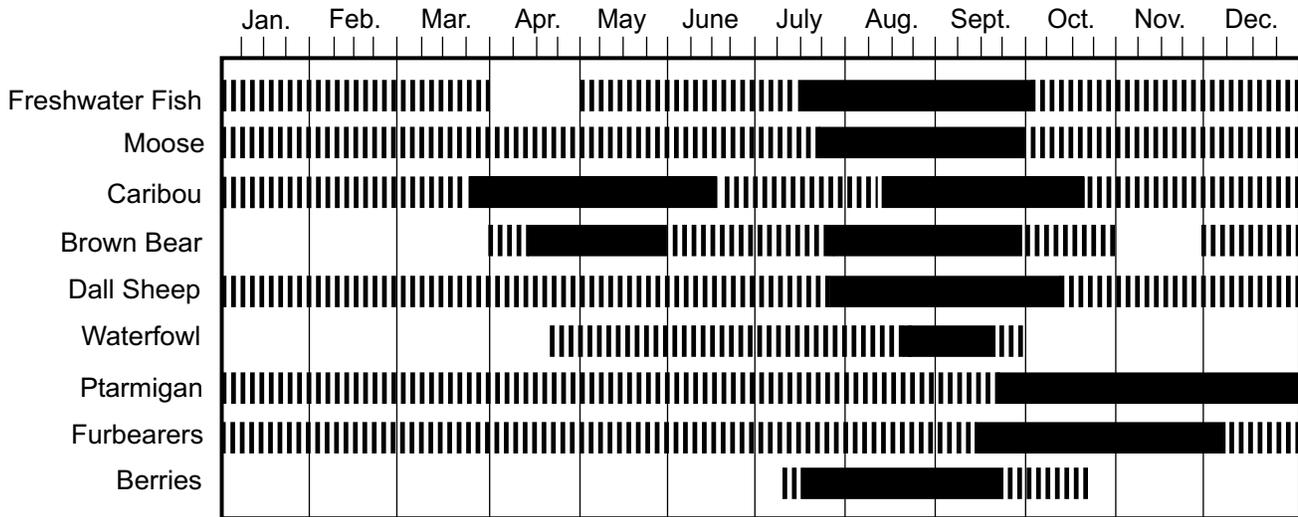
The importance of subsistence resources to the Anaktuvuk Pass Inupiat throughout the past, and still today is abundantly clear. In order to secure culturally, economically, and nutritionally necessary subsistence resources, the people of Anaktuvuk Pass must have continued access to the area (Hall, 1985:84). The reasonably foreseeable cumulative effects of the sale on subsistence activities are discussed in Chapter Five. Mitigation Measures and Lessee Advisories designed to minimize impacts to subsistence resources are listed in Chapter Seven.

## 2. Nuiqsut

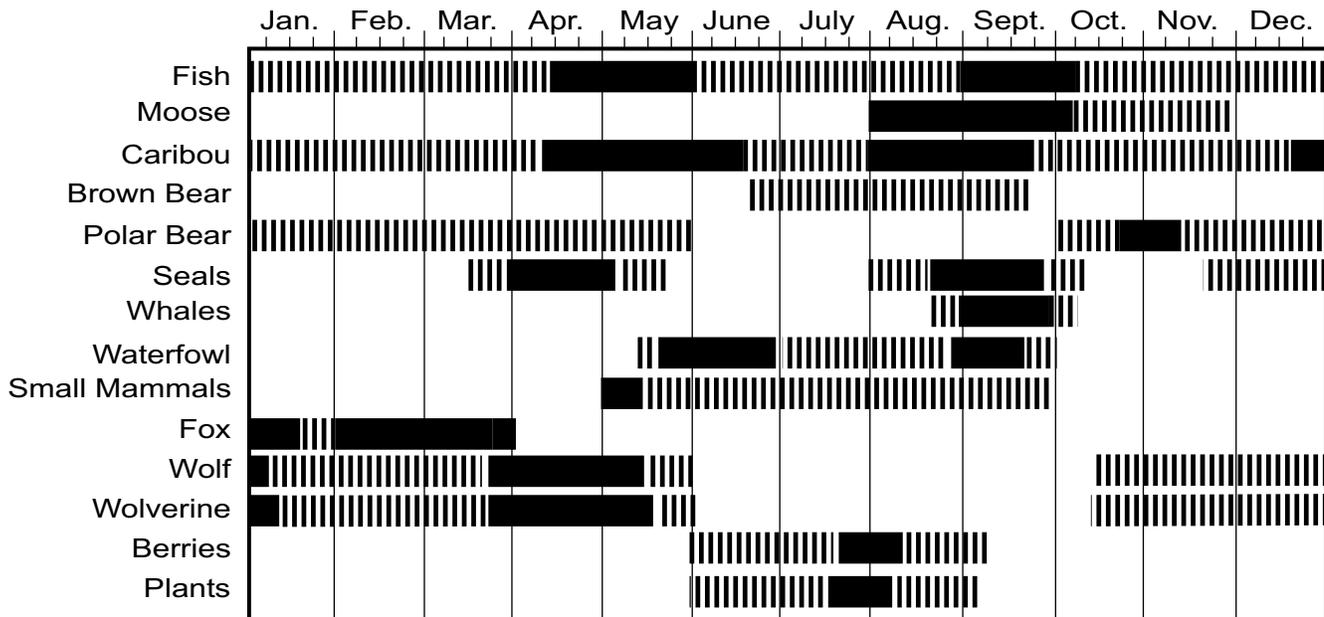
Nuiqsut (population 486) is located on the west bank of the Nechelik Channel in the Colville River Delta (ADCED, 2000). Although Nuiqsut is located approximately 60 miles north of the sale area, its residents use the area to meet part of their subsistence needs. Fishing occurs both during the summer and in the fall when the ice first becomes thick enough for snow machine travel. In June, after the ice goes out, broad

**FIGURE 4.1 Seasonal Use Harvest Activities**

Seasonal use harvest activities by **Anaktuvuk Pass** residents. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort. (ADF&G 1986b, p.566)



Seasonal use harvest activities by **Nuiqsut** residents. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort. (ADF&G 1986b, p.568)



whitefish move upriver. Two to four weeks after break-up, when muddy waters clear, fishing begins (Hoffman, et al., 1988:15). Residents travel from the village to fish along the river channels and fish and hunt for several days. Often several family members participate in the fishing activity. Those employed in wage earning positions may travel to the camps on weekends (George and Nageak, 1986:14).

The harvest is significantly higher in the fall than in the summer (George and Nageak, 1986:16) when Arctic char and salmon begin their migration upriver. The optimum time to harvest caribou is near the end of August, when caribou are fat from summer grazing and fit for their long migration south. Their hides are in good condition and now suitable for making clothing. It is also before rutting season, a time when the bulls are not good to eat (Hoffman, et al., 1988).

In September, caribou begin moving down the Ublutuoch River and then eastward across the Colville before heading south toward the Brooks Range. After calving, caribou from the CAH move toward the Sagavanirktok and follow it south to the mountains. Arctic cisco and small whitefish run upriver just before freeze-up (Hoffman, et al., 1988). Residents hunt moose in an area between the village and the confluence of the Anaktuvuk and Colville Rivers. However, due to a steep decline in moose populations on the North Slope, residents may need to travel further upriver for a successful hunt (Carroll, 1996). Blueberries, cloudberry, cranberries, wild potato, and wild rhubarb are also harvested (Jacobson and Wentworth, 1982).

By mid-October, after the rivers freeze, residents travel by snowmachine to fish camps on the Colville River or Fish Creek where they fish for arctic cisco and small whitefish (Hoffman, et al., 1988). Ice fishing is accomplished by cutting holes in the ice and then stretching gill nets under the ice (George and Nageak, 1986: 16). Hook and line are used to fish for lingcod and grayling. Some moose and caribou hunting may occur during October and November (Hoffman, et al., 1988). In December, Arctic fox, cross fox, red fox, wolves, and wolverine are trapped or shot. Some caribou and moose may be harvested. From January to March, trapping continues and some hunting of caribou and moose may occur, depending on the depth of the snow and ability to move about (Hoffman, et al., 1988).

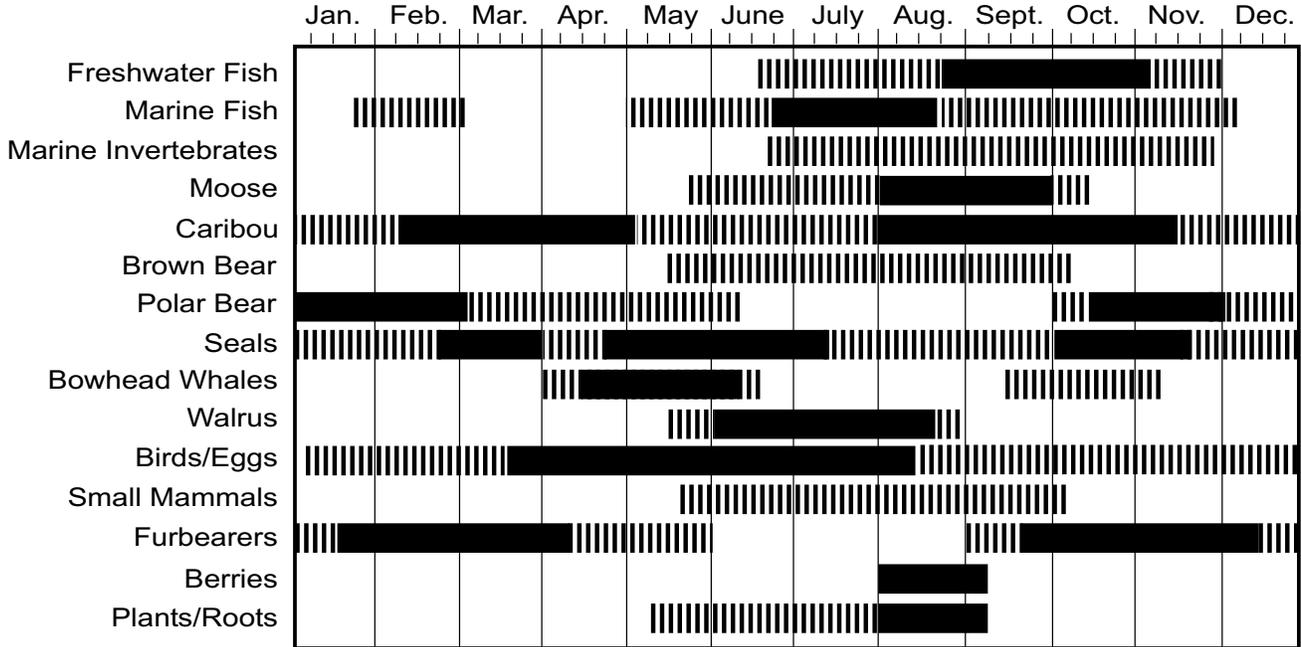
Mid-April brings an end to trapping season, and hook and line fishing for lingcod and lake trout resumes. Wolf and wolverine are hunted using rifle and snow machine. These conditions persist through May until the river ice again washes out to sea, completing the annual cycle of subsistence harvest (Hoffman, et al., 1988).

Nuiqsut subsistence harvesters brought in 267,817 pounds of locally obtained fish, game, birds and plants for local use in 1993. The mean household harvest was 2,943 pounds of useable (dressed) food, or 742 pounds per capita. Fish rank highest with an estimated community harvest of 90,490 pounds, followed closely by terrestrial mammals and marine mammals at 87,390 pounds and 85,216 pounds, respectively. Together these three resource categories account for 98 percent of the community harvest, and birds/eggs and plants make up the remaining two percent of the community's harvest for 1993 (MMS 1995a:XXII-6).

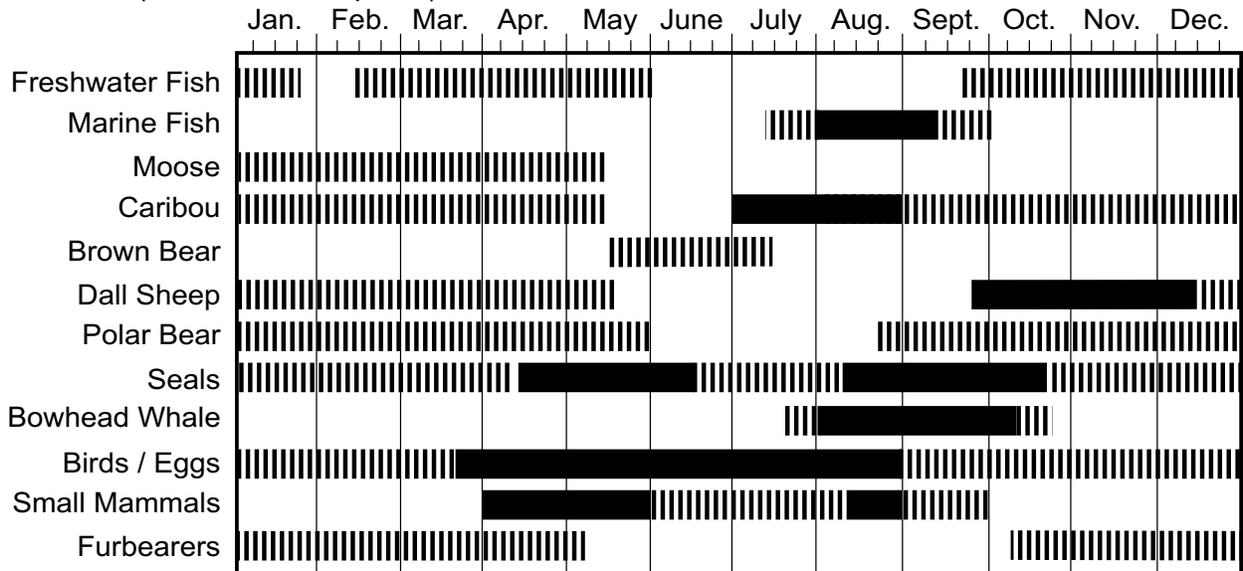
Among the fish harvested, non-salmon fish rank as the highest category with a per capita harvest of 248 pounds, or 99 percent of the catch. Salmon are sporadically available, but do not contribute in any major way in Nuiqsut fish harvests. It is the whitefish, burbot and grayling that Nuiqsut fishermen are so successful in harvesting. These three resources contributed 215, 16, and 11 pounds per capita to the household fish harvest in 1993. Among the whitefish, Broad Whitefish and Arctic Cisco, are the targeted fish in the summer and fall net-fishery on the Colville River. Caribou contributed 228 pounds (94 percent), moose 12 pounds (5 percent), and grizzly bear 2 pounds (0.8 percent) to the per capita harvest. Ninety-eight percent of Nuiqsut households used 76 percent of the harvested terrestrial mammals during the study period (MMS 1995a:XXII-6). Information is unavailable as to how much of these subsistence resources are obtained in the sale area.

**FIGURE 4.2 Seasonal Use Harvest Activities**

Seasonal use harvest activities by **Barrow** residents. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.  
(ADF&G 1986b, p.566)



Seasonal use harvest activities by **Kaktovik** residents. Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.  
(ADF&G 1986b, p.570)



### 3. Kaktovik

Kaktovik (population 259) lies approximately 100 miles northeast of the sale area on Barter Island, off the coast of ANWR (ADCED, 2000). The annual cycle of subsistence activity for Kaktovik is similar to that of Nuiqsut; the same species are harvested at the same time, but from different lakes, rivers and uplands. Residents travel to the mountains to hunt wolf, sheep, wolverine, and moose in March. April and May are important months for hunting ground squirrel, ptarmigan, and marmot. Kaktovik residents harvest caribou year-round from two caribou herds: the migratory Porcupine Caribou herd (PCH) and the resident (CAH). This harvest occurs inland during the fall and spring when snowmachine travel is possible. In the fall, caribou begin moving toward their winter habitat on the south side of the Brooks Range. August is good for fishing for char and arctic cisco (Jacobson and Wentworth, 1982). Blueberries, salmonberries, cranberries, wild potato and wild rhubarb are also harvested (Jacobson and Wentworth, 1982).

Overall, 96 percent of sampled households in Kaktovik used locally harvested wild resources. Additionally, 89 percent of the surveyed households attempted to harvest wild resources, 89 percent were successful harvesters, 92 percent received shares of wild resources from other households, and 83 percent gave wild resources away to other community households in 1992 (MMS 1995a:XXI-4). Information is unavailable as to how much of these subsistence resources are obtained in the sale area.

Land mammal harvest contributed an estimated 149.6 pounds per person or 17 percent of the total community catch, and fishing produced an estimated 118.91 pounds per person or 13 percent of the total harvest. Birds and eggs, and plants and berries also contributed to the community's wild resource harvest in 1992. They produced 16.83 lbs (2 percent) and 1.17 pounds (< 1 percent) per person, respectively, and served to supplement and bring additional variety to the locally resource-based dietary regime. Wood, used primarily for heat production but also as a source of construction material at camps, was also found to contribute to the local resource harvest in 1992. The average household harvest of wood was estimated at 0.64 cords for the survey period (MMS 1995a:XXI-4). Information is unavailable as to how much of these subsistence resources are obtained in the sale area.

### 4. Barrow

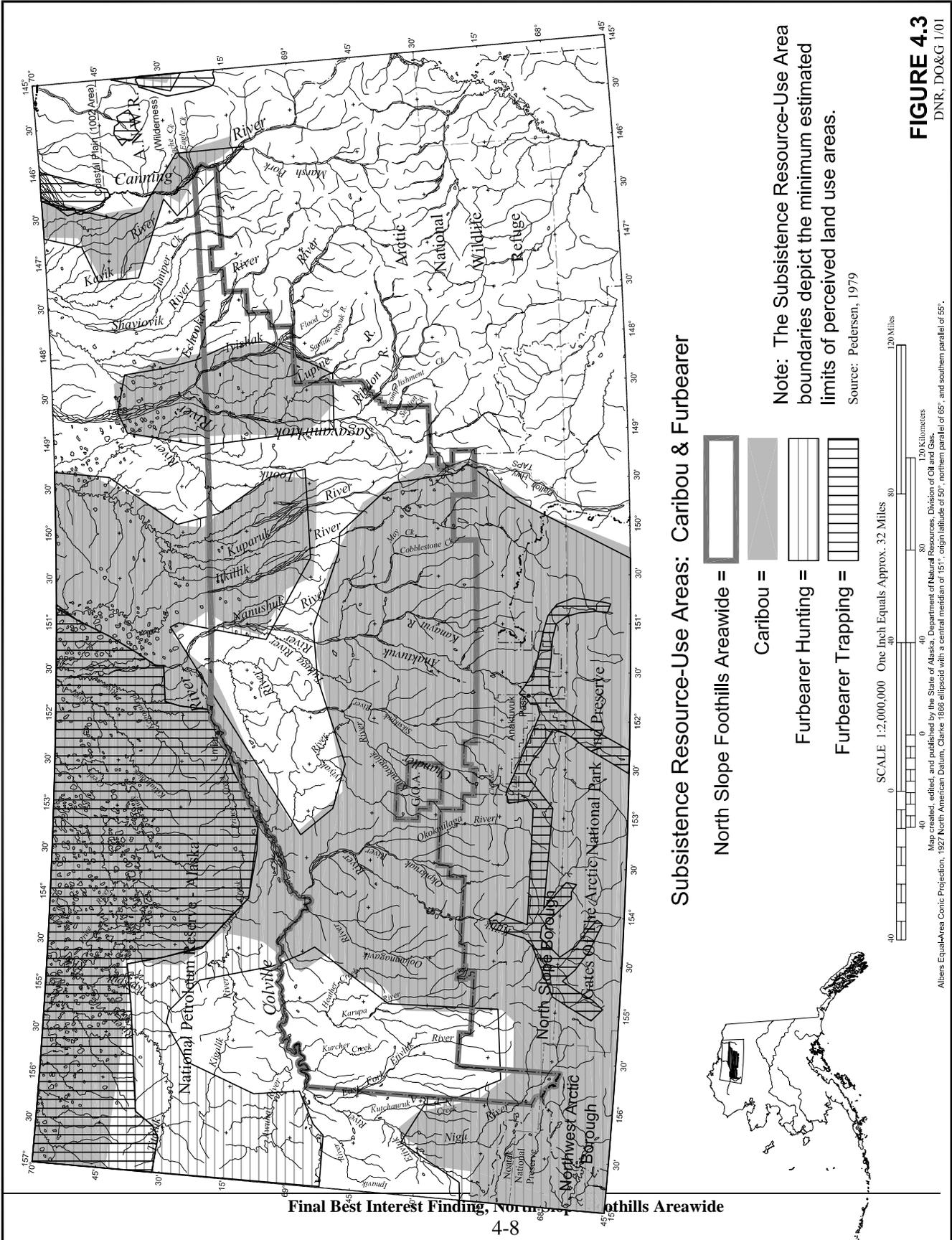
Barrow (population 4,438) is located on the Chukchi Sea coast, ten miles south of Point Barrow (ADCED, 2000). Residents enjoy a diverse subsistence hunting base that includes both marine and terrestrial animals. Barrow residents fish year round and harvest marine and riverine fishes. The subsistence harvest for fish is extensive, because residents supplement their camp food with fish whenever they are hunting (MMS, 1996:III-C-12). Most fishing occurs in inland camps located along rivers. Set nets are used for whitefish, char, and salmon. These camps provide access to caribou and waterfowl hunting grounds. Whitefish and grayling migrate out of inland lakes into major rivers in August (MMS, 1998).

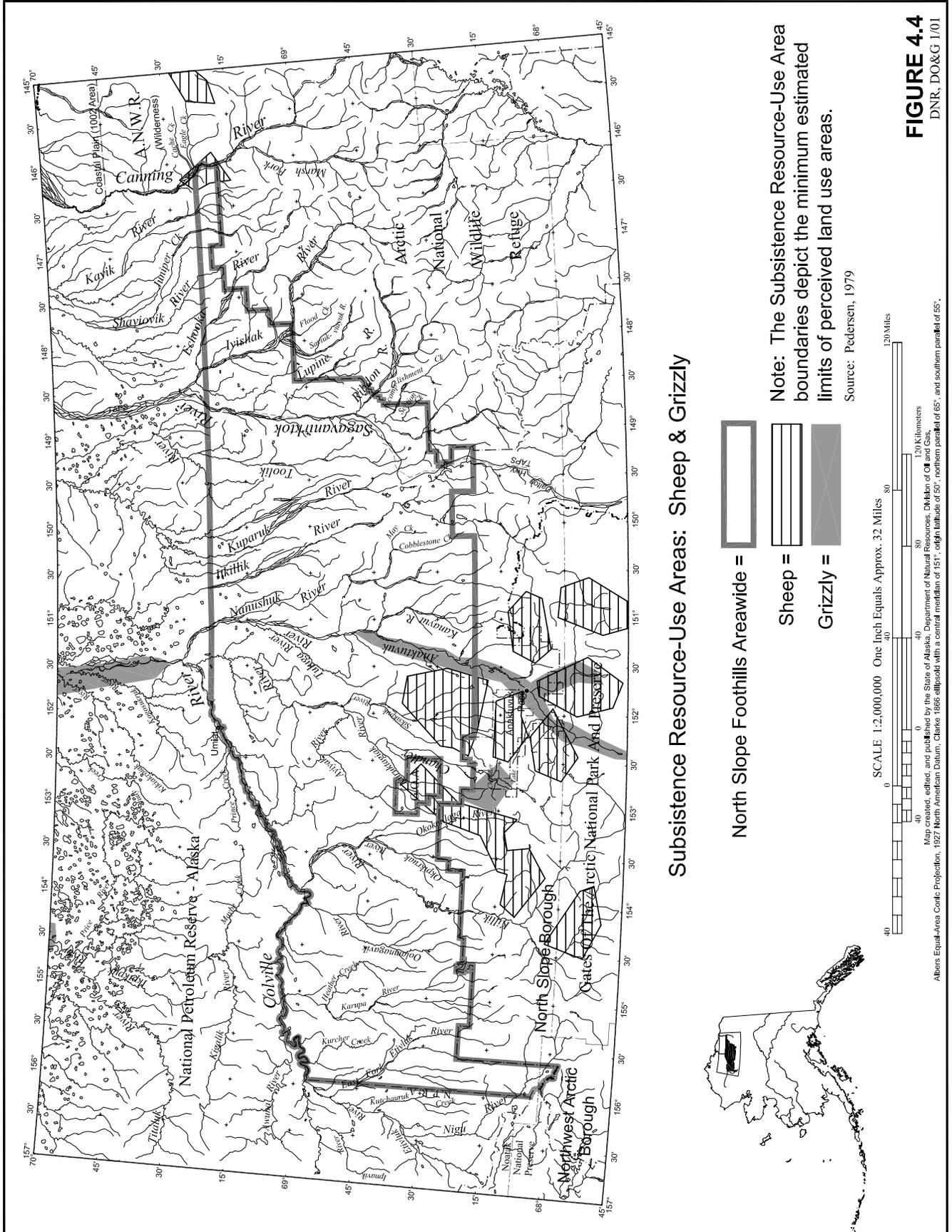
Migratory birds, particularly eider, ducks and geese, provide an important food source for Barrow residents. Geese are harvested more inland, along rivers, while eider and ducks are taken along the coast. Barrow residents hunt caribou throughout the year along the Chukchi coast, inland to the Brooks range, and east to the Colville River (MMS, 1998).

### 5. Subsistence Resource-Use Areas

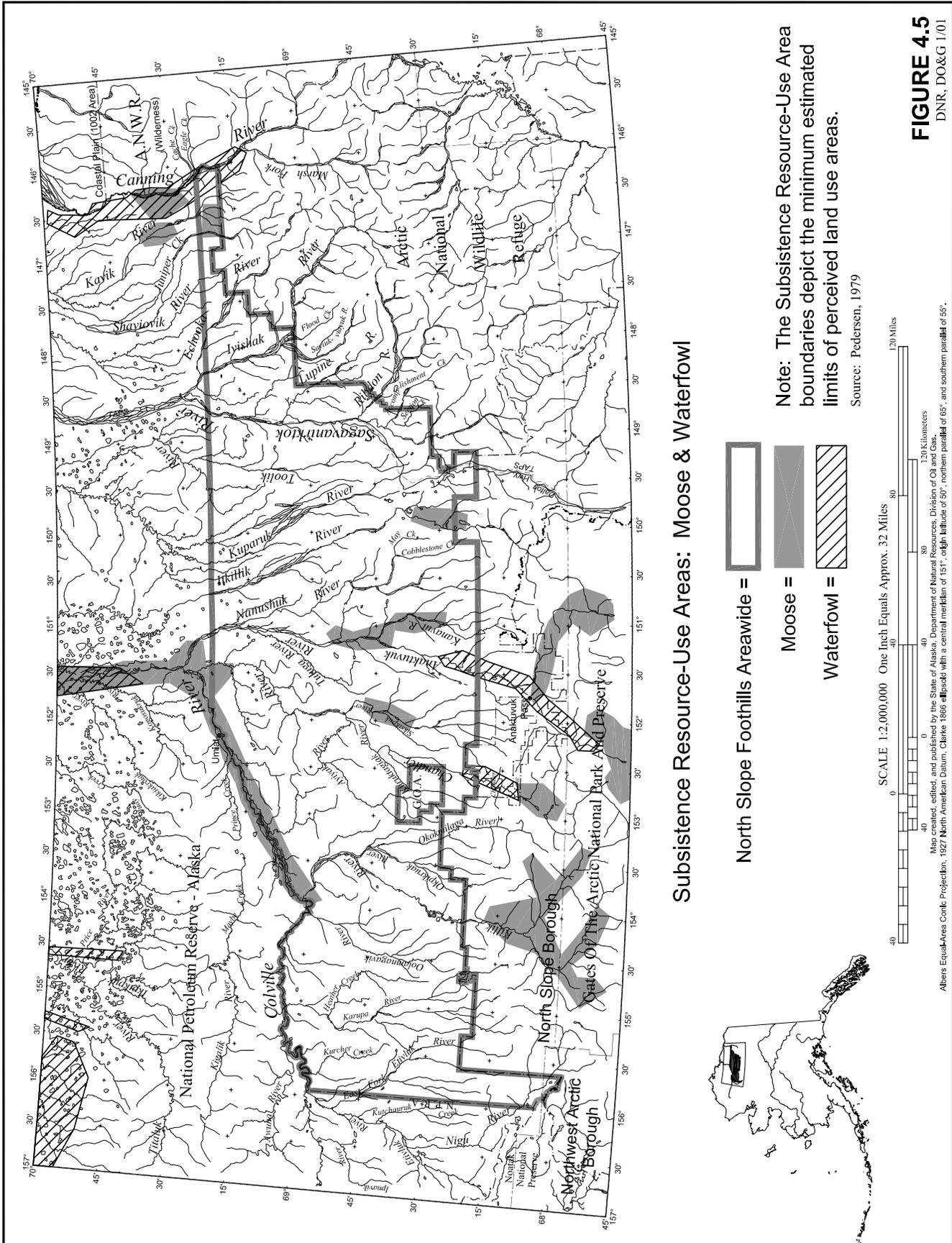
Figures 4.3, 4.4, and 4.5 depict subsistence resource-use areas for all communities as mapped by Pedersen. Although published in 1979, it is the most current documented information available. The land use

boundaries depicted on these maps provide minimum estimated limits of perceived subsistence hunting and trapping areas.





**FIGURE 4.4**  
DNR, DO&G 1/01



Subsistence Resource-Use Areas: Moose & Waterfowl

- North Slope Foothills Areawide = [White Box]
- Moose = [Solid Grey Box]
- Waterfowl = [Hatched Box]

**Note:** The Subsistence Resource-Use Area boundaries depict the minimum estimated limits of perceived land use areas.

Source: Pedersen, 1979



Map created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas.  
 Albers Equal-Area Conic Projection, 1927 North American Datum, Clarke 1866 ellipsoid with a central meridian of 151°, northern parallel of 65°, and southern parallel of 55°.

**FIGURE 4.5**  
 DNR, DO&G 1/01

## B. Other Uses

### 1. Commercial and Sport fishing

There are no commercial fishing operations within the sale area. ADF&G tabulates non-subsistence sport fishing catch and harvest estimates for the entire North Slope drainage area. Fishing effort, catch and harvest for the Sagavanirktok River is also tracked. Most sport fish caught are not harvested, but released back to the water. For example, ADF&G estimates that 1,716 Arctic char were caught on the Sagavanirktok River by sport fishers in 1994, but only 147 were harvested. Similarly, an estimated 2,644 grayling were caught on the river, but only 147 were harvested (ADF&G, 1996b).

### 2. Sport Hunting, Guiding & Outfitting

Sport harvesting of big and small game in the sale area is managed by ADF&G, Division of Wildlife Conservation. The state is divided into 26 game management units (GMU). The sale area includes portions of GMUs 26A and 26B. It is unknown exactly how many animals of each species are harvested within the sale area in any given year. Sport hunting harvest statistics collected by ADF&G are not specific to the sale area, but estimate the harvest of whole GMUs (ADF&G, 1996b).

Hunting seasons and guidelines are determined by the Alaska Board of Game, and administered by ADF&G. The Prudhoe Unit is closed to big game hunting (5 AAC 92.510), however, residents may sport hunt in other oil fields. The Dalton Highway corridor (extending 5 miles from each side of the highway) is closed to big and small game hunting, except with bow and arrow, and use of motorized vehicles is restricted in the corridor. Firearm possession by industry employees is restricted and workers are not likely to sport hunt in the area during their active-duty shifts (ADF&G, 1996c).

#### a. Brown Bear.

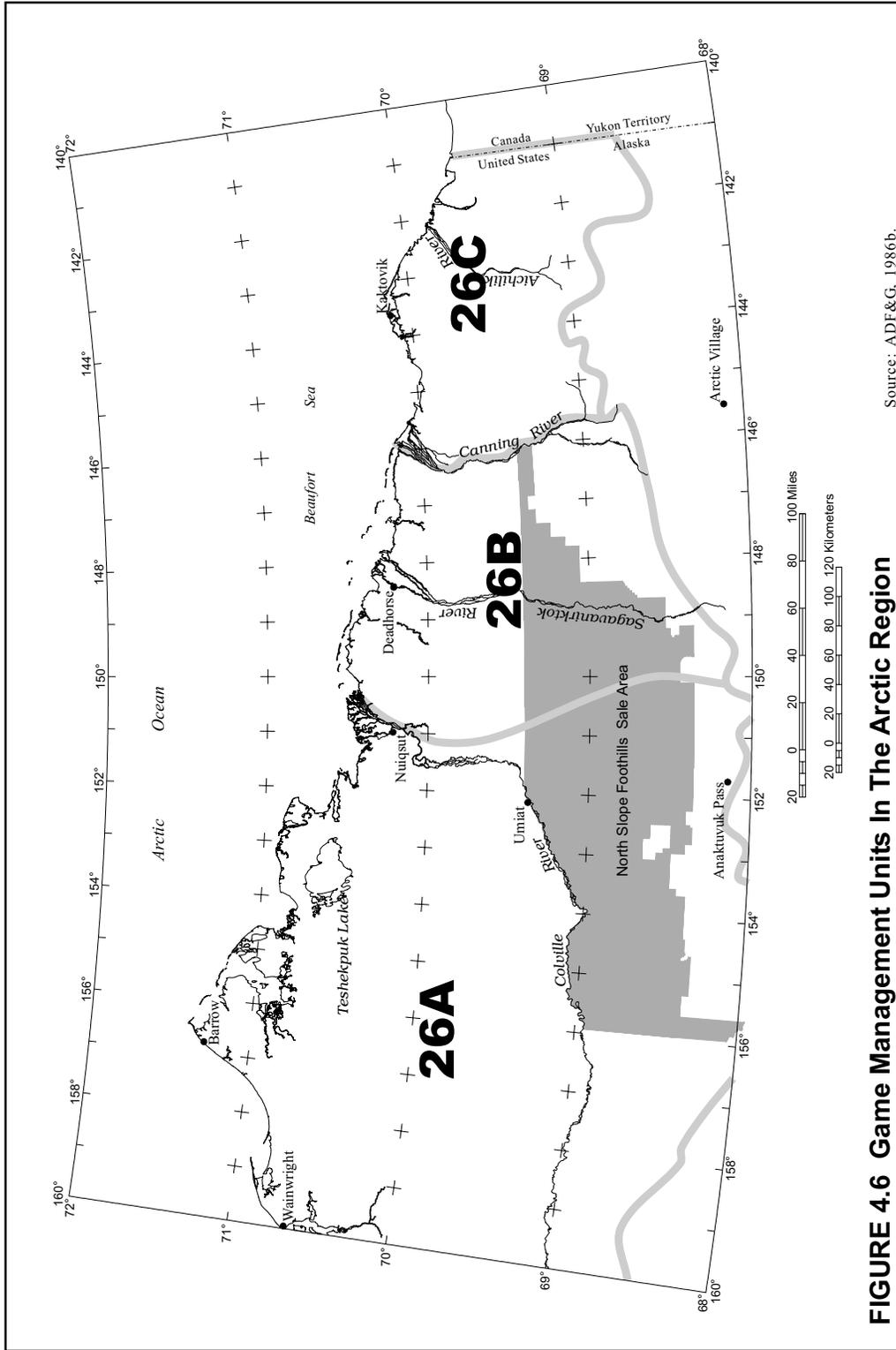
During the 1997-1998 season, hunters reported harvesting 20 bears in GMU 26A. North Slope residents harvested one bear, non-local residents harvested one bear, and nonresidents harvested 18 bears. ADF&G assumes the allowable sustained yield is approximately 51 bears. Final Harvest figures were unavailable for Units 26B and 26C (ADF&G, 2000).

#### b. Caribou.

North Slope Borough and ADF&G subsistence studies indicate Anaktuvuk Pass residents harvest 300-600 caribou a year, some of which are taken in the sale area. There were 51 caribou harvested in GMU 26A by hunters from south of the Yukon River in 1999-2000, most of which were probably WAH caribou. Hunters harvested 255 caribou from the CAH in GMU 26B in the 1997-1998 harvest year (ADF&G, 2000b).

#### c. Moose.

Due to population declines, restrictive hunting regulations have been established, and only one moose was reported harvested in 1997-1998 in GMU 26A. It is unclear how much of a role disease played in the population decline. There will be very little hunting until the population recovers. The Board of Game closed nearly the entire North Slope to moose hunting. Only a section of the lower Colville River will be open to bull hunting during August when airplanes are not permitted for hunting (ADF&G, 2000).



**FIGURE 4.6 Game Management Units In The Arctic Region**

**d. Wolf.**

During the 1997-1998 reporting period 10 wolves were harvested in GMU 26A. ADF&G's harvest monitoring program does not always effectively measure harvests in villages. The department recognizes that hunters harvest many wolves and do not have them sealed. The unreported harvest probably exceeds the reported take of wolves (ADF&G, 2000).

**e. Other Animals.**

In 1998-99 hunting season, 16 subsistence permits were issued to residents of Unit 26B for muskoxen. Ten wolverines from Unit 26A were sealed during the 1997-1998 season. Arctic foxes are fairly abundant in the area, but low fur prices resulted in relatively few foxes being trapped. No lynx, red fox, or river otter were reported harvested (ADF&G, 2000).

The level of sport hunting of waterfowl on the North Slope is currently very low. This is likely due to the number of hunters seeking them, rather than other factors, such as low population levels, climatic conditions affecting migration, or regulatory constraints. The estimated number of hunter-days afield (number of active waterfowl hunters multiplied by the number of days spent in the field) was 17 for the 1994-95 year; down from 157 hunter-days in the previous year. ADF&G reports that "there are fewer Alaskans hunting waterfowl than any time since the surge in the state's population during the 1970s." (ADF&G, 1996b:59)

### **3. Tourism and Recreation**

According to a 1993 survey conducted by the state Division of Tourism & Trade, 35,400 Alaska visitors traveled the Trans-Alaska Pipeline haul road (Dalton Highway), 17,700 visitors toured the Prudhoe Bay oil fields, and 3,000 visitors visited Barrow (ADCED, 1993:57). Anaktuvuk Pass, hosts about 1,500 tourists each year, and is the only community in the borough other than Barrow that sees a substantial number of tourists (NSB, 1993:65).

Recreational uses of the sale area include hiking, skiing, flight-seeing, boating or rafting. Each of these activities has its associated costs, which can be very high in the Arctic. Considering the remoteness and isolation of the sale area, all recreationists must use some kind of commercial outfitter to access the area, and nearly all must fly in. Most outfitters are based out of Fairbanks. In summer, visitors come to the region to camp, hike, float down the Canning River in a river raft, or watch and film whales, birds or caribou.

After October, there are virtually no non-resident recreationists in the sale area. Winter recreation for residents usually occurs near villages. The most favorable months for winter activities such as snow machining and dog sledding are mid-March to early May, when temperatures are higher and daylight hours longer (NSBCMP, 1984:3-29). The colder and darker months of winter are ideal for social gatherings and craftmaking.

The sale abuts the boundaries of the Gates of the Arctic National Park and Preserve and a small portion of the Noatak National Preserve. The Park offers the opportunity for extreme wilderness recreation activities such as: backpacking, river running, mountaineering, dog mushing, and others. The remote location and extreme climate of the Brooks Range requires travelers to have exceptionally strong wilderness skills and flexibility to adjust plans. The Dalton Highway offers a road accessible Brooks Range experience for those seeking a rugged wilderness journey (NPS, 2000). The Noatak National Preserve occupies a dramatic river basin ringed with mountains forming the western Brooks Range. The preserve is used for camping, backcountry hiking, fishing, wildlife observation and photography.



# Chapter Five: Reasonably Foreseeable Effects of the Sale.

## Contents

Reasonably Foreseeable Effects.....	1
A. Post Lease Sale Phases .....	3
1. Exploration .....	3
2. Development and Production .....	6
B. Fiscal Effects .....	9
1. Statewide .....	9
2. Local .....	11
C. Effects on Municipalities and Communities.....	12
1. Infrastructure.....	12
2. Employment .....	12
3. Local Tax Revenues .....	13
4. Land Planning and Uses.....	13
D. Cumulative Effects.....	14
1. Effects on Water and Air Quality, and Land Habitat .....	14
2. Effects on Fish and Wildlife Habitats, Populations, and Uses .....	20
3. Effects on Subsistence Uses .....	33
4. Effects on Historic and Cultural Uses .....	36



# Chapter Five: Reasonably Foreseeable Effects of the Sale.

Oil and gas exploration, development, production, and associated support functions occur across portions of Alaska's North Slope and into the Canadian Arctic. The study of impacts from oil and gas activities in the Arctic is a process, which began prior to the onset of petroleum exploration and development on Alaska's North Slope in the 1960s. Over the years, a large number of government and industry-sponsored studies have provided a comprehensive body of information concerning the Arctic's unique environmental and biological resources. Observations of direct and indirect impacts of industry operations on the North Slope environment over the past 30 years have also contributed to a large empirical database.

Each year government agencies, industry, and the public are better able to recognize and anticipate impacts and to institute measures, which will reduce or eliminate those impacts. As a result, much progress has been made in promoting efficient operating practices and minimizing effects on the sensitive arctic environment and its valuable fish and wildlife resources. The sale could influence subsequent North Slope petroleum activity and contribute to the cumulative effects of region-wide petroleum development on the environment. Until discoveries are made, it is impossible to predict the actual level of oil and gas activities and their effects. Strategies used to explore for, develop, produce, and transport petroleum resources will vary, depending on factors unique to an individual situation. Implementation of any exploration and development program must meet the requirements of regulatory agencies prior to approval. Permit requirements must be evaluated in light of the particular activity proposed, and plans of operation must be approved with appropriate project-specific and site-specific safeguards.

It is possible that none of the area offered will actually be leased. It is also possible that little or no exploration will occur on the majority of leases that may be issued and that no developable oil or gas deposits will be discovered in the sale area. Strategies used to explore for, develop, produce, and transport potential petroleum resources will vary, depending on factors unique to the individual tract, lessee, operator, or discovery. If a commercially developable deposit is found, any development would require construction of onshore drillsites. Construction of pipelines, as appropriate, plus other production and transportation facilities will also probably be necessary. Some new roads may also be required. Impacts to the North Slope region are considered to be small. However, local impacts might be significant. Until discoveries are made, it is impossible for DO&G to predict when any activity might occur or the type, location, duration, or level of any oil or gas activities and, therefore, it is impossible to predict the potential effects of all possible activities.

This chapter and the following one describe the ways in which lease activity resulting from the sale may change the environment and affect its people. The key to understanding the potential for effects lies in understanding the culture, communities, and economy of the North Slope Borough (Chapter Four). Equally important is knowledge of the surrounding natural environment (Chapters Two & Three).

Potential bidders begin the process by weighing the costs and benefits of obtaining and keeping the lease. They acquire and analyze existing data, conduct geophysical exploration, estimate the volume and type of recoverable reserves, estimate the cost of developing reserves, and attempt to calculate the expected return on their investment. These considerations may be weighed in light of other factors, such as the state's current leasing policy, schedule of future sales, or competing projects, such as developing prospects overseas. Considering all these variables, it is impossible to predict which tracts will be bid upon and leased.

Strategies used to explore for, develop, produce, and transport potential petroleum resources will vary, depending on factors unique to the individual tract, lessee, operator, or discovery. If a commercially

developable deposit is found, any development would require construction of one or more drillsites. If mineral resources can be developed, construction of pipelines would be likely, and other production and transportation facilities would also be necessary. Some new roads may be required, and machinery, labor, and housing would be transported to project sites.

The state of Alaska as a whole, the NSB, and the communities of Nuiqsut, Kaktovik, Anaktuvuk Pass, and Barrow may experience effects of activities following this sale in both monetary and non-cash terms. Impacts to the North Slope region may be minuscule. However, local impacts might be significant. Potential effects include:

- Erosion
- Use conflicts
- Disturbance to wildlife
- Oil spills
- Alteration of hydrology
- Loss of fish and wildlife
- Increased noise and traffic
- Habitat loss or change
- Environmental studies
- Water quality changes
- Chemical/pollutant releases
- Impacts to human environment
- Air quality degradation
- Siltation
- Employment opportunities
- Road, dock, airstrip, sanitary & utilities construction
- State petroleum tax & royalty revenues
- Local oil and gas property tax revenues

Most adverse effects would be temporary and may occur during development, and not during exploration and production phases. Positive effects occur at all phases and fiscal benefits of petroleum extraction may last several decades. All lease-related activities are subject to applicable local, state, and federal statutes, regulations, and ordinances, and subject to lease mitigation measures. Implementation of any exploration and development program must meet the requirements of regulatory agencies prior to approval. Permit requirements must be evaluated in light of the particular activity proposed, and plans of operation must be approved with appropriate project-specific and site-specific safeguards.

The state's resource agencies have developed general mitigation measures and lessee advisories to minimize pollution and habitat degradation, and disturbance to fish and wildlife species, subsistence uses, and local residents. Additional project-specific and site-specific mitigation measures will be applied to particular exploration and development proposals as additional information becomes available. Despite these protective measures, some impacts may occur. In this chapter, potential impacts are discussed, and measures to mitigate future impacts are summarized. For a full text listing of mitigation measures see Chapter Seven.

## A. Post Lease Sale Phases

Lease-related activities proceed in phases; each subsequent phase’s activities depend on the completion or initiation of the preceding phase. Table 5.1 lists activities that may occur during these phases.

**Table 5.1 Activities That May Be Found At Post Lease Sale Phases**

	water usage
	permitting
	environmental studies
	seismic tests
<b>Exploration</b>	exploratory drilling rigs
	ice roads & ice pads
	marine vessel support
	drilling muds
	gravel pads (rare)
	worker camps
	increased air traffic
	permitting
	environmental studies
<b>Development</b>	research and analysis
	gravel pits, pads and roads
	dock, bridge, and facility construction
	buried & elevated pipelines
	drilling rigs
	work camps
	increased air and vessel traffic
	air emissions
	permitting
	monitoring
	well workovers
<b>Production</b>	injection wells: gas and sea water
	gravel pads and roads
	produced water injection
	air emissions
	pipeline maintenance
	work camps
	support infrastructure

### 1. Exploration

The purpose of exploration is to gather as much information about the petroleum potential of an area as possible. Some activities take place before the lease sale as prospective bidders evaluate the offered acreage; however most extensive exploration operations occur after the lease sale.

Exploration activities may include the following: research and monitoring, examination of the surface geology, geophysical survey programs, researching data from existing wells, performing environmental assessments, and the drilling of an exploratory well. 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.

### **a. Geophysical Exploration**

Geophysical exploration activities are regulated by 11 AAC 96 and permits are tailored specifically for each 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 important habitat and species, such as caribou and waterbirds. The extent of effects on important species varies depending on the survey method and the time of year the operation is conducted.

The geophysical survey process involves sending energy into the earth to reveal what the subsurface looks like and help locate subsurface hazards. Vibroseis, which generates waves of continuously varying frequency, is the most common method used. The energy waves bounce back from the various rock layers and are received and changed into electrical impulses by devices called geophones. The impulses are recorded on computer tape, processed on high speed computers, and can be displayed in the form of a seismic reflection profile. Geophysicists then analyze the profile to determine subsurface features. Other sources of energy include explosive charges, however this method has largely given way to the Vibroseis method, and their use on the North Slope is rare.

Vibroseis components are usually mounted on trucks with large tires or tracked vehicles. Snow plows may be required in advance of these source units when snow is deep. Supply vehicles for crews may include 6-wheel drive articulating buggies with a 2,500 gallon fuel tank mounted on them and a crane for moving heavy parcels. These supply crews with fuel, water, groceries, parts, and personnel. Between 2 and 5 supply units may be used for each seismic survey depending on the size of the survey, whether it is 2-D or 3-D, and depending on the distance from a fuel source. Camps consist of strings of trailers hooked together and pulled where necessary by Caterpillar tractors. Each camp is equipped with generators, a kitchen, diner, wash house, recreation room, crew office, survey office, mechanic's shop, geophone and cable repair shop, dry stores, part house, and sleeping quarters. Camps also may include one or more fuel sleds, an incinerator, a snow melter for making water, and a steamer unit. Camps can house approximately 60 persons at a time for a 2-D survey, and 100 persons for a 3-D survey. Camps use between 2,800 to 3,300 gallons of fuel per day and 2,000 to 3,000 gallons of water per day (Rice, 1997).

Standard permit conditions for North Slope seismic operations are designed to protect resource values and ensure compliance with the Alaska Coastal Management Program.

### **b. Exploration Drilling**

Exploratory drilling only occurs after seismic surveys are conducted which may reveal petroleum potential. If geophysical exploration studies indicate the possibility that oil or gas may be present, lessees may initiate the drilling of an exploration well. The only way to learn whether or not commercial quantities of oil or gas are present in the rock formations beneath a lease is by drilling. Exploratory drilling happens after the lease sale (after mineral rights have been secured) and after preliminary exploration activities reveal the most likely places to find oil or gas. Occasionally in unexplored areas, companies have joined together to drill a stratigraphic test well (a test which merely determines subsurface layers) prior to the lease sale in order to gather information. However, this is rarely, if ever, done these days. Companies usually gather as much information as they can using less expensive methods and secure the lease before drilling an exploratory well.

Onshore exploratory drilling operations on the North Slope almost always occur in winter to minimize impact and reduce costs. Temporary roads are constructed of ice by adding water to the surface, which freezes into a form that can support heavy loads. Mitigation Measure 6 states that exploration facilities must be temporary and must be constructed of ice unless the Director determines that no feasible and prudent alternative exists. In extraordinary circumstances, permanent roads made of sand and gravel may be permitted.

A drill site is selected to provide access to the prospect to be drilled and is located to minimize impacts to any sensitive areas, such as private property or an archaeological site. The ice pad supports the drill rig assembled at the site, a fuel storage area, and a camp for 50 to 60 workers. Ice pads are approximately 500 feet by 500 feet. If the facilities are not available, a temporary camp of trailers on skids or wheels can be placed on the pad. Ice road and pad construction begins during middle to late December when ambient temperatures are cold enough for relatively fast construction (Hazen, 1997). Potential impacts of ice pads on tundra are discussed in Section B.

Exploratory drilling generates information for the lessee that will aid in the decision whether to proceed to the development phase. Drilling operations collect core samples, well logs, cuttings, and various test results. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled. Well logs are records of tests conducted by lowering various instruments into the well bore.

If the exploratory well is successful, the operator will probably drill one or two more wells to delineate the extent of the discovery and gather more information about the field. The lessee needs to know how much oil and gas may be present, and must determine the quality of the rocks in which they are found to determine whether or not to proceed to the next phase. The extent and location of offshore exploratory and delineation drilling depends on petroleum potential (BPX, 1996).

The drilling process is as follows:

1. Special steel pipe, conductor casing, is bored into the soil.
2. The bit rotates on the drill pipe to drill a hole through the rock formations below the surface and into the lease.
3. Blowout preventers are installed on the surface and only removed when the well is plugged and abandoned. Blowout preventers are large, high-strength valves, which close hydraulically on the drill pipe to prevent the escape of fluids to the surface. (ARCO, Undated: 80-84)
4. Progressively smaller sizes of steel pipe, called casing, are lowered into the hole and cemented in place to keep the hole from caving in, to seal off rock formations, seal the well bore from groundwater, and to provide a conduit from the bottom of the hole to the drilling rig.

An exploratory drilling operation generates approximately 12,000 cubic feet of drilling solids. Cuttings are fragments of rock cut by the drill bit. These fragments are carried up from the drill bit by fluids pumped into the well (Gerding, 1986: 97-174). The fluids pumped down the well are called mud, and different formulations are used to meet the various conditions encountered in the well. Muds are naturally occurring clays and small amounts of biologically inert products. They cool and lubricate the drill bit, prevent the drill pipe from sticking to the sides of the hole, seal off cracks in down-hole formations to prevent the flow of drilling fluids into those formations, and as stated, carry cuttings to the surface (ARCO, Undated: 80-84). Also produced from drilling operations are gas, formation water, and fluids and additives used in the drilling process.

The state discourages the use of permanent reserve pits and most operators store drilling solids and fluids in tanks until they can be disposed of, generally down the annulus of the well, in accordance with 20 AAC 25.080. Frozen cuttings may also be temporarily stored on the pad. In most circumstances, the cuttings are transported to a grind and inject facility. If necessary, a flare pit may be constructed to allow for the safe venting of natural gas that may emerge from the well. If the exploratory well discovers oil, it is likely that the pad used for the exploratory well will also be used for production testing operations.

Mitigation measure 17b regulates the disposal of muds and cuttings; the preferred method is by underground injection. Injection of non-hazardous oil field wastes generated during development is regulated by AOGCC through its Underground Injection Control (UIC) Program for oil and gas wells. Annular disposal

of muds and cuttings associated with drilling an exploratory well is permitted by ADEC. Surface discharge of drilling muds and cuttings into lakes, streams, rivers, and high value wetlands is prohibited. Surface discharge of drilling muds and cuttings into reserve pits shall be allowed only when the Director, in consultation with ADEC, determines that alternative disposal methods are not feasible and prudent. If use of a reserve pit is proposed, the operator must demonstrate the advantages of a reserve pit over other disposal methods, and describe methods to be employed to reduce the disposed volume. On-pad temporary cuttings storage will be allowed as necessary to facilitate annular injection and/or backhaul operations.

Mitigation measure 17 regulates the disposal of produced water and other wastewater. Disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques. ADEC may permit alternate disposal methods if the lessee demonstrates that subsurface disposal is not feasible or prudent. Surface discharge of reserve pit fluids will be prohibited unless authorized by ADEC permit and approved by DL.

## 2. Development and Production

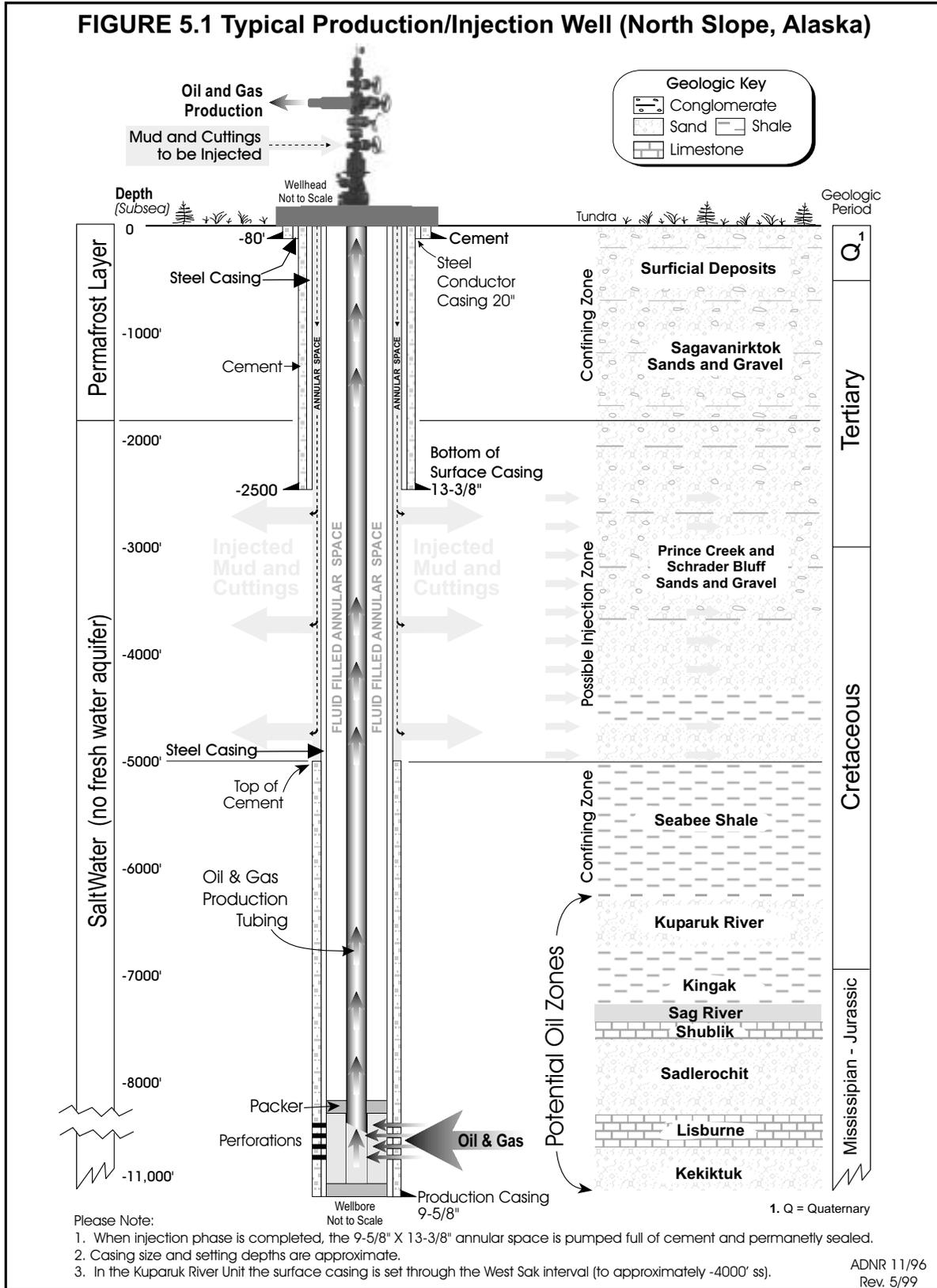
The development and production phases are interrelated and overlap in time; therefore, this section discusses them together. During the development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well 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: 177-199)

After designing the facilities, the operator constructs permanent structures and drill production wells (See Figure 5.1). 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. Gravel pads are semi-permanent structures used for production facilities and can be rehabilitated following field depletion.

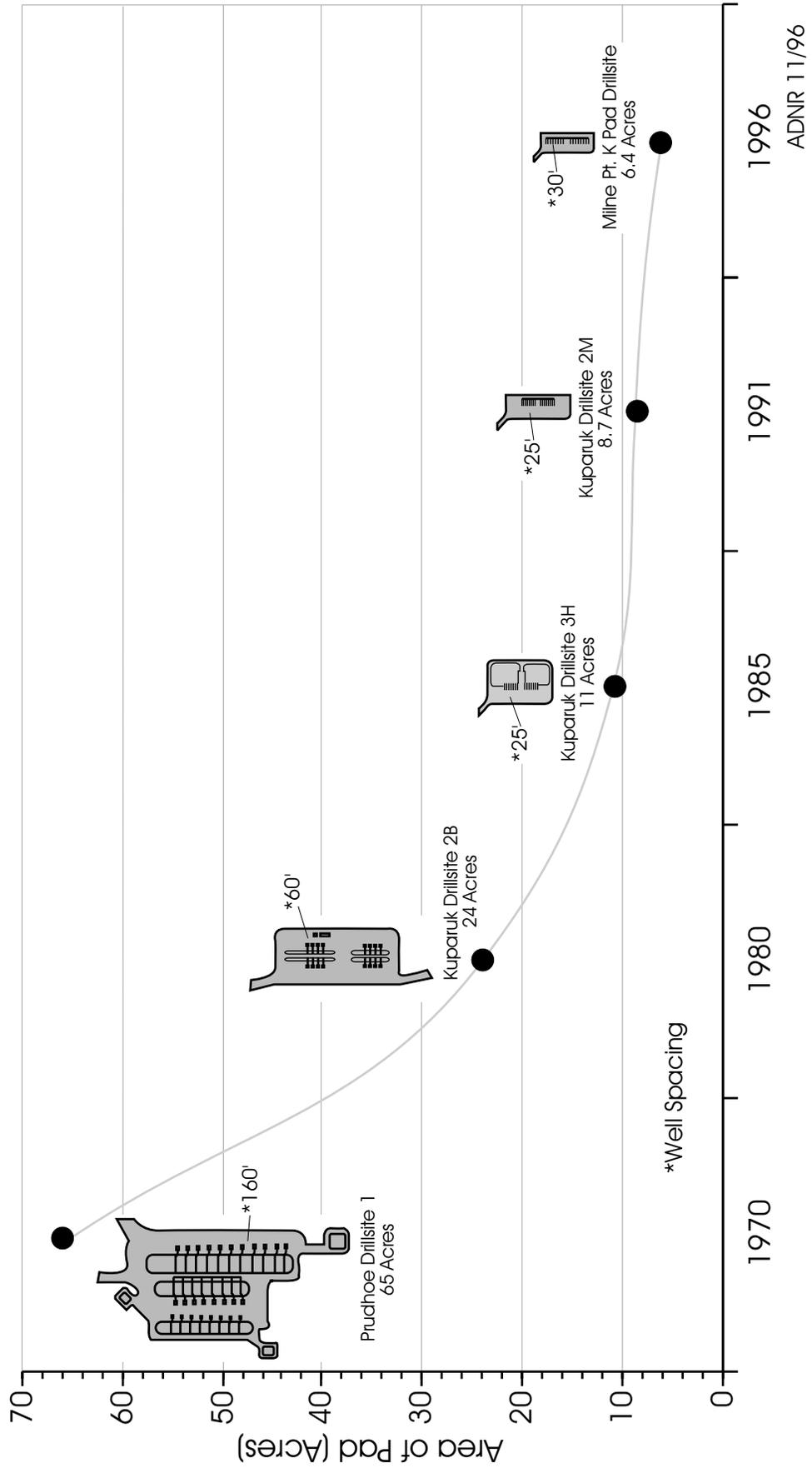
The development “footprint” in terms of habitat loss or gravel filling has decreased in recent years as advances in drilling technology have led to smaller, more consolidated pad sizes (see Figure 5.2). A single production pad and several directionally drilled wells can develop more than one and possibly several 640 acre sections. Unless pool rules (oil or gas field rules governing well drilling, casing, and spacing which 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.

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 would remove water and gas from the produced crude, and pipelines would carry the crude to the Trans-Alaska Pipeline System (TAPS). Some of the natural gas produced is used to power equipment on the facility but most is re-injected to maintain reservoir pressure. Produced water is also reinjected. Often, seawater is treated and injected into the reservoir in order to maintain pressure, improve recovery, and replace produced fluids. Produced water is treated to remove sand and other particles. Seawater is filtered to remove solids and dissolved oxygen.

**FIGURE 5.1 Typical Production/Injection Well (North Slope, Alaska)**



**FIGURE 5.2 Evolving Consolidation of North Slope Production Pad Size**



## B. Fiscal Effects

### 1. Statewide

Alaska's economy depends heavily on oil and gas revenues and resultant government spending. Lease sales generate income to the state in five ways, as described below. Some of these bonus payments, rentals, and, to a certain extent, corporate income taxes are generated for each lease sold, regardless of whether a discovery is ever made or production established.

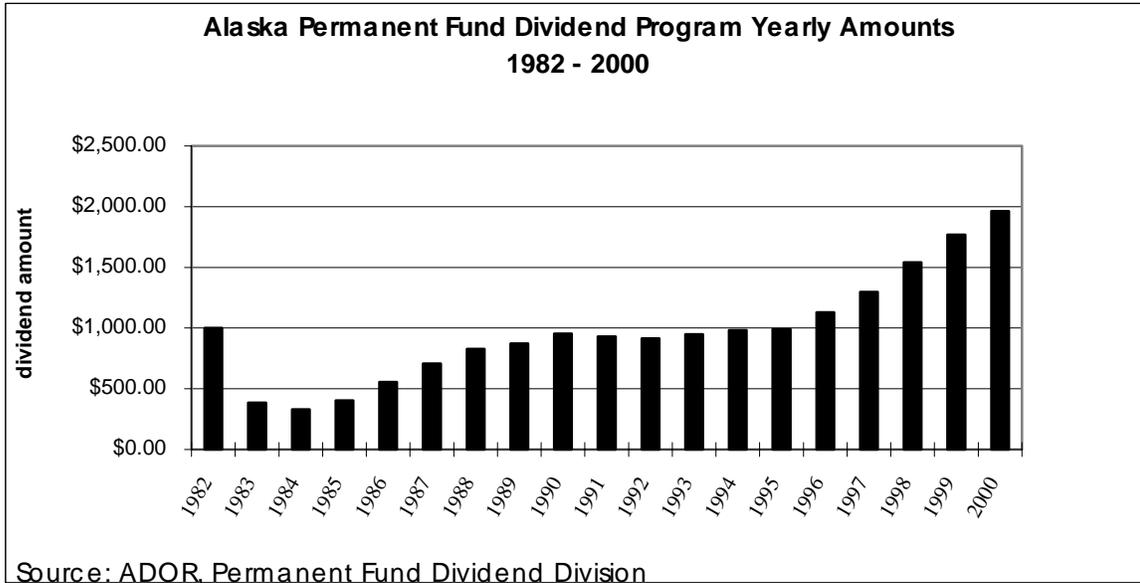
- **Bonus Payments.** These are the amounts paid by winning bidders for the individual tract lease at a lease sale. Since 1959, 5,392 tracts have been sold, generating more than \$2 billion in bonus bid income to the state.
- **Rentals.** Each lease requires an annual rental payment. The first year rent is \$1.00 per acre or fraction of an acre, and the rent increases in 50¢ increments to \$3.00 per acre or fraction of an acre in the fifth and all following 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 for fiscal year (FY) 2000 (July 1999 through June 2000) amounted to just over \$5.8 million.
- **Royalties** represent the state's share of the production as the mineral interest owner. Royalty payments provided over \$1 billion in revenue to the state in FY 2000.
- **Production taxes.** All producers must pay tax on all taxable oil and gas produced from each lease or property in the state on a percentage-of-gross value basis. For FY 1999, unrestricted oil and gas production taxes were \$702.7 million for FY 2000 and are projected to be 810.9 million in FY 2001 (ADOR, 2000a).
- **Income taxes.** All corporations in the state must pay corporate income tax 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 2000, oil and gas corporation taxes were \$162.7 million and are expected to be \$250 million in FY 2001 (ADOR 2000a).

Together these revenues comprised approximately 71 percent of the state's general fund unrestricted revenue in FY 2000. Such revenues finance the state's revenue sharing, municipal assistance, education funding, operating budget and capital budget. State spending supports nearly one out of every three jobs, and three of every ten dollars 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 (ISER, 1990). Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund, which pays significant dividends each year to every qualified state resident.

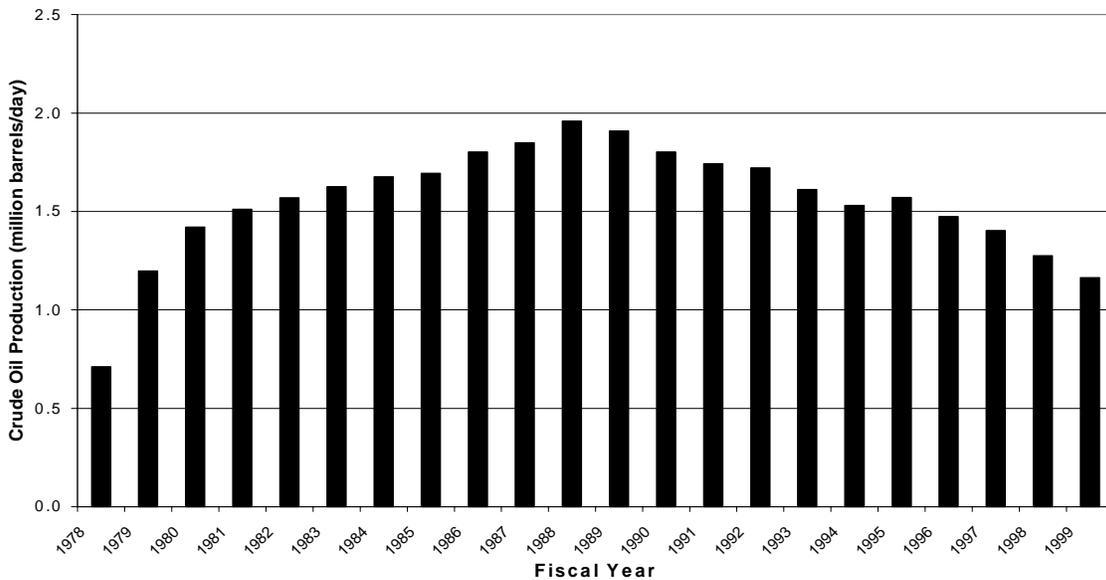
The Alaska Permanent Fund was established by ballot proposition in 1976. Fifty percent of all revenue generated by this lease sale (rentals, payments, and taxes) will be placed in the permanent fund. The state's oil-wealth savings account stood at \$27 billion on September 30, 2000. All qualified Alaskans who apply, receive an annual dividend from the earnings of the permanent fund. In 2000, approximately \$1.172 billion was distributed under the program to approximately 585,000 eligible Alaskans. Every qualified man, woman, and child in Alaska received a dividend check of about \$1,964. The PFD is an equitable benefit transfer because it reaches every individual regardless of income or socio-economic status.

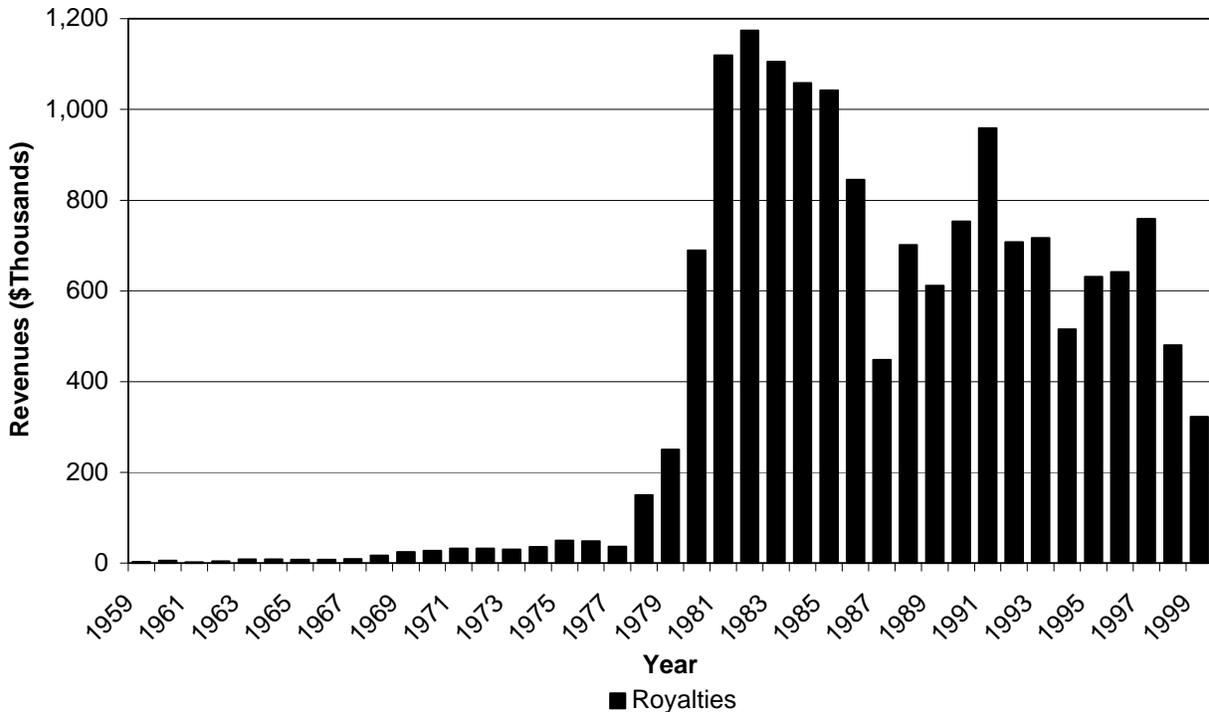
Furthermore, the total economic effect of any spending, including state government spending and salaries paid to private oil and gas industry employees, is always greater than the direct effect. When money is re-spent in the economy, its original value multiplies. For example, this "income multiplier" 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 (ISER, 1990).

**Figure 5.3: Alaska Permanent Fund Dividends, 1982-2000**



**Figure 5.4 Statewide Crude Oil Production Volumes, 1978-1999**



**Figure 5.5: State Revenue from Oil and Gas Royalties**

Source: ADOR 2000.

## 2. Local

Although some North Slope Borough funds are derived from revenue sharing programs with the state, borough revenues are primarily generated from taxes on residential, commercial, and oil and gas properties. These revenues fund capital improvement projects and community services such as education, public safety, planning, and health care, and allow the borough to employ local residents. In 1991, the NSB Assembly was able to repeal the sales tax as a result of an agreement by the major North Slope oil producers to pay the NSB an additional \$5 million per year for five years.

Oil and gas production activities from existing discoveries already comprise a significant percentage of the NSB economy and tax base. Approximately 98 percent of the borough's property taxes come from assessments on the oil industry. However, the NSB is dependent on revenue tied to production from oilfields that are in decline. At present, it is facing a non-increasing revenue base. The FY 2000 assessment of property within the borough is estimated to be \$10.8 billion, down from a peak value in 1987 of about \$13.5 billion (NSB, 2000). This includes the segments of TAPS (containing the first 177 miles of the pipeline, including support facilities), which lie within borough boundaries.

In preparation for declining tax revenues, the NSB has established a permanent fund. Whenever the borough government's income exceeds expenditures, the surplus is added to the existing fund's investment base. As of March 2000 the value of the fund was approximately \$470 million (NSB 2000).

The NSB economy, like all of Alaska, is heavily dependent on state spending. Government employment (federal, state, and local) accounts for 2,294 full time permanent jobs. Next to the oil industry, the NSB is the region's principal employer. Borough employment policies help ensure that local residents are hired for borough-funded community projects.

The NSB received over \$9.6 million in state education foundation funding in FY 1999 (Janes, 2000). Revenue sharing totaled \$317,698 and other state revenue totaled \$7,083,173 for FY 1998 (ADCED, 2000). Alaska Permanent Fund Dividends provided approximately \$1.7 million to borough residents in 1999.

**Table 5.2 North Slope Borough Employment Profile**

NSB average monthly employment and earnings, 1999.

Industry	Workers	Av. Monthly Earnings
Mining	1990	\$3,592
Oil and Gas	2,922	\$6,503
Construction	624	\$6,474
Trans/Comm/Utilities	405	\$5,905
Retail Trade	474	\$2,963
Services	846	\$3,749
Finance, Insurance, Real Estate	177	\$4,294
Federal Government	24	\$3,422
State Government	56	\$4,445
Local Government	1,910	\$3,569

Source: Alaska Department of Labor, 2000

As exploration takes place, and if development occurs, the sale would add jobs to the state and regional economy. These jobs would not be limited to the petroleum industry, but would be spread throughout the trade, service, and construction industries. However, the number of jobs produced would depend on whether commercial quantities of oil and gas are discovered. Discovery and development of commercial quantities of petroleum or natural gas in the sale area would bring direct economic benefits to the North Slope area in the form of additions to local property tax revenue.

## C. Effects on Municipalities and Communities

### 1. Infrastructure

The communities most directly affected by the sale are Anaktuvuk Pass and Nuiqsut. However, oil and gas exploration, development, production and transportation can have important effects on all North Slope communities. Such activities have already brought new job opportunities to the North Slope region in both industry and government through additional revenues. These activities have also heavily impacted the flow and sources of revenue for the NSB, resulting in improved infrastructure (public buildings and services) in each village in the borough.

### 2. Employment

As discussed under Fiscal Effects, the oil industry and the NSB are the region's two principal employers. There may be additional short-term job opportunities during the exploration phase. The long-term

employment benefits of this sale in the NSB and local communities will depend on the subsequent production of commercial quantities of petroleum and local hire opportunities.

### **3. Local Tax Revenues**

As discussed under Fiscal Effects, oil and gas activities could also provide direct benefits to the NSB by increasing the taxable property base. Significant revenues have been generated through taxing the oil industry, services, and support facilities. If commercial quantities of petroleum or natural gas in the proposed sale area were discovered and developed, there would be direct economic benefits to the North Slope area in the form of additions to local property taxes.

### **4. Land Planning and Uses**

#### **a. Land Use Plans**

The Borough has an approved coastal management plan. Provided proposed activities are conducted in a manner consistent with the coastal management plan, the NSBCMP does not prohibit oil and gas exploration and development, nor does the NSBCMP require revision to allow these activities.

#### **b. Access**

Local residents' use of the sale area depends on access to the area. Development of the sale area could adversely affect human uses of the area and its resources if access to hunting, fishing, or trapping areas is restricted or if industry activities occur at the same place and time as these activities. Conversely, development of the sale area could actually increase public access for users of the area's resources. If roads were constructed across general state lands, they would be open to the public and available for multiple use activities.

#### **c. Recreation, including Fishing and Hunting**

Subsistence activities, including hunting and fishing, are discussed in Chapter Four. Cumulative effects on subsistence are discussed in subsection 3 of this chapter. There is low potential for interference with recreational hunting and fishing due to the timing of development or the placement of structures. Most recreation in the area would occur during summer, while development would occur during winter. If development occurs, consolidation of petroleum facilities would reduce conflicts with recreation users of the area. Consolidation benefits both the public and industry. The "visual, environmental, social, and economic effects are concentrated, and are less complicated and less costly" (ADCRA 1978:31). Use of the sale area will be unrestricted, except when required within a radius of 1,500 ft. around facilities or structures. If development occurs, there could be a small but unpredictable number of new hunters and fishermen from the potential increase in local population in the oilfields or at Deadhorse.

### **Mitigation Measures**

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories pertaining to fiscal effects.

- Increased employment opportunities -- Lessees are encouraged to employ local and Alaska residents and contractors.
- Compliance with land use plans and coastal management plans -- all proposed activities must be reviewed for consistency with the approved state and district coastal management program standards. Lessees must involve local communities and interested local community groups in the development plans of operations.

- Unrestricted public access -- public access to leased land may only be restricted within the immediate vicinity of onshore drill sites, buildings, and other related structures.

## D. Cumulative Effects

AS 38.05.035(g) requires DNR to consider and discuss the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources. However, DNR is not required to speculate about possible future effects subject to future permitting that cannot reasonably be determined until a project or proposed use, for which a written best interest finding is required, is more specifically defined. AS 38.05.035(h).

Accordingly, in this section, DNR sets out relevant and important information which is currently known to DNR about the lease sale area, and considers and discusses the reasonably foreseeable effects of additional activities which may result from sale-related oil and gas exploration, development, production and transportation. By necessity, some of this discussion is general in nature. While certain activities are reasonably foreseeable because they would be components of any oil and gas activity on the North Slope, activities specific to certain areas or tracts are not reasonably foreseeable because the odds of finding and developing commercially exploitable quantities of oil or gas from any particular tract are unpredictable.

Therefore, DNR will require numerous general mitigation measures, which will be applicable to any sale activity, no matter where in the sale area. These mitigation measures provide a floor of protection, to be enhanced by more specific mitigation measures as required by any particular plan of operation, which may eventually be proposed.

## 1. Effects on Water and Air Quality, and Land Habitat

### a. Effects on Water Quality

Water quality throughout the sale area varies seasonally with changes associated with streamflow. Mean annual peak runoff occurs from late May to early July during and after breakup and elevated turbidity and suspended sediment levels are common during these months. Natural as well as man-made contaminants can result in exceedences of water quality criteria. Natural contaminants to fresh water supplies include dead fish, birds, and animals; mosquito and insect larvae; algae and other plants; bacteria; parasites such as Giardia; silt and glacial flour; arsenic, iron, manganese; and hydrogen sulfide gas (AEIDC, 1975).

Water quality characteristics that may be altered by post-sale activities include pH, total suspended solids, organic matter, calcium, magnesium, sodium, iron, nitrates, chlorine, and fluoride. Potential impacts, which may alter surface water quality parameters of the sale area, include accidental spills of fuel, lubricants or chemicals; increases in erosion and sedimentation causing elevated turbidity and suspended solids concentrations; and oil spills (Parametrix, 1996).

Geophysical exploration of the sale area with tracked seismic vehicles is not expected to alter water quality because seismic surveys are conducted in winter and permit conditions mitigate potential damage. Under standard DNR permit conditions for winter seismic exploration on the North Slope, the use of ground-contact vehicles for off-road travel is limited to areas where adequate ground frost and snow cover prevent damage to the ground surface. Operations are restricted to the winter seasonal opening. Equipment, other than vessels must not enter open water areas of a watercourse during winter, and any ice roads, ice bridges, or approach ramps constructed near river, slough, or stream crossings must be free of extraneous material before break-up. Alterations of the banks of a watercourse are prohibited (ADGC, 1995). Adherence to these

conditions thus avoids or minimizes post-seismic increases in erosion, turbidity, and suspended solids in a drainage area.

The extent and duration of water quality degradation resulting from accidental spills depends on the type of product; the location of the spill; volume; season and duration of the spill or leak; and the effectiveness of clean-up response. Heavy equipment, such as trucks, tracked vehicles, aircraft, and tank trucks commonly use diesel fuel, gasoline, jet fuel, motor oil, hydraulic fluid, antifreeze, and other lubricants. Spills or leaks could result from accidents, such as during refueling, or from corrosion of lines (Parametrix, 1996). Under standard ADNR permit conditions for off-road activity, fuel and hazardous substances must have secondary containment apparatus. A secondary containment or surface liner must be placed under all container or vehicle fuel tank inlet and outlet points. Appropriate spill response equipment must be on hand during any transfer or handling of fuel or hazardous substances. Vehicle refueling is prohibited within the annual floodplain or tidelands (ADGC, 1995). Impacts of oil spills are discussed in Chapter Six.

Other standard DNR land use permit conditions serve to protect water quality values from facility construction and operation. Trails, campsites and 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 on the surface of lakes, ponds, or rivers are prohibited (ADGC, 1995).

The federal Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) to permit discharges of pollutants into U.S. waters by "point sources," such as industrial and municipal facilities. In Alaska, the U.S. Environmental Protection Agency issues NPDES permits, designed to maximize treatment and minimize harmful effects of discharges as water quality and technology improvements are made. ADEC certifies that these discharge permits will not violate the state's water quality standards.

The Alaska Department of Environmental Conservation issues industrial and municipal wastewater permits, and monitors wastewater discharges and the water quality of waterbodies receiving the discharges. ADEC certifies federal wastewater permits with mixing zones that allow industrial and municipal facilities to meet state water quality standards. Industrial and municipal wastewater facilities are inspected annually. ADEC also certifies U.S. Army Corps of Engineer dredge and fill permits in wetlands and navigable waters to ensure compliance with state water quality standards, and provides technical assistance for design, installation, and operation of industrial and municipal wastewater systems.

### **Mitigation Measures**

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to water quality.

- Tundra protection -- Winter and summer off-road vehicular traffic is restricted and must be approved in plan of operations.
- Wetland and Riparian Protection -- Lessees must avoid siting facilities in key wetlands and identified sensitive habitat areas. Onshore facilities other docks, or road and pipeline crossings, will not be sited within 500 feet of fishbearing streams. Permanent facility siting is prohibited within one-half mile of the banks of major rivers.
- Water Conservation -- Removal of water from fishbearing rivers, streams, and natural lakes shall be subject to prior written approval by DMLW and ADF&G.

- Turbidity Reduction -- Gravel mining sites will be restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage and must not be located within an active floodplain of a watercourse.
- Drilling Waste -- Underground injection of drilling muds and cuttings is preferred method of disposal. For onshore development, produced waters must be injected. Surface discharge of drilling wastes into waterbodies and wetlands is prohibited. Discharge of produced waters in marine waters less than 10 m deep is prohibited. Unless authorized by NPDES or state permit, disposal of wastewater into freshwater bodies, including Class III, IV, VI, and VIII wetlands, is prohibited.
- Oil Spill Prevention and Control -- Lessees are advised they must prepare contingency plans addressing prevention, detection, and cleanup of oil spills. Pipelines must be designed and located to facilitate clean-up. Buffer zones of not less than 500 feet will be required to separate onshore oil storage facilities (with a capacity greater than 660 gallons) and sewage ponds from freshwater supplies, streams, and lakes and key wetlands

### **b. Effects on Air Quality**

Air quality throughout the sale area is very good, with concentrations of regulated pollutants well below the maximum allowed under National Ambient Air Quality Standards designed to protect human health. In order to ensure that air quality standards are maintained, additional limitations on nitrogen dioxide, sulfur dioxide, and total-suspended-particulate matter are imposed on industrial sources under the provisions of the Prevention of Significant Deterioration Program, administered by EPA.

Routine activities associated with oil and gas exploration, development and production that are likely to affect air quality are emissions from construction, drilling and production. Air pollutants include nitrogen oxides (NOX), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), particulate matter (PM), and volatile organic compounds<sup>1</sup> (VOC) (MMS, 1995, IV.B.1-92). Effects from VOC emissions would be insignificant because of the low potential for ozone formation. Photochemical pollutants such as ozone (O<sub>3</sub>) form in the air from the interaction of pollutants in the presence of sunshine and heat. In the upper atmosphere ozone is beneficial because it absorbs solar ultraviolet radiation. In the lower atmosphere however, it is a strong oxidizing agent and can be harmful. There is a low potential for ozone formation in the sale area because the summer time air temperatures remain relatively low (MMS, 1996a, IV.B.1-94).

Emissions, such as engine exhaust and dust would be produced by trucks, heavy construction equipment and earth moving equipment. Emissions would be generated during installation of pipelines and utility lines, excavation and transportation of gravel, mobilization and demobilization of drill rigs, and during construction of gravel pads, roads, and support facilities. Elevated levels of airborne emissions would be temporary and would diminish after construction phases are complete. Emissions would also be produced by engines or turbines used to provide power for drilling, oil pumping, and water injection. In addition, aircraft, personnel carriers, rollogon trucks, mobile support modules, as well as intermittent operations such as mud degassing and well testing would produce emissions (MMS, 1996a, IV.B.1-93).

Other sources of air pollution include evaporative losses (VOC) from oil/water separators, pump and compressor seals, valves and storage tanks. Venting and flaring could be an intermittent source of VOC and SO<sub>2</sub> (MMS, 1995, IV.B.1-93). Gas blowouts, evaporation of spilled oil and burning of spilled oil may also affect air quality. Gas or oil blowouts may catch fire. A light, short-term coating of soot over a localized area could result from oil fires. However, soot produced from burning oil spills tends to slump and wash off vegetation in subsequent rains, limiting any health effects (MMS, 1995, IV.B.1-95).

Several kinds of atmospheric pollutants can be found in the Arctic including organic contaminants and pollutants associated with the burning of fossil fuels, smelting, and industry. There is increasing concern about these contaminants entering the Arctic food chain; a concern that researchers have been aware of since the

1970's. Most contaminants do not originate in the Arctic, but likely result from long-range transport from lower latitudes. The U.S. EPA has initiated a regional study to collect data on atmospheric contaminants, which would complement other circumpolar nations' research efforts. Although there are published data on food chain contamination by DDT and radionuclides, there are little if any data on U.S. Arctic food web contamination from other sources (MMS, 1991).

Arctic haze is a generic term for pollutant-laden aerosols distributed throughout the polar regions in late winter and early spring. Arctic haze probably develops from both man-made contaminants reaching the Arctic from the south, and from pollutants originating from the industrialized Arctic. In late spring, these materials may be deposited on snow-covered land masses. Brown snow events occur intermittently in the Arctic and are believed to be caused by industrial emissions from Asia (MMS, 1991). Despite the seasonal long-distance transport of contaminants into the Arctic, pollutant levels in the air above the sale area are still far below maximum allowable standards (MMS, 1996b:III-A-14).

It is not possible to predict at the lease sale stage the amount of additional pollutants that could be produced. All industrial emissions in the Arctic U.S. must comply with the Clean Air Act (42 U.S.C. §§ 7401-7642) and state air quality standards. 18 AAC 50 provides for air quality control including permit requirements, permit review criteria, and regulation compliance criteria. 18 AAC 50.300 sets up standards for air quality at certain facilities, including oil and gas facilities, at the time of construction, operation, or modification. DO&G continues to search for, but has not found any evidence that fish or terrestrial mammal population declines are linked to industrial emissions emanating from existing North Slope oil and gas facilities. Federal and state statutes and regulations that will mitigate potential impacts air quality include:

- 42 U.S.C. §§ 7401-7642. Federal Clean Air Act
- AS 46.03. Provides for environmental conservation including water and air pollution control, radiation and hazardous waste protection.
- 18 AAC 50. Provides for air quality control including permit requirements, permit review criteria, and regulation compliance criteria.
- 18 AAC 50.300. Sets up standards for air quality at certain facilities including oil and gas facilities at the time of construction, operation, or modification.

ADEC's Air Quality Maintenance program controls significant, stationary sources of air contaminants to protect and enhance air quality and abate impacts on public health and the environment. The 1970 Clean Air Act established air quality programs to regulate air emissions from stationary, mobile and other sources which pose a risk to human health and the environment. ADEC monitors compliance with regulations and air quality standards through annual inspections and uniform enforcement procedures. The agency issues operating permits to existing major facilities incorporating all applicable requirements, and issues construction permits to new large facilities and for expansions of existing facilities.

### **c. Effects on Land Habitat**

Seismic surveys: Winter seismic surveys affect tundra vegetation depending on snow depth, vehicle type, traffic pattern, and vegetation type. Camp move trails disturb vegetation more than seismic trails. Multiple vehicles in a single narrow trail cause more disturbance than dispersed tracks. Trails in shrub-dominated tundra recover slower than other vegetation types (Jorgenson and Martin, 1997).

Winter seismic trails can compress microtopography resulting in a wetter microenvironment and decreased vegetation cover of upright shrubs (willows), lichens, and mosses. Winter seismic trails have little adverse effect on (and may possibly enhance growth of) *C. aquatalis* and *E. angustifolium* due to the resulting

wetter microenvironment (Noel & Pollard, 1996, citing to Felix & Reynolds, 1989). Effects can be substantial if operations are conducted improperly. Vehicles can leave visible tracks in the tundra which should disappear and vegetation should recover within a few years. Vehicles using tight turning radii have sheared off upper layers of vegetation, but left rhizomes intact, and plants should recover. Dry snowless ridges and vegetated sand dunes are at higher risk of damage. Damage to vegetation can be avoided by limiting travel to areas with at least 6 inches of snow cover, and avoiding minimum radius turns. In areas where damage is extensive, and natural recovery not expected, restoration may be required of operators (Schultz, 1996).

A study of the impact of a 1984-1985 seismic exploration program in ANWR indicated that recovery was not complete a decade after disturbance. Trails in sedge-dominated tundra recovered well, unless initial disturbance was high. Impacts on medium and highly disturbed trails may persist for a decade or more. Such impacts include increased thaw depths, trail subsidence, shifts to wetter conditions, ruts, invasion of grasses, and decreases in shrub cover (Jorgenson and Martin, 1997). Today, winter and summer off-road vehicular traffic is restricted and must be approved in the plan of operations.

Drilling and Production Discharges: During exploration well drilling, muds and cuttings are stored on-pad, in holding tanks, or in a temporary reserve pit, and then hauled to an approved solid waste disposal site or reinjected into the subsurface at an approved injection well. All production muds and cuttings on the North Slope are reinjected into a Class II injection well. All produced waters are reinjected either into the producing formation to enhance recovery, or into an injection well. The Underground Injection Control program is administered by AOGCC. Drilling and production discharges are expected to have no impact on tundra habitat.

Effects of Construction and Gravel Infilling: Effects of constructing production pads, roads, and pipelines include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. A secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth. Construction activity involving vehicular passage (see above, Effects of Seismic Surveys), such as a rollogon, may upset the thermal balance of the permafrost beneath the tundra, especially in non-winter months. Road construction, vehicular passage, and oil spills 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 specie composition may also change after disturbance from construction activities (Linkins, et al., 1984).

After an oil field is abandoned, some level of land rehabilitation will be required to restore areas impacted by oil and gas activities. Recovery of wetlands disturbed by gravel infilling varies depending on soil moisture content and amount of available soil organic matter (Kidd, et al., 1997, citing to Jorgenson and Joyce, 1994). Removal of gravel from pads and roads is the initial step in rehabilitation. At sites on the North Slope where gravel fill has been removed, problems have emerged associated with ponding, thaw subsidence, and nutrient cycling. One method preferred by ADF&G is to remove all gravel and create pond habitat that resembles pre-construction conditions. In some cases, full gravel removal may not be the optimum recovery option. In most cases, plant cultivation is desirable with the use of plant species identified as important for waterbird habitat. While rehabilitation methods for gravel pad and roads vary depending on site-specific conditions, the overall goal of rehabilitation in the existing oil fields is to create a mosaic of moist meadows, sedge meadows, and grass marshes (Kidd, et al., 1997).

Ice roads and Pads: Ice roads and pads cause depressions in microtopography due to compaction. The thaw depth in summer increases beneath the impacted area after melt and there is an increase in wetness due to compression. Ice roads compress and shear tussocks, which may take up to four years or more to recover. Some tussocks remain dead and damaged from ice road effects for years (Noel and Pollard, 1996, citing to Walker, et al., 1987). Ice roads and pads also affect tundra regeneration, with certain species recovering faster

after summer melt than others. Most vegetation should recover within three seasons following melt. Ice road thaw depths return to pre-impact levels after several years (Noel and Pollard, 1996).

Single season ice roads melt in spring and leave little if any trace. Multi-season ice pads can result in limited short-term impact, if tundra around the perimeter of the pad thaws and is blocked from sunlight. Insulated paneling held down by fabric and timbers at the perimeter of a multi-season pad can result in sun-blockage and impeded growth. Modifications to pad design are currently being tested on the North Slope to minimize impacts to the tundra surface (Hazen, 1997).

**Gas Blowouts:** If a natural gas blowout occurred, plants in the immediate vicinity may be destroyed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. Insects, such as mosquitoes would also be affected or killed by a gas blow-out. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site, but is not expected to be hazardous for more than one kilometer downwind or for more than one day. Natural gas development is expected to have little to no effect on lower trophic-level organisms (MMS, 1996b: IV-L-2).

**Oil Spills:** Spilled oil will affect tundra depending on time of year, vegetation, and terrain. Oil spilled on the tundra will migrate both horizontally and vertically. This flow depends on various factors including the volume of the spill, type of cover (plant or snow), slope, presence of cracks or troughs, moisture content of 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). The spread of oil is 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 will pool and be easier to contain. Absorption of the oil by the tundra itself will also limit flow and reduce the area contaminated. Experiments in Canada by MacKay, et al. (1974) revealed that mosses have high absorption capacity. Moss-covered tundra can absorb more than 13 gallons of oil per square meter, compared to less than a gallon for non-moss covered tundra (Linkins, et al., 1984). If there is a vertical crack through different soil horizons, oil will migrate down to the permafrost. If no cracks are present in the soil layers beneath the tundra, oil moves laterally in the organic material and does not penetrate the silty clay loam mineral soils beneath. Because of this, oil contamination would be restricted to the top few centimeters of the soil layer. Dry soils have greater porosity and the potential for vertical movement 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 would occur in following summers.

Fungi are important decomposers of organic material in tundra soil. In experiments near Barrow, Campbell et al. (1973) noted that oil spilled on acid-wet meadow tundra resulted in increased yeast, and decreases in filamentous fungi populations. Large numbers of fungi have been found in association with a natural oil seep at Cape Simpson. Under the right conditions involving oxygen, temperature, moisture in the soil, and the composition of the crude being spilled, bacteria assist in the breakdown of hydrocarbons in soils. Petroleum-contaminated soils are commonly treated with fertilization, raking, and tilling (bioremediation). Research is ongoing in the use of microbes to assist the natural breakdown of petroleum in soils and gravel (Linkins, et al., 1984) (AJC, 1996b).

### **Mitigation Measures**

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to land and habitat.

- Tundra protection -- Winter and summer off-road vehicular traffic is restricted and must be approved in plan of operations.

- Wetland protection -- Lessees must avoid siting facilities in key wetlands and identified sensitive habitat areas.
- Habitat loss minimization -- Exploration facilities must not be constructed of gravel. Ice roads and pads are preferred structures. Gravel mining is restricted to the minimum necessary to develop the field efficiently.
- Drilling waste -- Underground injection of drilling muds and cuttings is preferred method of disposal. For onshore development, produced waters must be injected. Surface discharge of drilling wastes into waterbodies and wetlands is prohibited.
- Oil Spill Prevention and Control -- Lessees are advised they must prepare contingency plans addressing prevention, detection, and cleanup of oil spills. Pipelines must be designed and located to facilitate cleanup.
- Rehabilitation -- At the option of the state, all improvements such as roads, pads, and wells must be either abandoned and the sites rehabilitated by the lessee, or left intact. Any machinery, equipment, tools or materials left behind after the lease is terminated become the property of the state, and may be removed by the state at the lessees expense.

## 2. Effects on Fish and Wildlife Habitats, Populations, and Uses

### a. Fish

Anadromous streams within the sale area include the Canning, Echooka, Ivishak, Ribdon, Sagavanirktok, Saviukviayak, Itkillik, Nanushuk, Kanayut, Chandler, and Colville Rivers. Numerous other rivers and streams that flow through the sale area also support anadromous fish populations. Several species of anadromous fish spawn and overwinter in these rivers and during summer migrate to nearshore coastal waters to feed. Migration patterns vary by species and within species by life stage (see Chapter Three). Potential effects include degradation of stream banks and erosion; reduction of or damage to overwintering areas; habitat loss due to gravel removal, facility siting, and water removal; impediments to migration; and fish kills due to oil spills.

Habitat loss: Potential impacts at include erosion. Erosion results in siltation and sedimentation, which in turn may result in a reduced or altered stream flow that may affect overwintering habitat availability, and affect the ability of fish to migrate upstream. Protecting the integrity of stream bank vegetation and minimizing erosion are important elements in preserving fish habitat. Streambeds could be affected if stream banks are altered, such as damage from equipment crossings.

Removal of water from lakes where fish are overwintering may affect the viability of overwintering fish, and long-term effects of lake drawdown may impede the ability of fish to return to the lake in subsequent years. Removal of snow from lakes may increase the freeze depth of the ice, kill overwintering and resident fish, and adversely affect the ability of fish to utilize the lake in future years.

During development, unregulated gravel removal from fishbearing streams to support oil and gas activities could adversely impact anadromous fish they support. Gravel removal could increase sediment loads, change the streambed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration. Gravel removal from streambeds could also cause potential damage to overwintering fish populations. Gravel mine sites can be restored as overwintering habitat and thus add to total available fish habitat.

Oil spills: Adult fish are likely to avoid an oil spill and not suffer great mortality; but larvae, eggs, and juveniles are more vulnerable because they are more sensitive and less mobile (MMS, 1996a: IV-B-17). The

total number of fish killed depends on the volume of oil discharged, the time of year of the spill, and the prevention, response and preparedness of cleanup efforts.

Adult fish are less susceptible to spilled oil and may be able to avoid areas containing spilled oil or dissolved hydrocarbons by swimming upstream. Less motile juveniles in late summer would be near the surface seeking sunlight and warmth. Most anadromous fish migrate downstream to marine waters to feed, and then upstream to spawn. It is not likely that an entire year class would be lost as it migrated in or out of a stream. Furthermore, if a spill affected an anadromous river during migration, the spill would likely not affect the entire river area and, thus, would not affect the entire migration (MMS, 1987: IV-B-16-19).

**Seismic activities:** Vibroseis is the most widely used method for acquiring seismic data onshore and is limited to the winter season on the North Slope. There may be instances, however, where the use of Vibroseis is not practicable (such as in difficult terrain or if the substrate prevents adequate data collection), and it is necessary to use explosives as an energy source. Generally, using explosives includes the drilling of holes (10 to 50 feet in depth) spaced as close as 100 feet apart and inserting charges (2 to 20 pound charges), and detonating them. Seismic surveys using explosives are conducted in winter, thus it is possible that some terrestrial wildlife may be exposed to the energy created by the shot blasts. Pressure waves from high explosives, like ammonia nitrate, will kill and injure fish, near the explosion (Fink, 1996 citing to Trasky, 1976; Falk and Lawrence, 1973; Hill, 1978). Overpressures 30 to 40 psi will kill fish with swim bladders, and 3-4 psi will kill juvenile salmonids. Shock waves from explosions can also shock and jar fish eggs at sensitive stages of development (Fink, 1996, citing to Trasky, 1976; Linton et. al., 1985). These types of impacts are mitigated by restricting the use of explosives in open water or in close proximity to fish-bearing lakes and streams.

The table associated with Mitigation Measure 1 (see Chapter Seven), depicting minimum distances from waterbodies for various sizes of explosive charges, represents the minimum distance that explosives can be used without harming fish or eggs, and reflects *Alaska Department of Fish and Game Blasting Standards* (1991). These standards were generated after a thorough review of literature and represent ADF&G's considered opinion on the maximum allowable blast impact within fish habitat.

### **Mitigation Measures**

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. Title 16 of the Alaska Statutes requires protection of documented anadromous streams from disturbances associated with development. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to fish.

- **Habitat Protection** -- Lessees may be required to construct ice and/or snow bridges if ice thickness at a crossing is insufficient to protect the streambed and the stream bank. Any removal of water from fishbearing streams, rivers, and natural lakes requires written approval. When a fishbearing waterbody is used as a water source, lessees must use appropriate measures to avoid entrainment of fish (prevent fish from being drawn into the intake pipe). Lessees must locate, develop, and rehabilitate gravel mine sites in accordance with ADF&G guidelines. Disposal of wastewater, such as domestic greywater, into fresh waterbodies is prohibited.
- **Production Discharges** -- Unless authorized by NPDES or state permit, disposal of wastewater into freshwater bodies, including Class III, IV, VI, and VIII wetlands, is prohibited. Surface discharge of reserve pit fluids will be prohibited unless authorized by ADEC permit and approved by DL. Disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques.
- **Stream Buffers** -- Facilities other than roads, docks, and airstrips must not be sited within 500 feet of all fishbearing streams and lakes. Facilities may not be sited within one-half mile of the Canning, Echooka, Ivishak, Ribdon, Sagavanirktok, Saviukviayak, Toolik, Kavik, Shaviovik, Kuparuk, Itkillik, Nanushuk,

Kanayut, Chandler, Colville, Anaktuvuk, and Killik Rivers, and Accomplishment, Section, and May Creeks. Facilities will be not be sited within 500 feet of all other fishbearing waterbodies

- No facilities will be sited within one-half mile of Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayut, and Nanushuk Rivers; and on May, Cobblestone, Section and Accomplishment Creeks. Roads and pipelines may only be sited in these buffers if the lessee demonstrates to the satisfaction of ADNR, and ADF&G, that either (1) the scientific data indicates the proposed crossing is not within an overwintering and/or spawning area; or (2) the proposed road or pipeline crossing will have no significant adverse impact to Dolly Varden overwintering and/or spawning habitat.
- Applicants are advised to make every effort to avoid road and pipeline crossings within one-half mile of identified Dolly Varden overwintering and/or spawning areas
- Activities that may block fish passage in anadromous streams are prohibited. Alteration of river banks, except for approved crossings is prohibited. Operation of equipment other than boats in open water areas of rivers and streams is prohibited. If bridges are not feasible, culverts used for stream crossings must be designed, installed, and maintained to provide efficient passage for fish.
- Protection from Seismic Activities -- Lessees must follow requirements for the use of explosives during onshore seismic activities.
- Oil Spill Prevention and Control -- Lessees are advised they must prepare contingency plans addressing prevention, detection, preparedness, response capability, and cleanup of oil spills. Lining and diking of oil or fuel storage tanks is mandatory, and buffer zones are required to separate oil storage facilities from marine and freshwater supplies.

### **b. Birds**

Over the years there have been many studies on the effects of North Slope oil and gas development on birds. The results and interpretation of these studies vary. Some nesting, molting, and staging bird species are sensitive to activities associated with development. Generally, responses to industrial activities depend on species exposed, the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and possibly other factors (MMS, 1996: IV-B-21). Potential impacts are more likely to occur after the exploration phase, as few resident species are present during winter when exploration occurs. Potential impacts include: habitat loss, barrier to movement, disturbance during nesting and brooding, change in food abundance and availability, and oil spills.

Habitat loss: Siting of onshore facilities such as drill pads, roads, airfields, pipelines, housing, oil storage facilities, and other infrastructure could eliminate or alter some preferred bird habitats such as wetlands. Onshore pipeline corridors may include a road and associated impacts from traffic, noise and dust may deter nesting in the immediate vicinity. Impacts to bird populations are not likely to persist after development phase activities are completed (MMS, 1996b: IV-B-23).

After facilities are built, some birds (individuals) can no longer nest in areas because these areas are covered by the new facility. Additional birds may avoid the areas adjacent to the facility due to disturbance effects. However, these habitat changes did not translate into reduced numbers of birds in the area, as the displaced birds were found nesting in nearby areas and returned at rates similar to unaffected birds. There is no indication that displaced birds settled in habitat inferior to that from which they were displaced because they did not incur disproportionately lower nest success at their new nest sites. Habitat availability does not limit most bird populations at Prudhoe Bay.

Nest predation by Arctic foxes is proposed as the factor most likely limiting bird population levels (TERA, 1990:35). The USF&WS disputes this conclusion, citing the small sample size (only one marked bird lost its nest site, and an additional seven had nest sites that were physically altered in some way). USF&WS notes, however, the results lend no support to the hypothesis of habitat limitation (Sousa, 1997).

A five-year monitoring program to assess the effects of construction and operation of the Lisburne Oil Field on White-fronted Geese, Brant, Snow Geese, and Tundra Swans was conducted from 1985-1990. The purpose was to determine whether development-related disturbance and habitat loss have caused changes in the extent and nature of use of the Lisburne development area by geese and swans. The study concluded that the Lisburne development did not change the extent or nature of use of the area by geese and swans during construction and the first three years of operation of the oil field (Murphy and Anderson, 1993:156). This study synthesized the results from pre-construction studies conducted in 1983 and 1984. The pre-construction studies, however, did not investigate all aspects of goose and swan ecology and therefore a complete comparison with pre-development results was not possible (Murphy and Anderson, 1993:1).

Disturbance: Human activities such as air traffic and foot traffic near nesting waterfowl, shorebirds, and seabirds, could cause some species to temporarily abandon important nesting, feeding and staging areas. Birds have keen eyesight, and even slight movements may cause adults to abandon young hatchlings. A study of effects of aircraft on molting brant in the Teshekpuk Lake area (Derksen et al. 1992) concludes that helicopters (and to a lesser extent, fixed wing aircraft) cause serious disturbance. However, as pointed out in the Habitat Loss section, disturbance does not translate into a population reduction. Some species such as tundra swans, are particularly sensitive to humans on foot, and may abandon their nests when humans approach within 500 to 2000 m of the nest (MMS, 1996b: IV-B-21).

A study of the Gas Handling Expansion Project (GHX-1) to determine the potential effect of gas-compressor turbine noise on waterbird populations, particularly nesting Canada geese and brood-rearing brant, concluded that noise from the GHX-1 facility made only a small contribution to the total noise around the Central Compressor Plant and the Central Gas Facility and had little effect on the use of the study area by waterbirds (Anderson et al. 1992:110).

Research has indicated that some birds may not be readily disturbed. A 1993 study, *Bird Use of the Prudhoe Bay Oil Field*, concluded that on the order of 5 percent of the birds in the Prudhoe Bay oil field may have been displaced by gravel placement and secondary alterations of adjacent areas, but that these birds most likely occupy nearby areas. Overall there is rearrangement of birds but probably no net change in bird abundance within the oil field (TERA, 1993:48). The nesting of most local birds is widely dispersed over the coastal tundra and disturbance probably would have little effect on North Slope bird populations as a whole (MMS, 1996b: IV-B-21).

In 1985, ARCO Alaska, Inc., initiated a five-year monitoring program to assess the effects of construction and operation of the Lisburne Oil Field on Canada Geese, Greater White-fronted Geese, Snow Geese and Tundra Swans. Pre-construction studies were conducted in 1983 and 1984, however they did not investigate all aspects of goose and swan ecology evaluated during construction and post-construction. In addition, the Lisburne Field is located within the existing Prudhoe Bay oil field, where oil development activities have been ongoing since the early 1970s. The study encompassed the construction phase (1985-1986) and the first three years of operation (1987-1989). The final synthesis report concluded that the Lisburne development did not change the extent or nature of use of the development area by geese and swans during construction during the first three years of operation. No major shifts in the use of the study area were detected when comparing survey results between construction and post construction and the limited data on bird distribution from pre-development studies (ABR, 1993:156).

In 1983, Sohio Alaska stockpiled over one million cubic meters of gravel on the western tip of Thetis Island. Operations also involved the installation of a temporary support camp, construction of helicopter landing pad, gravel berms to support two large conveyor belts and a fleet of barges to haul the gravel. Sohio instituted a series of mitigation measures—the establishment of an aircraft flight corridor and buffer zone, a restricted access zone for camp personnel, and, at the request of USF&WS, a program to remove arctic foxes.

The numbers of common eiders nesting on Thetis Island in 1983 were higher than had been recorded in any previous year. The mitigation program implemented by Sohio may have been at least partly responsible for the increase. Three eiders established nests and successfully incubated and hatched eggs at different sites within 300 m of the helicopter landing pad (LGL Associates, 1984:50-54).

Oil Spills: Direct contact with spilled oil by birds is usually fatal, causing death from hypothermia, shock, or drowning. Oil ingestion from preening oily feathers or consumption of oil-contaminated foods may reduce reproductive ability, and could lead to chronic toxicity through the accumulation of hydrocarbon residues. Oil contamination of eggs by oiled feathers of parent birds significantly reduces egg hatching through toxic effects on chick embryo or abandonment of the nest by parent birds (MMS 1996: IV-B-19). The presence of humans, aircraft, and vehicular traffic involved in cleanup activities is expected to cause displacement of nesting, molting, and feeding birds in the oiled areas and contribute to reduced reproductive success of the birds (MMS 1996: IV-B-23). The number of birds impacted by a spill would depend on the time of year and the density of local bird populations. Spill prevention and response are described in Chapter Six.

Gas Blowouts: In the event of a natural gas explosion and fire, birds in the immediate vicinity could be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site, so it is not likely that toxic fumes would affect birds or their food sources except those very near to the source of the blowout (MMS, 1996b: IV.L.2).

### Mitigation Measures

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to birds.

- Habitat Protection -- Permanent facilities must be sited minimum distances from stream and lakes. Lessees are advised to consider identified sensitive bird habitats when planning operations.
- NSB Municipal Code requires that vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where sensitive species are concentrated. Horizontal and vertical buffers will be required where appropriate under local code (19.70.050(I)(1)).
- Peregrine falcon nesting sites may occur in the sale area. Lessees are advised that disturbing a peregrine falcon nest violates federal law. Lessees are required to comply with the federal resource recovery plan for the arctic peregrine falcon.
- Oil Spill Prevention and Control -- Lessees are advised they must prepare contingency plans addressing prevention, detection, and cleanup of oil spills. Lining, diking and buffer zones are required to separate oil storage facilities from marine and freshwater supplies.

If development occurs, some alteration of bird habitat can be expected. However, with state and federal government oversight, any activities within the sale area should not prevent overall bird population levels from remaining at or near current levels.

### c. Caribou

Since 1975, both government and industry have conducted research on caribou biology and on various aspects of their interaction with North Slope oil and gas developments. Population characteristics (calf production and survival, and adult mortality), habitat use, movement and distribution, and behavioral responses of caribou to oil and gas developments have been studied, but there is disagreement regarding the interpretation of data with respect to the effects of oil and gas development. Some researchers attribute declines in caribou populations to oil and gas development, while others think populations (reproduction and viability) are subject to natural cycles in the ability of the land to support large numbers of caribou (carrying capacity). Still others think caribou numbers are influenced by many factors, such as disease, nutrition, predator abundance (including insects), and weather. Hunting pressure and loss of high quality tundra from oil and gas development is not a primary factor in the rise and fall of caribou populations. Nonetheless, studies show that local distribution and behavior of caribou is affected by infrastructure and human activities within producing oil fields.

Potential impacts are most likely to occur during development and production. Potential effects to caribou populations from the sale include displacement from insect relief areas due to construction and operations, and from oil spills.

Disturbance: The potential response of caribou to disturbance is highly variable and depend on their distance from human activity; speed of approaching disturbance source (altitude of aircraft) and frequency of disturbance; sex, age and physical condition of the animals; size of caribou group; and season, terrain, and weather. Habituation to aircraft and vehicle traffic, and other human activities has been reported in several studies of hoofed-mammal populations in North America. The variability and instability of Arctic ecosystems dictate that caribou have the ability to adapt behaviorally to some environmental changes (MMS, 1996b: IV-B-50).

According to ADF&G there are no identified caribou calving areas within the sale area. However, a brief discussion of the effects on caribou calving is included in the event that a small amount of calving may occur in the sale area. One source of disturbance to caribou is construction. During construction, small groups of caribou may be temporarily displaced, but the disturbance reaction would diminish after construction is complete. If caribou are displaced from calving in a certain area due to construction, they are likely to calve in an area where construction is not taking place.

The use of specific calving sites within the broad calving areas varies from year to year. However, one local resident has testified that there is no core calving area, and that pregnant females will birth their calves wherever they are when its time (MMS, 1996b:V-142). If calving caribou are displaced from high nutrition forage near a drill site or facility, they are likely to seek any protective area regardless of the forage. The cumulative effect of displacement from high value tundra could be lower calf survival. On the other hand, high populations would force the caribou into lower nutrition areas anyway (MMS, 1996b: IV-B-50).

Caribou, particularly during calving, may be more affected by oil development than previously thought (Smith and Cameron 1991). Cow and calf groups are most sensitive to human disturbance just prior to calving, and during the post calving period (Cronin et al., 1994:11). Ground-vehicle traffic, aircraft, and human presence near cows with newborn calves also affect individuals as they migrate (MMS, 1996b: IV-B-50).

Aerial surveys of radio-collared females conducted between 1978 and 1987 indicate that parturient females can be displaced by road systems (Cameron, et al., 1992). After construction of the Milne Point road,

caribou were significantly less numerous within 1 km of roads and significantly more numerous 5 to 6 km from roads. In addition to the locally perturbed distribution of caribou, researchers observed a decline in relative use of a portion of the study area between Olitok Point and Milne Point roads. However, the causes of reduced use of oil field tundra by calving caribou of the Central Arctic Herd (CAH) is difficult to determine by aerial observations, because of unpredictable random factors, such as weather. "Annual variation in the numbers of caribou observed near Milne Point is primarily an effect of spring snow conditions." (Cameron, et al., 1992:340) Distribution of caribou tends to be skewed inland in years of late snow melt, and concentrated near the coast in years of early melt. In addition to snow conditions and resultant forage availability is influenced by predator and insect avoidance behavior. Overall caribou use of an area could be greatly reduced if roads with moderate traffic are routed too closely (Cameron, et al., 1992). "And inaccessible habitat is habitat lost." (Cameron, et al., 1995).

While some researchers point to the presence of oil field road and associated traffic as a factor contributing to a decline in calving success (Cameron, et al., 1995), recent survey data do not support this claim. A survey of caribou in the Kuparuk oil field during the 1996 calving season indicates that the ratio of calves to cows was the highest recorded since 1985, and was near the maximum recorded for the CAH since calving surveys began in 1978 (Lawhead, et al., 1997).

In the absence of insect harassment, caribou within 1,640 feet of roads with no traffic spent more time feeding than did caribou 1,640 feet and farther from roads with traffic. Avoidance of roads during periods of high traffic in the post calving period was noted by Roby in 1978 and by Dau and Cameron in 1986. Some research has indicated that roads that receive little use by humans need not be separated from pipelines (Curatolo and Reges 1985:35). Pipelines elevated at least five feet allow for effective crossing except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles/hour). The Alaska Caribou Steering Committee concludes the most effective mitigation is achieved when pipelines and roads are separated by at least 500 feet (Cronin et al., 1994:10). Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report of the Alaska Caribou Steering Committee.

Disturbance of caribou associated with cumulative oil exploration (particularly by helicopter traffic) is expected to have minor effects on caribou (particularly large groups), with animals being briefly displaced from feeding and resting areas when aircraft pass nearby. Vehicle traffic associated with transportation corridors has the potential to affect habitat use in intensely developed areas of the Prudhoe Bay and Kuparuk oil fields. Acute disturbance effects may, in combination, result in a cumulative effect on habitat availability for those individuals with fidelity to the Kuparuk River calving area, but may have little or no effect on the CAH population. Despite the fact that cumulative effects at the population level are difficult to quantify, measures should be incorporated into operations planning and facility design to avoid both direct and indirect impacts to caribou.

Habitat Loss and Displacement: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Caribou are subject to mosquito harassment from mid-to-late June through July, and to oestrid fly harassment from mid-July to late August. In response, caribou north of the sale area move from inland feeding areas to either windswept, vegetation-free coastal areas where the insects are limited, or if coastal habitat is unavailable, caribou may use the sale area for insect relief (USDOI, 1987:123). Insect relief zones not only include coastal areas, but mountaintops, river deltas, flood plains, and river bars.

In the absence of available insect-relief habitat, caribou gather into large groups or continue to move into the wind without feeding. A period of extensive insect harassment can result in weight loss. In addition, caribou lose blood (up to 125 grams/day) to mosquitoes and suffer increased parasitism from skin warbles and nasal bot flies. If caribou are delayed or prevented from free access to insect-relief habitat, the result may be

deterioration in body condition resulting in decreased growth, increased winter mortality, and lowered herd productivity (USDOI, 1987:122).

The frequency and duration of caribou movements to and from the coast depend on weather-related changes in the number of mosquitoes, and caribou distribution on the coastal plain can change dramatically within a 24-hour period. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases (Shideler, 1986:12).

Above-ground pipelines can restrict caribou movement and deter them from seeking preferred habitat unless provisions are made to allow for their free passage. Biologists representing both industry and ADF&G have agreed that facilities built earlier in the development of the Prudhoe Bay oil field have created impediments to caribou movements. Flow and gathering pipelines were elevated only 1 to 4 feet above the surface, thus forming an effective barrier to caribou crossing. However, extensive research on the response of caribou to development has now shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, elevating pipelines five feet and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field. Factors influencing the crossing success of caribou beneath elevated pipelines include group size or composition, topography, insect activity, traffic levels, the intensity of local construction, as well as road or pipeline configuration (Shideler 1986). Studies confirm that large numbers of caribou consistently traverse the area during their normal coastward or inland movements in response to insect harassment (Lawhead 1984:8-13).

Crossing success was observed as significantly higher during oestrid fly season than during the mosquito period. The crossing of pipeline corridors occurred more frequently during the insect season than before the onset of insect harassment. Some deflections occurred, but all groups eventually crossed. The incidence of deflection was highest for smaller cow or calf groups at corridors in which pipelines were less than 328 feet from roads. Success tended to be higher at roads or pads without pipelines than at corridors with pipelines. Crossings of up to eight corridors were observed, although no successful crossings occurred with more than ten adjacent pipelines. The groups that crossed more than two pipelines were small (Johnson and Lawhead 1989:i-v, 34-68).

Large groups of caribou tended to split and detour around drill site pads during mosquito-induced movements. However, during the oestrid fly harassment season, the caribou were attracted to pipelines, roads, and structures on pads, which presumably provided relief from insect harassment (Johnson and Lawhead 1989). If displacement from insect-relief areas did occur during the construction of oil and gas facilities, it would be temporary and disturbance reaction would diminish after construction is complete. Female caribou will tolerate considerable surface development in summer, especially when passage under (or over) pipelines is possible (Cameron et al., 1995, citing to Smith et al., 1994)

In areas known to contain significant numbers of caribou, above ground pipelines shall be elevated a minimum vertical clearance of 10 feet for a distance of at least 60 feet, at maximum intervals of one-half mile. ADNR may, after consultation with ADF&G, require additional measures to mitigate impacts to wildlife movement and migration.

The CAH has grown considerably during the period of oil field development, but lack of pre-development data makes assessment of effects of oil field development difficult. Also, the understanding of the population dynamics of the North Slope caribou herds is incomplete and no firm conclusions about the effects of oil field development on reproductive success of the herd can be drawn. Based upon comparisons with other herds, there have been no apparent effects of oil field development on the growth of CAH. This

does not suggest that there may not be effects in the future, or that other herds under different ecological conditions may not be affected (Cronin et al., 1994:3).

Post-sale activities have the potential to affect caribou of the CAH, Teshekpuk Caribou Herd (TCH), and the Porcupine Caribou Herd (PCH). While the summer range of the TCH is outside of the sale area to the west of the Colville River, caribou of the herd may pass through the area during their annual migration from the Brooks Range (Philo, et al., 1993). Caribou of the CAH migrate in a north-south direction along major river corridors of the sale area and thus could be affected year-round by oil and gas activities. Caribou of the PCH also can be found year-round in the far eastern portion of the sale area, although winter and summer populations are concentrated in the Arctic National Wildlife Refuge, and in Canada (Cronin, et al., 1994).

Documenting positive effects of oil field development is as equally challenging as documenting adverse effects. Dust settling alongside roads in the spring leads to earlier snow melt and green-up of vegetation. Caribou may feed in these areas in late May prior to calving (Cronin, et al., 1994:7, citing to Lawhead and Cameron, 1988). Caribou commonly congregate on gravel pads and roads, and in areas shaded by facilities, possibly for insect relief, particularly from oestrid flies (Cronin, et al., 1994, citing to Johnson and Lawhead, 1989; Lawhead 1990). Caribou were observed using roads and gravel pads and the shade of pipelines and buildings as insect relief areas, which at other times they tended to avoid. Caribou were also observed using unvegetated gravel pads at more than twice the average number of those using vegetated pads of comparable size (BPX, 1990:10). Caribou have habituated to onshore facilities and have been observed using roads, gravel pads, and the shade provided by pipelines and buildings, for insect relief (USDOI, 1987:122).

Measures can be taken in oil field facility design to reduce the potential for adverse effects on caribou, such as displacement. If pipelines must be elevated, they should be so at least five feet above the tundra. Where possible, sections of pipeline could be buried, especially at key migration corridors, such as river and stream crossings. There is a correlation between crossing success and the presence and use of an adjacent road. Adverse effects caused by roads with heavy traffic adjacent to pipelines can be mitigated by increasing the distance between the road and the pipeline, and by restricting traffic flow. Roads should be separated from elevated pipelines by at least 500 feet. Installing ramps to facilitate crossings is another option, however studies indicate the effectiveness of ramps is debatable. Ramps are not likely to play a significant role in facilitating direct and undelayed road and pipeline crossings, but may be important facilitators during large scale post-calving movements. Construction and re-supply activities should be scheduled to not occur during calving periods or when significant caribou movements are anticipated. Other measures include horizontal and vertical aircraft flight restrictions; restricting unnecessary public access to the oil field road system; training of oil field employees; and caribou migration monitoring. Biologists should be included in initial field design and in making decisions regarding the placement of facilities and routing of roads and pipelines in key areas (Cronin, et al., 1994:9-14). Finally, to reduce the potential for adverse effects on caribou from direct habitat loss, facility pad size should be minimized. When possible, facilities such as processing units, drill pads, and airstrips should be consolidated. Multiple wells should be drilled from a single surface location when possible, and the use of extended reach drilling techniques should be employed where feasible.

Oil spills: Caribou may also be impacted by oil spills. Caribou that become oiled could die from toxic-hydrocarbon inhalation and absorption through the skin. If caribou were to ingest oil-contaminated vegetation, the result would be significant weight loss and aspiration pneumonia, leading to death. In the event of an oil spill that contaminated tundra, however, caribou probably would not ingest the oiled vegetation. They are selective grazers that are particular about the plants they consume (MMS, 1996b: IV-B-15). Caribou may be temporarily disturbed by clean up crews (MMS, 1996b: IV-B-52). However, such a spill would be confined to a very small area.

Gas Blowouts: Impacts of a gas blowout on caribou would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred, caribou in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. It is therefore, not likely that toxic fumes would affect animals except those very near the source of the blowout.

### Mitigation Measures

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to caribou.

- Disturbance -- Pipelines must be designed and constructed to accommodate caribou movement and migration patterns.
- Pipelines must be located so as to facilitate the containment and cleanup of spilled hydrocarbons.
- Aircraft altitude restrictions apply in areas of caribou concentrations.
- Permanent roads may not be used for exploration and activities must be supported by air service or an existing road system.
- Wherever possible, pipelines must use existing transportation corridors and be buried where soil and geophysical conditions permit.
- Habitat Loss -- Lessees are advised that aircraft should avoid caribou concentrations. Lessees must avoid siting facilities in sensitive habitats and wetlands. Gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Exploration facilities must be temporary and constructed of ice.
- Exploratory drilling operations may be restricted during the fall caribou migration to allow for subsistence hunting.
- Lessees are advised in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee.
- Alteration of riverbanks, except for approved permanent crossings, will be prohibited. Except for approved stream crossings, equipment must not be operated within willow stands (*Salix spp.*).
- To the extent feasible and prudent, facilities will not be sited within one-half mile of the banks of Canning, Echooka, Ivishak, Ribdon, Sagavanirktok, Saviukviayak, Toolik, Kavik, Shaviovik, Kuparuk, Itkillik, Nanushuk, Kanayut, Chandler, Colville, Anaktuvuk, and Killik Rivers, and Accomplishment, Section, and May Creeks.

Other necessary measures can be imposed if and when lessees apply for the required permits to develop the leases. Moreover, the state has retained the right to cancel leases if it is determined that continued operations will cause serious harm or damage to the biological resources, property, or the environment.

### d. Muskoxen, Dall Sheep, and Moose

Muskoxen are present in low numbers in the Sagavanirktok drainage and other drainages west of the Canning River and are expanding their range. Little is known regarding the influence of roads, traffic, and pipelines on muskox movements (Ott, 1996).

Moose occur all across the North Slope, with the largest concentration along the Colville River and its tributaries. Moose generally remain in the foothill portions of the sale area along river corridors. Post-sale activities are expected to have little effect on the North Slope moose population.

Although sheep do not occupy the entire sale area, they are found in isolated mountain complexes such as Gunsight, Castle, Fortress, and Slope Mountains, in mountains around Galbraith Lake and the Atigun

River, and in the more rugged terrain along the southern boundary of much of the sale area. Mineral licks and lambing areas are known to occur on Slope Mountain and in the Atigun River valley

Habitat Loss: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure (Ott, 1996). Muskoxen have a high fidelity to particular habitat areas because of factors favorable to herd productivity and survival such as food availability, snow conditions, or absence of predators. Displacement from preferred habitat could have a negative effect on muskoxen populations. The magnitude of the effect is difficult to predict, but would likely be related to the magnitude and duration of the displacement. However, given the expanding population and the muskoxen limited use of the sale area, oil and gas development is unlikely to affect these animals (USDOJ, 1987:126).

Moose prefer riparian habitat; stands of willow and brush. Very little if any of this habitat is expected to be lost as a result of post-sale activities because of mitigation measures 15 and 19. Measure 15 prohibits alteration of river banks, except for approved permanent crossings, and except for approved stream crossings, equipment must not be operated within willow stands (*Salix spp.*). Mitigation measure 19 prohibits permanent facility siting within one-half mile of major rivers in the sale area, including the Colville.

Disturbance: Muskoxen and moose may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Muskoxen remain relatively sedentary in the winter, possibly to conserve energy. The energetic costs associated with forced movements during winter may be as significant an impact as disturbance during calving. Mixed groups of muskoxen showed a greater sensitivity to fixed-wing aircraft in winter and during calving than in summer, fall, or during rut. Increased activity during exploration and development in muskoxen overwintering areas may have an adverse effect on muskoxen survival (Sousa, 1992). Muskoxen may be able to habituate to aircraft and seismic disturbance (USDOJ, 1987:124).

To allow free movement and migration of moose and muskoxen, above ground pipelines shall be elevated a minimum vertical clearance of 10 feet for a distance of at least 60 feet, at maximum intervals of one-half mile in areas known to contain significant numbers of these animals. ADNR may, after consultation with ADF&G, require additional measures to mitigate impacts to wildlife movement and migration.

Moose adapt readily and habituate to the presence of human activity and are not easily disturbed (USDOJ, 1987:126). However, they can become agitated and may be more sensitive to disturbance when calves are present from mid-May to early June. On the Kenai National Wildlife Refuge, moose distribution, movements or behavior were not affected by helicopter-supported winter seismic surveys using explosives (USDOJ, 1987:126). Moose generally do not venture as far north as the existing oil fields, however in the southern portion of the sale area, some moose-production facility interaction may become common. Some fencing may be appropriate around facilities. Moose mortality may occur as a result of collisions with vehicles (USDOJ, 1987:126). Dall sheep may be susceptible to aircraft disturbance during lambing.

Oil Spills: In general, the effects of an oil spill on muskoxen and moose would be similar to that of other terrestrial mammals. An oil spill may result in oil contamination of individual mammals in the immediate vicinity, contamination of habitats, and contamination of some local food sources. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of muskoxen or moose, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of muskoxen during cleanup operations.

Gas Blowouts: Impacts on muskoxen and moose of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred, muskoxen in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at

the blowout site thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

### Mitigation Measures

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to muskoxen and moose.

- Disturbance -- If development occurs, pipelines must be designed and constructed to accommodate moose and muskoxen movement and migration patterns.
- Pipelines must be located so as to facilitate the containment and cleanup of spilled hydrocarbons.
- Lessees are advised that aircraft should avoid moose and muskoxen concentrations.
- Habitat Loss -- Wherever possible, pipelines must use existing transportation corridors and be buried where soil and geophysical conditions permit.
- Exploration facilities must be temporary and constructed of ice.
- Permanent roads may not be used for exploration and activities must be supported by air service or an existing road system.
- Alteration of riverbanks, except for approved permanent crossings, will be prohibited. Except for approved stream crossings, equipment must not be operated within willow stands (*Salix spp.*).
- To the extent feasible and prudent, facilities will not be sited within one-half mile of the banks of Canning, Echooka, Ivishak, Ribdon, Sagavanirktok, Saviukviayak, Toolik, Kavik, Shaviovik, Kuparuk, Ikillik, Nanushuk, Kanayut, Chandler, Colville, Anaktuvuk, and Killik Rivers, and Accomplishment, Section, and May Creeks.
- Aircraft, seismic, and facility siting restrictions apply to Dall sheep lambing areas and mineral licks.

#### e. Brown Bear

Brown bears can be found throughout the Arctic region in varying densities. The lowest densities occur along the coastal plain. In the Arctic, brown bears are at the northern limits of their range. The availability of food is limited and their reproductive potential is low (ADF&G, 1986a:41).

Habitat Loss: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Quantifying the number of animals involved is difficult. Brown bears travel along the major river corridors and feed in riparian areas of the sale area. Siting facilities outside these areas will reduce potential impacts on brown bears (USDOI, 1987:128).

Disturbance: Brown bears may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Seismic activity, which occurs in winter, may disturb denning bears. Studies have found that radio-collared bears in their dens were disturbed by seismic activities within 1.2 miles of their dens, demonstrated by an increased heart rate and greater movement within the den. However, no negative effect, such as den abandonment, was documented (USDOI, 1987:128).

Interaction with Humans: During exploration and development, human activity may attract foraging bears, especially to refuse disposal areas. Omnivores are attracted to food and food odors associated with human activity, and may become conditioned to non-natural food sources (Baker, 1987). This may pose a threat to human safety and the potential need to shoot "problem" animals. Bears can also be displaced by human land use activities.

Oil Spills: The potential effects of oil spills on brown bears include contamination of individual animals, contamination of habitats, and contamination of some local food sources. Bears feed on fish

concentrations at overwintering and spawning areas. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of brown bears, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of brown bears during cleanup operations.

Gas Blowouts: Impacts on brown bear of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred brown bear in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

### **Mitigation Measures**

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to brown bear.

- Waste management -- lessees must use appropriate methods of garbage and putrescible waste disposal to minimize attracting bears.
- Habitat protection -- lessees must avoid conducting exploration or development activities in the vicinity of occupied dens, or obtain approval for alternative mitigating measures.
- Avoidance of human/bear conflicts --- lessees are encouraged to prepare bear interaction plans.

### **f. Furbearers: Wolves, Wolverine, and Foxes**

Fox populations vary in response to fluctuations in their natural prey sources, but a constant food supply could maintain the fox population at artificially high levels. This could cause near total nest failure of all waterfowl in the development area as foxes prey on eggs and young birds. Foxes and wolves are also noted for their rabies outbreaks, which increase when population densities are high, creating health risks to humans. Activity during exploration and development may attract foraging foxes, and wolves, especially to refuse disposal areas. Wolverines apparently are not attracted to garbage (USDOJ, 1986: 534-537).

Habitat Loss: Habitat destruction would primarily affect foxes through destruction of den sites. Placement of oil and gas infrastructure at or near den sites may either destroy den sites or cause foxes to den elsewhere (USDOJ, 1986:533-536). However, foxes have been known to use culverts and other construction materials for denning. Wolverines occur exclusively in remote regions where human activity is unlikely, therefore, displacement of wolverines from local areas of development is not likely (USDOJ, 1987:127-128).

The effects of direct habitat loss on wolves would be negligible. The abundance of wolves is ultimately determined by the availability of prey. The ability of adults to provide food is the key determinant in wolf-pup survival. Reduction in prey species, such as caribou, could reduce wolf populations (USDOJ, 1987:126).

Disturbance: Wolves are unlikely to be disturbed by development, since they readily habituate to human activity. During construction of the Dalton Highway and TAPS, wolves readily accepted handouts from construction workers (USDOJ, 1987:127). Primary sources of disturbance are seismic activities and aircraft traffic. Helicopters generally invoke a stronger response from wolves and foxes than fixed-wing aircraft. Ice roads connecting well sites and supply areas would provide a source of vehicle disturbance. Impacts of seismic exploration and drilling on wolverines are unknown (USDOJ, 1986:535).

Oil Spills: The general effects of an oil spill on wolves, wolverines, and foxes are similar to that of other terrestrial animals. The potential effects of oil spills include contamination of individual animals,

contamination of habitats, and contamination of some local food sources. Furbearers, particularly foxes, may be attracted to dead, oiled wildlife at a spill site. Foxes may be attracted to the human activity at a spill site by the possibility of finding food or garbage. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of wolves, wolverines and foxes, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of these animals during cleanup operations, with the possible exception of foxes.

Gas Blowouts: Impacts on wolves, wolverines, and foxes of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, animals in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

### Mitigation Measures

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to wolves, wolverines, and foxes.

- Habitat protection -- Exploration facilities must be temporary and must utilize ice roads and pads. Facilities may not be sited within waterbody buffers utilized by furbearers.
- Waste management -- lessees must use appropriate methods of garbage and putrescible waste disposal to minimize attracting wolves, wolverines, and foxes.

## 3. Effects on Subsistence Uses

Traditional subsistence uses include brown bear, caribou, musk ox, and moose harvesting; hunting and trapping of furbearers, such as wolf, fox, weasel, wolverine, and squirrel; the taking of migratory waterfowl and their eggs; the fishing of whitefish, char, salmon, smelt, grayling, trout, and burbot; the collection of berries, edible plants, and wood; and the producing of crafts, clothing, and tools made from these wild resources. Subsistence also includes social activities of consuming, sharing, trading and giving, cooperating, teaching and celebrating among members of the community.

Direct effects on subsistence uses may include increased access and land use limitations, less privacy, immediate effects of oil spills, and potential increase in wage earning opportunities to supplant subsistence activities. Indirect effects include the potential reduction in local fish and wildlife populations due to development, increased travel distance and hunting time required to harvest resources, potential reductions in harvest success rates, increased competition for nearby subsistence resources, improvements in community transportation, trade, and utilities infrastructure, and increased revenues to local government through petroleum revenue taxes.

Alteration of the physical environment may affect migration, nesting, breeding, calving, denning and staging of animals which are sensitive to oil and gas development activities. For example, noise propagation from jet aircraft is known to affect the behavior of molting waterbirds. Drill pads and above-ground pipelines can disrupt annual caribou migrations if not elevated properly or buried. Vehicle traffic may adversely affect foraging caribou by displacing them from preferred forage areas. Such effects can be reduced or avoided by observing mitigation measures which restrict oil and gas activities.

Other physical alterations of the environment from post-sale activity could affect subsistence. If a road adjacent to a pipeline was heavily traveled (as in during a project's construction phase), caribou may avoid the area of higher vehicle activity. The result could be that a subsistence hunter may have to travel farther from the

village in order to capture the affected caribou. Another example might be the industrial use of water, which could affect the drainage pattern of a river distributary, thereby affecting a particular anadromous fish run. The construction of roads, pipelines and drill pads may impact the availability of and access to subsistence plants such as berries.

Any activity that has the potential to harm fish, plant, or wildlife has the potential to affect subsistence. Mitigation measures have been designed to avoid, reduce or minimize biological alterations to the sale area. Reducing impacts to subsistence resources from oil and gas development is a primary goal in lease sale planning. The objective of protecting subsistence uses lies in protecting cultural and biological resources (See previous subsection of this chapter and the following subsection).

The sale area contains critical overwintering habitat for anadromous and resident freshwater such as Dolly Varden, Arctic char, Arctic grayling, burbot, and whitefish (see Chapter Three, "Fish and Wildlife"). These species could be affected by disturbances from some oil and gas activities, such as pipeline river crossings and oil spills. These fish could be directly damaged, or otherwise made less accessible to subsistence fishers.

Community well-being depends on the continued use of subsistence resources because they are culturally and economically significant. The subsistence way of life, with its associated values of sharing food and its influence on the extended family and traditional knowledge, is considered an integral part of being Inupiat. In addition to this cultural component, subsistence is the direct source of economic well being for NSB residents. Subsistence resources enter into household income as a food source that does not have to be purchased. A loss of subsistence resources would be a loss of income for the entire community (MMS, 1996b:IV-B-57).

Previous subsections of this chapter describe the potential impacts to fish and wildlife populations due to habitat loss, disturbance, oil spills, and gas blowouts. They also discuss the mitigation measures that will be imposed to maintain fish and wildlife populations. Additional site-specific and project-specific mitigation measures may be required later if exploration and development take place.

As new discoveries are made, the number of development-related facilities will increase, and portions of the developed areas could be closed to public access, reducing the area available for subsistence activities. If subsistence hunters are displaced from traditional hunting areas they might have to travel greater distances and spend more time harvesting resources. At the same time, increased public access to hunting, fishing, and trapping areas, due to construction of new roads, could increase competition between user groups for subsistence resources. If competition for scarce resources on the North Slope were to increase, game managers would restrict non-subsistence hunting and fishing, as they have done for moose. Management practices to restrict non-local resident hunting are in place for Game Management Unit 26. See Chapter Four for a description of sport hunting and fishing in the sale area.

Impacts on subsistence usage from oil and gas exploration, development, production, and transportation depend on mitigation measures, operator and lease holder company policies, and all applicable wildlife conservation and protection laws. Additionally, Alaska Air Quality Control regulations may require temporary air exclusion zones around new facilities identified under 18 AAC 50.300. ADEC may require as a condition of permit approval, air exclusion zones around facilities and operations that exceed allowable emissions. Operators may be required by ADEC to restrict public access within 1.5 kilometers of such facilities. All plans of operations proposals (approval of these plans is required before any exploration or development activity can begin) are reviewed for consistency with applicable laws, including the Alaska Coastal Management Program and North Slope Borough Coastal Management Plan (NSBCMP). The entire sale area is located within the NSB Coastal Management Zone. The NSBCMP Standards for Development Policy 2.4.3(d) states, "Development shall not preclude reasonable subsistence user access to a subsistence

resource." For a complete review of this sale's consistency with coastal management plans, see *"Alaska Coastal Management Program Consistency Analysis Regarding Proposed Oil and Gas Lease Sale, North Slope Foothills."* (June 14, 2000).

ACMP standards are applied at the lease sale stage and they will be reapplied at all future phases. Under 6 AAC 80.120, Coastal Management Districts must identify areas in which subsistence is the dominant use of coastal areas and resources. Under (d) of that section, a study of the possible adverse impacts of the proposed potentially conflicting use or activity upon subsistence usage must be conducted for these designated areas and safeguards must be appropriated to protect the subsistence usage priority. This applies when an activity, use or project is actually proposed.

Subsistence conflict resolution --Prior to initiating any activity that may disrupt subsistence harvesting, lessees must consult with the affected community to discuss potential conflicts before plans of operation are approved. Lessees are advised to consult with the NSB when planning operations and generate potential solutions to problems. The parties must discuss the reasonably foreseeable effect on subsistence activities of any other operations in the area that they know will occur during the lessee's proposed operations. A discussion of resolutions reached and plans for continued consultation shall be included in the plan of operations. If the parties cannot agree, the commissioner or his representative may assemble them. Lessees are advised that interfering with reasonable access to subsistence resources violates the ACMP and NSB Municipal Code.

### **Mitigation Measures**

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to subsistence.

- Harvest disruption --Copies of seismic permit applications will be made available to the NSB and potentially affected subsistence communities for comment. Lessees are advised that interfering with reasonable access to subsistence resources violates the ACMP and NSB Municipal Code. Aircraft must avoid sensitive bird habitat, and vertical and horizontal buffers separating aircraft from waterfowl, caribou, and muskoxen may be required. Identified sensitive habitats must be avoided and potential adverse impacts considered in operations planning.
- Exploratory drilling operations may be restricted during the fall caribou migration to allow for subsistence hunting.
- Historic and Archaeological Site Preservation -- Lessees must conduct an inventory of traditional use sites in the area proposed for activity and ensure that archaeological resources are preserved. Lessees must include in any development plan, a program to educate oil field workers about community values, customs, lifestyles, and laws protecting cultural resources in the sale area.
- Unrestricted access -- No restriction of public access to, or use of, the lease sale area due to oil and gas activity will be permitted, except within the immediate vicinity of drill sites, buildings and other related facilities. Any area of restricted access must be justified in the plan of operations.
- Oil Spill Prevention and Response -- In addition to addressing the prevention, detection, and cleanup of releases of oil, contingency plans (c-Plans) include methods for detecting, responding to, and controlling blowouts; the location and identification of oil spill cleanup equipment; the location and availability of suitable alternative drilling equipment; a plan of operations to mobilize and drill a relief well.
- Harvest conflict resolution -- lessees must cooperate with agencies and the public to avoid conflicts by selecting alternative sites or implementing seasonal restrictions on certain activities, and by siting permanent facilities a minimum distance from rivers. Prior to initiating any activity which may disrupt

subsistence harvesting, lessees must consult with the affected community before plans of operation may be approved. Lessees are advised to consult with the NSB during planning of operations.

- Community participation -- Lessees are advised to bring local residents into their operations planning process. Residents can provide critical input and traditional knowledge to operations and oil spill prevention and response plans. Community representation on management teams facilitate understanding and the transfer of information between the lessee and the residents.

## 4. Effects on Historic and Cultural Uses

Cultural and historic resources are those sites and artifacts having significance to the culture of Arctic people. Historic and cultural sites are those identified by the National Register of Historic Sites, and include those identified in the NSB Traditional Land Use Inventory (TLUI), by the Commission on Inupiat History, Language and Culture, and sites identified in other published studies. Many places, such as ancient village locations along the distributaries of the Colville River, which contain archaeologically important relics continue to be used today. Information regarding important cultural and historic sites can be obtained by contacting the North Slope Borough Planning Department. See also Hoffman, et al., (1988), Jacobson and Wentworth (1982), the Nuiqsut Cultural Plan (NSB, 1979), and the NSBCMP Background Report and Coastal Resource Atlas (NSB 1984:b) and the NSB Municipal Code (NSBMC 19.70.050(E)).

Under NSB Land Management Regulations, any proposed development project shall not impact any historic, prehistoric or archaeological resource prior to an assessment of that resource by a professional archaeologist (NSBMC 19.50.030(F)). Additional protection from development disturbance is assured under NSBCMP Policy 2.4.3 to "sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state or local history or prehistory..." Finally, under NSB Land Management Regulation 19.70.050(F), "Development shall not significantly interfere with traditional activities at cultural or historic sites identified in the NSBCMP. These provisions give the NSB significant authority to protect both cultural historic resources, and current subsistence uses of these sites.

"It is the policy of the state to preserve and protect the historic, prehistoric and archeological resources of Alaska from loss, desecration and destruction . . ." AS 41.35.010. Existing statutes, which apply to both known sites and newly discovered sites, are:

- AS 41.35.200(a) prohibits a person from unlawfully appropriating, excavating, removing, injuring or destroying any historic, prehistoric, or archeological resources of the state. "Historic, prehistoric, or archeological resources" include "deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistoric culture of people in the state as well as to the natural history of the state." AS 41.35.230(2). Violators of this statute are subject to criminal (misdemeanor) penalties and civil penalties (fines up to \$100,000 per violation). AS 41.35.210, 215.
- AS 41.35.200(c) prohibits the unlawful destruction, mutilation, defacement, injury to, removal of or excavation of a grave site, tomb, monument, gravestone, or other structure or object at a grave site, even if the grave site appears to be abandoned, lost, or neglected. Violators of this statute are subject to the same penalties listed above for AS 41.35.200(a) [historic, prehistoric and archeological resources].

Potential impacts could occur in either the exploration, development, or production phases, but are more likely to occur if there is development. Impacts include disruption of culture and disturbance of historic and archeological sites.

## Historic use and archeological sites

The Alaska Heritage Resources Survey is an inventory of all reported historic and prehistoric sites within the state of Alaska. This inventory of cultural resources includes objects, structures, buildings, sites, districts, and travelways, with a general provision that they be over 50 years old. By knowing of possible cultural remains prior to construction, efforts can be made to avoid project delays and prevent unnecessary destruction. Listing on the AHRS does not, in and of itself, provide protection for sites.

For each individual site, the Office of History and Archaeology maintains a site record card containing such information as the site name, a description of the physical remains, data on the site's location, and list of bibliographic citations, as well as a variety of additional information relevant to management and research needs. DO&G has researched the available resources and found there are approximately 647 known historic or prehistoric sites in the sale area. There is a high potential for the discovery of additional sites (Dale, 2000).

Disturbance: Impacts may be caused by surface vehicle traffic, construction activity associated with drill pads, roads, airstrips, pipelines and processing facilities. Damage to archaeological sites can include direct breakage of cultural objects, damage to vegetation and thermal regime leading to erosion and deterioration of organic sites, and shifting or mixing of components in sites resulting in loss of association between objects. Crews at archeological or historic sites could damage or destroy sites by collecting artifacts (USDOI, 1986:537-539).

Oil Spills: Oil spills can have an indirect effect on archaeological sites by contamination of organic material, which would eliminate the possibility of using carbon dating methods (USDOI, 1986:537). The *Exxon Valdez* oil spill cleanup demonstrated that archaeological resources generally were not directly affected by the spill. The largest effects came from vandalism, because more people knew about the location of the resources and were present at the sites. That knowledge increased as the population and activities increased during the cleanup process (Bittner, 1993).

The detrimental effects of cleanup were slight during the *Exxon Valdez* oil spill because the work plan for cleanup was constantly reviewed, and cleanup techniques were changed as needed to protect archeological and cultural resources (Bittner, 1993).

Gas Blowouts: Disturbance to historical and archeological sites might occur as a result of a gas blowout or explosion. Cleanup after such accidents could result in disturbance by cleanup workers in the vicinity of the accident site. Archaeological resources in the immediate vicinity of the blowout might be destroyed.

## Mitigation Measures

For a complete listing of sale mitigation measures and lessee advisories in their entirety, see Chapter Seven. The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to historic, prehistoric, archeological resources, and cultural use areas.

- Education -- lessees are required to conduct training for all employees and contractors on environmental, social, and cultural concerns in the sale area.
- Protection of historic and archeological sites -- prior to exploration activities involving ground disturbance, and subsequent development, lessees must conduct an archeological inventory. If any objects are discovered at any time, they must be reported, and appropriate protective measures followed.





# Chapter Six: Issues Related to Oil and Gas Exploration, Development, Production, and Transportation

## Contents

- Issues Related to Oil and Gas Exploration, Development, Production, and Transportation ..... 6-1
  - A. Geophysical Hazards ..... 6-1
    - 1. Earthquakes ..... 6-1
    - 2. Frozen Ground ..... 6-3
    - 3. Seasonal Flooding And Icings ..... 6-3
    - 4. River-Bank Erosion ..... 6-3
    - 5. Conclusions ..... 6-4
  - B. Likely Methods of Transportation ..... 6-4
    - 1. Pipelines ..... 6-4
    - 2. Marine Terminals ..... 6-8
    - 3. Tanker Vessels ..... 6-8
  - C. Oil Spill Risk ..... 6-10
  - D. Oil Spill Prevention ..... 6-11
    - 1. Pipeline Leak Detection ..... 6-11
    - 2. Marine Terminals ..... 6-14
    - 3. Tanker Vessels ..... 6-14



# Chapter Six: Issues Related to Oil and Gas Exploration, Development, Production, and Transportation

## A. Geophysical Hazards

Geologic processes in this area will impose moderate constraints to exploration, production, and transportation activities associated with possible petroleum development, but can be mitigated through proper siting, design, and construction. Primary potential hazards within and around the area include earthquakes, frozen-ground phenomena, seasonal flooding, stream icings (aufeis), and riverbank erosion. This section provides a brief summary of available information related to these hazards in the North Slope Foothills area (Pinney and Combellick, 2000).

### 1. Earthquakes

Although northern Alaska is generally considered an area of low earthquake activity, there is a band of seismicity that extends south to north through the Arctic National Wildlife Refuge. The sale area lies along the western margin of this seismic zone (Pinney and Combellick, 2000).

In the region around the sale area, approximately 150 earthquakes were recorded between January 1968 and January 1998 (Figure 6.1). These included a magnitude 5.7 event in 1994, magnitude 5.2 event in 1993, and a magnitude 5.1 event in 1986. A magnitude 5.1 event occurred in the northeastern part of the sale area on June 19, 1969, and a magnitude 5.0 event occurred near the western edge on August 31, 1995 (Pinney and Combellick, 2000).

Wesson and others (Pinney and Combellick, 2000 citing to Wesson, 1999) estimate a 10 percent probability of exceeding 0.10 g<sup>1</sup> earthquake-generated horizontal acceleration in bedrock during a 50-yr period in this area (Figure 6.2). For comparison, ground acceleration in Anchorage during the great 1964 earthquake was estimated at 0.16 g. Accelerations in areas underlain by thick, soft sediments are likely to be higher than in bedrock due to amplification. However, thick permafrost may cause the earthquake response of sediments to be more like bedrock, which would limit amplification effects and would also tend to prevent earthquake-induced ground failure such as liquefaction. The effects of permafrost on earthquake response of sediments has not been documented.

The sale area is almost entirely within seismic zone 1 of the Uniform Building Code (on a scale of 0 to 4, where 4 represents the highest earthquake hazard). All structures in the area should be built to meet or exceed the UBC requirements for zone 1 (Pinney and Combellick, 2000).

There are no known active faults in or around the lease sale area (Pinney and Combellick, 2000 citing to Plafker and others, 1994).

---

<sup>1</sup> Gravitational acceleration. One g equals an acceleration rate of 32 feet per second per second.

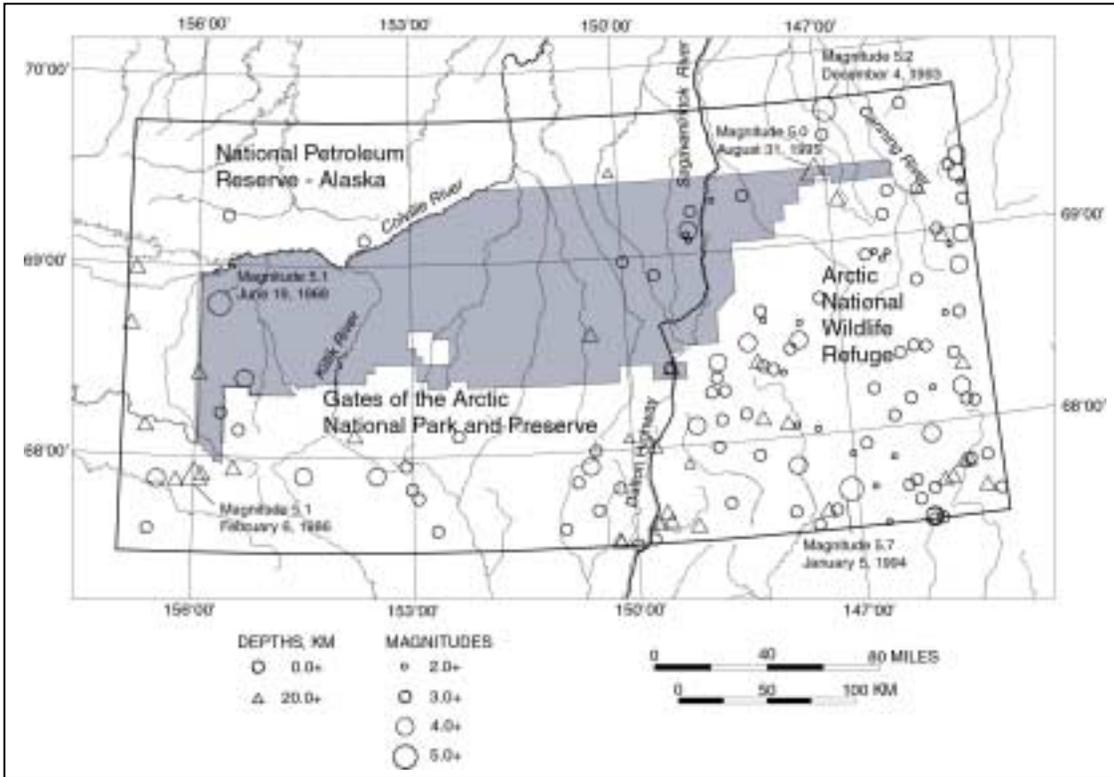


Figure 6.1. Map showing recent seismicity in the North Slope Foothills region, Alaska, and approximate boundaries of the sale area. (Pinney and Combellick, 2000 citing to Alaska Earthquake Information Center).

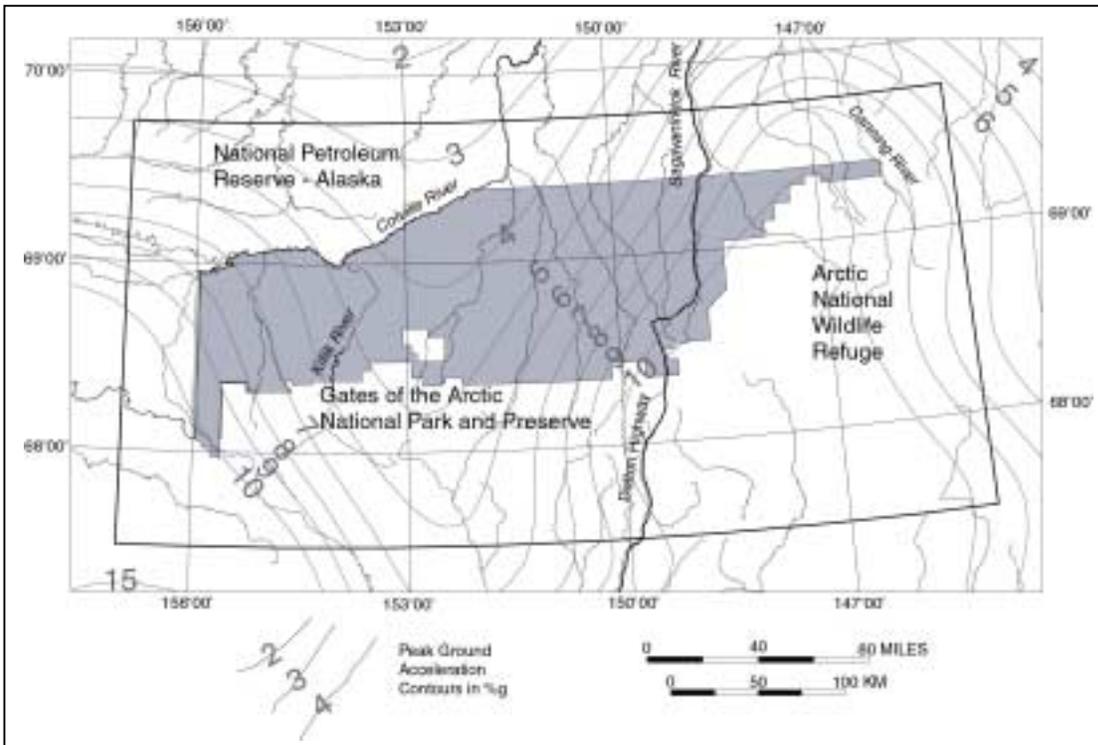


Figure 6.2. Map showing peak ground acceleration with 10 percent probability of exceedance in 50 years in the North Slope Foothills region, Alaska, and approximate boundaries of the sale area. (Pinney and Combellick, 2000 citing to Wesson and others, 1999).

## 2. Frozen Ground

All of the sale area is underlain by perennially frozen ground. Depth of seasonal thaw is generally less than 3 ft below the surface and 6 ft beneath active stream channels. Ice content varies from minor segregated ice to massive ice in the form of wedges and pingos. Ice content is highest in fine-grained, organic-rich deposits and lowest in coarse granular deposits and bedrock. Depth to the base of ice-bearing permafrost ranges from less than 400 ft in the southern part of the area to about 1600 ft in the northern part of the area (Pinney and Combellick, 2000 citing to Collett and others, 1989).

Thaw settlement will potentially occur whenever a heated structure is placed on ground underlain by shallow, ice-rich permafrost if proper engineering measures are not taken to adequately support the structure and prevent the building heat from melting the ground ice. Seasonal freeze-thaw processes will cause frost jacking of unheated structures placed in and on frost-susceptible soils unless the structures are firmly anchored into the ground with deep pilings or supported on non-frost-susceptible fill. Frost susceptibility is highest in fine-grained alluvium, colluvium, and thaw-lake deposits; moderate in alluvial-fan deposits and till; and lowest in coarse-grained floodplain deposits, alluvial terrace deposits, and well-drained bedrock (Pinney and Combellick, 2000 citing to Carter and others, 1986; Ferrians, 1971; Yeend, 1973a,b). Site-specific geotechnical studies should be conducted prior to any development activities to assess the local permafrost conditions. Permafrost problems can be mitigated through proper siting, design, and construction considerations. Pipelines can be trenched, backfilled, insulated (if buried), or elevated to prevent thawing of permafrost.

## 3. Seasonal Flooding And Icings

Floods occur annually along most rivers and many adjacent low terraces due to seasonal snow melt and jamming (Pinney and Combellick, 2000 citing to Rawlinson, 1993). Additionally, rivers in this area are subject to seasonal icing (aufeis) prior to spring thaw due to overflow of stream or ground water under pressure. In areas of repeated overflow, residual ice sheets often become thick enough to extend beyond the floodplain margin. Very large overflows and residual ice sheets have been documented on the Ambler, Anaktuvuk, Sagavanirktok, Shaviovik, Kavik, Ivishak, Junjik, Ribdon, Killik, Canning, Saviukviayak, and Echooka rivers (Pinney and Combellick, 2000 citing to Dean, 1984). Pre-development planning should include surveys of spring break-up activity, as well as flood-frequency analyses.

## 4. River-Bank Erosion

River banks in the region are subject to thermo-erosion processes that involve (1) thawing and removal of frozen sediments by stream water, creating a niche at the base of the bank, (2) collapse and slumping of overhanging riverbank materials, and (3) removal of the materials by flowage and stream action. Rates of erosion are highest along riverbanks composed of fine-grained, ice-rich sediments.

Sediment cohesiveness is a major factor in determining bank erodibility. Higher erosion rates occur in braided channels, which usually form in noncohesive sediment (Pinney and Combellick, 2000 citing to Scott, 1978). Along the Sagavanirktok River, aerial photographs showed a maximum erosion rate of 15 ft per year during a 20-yr period, but less than 12 percent of the vegetated bank was affected (Pinney and Combellick, 2000 citing to Brice, 1971). Most of the erosion appears to occur in small increments during breakup flooding and is concentrated in specific reaches where local conditions are favorable for thermo-erosional niching. Structural failure can be avoided by proper facility setbacks from rivers and main tributaries.

## 5. Conclusions

Development in the sale area would be subject to moderate geologic hazards, including earthquake shaking, thaw settlement, and seasonal frost action. Structures along rivers may be affected by seasonal flooding, local stream icing and bank erosion. Mitigation Measure 19 establishes a 500 foot setback from fishbearing streams. All structures should be built to meet or exceed requirements of the Uniform Building Code for seismic zone 1. Additional precautions should be taken to identify and accommodate special considerations such as unstable ground, flooding, and other local hazards. Proper siting and engineering will minimize the detrimental effects of these natural processes (Pinney and Combellick, 2000).

### B. Likely Methods of Transportation

The location and nature of oil or gas deposits determine the type and extent of facilities necessary to develop and transport the resource. Strategies used to transport potential petroleum resources depend on many factors, most of which are unique to an individual discovery. The following is a general discussion of the components that might be in any transportation system.

#### 1. Pipelines

If commercial quantities of oil are found in the sale area, it will go to market via the Trans-Alaska Pipeline System (TAPS), a 798-mile pipeline from Prudhoe Bay to Valdez. From Valdez, the oil is transported to the U. S. West Coast, and the U. S. Gulf Coast via tanker. In-field gathering lines bring the oil from individual well sites to processing facilities for injection into TAPS.

Feeder pipelines will be constructed to TAPS. These are either elevated or buried depending on local soil conditions and other considerations such as movement of wildlife. An individual pipeline may alternate between buried and elevated, as is the case with TAPS. The advantages and disadvantages of the two options are set forth below. It is possible that a transportation system used for oil or gas from the sale area would be based upon both options. The mode of transport from a discovery will be an important factor in determining whether or not discoveries can be economically produced. Buried pipelines are more expensive to install and maintain than elevated pipelines. The more expensive a given transportation option, the larger a discovery will have to be for economic viability.

##### a. Elevated Pipelines

Elevated pipelines are typically used in North Slope oil field development to prevent heat transfer from the hot oil in the pipeline to frozen soils, since heat would degrade the permafrost. Elevated pipelines are easy to maintain and visually inspect for leaks. However, above-ground pipelines can restrict caribou and other wildlife movements unless provisions are made to allow for their safe passage. For the Alpine development project, ARCO increased the standard five-foot minimum in some areas to accommodate undulating terrain, thus minimizing vertical bends in the pipeline. To further enhance caribou and human crossing, selected portions of the pipeline were elevated 7 to 8 feet near streams and lakes where caribou and human use are high (Fowler, 2000).

There appears to be a cumulative effect of roads and adjacent pipelines that creates a barrier to caribou crossing (See Chapter Five, "Cumulative Effects"). Pipelines elevated at least five feet have been shown to be effective except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles/hour). Roads with low levels of traffic and no adjacent parallel pipeline are not significant barriers to movement of caribou. The Alaska Caribou Steering Committee concludes the most effective mitigation is achieved when pipelines and roads are separated by at least 500 feet. Lessees are encouraged (Lease

Advisory 10) in planning and design activities to consider the recommendations for oil field design and operations contained in the final report of the Alaska Caribou Steering Committee (Cronin et al., 1994:10).

### **b. Buried Pipelines**

Buried pipelines are feasible in the Arctic provided that the integrity of the frozen soils is maintained. Such pipeline configurations have been used in the Milne Point area. There are some important considerations regarding long sections of buried pipe. First is cost, which depends on length, topography, soils, and distance from the gravel mine site to the pipeline. Second, buried pipe is more difficult to monitor and maintain. However, significant technological advances in leak detection systems have been made which increase the ease with which buried pipelines can be monitored. These systems are described under the oil spill prevention subsection in Chapter Six. Third, buried pipelines may involve increased loss of wetlands because of gravel fill. Finally, buried pipelines are sometimes not feasible from an engineering standpoint because of the thermal stability of fill and underlying substrate (Cronin et al., 1994:10).

For its Alpine development project, which went into production in November of 2000, ARCO constructed a buried oil pipeline under the Colville River. The pipeline was installed at a depth of approximately 50 feet or greater beneath the riverbed using horizontal directional drilling methods. The pipeline is insulated and is operated such that the oil temperature ensures that thaw settlement will be within tolerable limits. The leak detection system employs a state-of-the-art pressure point analysis (PPA) system supplemented by the use of inspection pigs, visual monitoring, and forward looking infrared (FLIR) technology. The Colville River pipeline is designed for a minimum service life of 20 years (Fowler, 2000).

### **c. Cleanup and Remediation**

Cleanup plans for terrestrial and wetlands spills must balance the objectives of maximizing recovery while 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, toxicity and destination of the spilled oil can help identify those cleanup techniques that can reduce the ecological impacts of an oil spill. Hundreds of laboratory and field experiments have investigated the destination, uptake, toxicity, behavioral responses, and population and community responses to crude oil. (Jorgenson, 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 6.1 lists cleanup objectives and techniques that may be applicable to each objective.

**Table 6.1: Advantages and Disadvantages of Techniques for Cleaning Up Crude Oil in Terrestrial and Wetland Ecosystems (Adapted from Jorgenson, 1996)**

Technique	Advantage	Disadvantage	Recommended
<b>Wildlife:</b>			
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
<b>Containment:</b>			
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
<b>Contact:</b>			
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
<b>Access:</b>			
Boardwalks	Reduces trampling	None	Yes
<b>Removal:</b>			
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

<b>Technique</b>	<b>Advantage</b>	<b>Disadvantage</b>	<b>Recommended</b>
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

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. As much as 40 percent of most crude oils may evaporate within a week after a spill. The factors that are most important during the initial stages of cleanup are the evaporation, solubility and movement of the spilled oil. Over the long term, microscopic organisms (bacteria and fungi) break down oil (Jorgenson, 1996).

Cleanup phases include initial response, remediation and restoration. During initial response, the spiller 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. The restoration phase usually includes a monitoring program to assess the results of the restoration activities (Jorgenson, 1996).

### **Mitigation Measures**

Any crude oil ultimately produced from this sale will have to be transported to market. It is important to note that the decision to lease oil and gas resources in the state does not authorize the transportation of any oil. If and when oil is found in commercial quantities and production of oil is proposed, final decisions on transporting that oil will be made through the local, state, and federal permitting process. That process will consider any required changes in oil spill contingency planning and other environmental safeguards.

No oil or gas will be transported from a lease until the lessee has obtained the necessary permits and authorizations from federal, state, and local governments. The state has broad authority to withhold, restrict, and condition its approval of transportation facilities. In addition, both the North Slope Borough and the federal government have jurisdiction over various aspects of any transportation alternative. Mitigation measures and lease advisories (listed in Chapter Seven) that mitigate any potential impacts of the selected transportation mode are:

- Mitigation Measure 7a requires that pipelines be located so as to facilitate the containment and cleanup of spilled hydrocarbons.
- Mitigation Measure 7b requires that pipelines be designed and built to provide adequate protection from geophysical and other hazards.
- Mitigation Measure 8 requires that pipelines be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns.

- Lessee Advisory 7 alerts lessees that they must develop an approved c-plan before they may begin operations. Among many other requirements, c-plans must identify the location of oil spill cleanup equipment; the location and availability of suitable alternative drilling equipment; and develop a plan of operations to mobilize and drill a relief well.

## 2. Marine Terminals

There are no marine terminals on the North Slope due to the presence of ice for most of the year. The Valdez terminal receives North Slope crude through TAPS, stores it and loads it onto tanker vessels for transport to the west coast of the United States and Pacific Rim. Most North Slope crude is transported to the U.S. west coast.

The Valdez terminal has maintained records of all spills since startup in 1977. From June 1977 to November 1994, there have been 48 spills greater than 55 gallons from terminal equipment or systems. Of these spills 34 (70 percent) were to land, 10 incidences (20 percent) were to water, and 4 (8 percent) were to both land and water. The causes have been personnel error and equipment failure or unknown. Twenty-six (42 percent) of the spills were North Slope crude, 19 (38 percent) were diesel fuel or lubricants, and 8 (11 percent) were chemicals and water (Alyeska Pipeline Service Co., 1996).

Petroleum hydrocarbons may enter Port Valdez harbor from ballast water that is off-loaded from incoming tankers. The water is treated to remove residual petroleum hydrocarbons and then discharged via a submarine diffuser into the inlet (Jarvella 1987:582). A four year, pre- and post-operational study undertaken by the University of Alaska (Jarvella 1987, citing Colonell 1980) concluded that no adverse effects on the fjord were presently evident (Jarvella 1987:582). Monitoring continues under National Pollutant Discharge Elimination System (NPDES) permits.

The stationary nature of exploration, production and terminal facilities and the predictability of maximum spill rates based on production rates and storage amounts somewhat simplifies the development and implementation of oil spill contingency plans for those facilities. In contrast, the mobile nature of tankers, the large volumes carried and the exposure to marine hazards places tankers at higher risk for oil spills. A badly damaged tanker can spill millions of gallons of oil in a matter of hours.

## 3. Tanker Vessels

North Slope crude oil is carried from the Port of Valdez to the U.S. west coast and to the Nikiski refinery in Cook Inlet. According to the most recent statistics, worldwide tanker spill rates have stayed constant at 1.20 spills (greater than 1,000 bbl) per billion bbl transported. The tanker spill rate for North Slope crude oil has been 0.98 spills per billion bbl (Anderson, 2000). 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 since ocean currents and tidal actions carry the oil over a much larger area.

During the summer of 1987, the tanker *Glacier Bay* spilled between 2,350-3,800 bbl of North Slope crude oil being transported into Cook Inlet for processing at the Nikiski Refinery (ADEC, 1988:1). Less than ten percent of the oil was recovered, and the spill interrupted commercial fishing activities in the vicinity of Kalgin Island during the peak of the red salmon run. Although not on the scale of the *Exxon Valdez* spill, this spill focused attention on oil spill response and cleanup capabilities in Cook Inlet.

An example of the potential magnitude of a tanker spill is the March 1989 *Exxon Valdez* spill, the largest recorded spill in U.S. waters (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 “*Exxon Valdez* Oil Spill Information Packet”). Effects of the oil spill on fish and other wildlife can be found in this finding in the section entitled Cumulative Effects.

The 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* spill in Cook Inlet, tidal currents and confusion concerning who would respond to the spill caused response problems. During the *Exxon Valdez* 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 updated or practiced and equipment stockpiles were not sufficient nor easily accessible.

In May 1994, a cracked hull in the *Eastern Lion* allowed approximately 8,400 gallons of crude oil to leak into the port of Valdez while the vessel was berthed at the marine terminal. As a result of analyzing response methods, Alyeska Pipeline purchased shallow draft boats to allow access of tow boom to the shallow duck flats area and a new ramp is to be built at the fish hatchery to move booms more efficiently from shore to water (Alaska Journal of Commerce, 1994a).

The *Glacier Bay* and *Exxon Valdez* incidents demonstrated that preventing catastrophic tanker spills is easier than cleaning them up and focused public, agency, and legislative attention on the prevention and cleanup of oil spills. Numerous changes were made 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)).

Tankers heading south out of Hinchinbrook Entrance stay 50 to 200 miles offshore, depending on each company’s route and sea and ice conditions. The U. S. Coast Guard does not establish the route. Since November 1994, new USCG safety regulations for tankers operating in the Prince William Sound area, especially through the Valdez Narrows, require tankers to add a third tugboat to accompany tankers when winds exceed 20 knots instead of 30 knots. Shippers voluntarily reduce tanker speed through the Narrows from 6 knots to 5 knots to enable a tugboat attached to the back of a tanker to guide the tanker more effectively.

An independent risk assessment study of oil tankers traversing Prince William Sound concludes that current safeguards instituted after the *Exxon Valdez* oil spill have significantly reduced the risks of oil spills. The study recommended a number of additional improvements to further reduce risk, and the TAPS shippers are instituting many new safeguards. The shippers are working with Alyeska to:

- Charter a high-powered tug for deployment at Cape Hinchinbrook to reduce the risk of a tanker grounding;
- Upgrade the current fleet of tugs with at least two newly enhanced tugs, incorporating risk assessment recommendations and the state’s new "best available technology" regulations;
- Revise tug operating procedures for Valdez Narrows to minimize dangers of human error identified in the risk assessment;
- Work with the U.S. Guard and ADEC to implement a new escort system using prepositioned tugs in central Prince William Sound to reduce the risk of a collision;
- Test new tractor tugs for use in Valdez Narrows; and
- Place new tractor tugs in service as soon as possible if their performance is equal to or better than the tethered-tug system currently in use.

## C. Oil Spill Risk

Any time crude oil or petroleum products are handled there is a risk that a spill might occur. Oil spills associated with exploration, development, production, storage, and transportation of crude oil may occur from well incidents (blowouts), pipeline spills, tanker spills, and chronic operational spills of low volumes involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels and other facilities. MMS (Anderson and LaBelle) quantify oil spill risk based on U.S. Gulf of Mexico and Pacific coast OCS development using the number of spills per billion barrels of oil transported as the variable. Draft statistics for the entire U.S. OCS dated July 2000, show a spill rate of 1.33 spills (larger than 1,000 bbl) for pipelines, 0.32 for platforms, 1.20 for tankers, and 0.98 for North Slope tankers (Anderson, 2000).

Hart Crowser Inc. prepared a study (*Estimation of Oil Spill Risk From Alaska North Slope, Trans-Alaska Pipeline, and Arctic Canada Oil Spill Data Sets*) for MMS in 2000. In comparison to Anderson and LaBelle, this study gathered and used data on oil spills with a lower quantity threshold (100 barrels and larger) from within eight study areas including the Alaska North Slope, TAPS, and Arctic Canada between 1970 and 1999. Hart Crowser identified 126 spills of 100 bbl or greater. Of these, 111 occurred in Alaska and 15 in Canada. When spill size was plotted by year to see if regulatory or reporting requirements had a significant effect, it appeared that in the period from 1975 to 1979 there were a considerable number of large spills, and then the number of spills dropped to a more or less constant rate. Hart Crowser concluded that spill rate is the best variable in predicting the volume of further oil spills and that a rate of approximately 52 gallons of oil spilled per million bbl of oil produced will be average. They also calculated oil spill risk based on the number of spills of a given volume per million bbl of crude produced using data from 1978 through 1999. They found these rates to be:

- 0.0053 spills per billion bbl produced  $\pm$ 24 percent, for spills of 100 bbl or greater
- 0.00093 spills per billion bbl produced  $\pm$ 58 percent, for spills of 500 bbl or greater
- 0.00039 spills per billion bbl produced  $\pm$ 89 percent, for spills of 1,000 bbl or greater
- 0.000078 spills per billion bbl produced  $\pm$ 200 percent, for spills of 10,000 bbl or greater

In its NPR-A EIS, MMS has performed a quantitative oil spill analysis for North Slope onshore oil and gas exploration and development spills. The pattern of crude-oil spills that occurred on the North Slope is one of numerous small spills. Thirty-two percent of crude oil spills that occurred between 1989 and 1996 were less than or equal to 2 gallons. Fifty-six percent were less than or equal to 5 gallons. During that time period, no spill greater than 1,000 bbl occurred. The database spill size ranged from greater than 1 gallon to 925 bbl. The average crude oil spill is 3.8 bbl, and the median spill size is 7 gallons. The estimated crude oil spill rate for the North Slope is 199 spills per billion bbl produced (MMS, 1998:IV-A-31).

This information shows that most spills associated with exploration or production facilities are normally quite small, 5 bbl (210 gal) or less, and are usually related to everyday operations. Even a worst-case oil discharge from an exploration facility, production facility, or pipeline is restricted by the maximum storage capacity or the well's ability to produce oil. For example, a well with a maximum production rate of 2,500 bbl per day will only spill a maximum of 2,500 bbl per day (Powers, 1989:2). As another example, a 14-inch pipeline can store approximately 1,000 bbl of oil per mile of pipeline length. Accordingly, under static conditions if oil were lost from a five mile stretch of pipeline (a hypothetical distance or spacing between emergency block valves), then a maximum of 5,000 bbl of oil is all that would be discharged into the environment.

The state has enacted stringent oil spill prevention, control, and cleanup legislation (AS 46.04.010-900). The statute requires oil spill contingency plans which include methods for detecting, responding to, and

controlling blowouts; prevention, control, and cleanup plans; and location and identification of cleanup equipment.

The risks associated with producing and transporting oil can never be reduced to zero. There is always some chance that spills will result from exploration, production, storage, and transportation of oil. However, the state's goal is to reduce the possibilities of spills to a level of acceptable risk and to improve the ability to respond to spills when they happen.

The stationary nature of North Slope exploration and production facilities and the predictability of maximum spill rates simplify the development and implementation of oil spill contingency plans for those facilities. Even TAPS, with the tremendous quantities of oil flowing through that system, is designed to quickly shut down in the event of a rapid decrease in pressure such as would happen if there was a major break in the line. This safety feature, and many others, such as daily visual monitoring and block valves along the entire pipeline, limit the volume of a spill.

## D. Oil Spill Prevention

### 1. Pipeline Leak Detection

The technology for monitoring pipelines is continually improving. A number of leak detection systems are already in use or proposed for Alaska oil and gas pipeline development. Elements of these systems could be incorporated into any new pipelines constructed in the sale area. Leak detection systems and effective emergency shut-down equipment and procedures are essential in preventing discharges of oil from any pipeline. 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, 1986:68). Industry on the North Slope currently uses the volume balancing method to determine this rate, which involves comparing input volume to output volume.

Leak detection methods include acoustic monitoring, pressure point analysis, and combinations of some or all of the different methods (Yoon, Mensik, and Luk 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, 1989:23). 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 hard wire system.

For TAPS, Alyeska employs three systems, which can 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.

### **a. 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.

### **b. Deviation Alarms**

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 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.

### **c. Transient Volume Balance**

TVB can both 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, 1999a).

### **d. LEOS**

Another available detection system is LEOS (Leck Erkennung und Ortungs System), a leak detection and location system manufactured by Siemens AG. The system has been in use for 21 years and in over thirty 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. A diffusion layer of EVA surrounds and allows gasses 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 gasses 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 gasses 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 will be made for the cold temperatures in which the system will operate and for the backfill installation method that will be used to install the pipeline. The tube will be placed in a protective cover, and the system will be tested continuously as the segments are installed. LEOS will be strapped to the oil pipeline next to the poly spacers that will separate the gas line from the oil line. The system will detect leaks from both lines, and operators will be able to tell the difference between the two. Engineers estimate that it will take about 5 to 6 hours for leaked molecules to migrate to the LEOS tube. The air inside the tube will be evacuated and tested every 24 hours

### **e. Smart Pigs**

Design and use of "smart pigs," data collection devices that are run through the pipeline while it is in operation, has greatly enhanced the ability of a pipeline operator to detect internal and external corrosion and differential pipe settlement in pipelines. These 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 TAPS 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.

#### **f. FLIR**

ARCO Alaska has implemented a comprehensive FLIR (Forward Looking InfraRed) pipeline monitoring program in the Kuparuk oil field to assist in detecting pipeline leaks and corrosion. InfraRed sensors have the ability to sense heat differentials. Since Kuparuk oil flows from the ground at temperatures in excess of 100°F, a leak shows up as a "hot spot" in a 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 effective 80 percent of the time 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 and was used to image spills at both Prudhoe Bay and Kuparuk. The video frames were processed and registered into a GIS map database. The map database, with the overlaid picture of the spill site, was then used to quickly and accurately determine the area of the spill. This action allowed swift and accurate reporting of the spill parameters to the appropriate agencies. The video footage of the spill area allowed the incident command team to receive near real-time information in IR and color. This information permitted timely decisions to be made and the results of those decisions to be reviewed with the subsequent fly-over zone site. Various agencies involved in the process were able to see and verify the results of the cleanup process (ARCO, 1998).

To insure safe operation, pipeline operators would follow the appropriate American Petroleum Institute recommended practices. They would inspect the pipelines regularly to determine if any damage was occurring and would also perform preventative maintenance. Preventive maintenance includes installing improved cathodic protection, using corrosion inhibitors and continuing regular visual inspections.

No oil or gas may be transported from leases until the operator has obtained the necessary permits and authorizations from federal, state, and local governments. ADNR and other state, federal, and local agencies will review the specific transportation system when it is actually proposed.

#### **Mitigation Measures**

The following are summaries of some applicable mitigation measures. For a complete listing of sale mitigation measures in their entirety, see Chapter Seven. Lease sale plan of operation terms and lessee advisories that would mitigate potential impacts to land habitat organisms are:

- Oil Spill Prevention and Control -- Lessees are advised they must prepare contingency plans addressing prevention, detection, and cleanup of oil spills. Lining, diking and buffer zones are required to separate oil storage facilities from freshwater supplies.
- Wherever possible, onshore pipelines must utilize existing transportation corridors and be buried where soil and geophysical conditions permit. In areas where pipelines must be placed above ground, they must be sited, designed, and constructed to allow free movement of moose and caribou.
- Pipelines must be located upslope of roadways and construction pads and must be designed to facilitate the containment and cleanup of spilled hydrocarbons. Pipelines, flowlines, and gathering lines must be designed and constructed to assure integrity against climatic conditions and other geophysical hazards.

## 2. Marine Terminals

The fixed location of loading facilities at marine terminals improves oil spill response and contingency planning. If a leak occurs, the facility can be rapidly shut down and the spill contained. Spill prevention measures include extensive inspection programs, monitoring of transfer operations, use of proper valves, overfill alarms, construction of secondary and tertiary containment systems around the tanks, facility security programs, training, and drug and alcohol testing of personnel. More detailed information regarding these programs are included in the oil discharge prevention and contingency plans for Alyeska's Valdez terminal.

## 3. Tanker Vessels

Tankers are the most cost effective and the only feasible method for transporting crude oil from Alaska to destinations in the Pacific Rim. Federal legislation through OPA 90 requires the phase-out of single-hulled tankers in favor of double-hulled tankers by the year 2010. Double-bottomed tankers, where at least 30 percent of the area beneath the cargo tank length has two bottoms, are an approved interim measure.

Several of the tankers transiting Prince William Sound are double-hulled, and OPA 90 requires tankers in Prince William Sound to be accompanied by two escort vessels to Hinchinbrook Entrance. Escort tugs are to keep tanker vessels off the rocks should the tanker lose power. Alyeska Pipeline Company's spill response organization, SERVS, maintains five escort response vessels and four tug escort vessels for this purpose. As a result of a recent risk assessment, a high-power escort tug is stationed at Hinchinbrook (Lisiechki, 1997).

Many carriers voluntarily follow various other practices that also reduce the risk of oil spills. These practices may include having two licensed officers or one licensed officer and one licensed marine pilot on deck at all times, keeping anchors ready for emergency use when traversing high risk areas, plotting fixes frequently, conducting unscheduled anchoring drills in the lower inlet, performing regular maintenance procedures and special inspections in preparation for the winter climate, and incorporating special adaptations for tanker use in severe winter conditions.

All tanker crews participate in spill prevention and response training and substance abuse testing. The oil discharge prevention and contingency plans for Prince William Sound vessel operations contain more detailed information regarding spill prevention programs.

# Chapter Seven: Mitigation Measures and Lessee Advisories

## Contents

Mitigation Measures and Lessee Advisories .....	1
1. General Measures .....	3
2. Facilities and Structures .....	4
3. Gravel Mining and Use .....	4
4. Prehistoric, Historic, and Archeological Sites .....	5
5. Training .....	5
6. Local Hire .....	5
7. Subsistence Harvest Protection.....	5
8. Title 16 Streams.....	6
9. Waste Disposal.....	7
10. Specific Measures.....	7
B. Lessee Advisories.....	10



# Chapter Seven: Mitigation Measures and Lessee Advisories

AS 38.05.035(e) and the departmental delegation of authority provide the director, Division of Oil and Gas (DO&G), 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 selected lease-related activities, DO&G has developed mitigation measures and will condition post-sale plans of operation, exploration, or development, and other permits based on these mitigation measures.

Under AS 38.05.035(e), ADNR has authority to apply the following mitigation measures for the North Slope Foothills Areawide 2001 Oil and Gas Lease Sale, to all oil and gas activities performed to access the state's leased mineral interest, regardless of the ownership status of the land from which the lessee seeks access.

Lessees must obtain approval of a detailed plan of operations from the director before conducting exploratory or development activities (11 AAC 83.158). An approved plan of operations is the authorization by which DO&G regulates exploration, development and production activities.

A plan of operations must identify the specific measures, design criteria, and construction methods and standards to be employed to comply with the restrictions listed below. It must also address any potential geohazards that may exist at the site. Plans of operation must comply with coastal zone consistency review standards and procedures established under 6 AAC 50 and 80 including coastal district plans. Applications for required state or federal agency authorizations or permits must be submitted with the plan of operations. DO&G will require, as a condition of consistency approval, such modification or terms as may be necessary to ensure consistency with the ACMP standards.

The measures presented in this preliminary best interest finding were developed after considering measures imposed in other North Slope oil and gas lease sales; fish and wildlife resource and harvest data submitted by ADF&G; and environmental data relating to air and water quality, solid and liquid waste disposal, and oil spills submitted by ADEC. Measures were also developed or modified after considering comments submitted by the public, industry, federal and state agencies, and local government. Additional project-specific mitigation measures may be imposed if and when oil and gas lessees submit plans of exploration, operation, or development.

In addition to compliance with these mitigation measures, lessees must comply with all applicable local, state and federal codes, statutes and regulations, and any subsequent amendments. Federal, state and local government powers to regulate the oil and gas industry are discussed in *the "Governmental Powers to Regulate Oil and Gas Exploration, Development, Production, and Transportation"* in Chapter One of this finding. Additionally, some applicable federal and state statutes and regulations are presented in Appendix B.

Information to lessees relevant to the sale is also presented under Lessee Advisories. This section contains important information to lessees and operators regarding the sale area. It also includes precautions, which may apply to post-lease sale activities, and reflect existing local, state, and federal law or policy at the time of the sale.

The following abbreviations are used in these mitigation measures: Alaska Coastal Management Program (ACMP), Alaska Department of Environmental Conservation (ADEC), Alaska Department of Fish and Game (ADF&G), Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water (DMLW), Division of Governmental Coordination (DGC), Director of the Division of Oil and Gas (Director), Division of Parks and Outdoor Recreation (DPOR), National Pollutant Discharge Elimination System (NPDES), North Slope Borough (NSB), North Slope Borough Municipal Code (NSBMC), North Slope Borough Coastal Management Plan (NSBCMP), State Historic Preservation Officer (SHPO), Spill Prevention Control and Countermeasure (SPCC), and the U.S. Fish and Wildlife Service (USF&WS).

Except as indicated, the restrictions listed below do not apply to geophysical exploration on state lands; geophysical exploration activities are governed by 11 AAC 96. See lessee advisory four.

## A. Mitigation Measures

### 1. General Measures

1. a. Explosives must not be detonated within, beneath, or in close proximity to fishbearing waters if the detonation of the explosive produces a pressure rise in the waterbody greater than 2.5 pounds per square inch (psi) unless the waterbody, including its substrate, is solidly frozen.

Explosives must not produce a peak particle velocity greater than 0.5 inches per second (ips) in a spawning bed during the early stages of egg incubation. The minimum acceptable offset from fishbearing streams and lakes for various size buried charges is:

1 pound charge	37 feet
2 pound charge	52 feet
5 pound charge	82 feet
10 pound charge	116 feet
25 pound charge	184 feet
100 pound charge	368 feet

Specific information on the location of fishbearing waterbodies may be obtained by contacting ADF&G.

- b. The lessee will consult with the NSB prior to proposing the use of explosives for seismic surveys. The director may approve the use of explosives for seismic surveys after consultation with the NSB.
2. Except for approved off-road travel, exploration activities must be supported only by ice roads, winter trails, existing road systems, or air service. Wintertime off-road travel across tundra and wetlands may be approved in areas where snow and frost depths are sufficient to protect the ground surface. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Exceptions may be granted by the director of the DMLW, and the Director, if an emergency condition exists or if it is determined, after consulting ADF&G, that travel can be accomplished without damaging vegetation or the ground surface.
  3. a. Removal of water from fishbearing rivers, streams, and natural lakes shall be subject to prior written approval by DMLW and ADF&G.  
b. Removal of snow cover from fishbearing rivers, streams, and natural lakes shall be subject to prior written approval by ADF&G. Compaction of snow cover overlying fishbearing waterbodies will be prohibited except for approved crossings. If ice thickness is not sufficient to facilitate a crossing, ice and/or snow bridges may be required.
  4. Water intake pipes used to remove water from fishbearing waterbodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Screen mesh size shall not exceed 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 0.1 foot per second.

## 2. Facilities and Structures

5. Lessees must minimize the impact of industrial development on key wetlands. Key wetlands are those wetlands that are important to fish, waterfowl, and shorebirds because of their high value or scarcity in the region. Lessees must identify on a map or aerial photograph the largest surface area, including reasonably foreseeable future expansion areas, within which a facility is to be sited or an activity is to occur. The map or photograph must accompany the plan of operations. DO&G will consult with ADF&G to identify the least sensitive areas within the area of interest. To minimize impacts, the lessee must avoid siting facilities in the identified sensitive habitat areas, unless no feasible and prudent alternative exists.
6. Exploration facilities must be temporary and must be constructed of ice unless the Director determines that no feasible and prudent alternative exists. Re-use of abandoned gravel structures may be permitted on a case-by-case basis by the Director, after consultation with the director, DMLW, and ADF&G. Approval for use of abandoned structures will depend on the extent and method of restoration needed to return these structures to a usable condition.
7.
  - a. Pipelines must be located so as to facilitate the containment and cleanup of spilled hydrocarbons. Where feasible and prudent, onshore pipelines must be located on the upslope side of roadways and construction pads unless the director, DMLW, determines that an alternative site is environmentally acceptable. Wherever possible, pipelines must utilize existing transportation corridors. Consideration should be given to burying pipelines where soil and geophysical conditions permit.
  - b. All pipelines, including flow and gathering lines, must be designed and constructed to provide adequate protection from water currents, storm and ice scouring, subfreezing conditions, and other hazards as determined on a case-by-case basis.
8. Pipelines shall be designed and constructed to avoid significant alteration of caribou, moose, and muskoxen movement and migration patterns. At a minimum, above ground pipelines shall be elevated five feet, as measured from the ground to the bottom of the pipe, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage. Lessees shall consider increased snow depth in the sale area in relation to pipe elevation to ensure adequate clearance for wildlife. In areas known to contain significant numbers of moose, caribou and muskoxen, above ground pipelines shall be elevated a minimum vertical clearance of 10 feet for a distance of at least 60 feet, at maximum intervals of one-half mile. ADNR may, after consultation with ADF&G, require additional measures to mitigate impacts to wildlife movement and migration.

## 3. Gravel Mining and Use

9. Gravel mining sites required for exploration and development activities will be restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage. Where feasible and prudent, gravel sites must be designed and constructed to function as water reservoirs for future use. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless the director, DMLW, after consultation with ADF&G, determines that there is no feasible and prudent alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.

Mine site development and rehabilitation within floodplains must follow the procedures outlined in McLean, R. F. 1993, *North Slope Gravel Pit Performance Guidelines*, ADF&G Habitat and Restoration Division Technical Report 93-9.

## 4. Prehistoric, Historic, and Archeological Sites

10. Prior to any ground disturbing activity resulting from exploration, development or production activities, the lessee must conduct an inventory of prehistoric, historic and archeological sites within the area affected by activity. The inventory must include consideration of literature provided by the NSB and local residents, documentation of oral history regarding historic and prehistoric 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 potential effects that might result from the activity. The inventory must be submitted to the Director for distribution to DPOR and the NSB for review and comment. In the event that an archeological, prehistoric or historical site or area may be adversely affected by an activity, the Director, after consulting DPOR, and the NSB, will direct the lessee as to what course of action will be necessary to avoid or minimize the adverse effect.

Discovery of prehistoric, historic, or archaeological objects: In the event any site, structure, or object of prehistoric, historic, or archaeological significance is discovered during leasehold operations, the lessee must immediately report such findings to the Director and the lessee must make every reasonable effort to preserve and protect such site, structure, or object from damage until the Director, after consulting the SHPO, has given directions as to its preservation.

## 5. Training

11. The lessee must include in any plan of exploration or plan of development a training program for all personnel, including contractors and subcontractors, involved in any activity. The program must be designed to inform each person working on the project of environmental, social, and cultural concerns that relate to the individual's job.

The program must employ effective methods to ensure that personnel understand and use techniques necessary to preserve geological, archeological and biological resources. In addition, the program must also be designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating. The program must include an explanation of the applicable laws protecting cultural and historic resources. The program shall address the importance of not disturbing archeological, cultural and historic resources and provide guidance on how to avoid disturbance.

## 6. Local Hire

12. To the extent they are available and qualified, the lessee is encouraged to employ local and Alaska residents and contractors for work performed on the leased 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 and hire local and Alaska residents and contractors. 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.

## 7. Subsistence Harvest Protection

13. a. Exploration, development or production operations shall be conducted in a manner that prevents unreasonable conflicts between lease related activities and subsistence activities. In enforcing this mitigation measure the division, during review of plans of operation, will work with other agencies

and the public to assure that potential conflicts are identified and avoided to the fullest extent possible. Available options include alternative site selection, requiring directional drilling, seismic and threshold depth restrictions, subsea completion techniques, seasonal drilling restrictions, and the use of other technologies deemed appropriate by the Director.

- b. Prior to submitting a plan of operations for activities that have the potential to disrupt subsistence activities, the lessee shall consult with the potentially affected subsistence communities and the NSB (collectively “parties”) to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. The parties shall also discuss the reasonably foreseeable effects on subsistence activities of any other operations in the area that they know will occur during the lessee’s proposed operations. Through this consultation, the lessee shall make reasonable efforts to assure that exploration, development, and production activities are compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests.
  - c. A discussion of resolutions reached or not reached during the consultation process and plans for continued consultation shall be included in the plan of operations. The lessee shall identify who participated in the consultation and send copies of the plan to participating communities and the NSB when it is submitted to the division.
  - d. If the parties cannot agree, then any of them may request the Commissioner of ADNOR or his designee to assemble the parties. The commissioner may assemble the parties or take other measures to resolve conflicts among the parties.
  - e. The lessee shall notify the director of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns.
  - f. Lease-related use will be restricted when the Director determines it is necessary to prevent unreasonable conflicts with subsistence harvests.
14. No restriction of public access to, or use of, the lease area will be permitted as a consequence of oil and gas activities except in the immediate vicinity of drill sites, buildings and other related facilities. Areas of restricted access must be identified and a rationale justifying the area restriction must be included in the plan of operations.

## 8. Title 16 Streams

15. Under Title 16 of the Alaska statutes, the measures listed below will be imposed by ADF&G below the ordinary high water mark in designated anadromous streams and fishbearing streams for activities that could block fish passage. Exceptions to these requirements, including exceptions for the use of spill containment and recovery equipment, may be allowed on a case-by-case basis. Specific information on the location of anadromous waterbodies in and near the area may be obtained from ADF&G.
- a. Alteration of riverbanks, except for approved permanent crossings, will be prohibited.
  - b. Except for approved stream crossings, equipment must not be operated within willow stands (*Salix spp.*).
  - c. The operation of equipment, excluding boats, in open water areas of rivers and streams will be prohibited.

- d. Bridges are the preferred watercourse crossings in fish spawning and important rearing habitats. In areas where culverts are used, they must be designed, installed, and maintained to provide efficient passage of fish.

## 9. Waste Disposal

### 16. Solid Waste Disposal:

- a. Garbage and domestic combustible refuse must be incinerated. Nonburnables must be disposed of at an approved upland site.
- b. The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Injection of non-hazardous oil field wastes generated during development is regulated by AOGCC through its Underground Injection Control (UIC) Program for oil and gas wells. Annular disposal of muds and cuttings associated with drilling an exploratory well is permitted by ADEC. Surface discharge of drilling muds and cuttings into lakes, streams, rivers, and high value wetlands is prohibited. Surface discharge of drilling muds and cuttings into reserve pits shall be allowed only when the Director, in consultation with ADEC, determines that alternative disposal methods are not feasible and prudent. If use of a reserve pit is proposed, the operator must demonstrate the advantages of a reserve pit over other disposal methods, and describe methods to be employed to reduce the disposed volume. Onpad temporary cuttings storage will be allowed as necessary to facilitate annular injection and/or backhaul operations.
- c. Proper disposal of garbage and putrescible waste is essential to minimize attraction to wildlife. The lessee must use the most appropriate and efficient method to achieve this goal. The primary method of garbage and putrescible waste disposal is prompt, on-site incineration in compliance with state of Alaska air quality regulations in 18 AAC 50. The secondary method of disposal is on-site frozen storage in animal-proof containers with backhaul to an approved waste disposal facility. The tertiary method of disposal is on-site non-frozen storage in animal proof containers with backhaul to an approved waste disposal facility. Daily backhauling of non-frozen waste only must be achieved unless safety considerations prevent this.

### 17. Wastewater Disposal:

- a. Unless authorized by NPDES or state permit, disposal of wastewater into freshwater bodies, including Class III, IV, VI, and VIII wetlands, is prohibited.
- b. Surface discharge of reserve pit fluids will be prohibited unless authorized by ADEC permit and approved by DMLW.
- c. Disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques. ADEC may permit alternate disposal methods if the lessee demonstrates that subsurface disposal is not feasible or prudent.

## 10. Specific Measures

### 18. Bears:

- a. Exploration and production activities must not be conducted within one-half mile of occupied grizzly bear dens, unless alternative mitigation measures are approved by ADF&G. Known den sites shall be obtained from the Division of Wildlife Conservation, ADF&G, phone 459-7213, prior to commencement of any activities. Occupied dens encountered in the field must be reported to the above, and subsequently avoided by one-half mile.

- b. For projects in close proximity to areas frequented by bears, lessees are encouraged to prepare and implement bear interaction plans to minimize conflicts between bears and humans. These plans could include measures to: (a) minimize attraction of bears to the drill sites; (b) organize layout of buildings and work areas to minimize human/bear interactions; (c) warn personnel of bears near or on drill sites and the proper procedures to take; (d) if authorized, deter bears from the drill site; (e) provide contingencies in the event bears do not leave the site or cannot be deterred by authorized personnel; (f) discuss proper storage and disposal of materials that may be toxic to bears; and (g) provide a systematic record of bears on the site and in the immediate area. The ADF&G has offered to assist lessees in developing educational programs and camp layout and management plans as lessees prepare their lease operations plans.

19. Waterbody Buffers:

- a. To the extent feasible and prudent, onshore facilities other than docks, or road and pipeline crossings, will not be sited within 500 feet of fishbearing streams. Additionally, to the extent feasible and prudent, facilities will not be sited within one-half mile of the banks of the main channel of the Colville, Canning, Echooka, Ivishak, Ribdon, Sagavanirktok, Saviukviayak, Anaktuvuk, Toolik, Kavik, Shaviovik, Kuparuk, Itkillik, Nanushuk, Kanayut, Chandler and Killik Rivers, and Accomplishment, Section, and May Creeks. Facilities will not be sited within 500 feet of all other fishbearing waterbodies. Essential facility siting will be allowed in buffer areas in those instances where no other suitable sites are available. Facilities will not be sited within buffers unless the Director, after consulting ADF&G, determines that such facility restrictions are not feasible or prudent. Road and pipeline crossings must be aligned perpendicular or near perpendicular to watercourses.
- b. No facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayat, and Nanushuk Rivers; and on May, Cobblestone, Section and accomplishment Creeks. Notwithstanding the previous sentence, road and pipeline crossings may only be sited within these buffers if the lessee demonstrates to the satisfaction of the Director of Oil & Gas, ADNRC, and the Director of Habitat, ADF&G, in the course of obtaining their respective permits, that either (1) the scientific data indicate the proposed crossing is not within an overwintering and/or spawning area; or (2) the proposed road or pipeline crossing will have no significant adverse impact to Dolly Varden overwintering and/or spawning habitat.

20. Caribou Subsistence:

- a. Exploratory drilling operations may be restricted during the fall caribou migration (August 1 through October 15) in the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk river valleys to allow for subsistence hunting.
- b. With the exception of pipelines and roads, permanent facilities siting within the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk river valleys will be prohibited unless the lessee demonstrates to the satisfaction of the Director, in consultation with the NSB, that the development will not preclude reasonable subsistence user access to caribou. Before requesting a determination from the Director to site a facility in one of these river valleys, the lessee shall consult with the NSB and the villages of Anaktuvuk Pass, Nuiqsut and Atqasuk regarding reasonable subsistence user access to caribou. When consulting with the NSB and these villages, the lessee must comply with all the requirements of mitigation measure 13 concerning subsistence harvest protection.

21. Dall Sheep:

- a. Aircraft shall remain one-half mile horizontal or 1,000 feet vertical from Dall sheep lambing areas between May 5 and June 20, and mineral licks from May 20 to June 30. Human safety will take precedence over flight restrictions.
- b. Minor ground activity (e.g., surveying, geological hand sampling) and major activity (e.g., seismic testing, construction) shall remain one-quarter mile and one mile from lambing areas and mineral licks, respectively, during the same time periods as above.
- c. Major manned facilities (e.g., processing facilities, camps) shall be sited at least one mile from lambing areas and mineral licks.
- d. Known Dall sheep lambing areas and mineral licks shall be obtained from the Division of Wildlife Conservation, ADF&G, phone (907) 459-7213.

22. Birds

Permanent, staffed facilities must be sited to the extent feasible and prudent outside identified tundra swan nesting and brood rearing areas.

## B. Lessee Advisories

### 1. Local Ordinances:

Lessees are advised that the NSB Assembly has adopted a comprehensive plan and land management regulations under Title 29 of the Alaska Statutes (AS 29.40.020-040). The NSB regulations require borough approval for all proposed uses, development and master plans. The NSBCMP policies are included as part of the NSB zoning regulations (19.70.060) and all NSB permit approvals will require the proposal to be substantially consistent with these policies. The NSB likely will aggressively assert its land management powers to the fullest extent permissible under law to address any outstanding concerns regarding impacts to the area's fish and wildlife species and to habitat and subsistence activities.

Restricting access to and use of fish camps and other subsistence use areas defined in the NSB Traditional Land Use Inventory may violate NSBCMP and NSBMC subsistence harvest protection and land use regulations. Lessees are advised to consult with the NSB Planning Department and local communities during planning of operations that may take place onshore.

### 2. Community Participation in Operations Planning:

Lessees are encouraged to bring one or more residents of communities in the area of operations into their planning process. Local communities have a unique understanding of their environment and community activities. Involving local community residents in the earliest stages of the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams developing plans of operation, oil spill contingency plans, and other permit applications can help communities understand permitting obligations and help industry to understand community values and expectations for oil and gas operations being conducted in and around their area.

### 3. Wetlands Identification:

The wetlands referred to in mitigation measures are based on a classification system developed by Bergmann et.al. (USFWS Resource Publication 129, Waterbirds and Their Wetland Resources in Relation to Oil Development at Storkersen Point, Alaska). Lessees are advised that the state may adopt or approve the use of a wetlands classification system in the future, however, the protective nature of the wetlands mitigation measures developed for this and other oil and gas lease sales will remain consistent regardless of the wetlands classification ultimately selected.

### 4. Geophysical Activity:

Except as indicated, the mitigation measures listed above do not apply to geophysical exploration on state lands. Geophysical exploration activities are governed by 11 AAC 96.

Lessees or nonlessee companies may propose various operations, which include seismic surveys, in the sale area. Lessees may not have control over those activities not contracted by them. However, post-lease seismic surveys conducted or contracted by the lessee, are considered lease-related activities. Restrictions on geophysical exploration permits, whether lease-related or not, will depend on the size, scope, duration, and intensity of the proposed project and on the reasonably foreseeable effects on important species.

Copies of the non-proprietary portions of all Geophysical Exploration Permit Applications will be made available to the NSB and potentially affected subsistence communities for comment.

### 5. Bird and Fish Protection:

- a. Lessees shall comply with the Recommended Protection Measures for Spectacled and Steller's Eiders developed by the USF&WS to ensure adequate protection of spectacled eiders during the nesting and brood rearing periods.

- b. Peregrine falcon nesting sites may occur in the sale area. Lessees are advised that disturbing a peregrine falcon nest violates federal law. Lessees are required to comply with the federal resource recovery plan for the arctic peregrine falcon.
6. Aircraft Restrictions:
- To protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle and vessel operations regulated by NSB Code §19.70.050(I)(1) which codifies NSBCMP policy 2.4.4.(a). Lessees are encouraged to apply the following provisions governing aircraft operations in and near the proposed sale area:
- a. To the extent feasible and prudent, all aircraft should maintain an altitude of greater than 1,500 feet or a lateral distance of one mile, excluding takeoffs and landings, from caribou, moose and muskoxen concentrations. A concentration means numbers of animals in excess of the general density of those animals found in the area.
  - b. From June 1 to August 31, aircraft overflights must avoid identified tundra swan nesting and brood rearing habitat by an altitude of 1,500 feet, or a lateral distance of one mile.
  - c. Human safety will take precedence over flight restrictions.
7. Oil and Hazardous Substance Pollution Control:
- Pursuant to regulations 18 AAC 75 administered by ADEC, lessees are required to have an approved oil discharge prevention and contingency plan (c-Plan) prior to 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.
8. a. To conform with ADEC requirements, impermeable lining and diking, or equivalent measures such as double-walled tanks, will be required for onshore oil storage facilities (with a total above ground storage capacity greater than 1,320 gallons, provided no single tank capacity exceeds 660 gal) and for sewage ponds. Additional site-specific measures may be required as determined by ADNR, with the concurrence of ADEC and will be addressed in the existing review of project permits or c-Plans.
- b. Buffer zones of not less than 500 feet will be required to separate onshore oil storage facilities (with a capacity greater than 660 gallons) and sewage ponds from freshwater supplies, streams, and lakes and key wetlands unless the Director after consultation with ADEC, determines that such a requirement is not feasible or prudent. Reserve pits, if used must be impermeable and otherwise fully contained through diking or other means.
9. Lessees are advised that certain areas are especially valuable for biological and cultural resources, and for their importance to subsistence harvest activities. The following areas must be considered when developing plans of operation.
- a. Dolly Varden spawning/overwintering areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayut, and Nanushuk Rivers; and, on May, Cobblestone, Section and Accomplishment creeks.
  - b. The Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk river drainages, from August 1 to October 15, for protection of subsistence caribou harvest opportunities.

10. Lessees are encouraged in planning and design activities for related onshore operations to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee: Cronin, M. et al, 1994. *Mitigation of the Effects of Oil Field Development and Transportation Corridors on Caribou*. LGL Alaska Research Associates, Inc., July.
11. Access:  
No lease facilities or operations may be located so as to block access to, or along, navigable and public waters as defined by AS 38.05.965(13) and (17).
12. We advise applicants they make every effort to avoid road and pipeline crossings within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayat, and Nanushuk Rivers; and on May, Cobblestone, Section and Accomplishment Creeks.

# Chapter Eight: Bidding Method and Lease Terms

## Contents

Bidding Method and Lease Terms.....	8-1
-------------------------------------	-----



# Chapter Eight: Bidding Method and Lease Terms

The selection of the bidding method, minimum bid, and term of the lease occurs after all comments and issues on this final finding have been received by the DO&G, considered and weighed. Under AS 38.05.180(f) and 11 AAC 83.100, the commissioner must lease all oil and gas resources by competitive bidding. The Alaska statutes provide a number of bidding methods to the department. AS 38.05.180(f)(3).

- (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.

Prior to issuing a final finding, the department conducts a pre-sale analysis of economic, engineering, geological, and geophysical data, including the petroleum potential. Much of these data are held confidential under AS 38.05.035(a)(9)(C) and (D). The data are then used to determine the bidding method, minimum bid, and lease term that best achieves the mix of sometimes conflicting state interests. Using standard economic benefit-cost and statistical decision theory, the value of the hydrocarbon resources is determined. The bidding method finally selected is the one the department believes will maximize the economic and physical recovery of the resource, and promote competition among individuals and companies seeking to explore and develop the area.

- The bidding method is cash bonus.
- The minimum bid is \$5.00 per acre on all tracts.
- There will be a fixed 12-1/2 percent royalty on all tracts.
- There will be a ten-year lease term on all tracts.
- There will be no exploration incentive credits for this sale.

In selecting the bidding method for the North Slope Foothills Areawide, the department considered and balanced the following state interests: protecting the state's ownership interest in hydrocarbon resources; promoting competition among individuals seeking to explore and develop the area; encouraging orderly and efficient exploration and development; and the need to generate revenues for the state.



# Chapter Nine: Conclusion

## Contents

Conclusion .....	9-1
A. Reasonably Foreseeable Effects of the Sale and their Mitigation.....	9-1
1. Fiscal Effects.....	9-1
2. Effects on Municipalities and Communities .....	9-2
B. Cumulative Effects and their Mitigation .....	9-3
1. Effects on Fish and Wildlife Habitats, Populations, and Uses .....	9-3
2. Effects on Subsistence Uses .....	9-4
3. Effects on Historic and Cultural Resources .....	9-5
C. Specific Issues Related To Oil And Gas Exploration, Development, Production, and Transportation ....	9-5
1. Geophysical Hazards.....	9-5
2. Likely Methods of Transportation.....	9-5
D. Bidding Method and Lease Terms .....	9-6
E. Summary and Signature.....	9-6



# Chapter Nine: Conclusion

DO&G is required by AS 38.05.035(e) and (g), to determine prior to an oil and gas lease sale, whether the sale serves the state's best interests. As the director of DO&G, my responsibility is to make that determination for the North Slope Foothills Areawide Sale. In making this decision for the final finding, I will balance the reasonably foreseeable positive and negative effects to determine whether the potential benefits exceed the potential negative effects and whether holding the 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, and on state revenue. DO&G analyzed the available socioeconomic; environmental; geological and geophysical data; and comments submitted by state and federal agencies, the petroleum industry, and local governments. The division has also considered the reasonable foreseeable cumulative effects of development in the area.

## A. Reasonably Foreseeable Effects of the Sale and their Mitigation

The discussion throughout this finding, and the record reflect the analysis of the issues. Below is a summary of this analysis.

### **1. Fiscal Effects**

The backdrop for any fiscal analysis and discussion is the current state revenue picture, including revenue sources, demand or need for revenues, and projected declines.

The primary source of state revenues is North Slope oil production. North Slope fields hold 98 percent of the state's known oil reserves and 90 percent of the state's known gas reserves. The remainder of state oil and gas reserves are found in Cook Inlet fields. However, oil and gas reserves are finite resources and North Slope production is declining. Even if the price of crude oil remained at present levels, general fund receipts will continue to decline (see Chapter Five). Hopefully, discovery and development of smaller, but important fields will temper the anticipated decline in revenues to the state treasury.

Most revenues generated from oil and gas activities go into the state's general fund, while some are set aside for the state permanent fund. Many funds, including oil and gas property taxes, are passed directly through to borough and municipal governments. Statewide, Alaskans receive direct and indirect benefits derived from general fund spending. General fund receipts are allocated to local governments and all state agencies, including the University of Alaska. Funds can be passed directly to local governments through programs, while others are authorized specifically by the state legislature.

As a result of this lease sale, there will be a one-time increase in state income from bonus payments, and an annual increase from rental payments. The potential for additional revenue from royalties and taxes is unpredictable, however, overall petroleum potential for the sale area is low to moderate. As exploration takes place, the sale would add jobs to the state and regional economy. These jobs would not be limited to the petroleum industry, but would be spread throughout the trade, transportation, service, and construction industries. The number of jobs produced would depend on whether commercial quantities of oil and gas are discovered, and whether projects to develop those resources are initiated. Discovery and development of commercial quantities of petroleum or natural gas in the North Slope Foothills sale area would bring direct economic benefits to the NSB in the form of additions to local property tax revenue. Additionally, industry

investment in environmental and wildlife studies, planning and design activities, materials acquisition, facility construction, seismic surveys, drilling, transportation, and logistics contributes to the well being of both the state and local economy.

## 2. Effects on Municipalities and Communities

Barrow, Nuiqsut, Kaktovik, and Anaktuvuk Pass are not located within the sale area, but use it for subsistence activities. There would be no direct impact to North Slope Borough or community operating expenses aside from normal planning and zoning responsibilities. However, development projects may provide revenue to the NSB, and improve infrastructure, like road or utility corridors. The oil industry and the NSB are the region's two principal employers, and there may be some employment opportunities during the exploration phase and more during development and production phases. The long-term employment benefits of this sale in the NSB and local communities would depend on the subsequent production of commercial quantities of petroleum, the hiring of local residents, and use of local service providers. Local residents' use of the sale area requires access to it, and any activity, facility or structure that restricts access can have an adverse impact on the community. Other effects include disturbance due to increased air traffic, drilling and construction machinery noise, and loss of cultural privacy due to the presence of project workers and construction camps. The extent of these effects depends on the size of development projects and the proximity of facilities, and utility, pipeline, and transportation corridors to the potentially affected community. Most disturbance effects would be temporary during development phases. Other financial and infrastructure impacts would be more long term. Employment effects could be both short and long-term.

Access to subsurface minerals that are beneath privately held lands could cause land use conflicts in absence of established easements. Communities adjacent to exploration activities may experience increased use of transportation systems, like air charter services, airstrips, ATV trails, and roads. Exploration could cause noise and disturbance in remote areas traditionally used by local residents for recreation, hunting, and fishing.

Mitigation measures protect existing uses of the area and reduce adverse impacts to communities. Workers must be educated about the land and its people. The lessee, including any contractors and subcontractors, must train employees about the environmental, social, and cultural values of the people of this area. Employees must be trained in how to avoid damaging biological and archaeological resources, and in an understanding of community values, customs, and lifestyles of local residents. Plans of operation must describe the lessee's efforts to communicate with local communities, and interested local community groups in the development of such plans. Under mitigation measure 14, 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 structures. Areas of restricted access must be identified in the plan of operations. Under lessee advisory 11, no lease facilities or operations may be located so as to block public access to or along navigable and public waters. Finally, under mitigation measure 13f, lease related activity will be restricted if the Director determines it is necessary to prevent unreasonable conflicts with local subsistence harvests. In order to avoid such conflicts, restrictions may include alternative site selection, directional drilling, and seasonal drilling restrictions.

## B. Cumulative Effects and their Mitigation

### 1. Effects on Fish and Wildlife Habitats, Populations, and Uses

Fish: In absence of mitigation measures and state law, potential impacts in the exploration phase could include degradation of streambanks and overwintering areas due to erosion and sedimentation. Potential impacts in future phases could include habitat loss due to gravel displacement and facilities siting; interference with migration and movement from structures and impoundments; fish mortality due to industrial water use, oil spills, unregulated discharge, and improper use of explosives. Long-term impacts may include habitat improvement due to restoration and rehabilitation of impacted sites.

Title 16 of Alaska Statutes regulates all activities that may affect anadromous fish streams or that may result in blockage of fish passage. Mitigation measures specify that alteration of riverbanks and use of in-stream equipment are prohibited. Bridges or non-bottom founded structures will be required for crossing fish spawning and important rearing habitats. Discharge of drilling muds and cuttings into lakes, streams, rivers, and high value wetlands is prohibited. Disposal of produced waters will be by subsurface disposal techniques. Unless authorized by a state permit, disposal of wastewater into freshwater bodies is prohibited. Gravel mining within an active floodplain is prohibited. 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 must be designed to prevent harm to fish. Use of explosives is prohibited in open water areas of fishbearing streams and lakes. Facility siting is restricted within 500 feet of all fishbearing streams and lakes or within one-half mile of major rivers.

Birds: In absence of mitigation measures, potential impacts could include habitat loss, barriers to movement, disturbance during nesting and brooding, and oil spills. In order to minimize the possibility of these impacts, the following mitigation measures will apply. The siting of new facilities in key wetlands and sensitive habitat areas may be restricted. Lessees must comply with the federal resource recovery plan for the arctic peregrine falcon. Permanent, staffed facilities must be sited to the extent feasible and prudent outside identified tundra swan nesting and brood rearing areas.

Caribou, Moose, Dall Sheep, and Muskoxen: In absence of mitigation measures, potential impacts could include loss of winter moose forage in riparian habitats, disturbance and obstruction of caribou migration from roads and pipelines and effects from increased human presence in remote areas. Caribou, Dall sheep, and muskoxen may be disturbed by aircraft overflights. Permanent roads may not be used for exploration and activities must be supported by air service or an existing road system. Wherever possible, pipelines must use existing transportation corridors and be buried where soil and geophysical conditions permit. In areas where pipelines must be placed above ground, pipelines must be sited, designed, and constructed to allow free movement of moose, caribou and muskoxen. Aircraft altitude restrictions apply in areas of moose and muskoxen concentrations. Permanent facilities siting within the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk river valleys will be prohibited unless the lessee demonstrates to the satisfaction of the Director, in consultation with the NSB, that the development will not preclude reasonable subsistence user access to caribou. Before requesting a determination from the Director to site a facility in one of these river valleys, the lessee shall consult with the NSB and the villages of Anaktuvuk Pass, Nuiqsut and Atqasuk regarding reasonable subsistence user access to caribou. Aircraft, seismic and facility siting restrictions apply to Dall sheep lambing areas between mineral licks. Human safety will take precedence over flight restrictions.

Brown and black bears: Exploration and development activities could result in habitat loss from construction of roads and oil-related facilities, and subsequent fragmentation of habitat. Denning bears could be disturbed resulting in cub abandonment and mortality. Avoidance of important salmon streams when fish are present would minimize the displacement of bears from streams. Mitigation measures specify that facilities may not be sited within 500 feet of anadromous streams or within one-half mile of major rivers. Permanent roads will not be approved for exploration activities. Exploration activities must be supported by air service, an existing road system or ice roads. For projects in close proximity to areas frequented by bears, lessees are encouraged to prepare and implement bear interaction plans to minimize conflicts between bears and humans. Prior to commencement of any activities, bear den location information must be obtained by ADF&G and occupied dens avoided by one-half mile.

Furbearers: Other animals in the sale area include wolf, wolverine, and fox. Attraction of animals to garbage and other waste can result in adverse impacts to individual animals. Proper disposal methods will minimize attraction of foxes and other small mammals. Some displacement of burrowing or denning is possible, but due to the scale of foreseeable effects, no population level impacts are likely. New solid waste disposal sites will not be approved or located on state property during the exploratory phase.

Oil Spills: Accidental discharge of oil or other industrial materials could affect any of the species listed above. A summer spill could result in mortality of local animals and birds. In order to mitigate the possibility of impacts from oil spills, all facilities are required to have oil spill contingency plans (c-Plans). In addition to addressing the prevention, detection, and cleanup of releases of oil, c-Plans for oil and gas extraction operations should include, but not be limited to, methods for detecting, responding to, and controlling blowouts; the location and identification of oil spill cleanup equipment; the location and availability of suitable alternative drilling equipment; and a plan of operations to mobilize and drill a relief well. Impermeable lining and diking, or double-walled tanks, will be required for oil storage facilities. Buffer zones of at least 500 feet will be required to separate oil storage facilities from freshwater supplies, streams, lakes, and key wetlands. Pipelines must be located upslope of roadways and construction pads and must be designed to facilitate the containment and cleanup of spilled hydrocarbons.

## 2. Effects on Subsistence Uses

In absence of mitigation measures and state law, effects on subsistence activities in the sale area could include increased access to limited resources by competing users, land use limitations and restrictions on access to subsistence, and the immediate effects of oil spills. Potential benefits from oil and gas activity include a potential increase in wage earning opportunities to supplement subsistence activities. Workers must be educated about the land and its people. The lessee, including any contractors and subcontractors, must train employees about the environmental, social, and cultural values of the people of this area. Employees must understand how to avoid damaging biological and archaeological resources. They should have an increased sensitivity and understanding of community values, customs, and lifestyles of local residents.

Public access to, or use of, the lessee area may not be restricted except within 1,500 feet or less of drill sites, buildings, and other related structures. No facilities or operations may be located so as to block public access to or along navigable and public waters as defined by state law. During review of plans of operation or development, DO&G will work with other agencies and the public to assure that potential conflicts are identified and avoided. Lease-related activity will be restricted if the ADNR commissioner determines it is necessary to prevent unreasonable conflicts with local subsistence harvests. Plans of operation submitted for review and approval must describe the lessees efforts to communicate with local communities, and interested local community groups, if any, in the development of such plans. Additional, site-specific and project-specific mitigation measures may be imposed as necessary to protect subsistence access.

### **3. Effects on Historic and Cultural Resources**

Potential impacts could occur in all phases. Previously unidentified or undiscovered sites could be damaged if the pre-construction historic resources inventory was incomplete. They could also be damaged if project workers were not adequately trained.

To prevent damage and insure preservation, an inventory of prehistoric, historic, and archeological sites must be conducted prior to the construction or placement of any structure, road, or facility. The inventory must include consideration of literature provided by the NSB, 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. In the event any site, structure, or object of prehistoric, historic, or archaeological significance is discovered during operations, the lessee must immediately report such findings to the Director. These measures will insure these resources are protected and preserved. Additionally, state laws prohibit the removal of historic and cultural resources. Violators are subject to criminal (misdemeanor) penalties and civil penalties, including fines up to \$100,000.

## **C. Specific Issues Related To Oil And Gas Exploration, Development, Production, and Transportation**

### **1. Geophysical Hazards**

Geophysical hazards that must be considered during development of production and transportation facilities are earthquakes, frozen ground, seasonal flooding and icing, and riverbank erosion. These geophysical hazards could impose constraints to exploration, production, and transportation activities and should be considered prior to any siting, design, or construction of facilities. Structures in the sale area must be built to meet or exceed the Uniform Building Code requirements for zone 1, areas of low earthquake probability. Pre-development planning should include surveys of spring break-up activity, as well as flood-frequency analyses. Structural failure can be avoided by proper facility setbacks from rivers and main tributaries. Containment dikes and berms can be installed to reduce flood damage. Site-specific geotechnical studies should be conducted prior to any development activities to assess the local permafrost conditions. Permafrost problems can be mitigated through proper siting, design, and construction considerations. Pipelines can be trenched, backfilled, insulated (if buried), or elevated to prevent thawing of permafrost.

### **2. Likely Methods of Transportation**

Elevated or buried flow, gathering, and common carrier pipelines would carry petroleum from wellheads to processing centers, and eventually into TAPS. Elevated pipelines are typically used in Alaska to prevent heat transfer from the hot oil in the pipeline to frozen soils, since heat would degrade the permafrost. Elevated pipelines are easy to maintain and visually inspect for leaks, but can obstruct caribou migration. However, mitigation measures require that pipelines be designed and constructed to allow free movement of caribou and moose. Under Mitigation Measure 7, wherever possible, onshore pipelines must utilize existing transportation corridors and be buried where soil and geophysical conditions permit. Buried pipelines are feasible as long as the integrity of the frozen soils is maintained, but buried pipe is more difficult to monitor and maintain, and can result in some habitat loss from gravel fill. On the other hand, buried pipelines are sometimes not feasible from an engineering standpoint because of the thermal stability of fill and underlying substrate. Exploration and development of the sale area will create a potential for oil spills. The likelihood of a large onshore oil spill is small. Spills may impact habitat, fish and wildlife populations in the immediate vicinity of the spill. However, buffer zones are required to separate oil storage facilities from freshwater

supplies, streams, lakes, and key wetlands. Before requesting a determination from the Director to site a facility the lessee the lessee must comply with all the requirements concerning subsistence harvest protection.

## D. Bidding Method and Lease Terms

The selection of the bidding method, minimum bid, and term of the lease was made following the department's pre-sale analysis of economic, engineering, geological, and geophysical data. The bidding method selected was one that best secures revenues for the state without creating disincentives to industry. This bidding method is described in Chapter Eight.

## E. Summary and Signature

No activity may occur without further review and proper authorization from the appropriate permitting agency, and all activities must comply with the NSBCMP and the Alaska Coastal Management Program. When lessees propose specific activities, more detailed information such as site, type, and size of facilities will be known, in addition to the historical project data. Except for some very limited types of proprietary information, permit applications are public information, and most permitting processes include public comment periods. The department may impose additional terms in any subsequent permits when applied for if additional issues are identified at that time.

Developing the state's petroleum resources is vital to the state economy and the well-being of its citizens. With the North Slope Foothills Areawide Lease Sale mitigation measures presented in this final finding imposed on leases and plans of operation, and additional project-specific and site-specific mitigation measures imposed in response to specific proposals, the petroleum resources of the sale area can likely be explored and developed without significantly affecting fish and wildlife populations or traditional human activities. The state has sufficient authority through general constitutional, statutory and regulatory empowerments, the terms of the 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 all other concurrent uses.

On the basis of the facts and issues presented at this time, the foregoing findings, applicable laws and regulations, and the documents reviewed during preparations of this final finding, I conclude, that the potential benefits of the sale, as conditioned, outweigh the possible adverse impacts, and that the North Slope Foothills Areawide Oil and Gas Lease Sale will best serve the interests of the state of Alaska. This Best Interest Finding is a final administrative decision of the department. A person who is aggrieved by this finding may request the commissioner to reconsider the decision under AS 35.05.035(i) and (j). To be eligible an appellant must have meaningfully participated in the process to develop the finding by either submitting written comments during the prescribed comment periods, or by presenting oral testimony at a public hearing regarding the sale. A request for reconsideration must be received by Pat Pourchout, Commissioner, Department of Natural Resources, 550 W 7<sup>th</sup> Ave, Suite 1400, Anchorage, Alaska 99501, or received by fax at 1-907-269-8918 by 5:00 p.m. (local time), February 27, 2001. If the commissioner fails to act on the request for reconsideration by March 9, 2001, the request is considered denied.

A denial of a request for reconsideration is the final administrative decision for purposes of appeal to Superior Court. A person may appeal the Final Best Interest Finding to Superior Court only if the person was eligible to request, and did request, an administrative reconsideration of the finding by the commissioner. An appellant must initiate an appeal to the Superior Court within 30 days from the date of denial of that reconsideration or from the date of distribution of the denial decision, in accordance with the rules of court and to the extent permitted by applicable law.



Mark D. Myers  
Director

February 7, 2001

I concur with the decision of the director that the North Slope Foothills Areawide Sale is in the best interests of the state.



Pat Pourchot  
Commissioner

February 7, 2001



# Appendix A: Comments and Responses

## Public Hearing in Anaktuvuk Pass 7/20/2000

The following people testified:

Ahmaogak, George	Barrow
Brower, Arnold	Barrow
Hill, Elfreda	Anaktuvuk Pass
Hugo, Harry	Anaktuvuk Pass
Hugo, Paul	Anaktuvuk Pass
Kunaknana, Sarah	Nuiqsut
Lampe, Leonard	Nuiqsut
Linclon, Gilbert	Anaktuvuk Pass
Mills, Dave	Fairbanks
Napageak, Tom	Nuiqsut
Okakok, Rex	Barrow
Rulland, Lazarus	Anaktuvuk Pass
Thomas, Bill	Barrow
Tickett, Laura	Anaktuvuk Pass
Weber, Vera	Anaktuvuk Pass
Williams, Earl	Anaktuvuk Pass
2 signatures were illegible	

### Common Issues:

Below is a summary of Common Issues raised at the public hearing and ADNR's response.

<p>1. The state should delay the sale and conduct a more comprehensive public process including a stakeholders group. Only one public hearing was held.</p>	<p>Unfortunately it is not possible to conduct a stakeholders process for the North Slope Borough. ADNR has faced budget cuts and has a very limited travel budget. ADNR did conduct a public hearing in Anaktuvuk Pass, and residents from Nuiqsut and Barrow attended. ADNR also extended the comment period by one month to give borough residents additional opportunity to participate in the public process. The City of Nuiqsut requested a public hearing in that community. ADNR offered to conduct a teleconference, but the offer was not accepted.</p>
<p>2. Subsistence is important to the people of Anaktuvuk Pass and other communities. The chapter on subsistence was inadequate.</p>	<p>ADNR recognizes the importance of subsistence to the residents of the North Slope Borough. The chapter on subsistence has been expanded based on input from local residents and ADF&amp;G.</p>
<p>3. Oil and gas exploration and development</p>	<p>DO&amp;G believes that adverse impacts to</p>

**Appendix A: Comments and Responses**

<p>have the potential to disrupt caribou migration. Pipelines act as a barrier to caribou.</p>	<p>caribou can be mitigated at the project proposal and design phase through lease sale mitigation measures, permit-specific stipulations, and thorough review of project proposals via the ACMP process. Mitigation Measure 8 has been amended so that in areas known to contain significant numbers of moose, caribou and muskoxen, above ground pipelines shall be elevated a minimum vertical clearance of 10 feet for a distance of at least 60 feet, at maximum intervals of one-half mile. ADNR may, after consultation with ADF&amp;G, require additional measures to mitigate impacts to wildlife movement and migration.</p> <p>Under Mitigation Measure 20a, exploratory drilling operations may be restricted during the fall caribou migration (August 1 through October 15) in the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk river valleys to allow for subsistence hunting.</p> <p>Observations and research findings are important in assessing the effects of oil and gas development on caribou. DO&amp;G continues to review and incorporate all relevant data, observations, and information regarding the impacts of oil and gas activities on the long-term health of caribou herds.</p>
<p>4. The traditional knowledge of local residents is completely missing from the finding. The known migration of caribou through Anaktuvuk Pass was not depicted on the map.</p>	<p>ADNR incorporated traditional knowledge provided by the City of Anaktuvuk Pass. A caribou migration corridor through Anaktuvuk Pass was added to Figure 3.4.</p>
<p>5. Access to subsistence use areas must not be restricted</p>	<p>Under NSBCMP policy 2.4.3(d): Development shall not preclude reasonable subsistence user access to a subsistence resource. The intent of this policy is identical to that of Mitigation Measure 13, to ensure that development will not preclude reasonable subsistence user access to a subsistence resource.</p> <p>In addition, all lease activities must comply with borough ordinances. The NSB municipal code defines reasonable access as “access using means generally available to subsistence users.” Precluding access “addresses not only means of access, but access to areas where resources are present and can be used by subsistence users.”</p>
<p>6. There was no information on berry picking and the gathering of other types of plants for subsistence use.</p>	<p>ADNR recognizes the importance of berry picking to the residents of Anaktuvuk Pass. Information on berry picking and the gathering</p>

**Appendix A: Comments and Responses**

	<p>of other types of plants for subsistence use was added to Chapter Four. Mitigation Measure 13b requires lessees to consult with potentially affected subsistence communities and the NSB to discuss potential conflict with siting facilities. Protection of berry and other floral resource areas can be considered at this phase.</p>
<p>7. The sale should benefit local communities by providing employment opportunities and improving socio-economic conditions.</p>	<p>Mitigation Measure 12 encourages lessees to employ Alaska residents and contractors, and work with the state Dept. of Labor in seeking resident talent. Lessees should encourage their contractors to employ and train, when necessary, residents of Alaska. The effects of the sale on local communities are discussed in Chapter 5.</p>
<p>8. Surface entry should be prohibited on Native Allotments.</p>	<p>Impacts to private landowners are likely to be small. Land offered for lease may receive no bids. Tracts that are leased may not be developed. In the event that leasing and development of the subsurface estate of a Native Allotment takes place, stipulations can be attached to the plan of operations to minimize impacts to the surface estate owners. Where lands are owned by a third party interest subject to a state mineral reservation, a lessee may not enter until the lessee makes a good faith effort to agree with the surface interest holder on settlement of damages that may be caused by leasehold activities (AS 38.05.130). If an agreement cannot be reached, the lessee may enter upon that land in exercise of the state's reserved rights only after posting a surety bond determined by the director to be sufficient. Furthermore, lessees must submit a plan of operations to the state for approval as required by 11 AAC 38.158. If surface activities are proposed on non-state owned land, lessees must submit a copy of the plan of operations to the private land owner. Plans of operation must describe the lessee's efforts to minimize impacts on privately-owned surface lands.</p>
<p>9. Sport hunting by outsiders will increase because of easy access to subsistence use areas.</p>	<p>ADNR believes that protection of subsistence is a function of fish and game management rather than control of access. For example, restrictions on hunting or fishing within specified distances of roads have protected fish and game resources in other areas of the state. The NSB can work with the state Boards of Fisheries and Game to provide protections through the regulatory process. Furthermore,</p>

**Appendix A: Comments and Responses**

	<p>industry prohibits its employees, contractors, and subcontractors from hunting and the possession of firearms while in the region. Public use of most local service roads into oil production units is already restricted by industry.</p>
<p>10. Pipeline height must be increased to 10 feet in areas of deep snow so that caribou, moose and muskoxen can pass.</p>	<p>In response to concerns raised by the North Slope Borough and residents of Anaktuvuk Pass, Mitigation Measure 8 has been amended so that in areas known to contain significant numbers of moose, caribou, moose, and muskoxen, above ground pipelines shall be elevated a minimum vertical clearance of 10 feet for a distance of at least 60 feet, at maximum intervals of one-half mile. ADNRM may, after consultation with ADF&amp;G, require additional measures to mitigate impacts to wildlife movement and migration.</p>
<p>11. The village of Anaktuvuk Pass should get impact funds for this sale.</p>	<p>Impact funds are petroleum-derived revenues set aside by Congress for communities experiencing direct impacts of leasing. For example, a portion of revenues derived from leasing efforts in the NPRA are set aside for NSB communities directly impacted by NPRA leasing. There is presently no impact fund program associated with the state leasing program. Such a program would have to be created and funded by the legislature.</p>
<p>12. Local residents and staff from the Simon Paneak Memorial Museum should be utilized in the processes of identifying cultural and historic sites. We want an option for full preservation rather than the current mitigation measure that leads to irreparable site disturbance.</p>	<p>Mitigation Measure 10 is designed to protect known and unknown prehistoric, historic and archaeological sites. It requires lessees to conduct an inventory of prehistoric and archaeological sites prior to exploration, development, or production activities. The inventory must include consideration of literature provided by the NSB and local communities. We suggest that Anaktuvuk Pass work with the NSB to include local residents and staff from the Simon Paneak Memorial Museum in preparing this inventory. The inventory will be submitted to the Director of DO&amp;G for distribution to DPOR for review and comment. In the event that a prehistoric, historic, or archeological site or area may be adversely affected by a leasehold activity, the Director, after consultation with DPOR and the NSB, will direct the lessee as to what course of action will be necessary to avoid or minimize the adverse effect. In the event any site, structure, or object of prehistoric, historic, or archaeological significance is discovered</p>

	during leasehold operations, the lessee must immediately report such findings to the Director. The lessee must make every reasonable effort to preserve and protect such site, structure, or object from damage until the Director, after consultation with the SHPO, has given directions as to its preservation. ADNR believes this will provide adequate protection for cultural and historic sites.
--	---

This section of the appendix includes a summary of comments received regarding the proposed North Slope Foothills Areawide and ADNR's responses.

Comments submitted in response to:

- Preliminary Best Interest Finding, Propose Oil and Gas Lease Sale, North Slope Foothills Areawide 2001, issued June 14, 2000.

### **State Agencies**

<b>Alaska Department of Fish And Game, A. Ott, 9/5/2000</b>	
There is little information concerning the Western Arctic Caribou and Teshekpuk Lake Herd which may use portions of the sale area.	Information on the WAH and TKH has been incorporated into the final finding.
Information we provided on subsistence was not used. There is no map portraying community subsistence use areas.	This information has been incorporated into the final finding.
We recommend that plans of operation submitted to DO&G which contain efforts to reduce negative effects on subsistence activities be copied to ADF&G for evaluation and follow-up.	Adopted. The DO&G permitting section will copy plans of operation which contain efforts to reduce negative effects on subsistence activities to ADF&G.
We request a no surface occupancy provision within one-half mile of identified Dolly Varden spawning/overwintering areas in the sale area, and request that the following sentence be dropped from Mitigation Measure 19(b), Waterbody Buffers:  "Road and pipeline crossings will not be sited in these spawning/overwintering areas unless the Director, after consulting ADF&G, determines that such restrictions are not feasible and prudent."	This issue was elevated to the resource commissioners by ADF&G. Mitigation Measure 19b now reads: No facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayat, and Nanushuk Rivers; and on May, Cobblestone, Section and accomplishment Creeks. Notwithstanding the previous sentence, road and pipeline crossings may only be sited within these buffers if the lessee demonstrates to the satisfaction of the Director of Oil & Gas, ADNR, and the Director of Habitat, ADF&G, in the course of obtaining their respective permits, that either (1) the scientific data indicate the proposed crossing is not within an overwintering and/or spawning area; or (2) the proposed road or pipeline crossing will have no

**Appendix A: Comments and Responses**

	<p>significant adverse impact to Dolly Varden overwintering and/or spawning habitat. Additionally, a new Lessee Advisory 12 was added: We advise applicants they make every effort to avoid road and pipeline crossings within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayat, and Nanushuk Rivers; and on May, Cobblestone, Section and Accomplishment Creeks.</p>
<p>Requests a new mitigation measure for Dall sheep.</p>	<p>DO&amp;G adopted this recommendation with modifications as Mitigation Measure 21:</p> <ul style="list-style-type: none"> <li>a. Aircraft shall remain one-half mile horizontal or 1,000 ft vertical from Dall sheep lambing areas between May 5 and June 20, and mineral licks from May 20 to June 30. Human safety will take precedence over flight restrictions.</li> <li>b. Minor ground activity (e.g., surveying, geological hand sampling) and major activity (e.g., seismic testing, construction) shall remain one-quarter mile and one mile from lambing areas and mineral licks, respectively, during the same time periods as above.</li> <li>c. Major manned facilities (e.g., processing facilities, camps) shall be sited at least one mile from lambing areas and mineral licks.</li> <li>d. Known Dall sheep lambing areas and mineral licks shall be obtained from the Division of Wildlife Conservation, ADF&amp;G, phone (907) 459-7213.</li> </ul>
<p>Lessee Advisory 2, involving communities in operations planning needs to be closely monitored.</p>	<p>ADNR looks forward to working with ADF&amp;G to monitor the effectiveness of all Mitigation Measures and Lessee Advisories.</p>
<p>Add concentrations of moose to Lessee Advisory 6.</p>	<p>Adopted.</p>

## Federal Agencies

<b>National Park Service G. Yankus, 9/13/2000</b>	
<p>The sale abuts the boundaries of the Gates of the Arctic National Park and Preserve and a small portion of the Noatak National Preserve. There is a potential for oil and gas activities to adversely affect the values of these areas. We oppose leasing adjacent lands.</p>	<p>The North Slope Foothills Areawide sale is outside the boundaries of the Gates of the Arctic National Park and Preserve and the Noatak National Preserve. NPS has no authority to manage activities on state lands adjacent to park and preserve lands. ADNR foresees no impact on adjacent park and preserve lands at the lease sale phase. If this lease sale results in leasing of sites that are considered for exploration or development at a later phase of this project, ADNR believes adequate protection can be achieved through the application of mitigation measures; existing federal, state, and local government restrictions; and site-specific project review.</p>
<p>All activities within any unit of the National Park System that involve the exercise of rights to oil and gas not owned by the United States where access is on across, or through federally owned or controlled lands or waters are subject to regulation under 36 CFR Part a and subpart b.</p>	<p>Comment noted.</p>
<p>The preliminary tract maps do not accurately delineate the boundary of the Gates of the Arctic National Park and Preserve.</p>	<p>The final tract maps accurately delineate the boundary of the Gates of the Arctic National Park and Preserve.</p>
<p>The planning process should recognize the value of the Gates of the Arctic National Park and Preserve and evaluate the potential for these values to be adversely affected. The area between the Gates of the Arctic National Park and Preserve and the park's Castle Mountain Unit is of special concern as it is used by wildlife moving between the two areas.</p>	<p>ADNR foresees no impact on park and preserve lands at the lease sale phase. If this lease sale results in leasing of sites that are considered for exploration or development at a later phase of this project, ADNR believes adequate protection can be achieved through the application of mitigation measures; existing federal, state, and local government restrictions; and site-specific project review.</p>
<p>Appropriate mitigation measures should be developed in cooperation with the NPS. Measures should be incorporated to minimize contamination of aquifers or groundwater.</p>	<p>Under 20 AAC 25.252, AOGCC reviews and approves proposals for the underground disposal of water and oil field waste. Before receiving an approval, an operator must demonstrate that the movement of fluids into freshwater sources will not occur. ADNR is willing to consider additional mitigation measures, developed in cooperation with NPS on a case-by-case basis at the plan of operations phase.</p>
<p>NPS request the opportunity to review subsequent lease information when it is available.</p>	<p>Comment noted. The NPS is on the North Slope Foothills Areawide mailing list.</p>

## Local Government

<b>City Council of Anaktuvuk Pass, 9/8/2000</b>	
Residents of Anaktuvuk Pass believe that all animals, fish birds, and vegetation are of equal importance. Local residents know the best time to gather certain animals, fish, birds and vegetation. People depend on subsistence when there is little or no income, which is the whole winter season.	ADNR recognizes the importance of subsistence to the people of Anaktuvuk Pass. Chapter Four has been expanded to include additional information on subsistence including information on subsistence use of vegetation. Mitigation Measure 13 requires consultation with local communities to minimize conflicts with subsistence activities. Under Mitigation Measure 20, exploratory drilling operations may be restricted during the fall caribou migration to allow for subsistence hunting. Under Mitigation Measure 14, no restriction of public access to, or use of, the lease sale area due to oil and gas activity will be permitted, except within the immediate vicinity of drill sites, buildings and other related facilities. Any area of restricted access must be justified in the plan of operations.
There is no acknowledgement of the need to protect caribou rutting areas.	According to ADF&G caribou rutting occurs throughout the sale area. Therefore, no specific areas can be protected.
Residents of Anaktuvuk Pass are concerned that a pipeline built north of Anaktuvuk Pass will change the migration route of caribou. The ACMP allows local districts to designate areas identified as subsistence zones. The City of Anaktuvuk pass suggests removing all tracts between 1242 to 0737 west to east; 799 to 22 west to east; 1242 to 799 north to south; and 022 to 737 north to south and designating them as a subsistence zone.	See response to Issue 3 under the Anaktuvuk Pass public hearing. The North Slope Borough has not yet designated subsistence zones. ADNR is opposed to large scale tract deletions. We feel mitigation measures imposed in previous North Slope sales have protected subsistence use areas.
We demand that you change the pipeline clearance to 10 feet so that caribou can pass when snow is deep.	See response to Issue 10 under Common Issues, Anaktuvuk Pass public hearing.
The PBIF refers to studies that are more than 10 years old. We suggest using more reliable and current caribou studies.	ADNR makes every attempt to use the most up to date information when preparing the best interest findings. Studies are expensive to conduct and sometimes there are no current studies available. In this case ADNR always checks with other resource agencies to make sure the information is still accurate or is the best information available at the time.
We intend to continue to use the lands in the sale area as we wish. We would like to see a	ADNR supports the continued use of traditional subsistence areas by local

**Appendix A: Comments and Responses**

<p>mitigation measure that would ensure our complete use of the lands.</p>	<p>residents. Lessees are required to comply with proposed Mitigation Measure 13, which protects the subsistence harvest. This measure states that lease-related use will be restricted when the commissioner determines it is necessary to prevent unreasonable conflicts with local subsistence harvests. Conflicts can be avoided with alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the commissioner. Mitigation Measure 14 maintains public access to the lease area.</p>
<p>We would like to see and impact fund for our community. This would insure that we obtain our yearly subsistence.</p>	<p>See response to Issue 11 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>We demand that you include several residents and the Simon Paneak Memorial Museum in all processes for identifying cultural and historic sites. We want an option for full preservation rather than the current mitigation measure that leads to irreparable site disturbance.</p>	<p>See response to Issue 12 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>We demand that residents of Anaktuvuk Pass be used, employed and hired as principal resources and agents for training under Mitigation Measure 11.</p>	<p>See response to Issue 7 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>Mitigation Measure 3 should require the approval of the City of Anaktuvuk Pass, the Nasragmiuit Tribal Council and the NSB for removal of water from fishbearing streams.</p>	<p>Under 11 AAC 93.210-220, Temporary Water Use permits are issued by the Division of Mining, Land and Water Management. Industrial or commercial use of water requires a Permit to Appropriate Water under 11 AAC 93.120. ADNRR cannot delegate these responsibilities to the City of Anaktuvuk Pass, the Nasragmiuit Tribal Council and the NSB.</p>
<p>Residents are worried about the leasing of their Native Allotments. We would also like to see a buffer zone around these tracts. We also suggest getting a copy of land selections before any leases are agreed on.</p>	<p>See response to Issue 8 under Common Issues, Anaktuvuk Pass public hearing. Sale results are made available to the public after the sale is completed.</p>

**City of Anaktuvuk Pass, Hugo, P. Mayor, 7/20/2000**

<p>We depend on caribou for subsistence. Our life style within the past 30 years has been impacted by developments from the oil and gas field and outside impacts from sport hunting and outfitters coming in from the haul road</p>	<p>See response to Issues 9 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>Caribou herds will be deviated to other valleys and rivers. Normal spring migration routes by the caribou herds will also be affected from the</p>	<p>See response to Issue 3 under Common Issues, Anaktuvuk Pass public hearing.</p>

**Appendix A: Comments and Responses**

<p>noise and activities, on their way to calving grounds.</p>	
<p>Migrating waterfowl will be diverted from their resting areas just out of the mountains on their way to nesting areas.</p>	<p>DO&amp;G believes that adverse impacts to migrating waterfowl can be mitigated at the project proposal and design phase through lease sale mitigation measures, permit-specific stipulations, and thorough review of project proposals via the ACMP process. Mitigation Measure 5 states that lessees must minimize the impact of industrial development on key wetlands and avoid siting facilities in identified sensitive habitats. Mitigation Measure 19 establishes buffers around waterbodies and restricts the siting of facilities within the buffers.</p>
<p>No matter what height you come up with for pipelines there is no proven theory that animals will go under any pipeline during migrations since the Alyeska pipeline was built.</p>	<p>Extensive research on the response of caribou to development has shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, elevating pipelines five feet and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field. See chapter Five, "Cumulative Effects." Mitigation Measure 8 requires pipelines to be elevated a minimum of five feet. A ten-foot elevation will be required depending on local snow depth conditions</p>
<p>The majority of our fur bearing animals are taken in this area of lease sale. Our yearly fur bearing hunting and trapping will decrease because of these activities.</p>	<p>DO&amp;G believes that adverse impacts to fur bearing animals can be mitigated at the project proposal and design phase through lease sale mitigation measures, permit-specific stipulations, and thorough review of project proposals via the ACMP process.</p>
<p>Our yearly fish migration is at risk from spills and other man made pollution on all rivers that connect to the Colville.</p>	<p>There are several mitigation measures that address fishbearing streams. Mitigation Measure 15 protects anadromous streams. Mitigation Measure 17 regulates wastewater disposal. Mitigation Measure 19 establishes stream buffers. Lessee Advisory 7 requires lessees to prepare an oil spill contingency plan.</p>
<p>Any future road system to these areas will not be acceptable, it will disrupt our ecosystem as it had done with the haulroad.</p>	<p>Mitigation Measure 2 requires that exploration activities must be supported only by ice roads, winter trails, existing road systems or air service. Winter and summer off road vehicular traffic is restricted.</p>
<p>Any future airport system will also be unacceptable it will also disrupt our ecosystem like the Happy Valley and Galbraith Lake airports, which are playground for many out of</p>	<p>Public use of lease related airstrips is already restricted by industry. See response to Issue 9 under Common Issues, Anaktuvuk Pass public hearing.</p>

**Appendix A: Comments and Responses**

state residents.	
Local hire from here has not always been good. An example is the Atigun corrosion project in early 1990s no one was hired here, but 300-400 from outside were, and this project was only 75 miles from this community.	See response to Issue 7 under Common Issues, Anaktuvuk Pass public hearing.
An impact fund should be in place for our benefit for subsistence oversight panel and a subsistence representative to assist us in this area.	See response to Issue 11 under Common Issues, Anaktuvuk Pass public hearing.
Prohibit any permanent structures during the exploration period including airports and roads, using only ice roads and airstrips.	Mitigation Measure 6 requires that exploration facilities must temporary and constructed of ice unless the director determines that no feasible or prudent alternative exists.
Prohibit any lease sales in the head waters of the Sagavanirktok River because of historic graves and artifacts.	The headwaters of the Sagavanirktok River are outside the sale area. Historic and cultural sites are protected by Mitigation Measure 10, which requires lessees to conduct an archaeological inventory and implement protective measures. Mitigation Measure 11 requires training industry workers in the social and cultural concerns of the sale area.
Mitigation measures should not contain the word "may."	Lease sale mitigation measures must be worded specifically enough so the intent or purpose of the measure is preserved, but flexible enough to accommodate change. These proposed mitigation measures as written give the state flexibility to consider alternatives at future permitting phases. ADNR may include new mitigation measures at the time it reviews lease plans of exploration, operation, or development.
Land entitlement from the state should be turned over to the NSB that was requested in this lease sale area.	ADNR is processing the municipal entitlement selections of the NSB. The NSB's municipal entitlements are for the surface only and will not be affected by the state leasing the underlying minerals. Following conveyance of the surface to the NSB under their municipal entitlement, the same protections will exist for the NSB as those for other private landowners.
Comments made for Sale 57 in 1993 should also be included for this area wide comments.	Sale 57 was a separate sale and administrative decision. However, DO&G staff reviewed the Sale 57 Final BIF before drafting the Preliminary finding for this sale.

**City of Nuiqsut, Tallak, J. 8/23/00**

The City of Nuiqsut and its municipal City Council members oppose the sale.	Comment noted.
---	----------------

**Appendix A: Comments and Responses**

<p>We believe when oil and gas development continues to expand across the North Slope our access to traditional subsistence will be restricted.</p>	<p>See response to Issues 2 and 3 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>It has been determined that the sale has low to moderate petroleum potential therefore developing this area would not be ideal. We recommend that this sale be postponed until developments like Alpine, Tarn, Tabasco, and Meltwater are completed and have been in production for some time.</p>	<p>Even though an area might be considered to have low to moderate potential, this does not rule out the possibility of a significant discovery. Using new technology, especially 3-D seismic data, companies have made significant discoveries in areas previously thought to have only moderate potential. Recent discoveries at Tarn and Meltwater on the North Slope, with estimated reserves of 42 million and 50 million barrels of recoverable oil, are prime examples. It would not be beneficial to the state to delay this sale.</p>
<p>It is extra important to ensure that habitat, fish and wildlife are not disturbed by oil and gas exploration from accidental spills, dangerous gasses and other hazards.</p>	<p>The Mitigation Measures and Lessee Advisories are designed to minimize impacts to fish and wildlife habitat. In addition lessees must comply with all applicable laws including the Clean Water Act, Clean Air Act, Safe Drinking Water Act, and National Environmental Policy Act.</p>
<p>Subsistence hunting, fishing and trapping are the focal interests of our community. The arrival of the petroleum industry has caused us to make adjustments.</p>	<p>ADNR makes every attempt to ensure continued access for subsistence activities. See response to Issues 2, 3, 5, and 9 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>Ice roads are especially damaging to our environment. These require excessive amounts of water and have affected local fish populations. Stickelback fish are being withdrawn from some lakes in NPRA.</p>	<p>Mitigation Measure 3 regulates removal of water from fishbearing waters. Mitigation Measure 4 regulates water intake pipes to prevent fish entrainment and impingement. Additional mitigation measures can be imposed at the plan of operations phase when a specific project is proposed.</p>
<p>Additional pipelines are unwelcome. We do not believe that leak prevention is fool proof. Pipelines also restrict caribou movements.</p>	<p>No pipeline system is foolproof but North Slope operators have a good record in pipeline spill prevention. See Chapter Six, "Oil Spill Risk" for a discussion of risk. Also, see response to Issue 10 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>Since the arrival of the petroleum industry on the North Slope our people haven't been given much opportunity for jobs. They have gone to outsiders. We feel that industry has broken it's to us in regard to equal opportunity.</p>	<p>See response to Issue 7 under Common Issues, Anaktuvuk Pass public hearing.</p>

**North Slope Borough, Ahmaogak, G. Mayor**

<p>The North Slope Borough is generally supportive of the concept of areawide leasing.</p>	<p>ADNR made an effort to incorporate traditional knowledge of local residents into</p>
--	---

**Appendix A: Comments and Responses**

<p>Every effort must be made to maximize the opportunity for public input, and to treat that input in a meaningful way. Only a single public hearing was held in connection with this proposed sale. The traditional and contemporary knowledge of our residents regarding the wildlife and environment of the proposed sale area is entirely absent from the sale documents.</p>	<p>the final finding. See Chapter Four. Also, see response to Issue 1 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>The Borough recommends that the state delay this sale by at least several months to allow for an appropriate public process. The state should empanel a group of multi-interest stakeholders. Such a group would meet periodically on issues of concern relating to state areawide lease sales.</p>	<p>See response to Issue 1 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>The Borough suggests that the state significantly increase the level of its consultation with local groups and residents. Given the revenue typically generated by the oil and gas leasing program, and the infrequency of conducting full public processes, it is not unreasonable to ask the state to commit the funds necessary to conduct those processes in a comprehensive and meaningful manner. You simply have to spend the money and do what it takes, including travel to potentially affected villages, to do the job right.</p>	<p>Revenue from oil and gas lease sales goes into the state's general fund, not to ADNDR. State spending decisions are made by the legislature and the governor. ADNDR must work within its allocated budget. See response to Issue 1 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>Anaktuvuk Pass residents are frustrated by Figure 3.4, which does not indicate a north-south "known migration pattern" for caribou through the Pass. Avoiding disruption of that migration is for us, and should be for the state, a central issue in evaluating this proposed lease sale.</p>	<p>This information was added to the map.</p>
<p>Chapter 4 provides an inadequate discussion of the use of the proposed sale area for subsistence. A detailed description of all subsistence activities which may be impacted by the proposed sale, and a comprehensive analysis of those potential subsistence impacts, must be critical components of the state's best interest analysis.</p>	<p>Chapter Four has been expanded using information provided by the village of Anaktuvuk Pass and ADF&amp;G.</p>
<p>Anaktuvuk Pass residents have described changes in caribou migration and subsistence harvest patterns following construction of the Trans Alaska Pipeline and Dalton Highway. They have also at times endured disruption of caribou harvest efforts related to the activities of guides and sport hunters in the region.</p>	<p>See response to Issues 3, 9 and 10 under Common Issues, Anaktuvuk Pass public hearing.</p>

**Appendix A: Comments and Responses**

<p>Traditional knowledge regarding caribou does exist, but has not been adequately researched and presented by the state. The state cannot with any certainty predict the potential long-term impacts of industrial activities on the region's caribou numbers, distribution, or behavior.</p>	<p>See response to Issue 4 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>The potential for lease related activities within the sale area to compound the existing and potential impacts of continued sport hunting and other recreational activities must be evaluated.</p>	<p>See response to Issue 9 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>In addition, the preliminary finding fails to evaluate the potential cumulative effects of activities related to this lease sale in conjunction with both industrial and non-industrial activities occurring outside of the proposed sale area.</p>	<p>Under AS 38.05.035 (g) (vi) ADNR is required to discuss the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources. This was done in Chapter Five.</p>
<p>Mitigation Measure 8 should be modified to more clearly reflect that a ten foot elevation will be required in certain areas, as determined by ADF&amp;G in consultation with the local community, to allow for the free passage of caribou.</p>	<p>See response to Issue 10 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>A Specific Measure (Mitigation Measure 19) was included in North Slope Areawide Lease Sale 87 which directed the placement of permanent staffed facilities outside the identified nesting and brood-rearing areas of specified bird species. While those species are among those listed in Table 3.2 as being commonly observed within the proposed sale area, there is no text or figure more specifically defining their use of the area.</p>	<p>Mitigation Measure 19 in sale 87 was designed to protect specific bird activities in high use areas such as nesting and brood rearing areas. While many of the birds listed in Table 3.2 are present in the sale area, only tundra swans have been identified as nesting there. Therefore a new Term 22 has been added: Permanent, staffed facilities must be sited to the extent feasible and prudent outside identified tundra swan nesting and brood rearing areas.</p>
<p>A term included in Sale 87 (Lessee Advisory 6a) applying aircraft restrictions for the protection of certain birds has not been included in the terms for the proposed sale.</p>	<p>A new Lessee Advisory 6b has been added: From June 1 to August 31, aircraft overflights must avoid identified tundra swan nesting and brood rearing habitat by an altitude of 1,500, or a lateral distance of one mile.</p>
<p>Does the state believe that the placement of one or more permanent production facilities, with associated pipelines and/or roads, in the tracts north of Anaktuvuk Pass would be consistent with provisions 2.4.3(a), 2.4.3 (d), 2.4.5. 1 (b), and 2.4.5.2(h) of the NSBCMP?</p>	<p>ADNR believes that the sale as conditioned by existing laws and regulations, the Mitigation Measures and Lessee Advisories is consistent with the NSBCMP. The mitigation measures developed for a lease sale are general and areawide as opposed to the detailed, site and time-specific measures applied at the permitting phase. For a more detailed discussion, see the Proposed ACMP</p>

**Appendix A: Comments and Responses**

	Consistency Determination for North Slope Foothills Areawide 2001.
<p>The state offers only conflicting and incomplete data from which it can draw no firm conclusions regarding the potential for permanent production facilities and operations to deflect migrating caribou beyond the reach of Anaktuvuk subsistence hunters.</p>	<p>ADNR is required to consider and present conflicting scientific studies and reach a conclusion on whether the sale is in the state's best interests. In making these findings, ADNR considers information from various sources, some of which can be inconsistent. ADNR considers the facts available at the time and discusses material issues raised. ADNR weighed all of the information, considered the experience in other North Slope developments and determined that potential adverse effects can be mitigated.</p>
<p>With respect to other provisions of the NSBCMP, we offer the following comments: 2.4.4. (a) Vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated. Concentrations may be seasonal or year-round and may be due to behavior (e.g., flocks or herds) or limited habitat (e.g., polar bear denning, seal haul-outs). Horizontal and vertical buffers will be required where appropriate. Concern for human safety will be given special consideration when applying this policy.</p>	<p>Mitigation Measure 2 restricts off road travel. Mitigation Measure 19 establishes waterbody buffers. Lessee Advisory 6 addresses horizontal and vertical buffers for aircraft, vehicles and vessel operations. Human safety will take precedence over flight restrictions. For a more detailed discussion, see the Proposed ACMP Consistency Determination for North Slope Foothills Areawide 2001.</p>
<p>There is no measure that would address the potential for the permanent placement of facilities which allow for or require vehicle or aircraft traffic, including pipelines and roads, to disturb migrating caribou. The operation of roads and or pipelines, for example, would require vehicle or aircraft traffic for routine monitoring and maintenance, as well as for response in an emergency. Proposed Measure 20 only permits restrictions during exploratory activities.</p>	<p>Mitigation Measure 2 requires that exploration activities must be supported only by ice roads, winter trails, existing road systems or air service. Mitigation Measure 6 requires that exploration facilities must be temporary and must be constructed of ice. It is true that these measures apply to exploration facilities only. Because production may occur over decades, it is not practical to construct temporary facilities. When specific projects are proposed at the production phase, permanent facilities will be subject to review under the NSBCMP. Issues of disturbance to wildlife from vehicle or aircraft traffic for routine monitoring and maintenance will then be addressed on a site specific basis.</p>
<p>A buried pipeline or one elevated to 10 feet where appropriate to allow free movement of subsistence users and resources must be considered for production facilities to be consistent with this provision.</p>	<p>See response to Issue 10 under Common Issues, Anaktuvuk Pass public hearing.</p>

**Appendix A: Comments and Responses**

<p>Policy 2.4.5.2(f) specifies that transportation facilities and utilities must be consolidated to the maximum extent possible. A requirement that development must consider roadless options or the burying of pipelines in roads would ensure consistency with this provision.</p>	<p>Paragraph 9 of the lease contract requires that a plan of operations permit be obtained from DO&amp;G prior to building any facilities. In order for DO&amp;G to approve the permit, facilities must comply with the ACMP including 6 AAC 80.070, which requires consolidation to the maximum extent possible, and with Policy 2.4.5.2(f). Mitigation Measure 7(a) states that wherever possible, pipelines must use existing transportation corridors, and that consideration should be given to burying pipelines where soil and geophysical conditions permit.</p>
<p>Policy 2.4.5.2(h) specifies that development is required to be located, designed, and maintained in a manner that does not interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence use areas. A requirement that development shall not interfere with cultural uses or routes essential for transportation to cultural and subsistence use areas would ensure consistency with this provision.</p>	<p>Mitigation Measure 10 requires that the discovery of previously unknown prehistoric, historic, and archaeological objects be reported immediately so that directions for their preservation may be given. This requirement helps prevent possible harm to or loss of these objects, and enhances ability to use sites that are important for cultural uses. This measure also requires an inventory of prehistoric, historic and archeological sites prior to any ground disturbing activity. The inventory must consider literature provided by the NSB and local residents, documentation of oral history regarding historic and prehistoric 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 potential effects that might result from the activity. The inventory must be submitted to the NSB for review and comment. This requirement helps prevent possible harm to or loss of these sites.</p> <p>Mitigation Measure 13, subsistence harvest protection, requires that all exploration, development or production operations must be conducted in a manner that prevents unreasonable conflicts between lease related activities and subsistence activities. Available options include alternative site selection, requiring directional drilling, seismic and threshold depth restrictions, and the use of other technologies deemed appropriate by the Director.</p>
<p>Lessees should be required to evaluate water bodies prior to their use. This should include, where appropriate, consultation with local residents who can provide information on fish</p>	<p>Mitigation Measure 13b requires consultation with affected subsistence communities prior to submitting a plan of operations. Mitigation Measure 15 protects anadromous streams.</p>

**Appendix A: Comments and Responses**

and waterfowl, their habitats, their behaviors, and seasonal use of differing sites within the proposed sale area.	Mitigation Measure 19 establishes facility setbacks along fishbearing streams.
Lessees should be required to identify areas that can accommodate pipeline burial, such as thaw stable bulbs that may exist along rivers to permit unimpeded wildlife movement.	This will be done at the plan of operations phase when specific pipeline projects are proposed.
There are specific tracts north of Anaktuvuk Pass in which we can never envision permitting the placement of permanent production facilities for fear that they would affect the caribou migration. Our preferred approach is the deferment of tracts north of Anaktuvuk Pass within which the siting of permanent facilities would contribute to the possibility that migrating caribou would utilize alternate routes and pass out of the reach of subsistence hunters. We will defer to the community of Anaktuvuk Pass the identification of the tracts which should be deferred from this lease sale.	See response to Issue 3 under the Anaktuvuk Pass public hearing. The North Slope Borough has not yet designated subsistence zones. ADNR is opposed to large scale tract deletions. We believe that mitigation measures imposed in previous North Slope sales have protected subsistence use areas.  In the ACMP elevation DO&G and the NSB agreed that with the exception of pipelines and roads, permanent facilities siting within the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk river valleys will be prohibited unless the lessee demonstrates to the satisfaction of the Director, in consultation with the NSB, that the development will not preclude reasonable subsistence user access to caribou.

**Industry**

<b>Alaska Oil and Gas Association, Brady, J., 9/14/2000</b>	
AOGA supports the North Slope Foothills Areawide Sale. The PBIF is both legally and technically complete.	Comment noted.
The sale is consistent with the ACMP and the NSBCMP.	Comment noted.
AOGA recommends a lease term of 10 years and a 12.5 percent royalty. The state should also offer Exploration Incentive Credits (EIC's) to encourage industry exploration.	In selecting the bidding method and lease term for this sale ADNR considered and balanced the following state interests: protecting the state's ownership interest in hydrocarbon resources, promoting competition among individuals seeking to explore and develop the area, encouraging orderly and efficient exploration and development; and the need to generate revenues for the state. The bidding terms for this sale may be found in Chapter Eight.

<b>BP Exploration, Zselezky, P. 7/27/2000</b>	
BP supports the director's conclusion that the potential benefits of the sale, as conditioned, outweigh any possible adverse effects.	Comment noted.

**Others**

<b>Arctic Slope Regional Corporation, Leavitt, O., 9/10/2000</b>	
ASRC owns over two million acres within the sale area and strongly supports the sale. The Foothills sale is in the best interest of the sate and will benefit ASRC shareholders as well	Comment noted.
Any oil and gas discoveries on state land will increase interest in the exploration of ASRC lands. Since oil and gas accumulations do not follow property lines it is possible that the state and ASRC will find themselves in a situation similar to the Alpine Field where separate lands have been committed to unitized development and production. Based on this positive experience ASRC looks forward to working with the state in common endeavors.	Comment noted.
ASRC supports the efforts of the people of Anaktuvuk Pass to protect their subsistence lifestyle, however we do not support deleting tracts from the sale area. Issues related to protecting caribou and other subsistence activities can be dealt with in lease stipulations.	Comment noted. ADNR makes every attempt to ensure a continued subsistence lifestyle. Mitigation Measure 13 addresses the protection of subsistence. Lessee advisory 11 addresses access to subsistence use areas.

<b>Nasragmiuit Tribal Council, 9/15/2000</b>	
We insist on the removal of tracts 831 to 1316 north to south, and 50-666 east to west. This will insure safe keeping of Native Allotments, historical gravesites, and wildlife habitat. We insist that you keep the location of gravesites confidential.	ADNR believes that Native allotments, historical gravesites, and wildlife habitat can be protected at the plan of operations phase. See response to Issue 8 under Common Issues, Anaktuvuk Pass public hearing. Mitigation Measure 10 will minimize impacts to gravesites. Lessees must conduct an inventory of traditional use sites in the area proposed for activity and ensure that archaeological resources are preserved. Lessees must include in any development plan, a program to educate oil field workers about community values, customs, lifestyles, and laws protecting cultural resources in the sale area.
We demand a pre-sale agreement with landowners rather than a post sale agreement.	The sale area is too vast to complete a pre-sale title search. Following the sale ADNR will complete the title work and issue all of the leases. The state cannot legally lease federal, borough, native or private land, therefore there

**Appendix A: Comments and Responses**

	will be no need for local people to defend their property rights.
We do not want roads on the tundra and expect you to use ice roads in the winter.	Mitigation Measure 2 requires that exploration activities must be supported only by ice roads, winter trails, existing road systems or air service. Winter and summer off road vehicular traffic is restricted.
We expect impact funds for our residents from the profit the state makes on any lease sales.	See response to Issue 11 under Common Issues, Anaktuvuk Pass public hearing.
Is the state prepared to exchange the last, unique Nanamiut tradition and culture for something that will only last a decade? A petition is enclosed signed by 107 residents opposing the sale.	ADNR believes that the sale as conditioned by the mitigation measures, will not negatively impact Nanamiut tradition and culture. Historic and cultural sites are protected by Mitigation Measure 10, which requires lessees to conduct an archaeological inventory and implement protective measures. Mitigation Measure 11 requires training industry workers in the social and cultural concerns of the sale area.

**Carrol, G. Barrow AK 9/15/2000**

Anaktuvuk Pass is at the eastern edge of the range of the Western Arctic Caribou Herd (WAH). If there is disturbance during exploration caribou will most likely be diverted. They are free ranging animals. If there is a disturbance in front of one of the passes they will simply use another pass. There should be no surface structures, including above surface pipelines, in an area bounded by the Nanushuk and Chandler Rivers and south to the area of Rooftop Ridge. The Foothills region is very important to the Teshekpuk Lake Caribou Herd for overwintering during some years and an important migration route for pregnant WAH. Great care must be taken not to obstruct caribou movements into and through this area. Pipelines will be a problem because some will need to run east-west while caribou migrations generally run north-south.	Biologists representing both industry and ADF&G have agreed that facilities built earlier in the development of the Prudhoe Bay oil field have created impediments to caribou movements. Flow and gathering pipelines were elevated only 1 to 4 feet above the surface, thus forming an effective barrier to caribou crossing. However, extensive research on the response of caribou to development has now shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, elevating pipelines five feet and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field. Factors influencing the crossing success of caribou beneath elevated pipelines include group size or composition, topography, insect activity, traffic levels, the intensity of local construction, as well as road or pipeline configuration.
--	--

**Appendix A: Comments and Responses**

<p>There is often deep hard packed snow so the standard 5-foot clearance will not be adequate. It will be necessary to place considerable distance of any pipelines underground. Sections above ground will need to be 8-10 feet. Moose and Muskoxen also need clearance.</p>	<p>See response to Issue 10 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>There must be restrictions on aircraft to prevent them from harassing caribou.</p>	<p>Lessee Advisory 6 restricts aircraft operations and require all aircraft to maintain an altitude of 1,500 feet, excluding takeoffs and landings, from caribou and muskoxen concentrations.</p>
<p>There should no surface entry within 1/2-mile of Dolly Varden overwintering and spawning areas.</p>	<p>This issue was elevated to the resource commissioners by ADF&amp;G. Mitigation Measure 19b now reads: No facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayat, and Nanushuk Rivers; and on May, Cobblestone, Section and accomplishment Creeks. Notwithstanding the previous sentence, road and pipeline crossings may only be sited within these buffers if the lessee demonstrates to the satisfaction of the Director of Oil &amp; Gas, ADNR, and the Director of Habitat, ADF&amp;G, in the course of obtaining their respective permits, that either (1) the scientific data indicate the proposed crossing is not within an overwintering and/or spawning area; or (2) the proposed road or pipeline crossing will have no significant adverse impact to Dolly Varden overwintering and/or spawning habitat. Additionally, a new Lessee Advisory 12 was added: We advise applicants they make every effort to avoid road and pipeline crossings within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayat, and Nanushuk Rivers; and on May, Cobblestone, Section and Accomplishment Creeks.</p>
<p>Lessees must develop bear interactions plans to minimize conflicts between brown bears and humans. During the spring and summer bears use east-west orientated ridges as important feeding areas. Both exploration and development should avoid these ridges.</p>	<p>Mitigation Measure 18b encourages lessees to prepare and implement bear interaction plans. ADF&amp;G has offered to assist lessees in developing educational programs and camp layout and management plans.</p>

<b>McConnell, S. Anaktuvuk Pass 9/13/2000</b>	
The maps fail to show specific identifying information including latitude and longitude, topographic contours and landmarks such as lakes and mountain tops. This has made it impossible to know exactly which land is included in the lease sale. This information should be provided.	Maps in the findings show latitude and longitude and major rivers. Due to space limitations, topographic contours are not shown. More detailed, color tract maps can be viewed on the division's website at: <a href="http://www.dog.dnr.state.ak.us/oil/">http://www.dog.dnr.state.ak.us/oil/</a> then click on Tract Maps under the North Slope Foothills Areawide 2001 link. Although topographic contours are not included on these maps the maps show sufficient detail to make it possible to know which land is in the lease sale.
Native Allotments should be excluded. There should be a pre sale title search rather than a post sale search. Local people should not have the aggravation, potential anxiety, and work of defending their property rights.	See response to Issue 8 under Common Issues, Anaktuvuk Pass public hearing. The sale area is too vast to complete a pre-sale title search. Following the sale ADNR will complete the title work and issue all of the leases.
Given the remoteness of the area a \$100,000 bond seems far too low. The mess left by exploration during the 70s remains littering the tundra north of Anaktuvuk Pass.	Paragraph 23 of the lease contract and 11 AAC 83.160 require the lessee to post a performance bond with the division before operations commence on a lease. AOGCC also requires that the lessee post a separate bond of at least \$100,000 prior to any drilling activity. ADEC, in its Oil Discharge Contingency Plan permitting process, requires proof of financial assurance of \$50 million for a pipeline or offshore exploration or production facility, \$20 million for an onshore production facility, and \$5 million for an onshore exploration facility. Regardless of the required bond amount, and the bond amounts required by other state agencies, the lessee is still fully liable for the cleanup and rehabilitation of all disturbed areas.
Drinking water is very important to the life of Anaktuvuk Pass. It seems risky that it could be appropriated by the commissioner at his discretion.	Under 11 AAC 93.210-220, the commissioner is granted discretionary authority regarding the use of water, including suspension and termination of water rights to protect the public interest.
The importance of berry picking and gathering plant roots is completely omitted from this section. There should be mitigation measures to protect salmonberry and other floral resources.	ADNR recognizes the importance of berry picking for residents of Anaktuvuk Pass. The final finding includes information on berry picking. See response to Issue 6 under Common Issues, Anaktuvuk Pass public hearing.
Tourism is one of the primary areas of development in the NSB's long range plan. Tourists are attracted to Anaktuvuk Pass by the outstanding scenery. The view shed and back country travel resources will potentially be	The visual impact of development activities of any kind is difficult to mitigate. What constitutes an impaired view shed is highly subjective. The ambiance of an area is less affected by physical surroundings than by the

**Appendix A: Comments and Responses**

impaired.	viewer's perception. What may be less desirable to one person may be quite pleasing to another. View shed management is best addressed at the plan of operations phase.
Recreation extends far beyond the village of Anaktuvuk Pass. Again, it appears important to increase the use of local informants.	ADNR welcomes the input of local residents. Mitigation Measure 13b requires consultation with affected subsistence communities prior to submitting a plan of operations.
Mitigation measures to protect historic cultural, and archaeological sites must include an option for complete protection.	Mitigation Measure 10 is designed to protect known and unknown prehistoric, historic and archaeological sites. See response to Issue 12 under Common Issues, Anaktuvuk Pass public hearing.
Regarding education and training, is there a sample of a successful curriculum available. Are there any quality assurance measures to insure the effective application of such training. Residents of Anaktuvuk Pass should be intimately involved in this training to assure respect for the Nunamiut people, promoting cultural integrity and minimizing negative affects.	Phillips and BP have course outlines and curriculum available for public review and welcome the input of local communities in development and evaluation of training programs, particularly in the area of social and cultural concerns.
Training should be offered in Anaktuvuk Pass so local residents can be available and qualified for work in the lease area.	See response to Issue 7 under Common Issues, Anaktuvuk Pass public hearing.
The following measures should require consultation and relevant approval from local subsistence panel in Anaktuvuk Pass and Nuiqsut. Mitigation Measure 13b requires lessees to consult with the NSB and affected communities prior to submitting plan of operations for activities that have the potential to disrupt subsistence. Mitigation Measure 13e says the lessee shall notify the director of all concerns expressed by subsistence hunters.	Mitigation Measure 13 requires lessees to consult with potentially affected subsistence communities. Anaktuvuk Pass may decide which form their representation will take in the consultation process including a local subsistence panel.
Mitigation Measure 20 should read "must" rather than "may" be restricted during the fall and spring should be added.	Proposed lease sale mitigation measures must be worded specifically enough so the intent or purpose of the measure is preserved, but flexible enough to accommodate change. These proposed mitigation measures as written give the state flexibility to consider alternatives at future permitting phases. ADNR may include new mitigation measures at the time it reviews lease plans of exploration, operation, or development.
Access by local residents to traditional subsistence areas must not be restricted.	See response to Issue 5 under Common Issues, Anaktuvuk Pass public hearing.
It has not been demonstrated that sites can be rehabilitated to mirror the wilderness that currently exists in the sale area. Without	Paragraph 21 of the lease contract requires that all improvements rehabilitated by the lessee to the satisfaction of the state. It is impossible to

**Appendix A: Comments and Responses**

<p>exacting restoration of flora, streambed and view this area would be significantly devalued for recreation and tourism.</p>	<p>achieve an exacting restoration of flora, streambed and view. It is best to design projects so that they have the smallest footprint possible. That way there is less disruption and less to restore. This should be done at the plan of operations phase.</p>
<p>There is a lack of research or mitigation measures to protect important salmonberry resources.</p>	<p>See response to Issue 6 under Common Issues, Anaktuvuk Pass public hearing.</p>
<p>The training program for lessee contractors and subcontractors should use local residents of Anaktuvuk Pass, in particular personnel from the Simon Paneak Memorial Museum.</p>	<p>Phillips and BP have course outlines and curriculum available for public review and welcome the input of local communities in development and evaluation of training programs, particularly in the area of social and cultural concerns.</p>
<p>Not so long ago the public was told that the supply of North Slope crude was so abundant that Congress lifted the export ban. Now we are being told that there is a shortage. ADNR should investigate alternative energy resources.</p>	<p>The export ban was lifted during a time when there was a surplus of oil on the west coast. Surplus Alaskan oil had to be transported to the Gulf Coast. The additional transportation costs reduced the value of the oil and resulted in lost income for the state. Between 1996, when the export ban was lifted, and 1999, approximately five percent of ANS crude was exported to Asian markets. Today, due to production declines and rising demand there is no surplus of oil on the west coast. Little ANS crude is being exported today. Alternate energy sources such as wind and solar will not offset Alaska's need for oil revenues to fund state government spending, including assistance for local communities and schools.</p>
<p>Regarding Mitigation Measure 2 The Dalton Highway was supposed to be such a system. Off-road summertime travel should be prohibited without exception.</p>	<p>The Dalton Highway was never intended to be an ice road or temporary road or limited to seasonal use.</p>
<p>Mitigation Measure 10 needs an option for permanent protection of certain sites. It is probable that all cultural or historic sites have not been identified. It is not clear who shall give directions for their preservation.</p>	<p>The finding states that there is the high potential for discovery of additional sites. Mitigation Measure 10 says that the director of DO&amp;G, in consultation with the State Historic Preservation Officer, will give directions for the preservation of cultural or historic sites.</p>
<p>Residential developments should not be permitted if their removal will be more environmentally harmful than non-removal.</p>	<p>Paragraph 21 of the lease contract requires that all improvements must either be abandoned and the sites rehabilitated by the lessee to the satisfaction of the state, or at the option of the state, be left intact and the lessee absolved of all further responsibility as to their maintenance, repair, and eventual abandonment and rehabilitation. In some instance the state may determine that removal</p>

**Appendix A: Comments and Responses**

	will be more environmentally harmful than non-removal is a determination that will be made on a case by case basis
--	--

**Napageak, T. Nuiqsit, 7/20/2000**

The Nuiqsut Cultural Plan contains some objectives to be considered: Protect the natural environment and wild resources from adverse effects of industrial and technological activities. Establish the historical cultural subsistence resource and major considerations in land use planning, and development and operations. Adapt imposed land ownership and jurisdiction to the traditional law of free access and use by the homeland people.	All the mitigation measures are designed to protect the natural environment and wild resources from adverse effects of industrial and technological activities. Mitigation Measure 10 addresses the protection of historic and cultural sites. Mitigation Measure 13 addresses the protection of subsistence. Mitigation Measure 14 protects public access to a lease area.
Villagers want to exert control over non-traditional use by others. They feel that in the recent past this pattern has been reversed traditional users have been controlled and nontraditional users have been free to go anywhere and do many things viewed as destructive and intrusive.	Villages may assert control over their lands. They do not have the authority to exert control over non-traditional use by others on lands outside of the village. These powers reside with the federal, state, and borough governments. See response to Issue 9 under Common Issues, Anaktuvuk Pass public hearing.

**Northern Alaska Environmental Center, Moore, D., 9/15/2000**

BLM is undertaking a planning process for the entire Colville River corridor as required by the final EIS for NPR-A. We encourage you to redefine the lease area such that the western boundary is not within five miles of the Colville River in order to allow the Colville planning process to move along unhindered.	The plan for the Colville River is at the preliminary stage. In November 2000, BLM issued a notice of intent to develop a plan and the agency is currently holding scoping meetings. ADNOR will track the progress of the plan and once the final plan is complete, make necessary adjustments.
--	---

<b>North Slope Subsistence Regional Advisory Council, Rexford, F., 9/15/2000</b>	
The NSSRAC recommends the state delay the sale for several months to allow for an appropriate public process. Consult with affected communities, create a multi-interest stakeholders process similar to the federal Alaska OCS Regional Advisory Committee or a subsistence oversight panel like that created in conjunction with leasing in NPR-A. Given the revenue generated by the sale it is not unreasonable to ask the state to commit funds necessary to conduct meetings in the potentially affected villages.	See response to Issue 1 under Common Issues, Anaktuvuk Pass public hearing. Under proposed Mitigation Measure 13b the lessee shall consult in advance with the potentially affected subsistence communities and the NSB to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. The lessee shall make reasonable efforts to assure that exploration, development, and production activities are compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests.
The PBIF Figure 3.4 did not show a North-South "known migration pattern" for caribou through Anaktuvuk Pass.	This was added to Figure 3.4.
The discussion of subsistence in Chapter Four is inadequate. The state cannot predict with any certainty the potential impacts of industrial activities on caribou. The state has not adequately researched traditional knowledge.	Additional information on subsistence has been added to Chapter Four. See response to Issues 2, 3 and 4 under Common Issues, Anaktuvuk Pass public hearing.

<b>Weber, V., Anaktuvuk Pass, 7/20/2000</b>	
The North Slope Borough is in the stage of declining revenues, which makes it more difficult to protect the land and animals as they have done in the past. We will not have an adequate local resource to look on behalf of the resident best interest if revenues keep declining at present rate.	New discoveries that result in commercial development will broaden the NSB tax base. See Chapter Five "Fiscal Effects."
The five foot height of pipelines will dramatically change the migration route and the annual migration schedule of caribou, which we depend on as a food and culture source. Pipelines should be minimum of 10 feet high.	See response to Issue 10 under Common Issues, Anaktuvuk Pass public hearing and Mitigation Measure 8.
Anaktuvuk Pass must be the state's first priority, more than ASRC and the North Slope Borough.	ADNR cannot give Anaktuvuk Pass priority over others. We listen to the concerns of all affected parties and strive to resolve conflicts with mitigation measures that are acceptable to all.
Subsistence is our lifestyle. If this development goes, we will not have the same migratory path for our caribou, moose, sheep, fishery and birds. Our land is full of edible plants that	See response to Issues 2, 3, and 5 under Common Issues, Anaktuvuk Pass public hearing.

**Appendix A: Comments and Responses**

---

might be damaged permanently.	
During the gas exploration and development, there should be no sport guide hunting permitted. Or prohibit all sports and guide hunting before, during and after the oil lease sale.	See response to Issue 9 under Common Issues, Anaktuvuk Pass public hearing.
The state shall provide impact funds to the City of Anaktuvuk Pass, Nunamiut Corporation, Tribal Council and Gates of the Arctic National Park and Preserve.	See response to Issue 11 under Common Issues, Anaktuvuk Pass public hearing.
The discussion of subsistence is inadequate.	See response to Issue 2 under Common Issues, Anaktuvuk Pass public hearing.
Archaeological sites need to be protected.	See response to Issue 12 under Common Issues, Anaktuvuk Pass public hearing.
There needs to be consideration and concerns about Native Allotments.	See response to Issue 8 under Common Issues, Anaktuvuk Pass public hearing.

# Appendix B: Laws and Regulations Pertaining to Oil and Gas Exploration, Development, Production, and Transportation

## Alaska Statutes and Administrative Code Sections

### ADNR

- AS 38.05.027 Management of legislatively designated state game refuges and critical habitat areas is the co-responsibility of ADF&G (AS 16.20.050-060) and ADNR. Lessees are required to obtain permits from both ADNR and ADF&G.
- AS 38.35.010-260 Right-of-way leasing for pipeline transportation of crude oil and natural gas is under the control of the commissioner of ADNR. The commissioner shall not delegate the authority to execute the leases.
- AS 38.05.127 Provides for reservation of easements to ensure free access to navigable or public water.
- 11 AAC 53.330 Implementing regulations for the reserving of easements to ensure free access to navigable or public water.
- 11 AAC 83.158(a) A plan of operations must be approved by the commissioner, ADNR, if (1) state owns all or a part of the surface estate, (2) lease reserves a net profit share to the state, (3) state owns all or part of the mineral estate, but the surface estate is owned by a party other than the state, and the surface owner requests such a plan.
- 11 AAC 96.010 Operations requiring permits, including the use of explosives and explosive devices, except firearms.
- 11 AAC 96.140 Land use activities are subject to general stipulations that will minimize surface damage or disturbance of drainage systems, vegetation, or fish and wildlife resources.

### ADNR/DO&G

- AS 38.05.035(a)(9)(C) Requires geological and geophysical data to be kept confidential upon request of supplier.
- AS 38.05.130 Allows the director, DO&G, to approve oil and gas exploration and development activities in the case where the surface estate is not held by the state or is otherwise subject to third party interests, provided the director determines that adequate compensation has been made to the surface estate holder for any damages which may be caused by lease activities.
- AS 38.05.180 Establishes an oil and gas leasing program to provide for orderly exploration and development of petroleum resources belonging to the state of Alaska.

11 AAC 96.010-150	Geophysical Exploration Permit provides controls over activities on state lands in order to minimize adverse activities
<b>ADNR/DL</b>	
AS 38.05.075	Establishes leasing procedures under public auction, including tide and submerged lands, bidding qualifications, and competitive or non-competitive bidding methods.
AS 38.05.850	Authorizes the director to issue permits, rights-of-way or easements on state land for recovery of minerals from adjacent land under valid lease.
11 AAC 80.005-055	Pipeline Right-of-way Leasing Regulations.
11 AAC 93.040-130	Requires a Water Rights Permit for the appropriation of state waters for beneficial uses.
11 AAC 96.010-140	Land use permit activities not permitted by a multiple land use permit or lease operations approval.
<b>ADNR/ DMWM</b>	
11 AAC 93.210-220	Provides for temporary water use permits and procedures for application.
<b>ADNR/DF</b>	
AS 41.17.082	Alaska Forest Resources Practices Act. Requires that all forest clearing operations and silvicultural systems be designed to reduce the likelihood of increased insect infestation and disease infections that threaten forest resources.
11 AAC 95.195	Describes the approved methods of disposal or treatment of downed spruce trees to minimize the spread of bark beetles and reduce the risk of wildfire.
11 AAC 95.220	Requires the lessee to file a detailed plan of operations with the state forester.
<b>ADF&amp;G</b>	
AS 16.05.840	A permit is required from ADF&G prior to obstruction of fish passage.
AS 16.05.870	Provides for the protection of anadromous fish and game in connection with construction or work in the beds of specified water bodies, and calls for approval of plans by the commissioner, ADF&G, for any diversion, obstruction, change, or pollution of these water bodies.
AS 16.20	Management of legislatively designated game refuges and critical habitat areas.
AS 16.20.060	The commissioner, ADF&G, may require submission of plans for the anticipated use, construction work, and proper protection of fish and game. Written approval must be obtained.
AS 16.20.180-210	Requires measures for the continued conservation, protection, restoration, and propagation of endangered fish and wildlife.
5 AAC 95.010-990	Fish and Game Habitat Authority.

5 AAC 95.420-430 Requires a Special Area Permit for certain activities within a special area, defined as a state game refuge, a state game sanctuary, or a state fish and game critical habitat area.

**AOGCC**

AS 31.05.005 Establishes and empowers the Alaska Oil and Gas Conservation Commission.

AS 31.05.030(d)(9) Requires an oil and gas operator to file and obtain approval of a plan of development and operation.

AS 46.03.900(35) Definition of waters.

AS 46.03.100 Accumulation, storage, transportation and disposal of solid or liquid waste standards and limitations.

20 AAC 25.005-570 Requires a permit to drill to help maintain regulatory control over the drilling and completion activities in the state.

20 AAC 25.140 Requires a Water Well Authorization to allow abandoned oil and gas wells to be converted to freshwater wells and to assure there is no contamination of the fresh water source.

**ADEC**

AS 46.03 Provides for environmental conservation including water and air pollution control, radiation and hazardous waste protection.

AS 46.03.100 Requires solid waste disposal permits.

AS 46.03.759 Establishes the maximum liability for discharge of crude oil at \$500 million.

AS 46.03.900(35) Definition of waters.

AS 46.04.010-900 Oil and Hazardous Substance Pollution Control Act. This act prohibits the 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 above-ground storage facilities with over 5,000 bbl of crude oil or 10,000 bbl of non-crude oil.

AS 46.04.050 Exemption for above-ground storage facilities for under 5,000 bbl of crude oil or 10,000 of non-crude oil.

18 AAC 15 Requires a Certificate of Reasonable Assurance (Water Quality Certification) in order to protect the waters of the state from becoming polluted. Assures that the issuance of a Federal Permit will not conflict with Alaska's Water Quality Standards.

18 AAC 50 Provides for air quality control including permit requirements, permit review criteria, and regulation compliance criteria.

18 AAC 50.300	Sets up standards for air quality at certain facilities including oil and gas facilities at the time of construction, operation, or modification.
18 AAC 60.220	Requires proof of financial responsibility before a permit for operation of a hazardous waste disposal facility may be issued.
18 AAC 60.220-240	Requires a Solid Waste Disposal Permit to control or eliminate detrimental health, environmental, and nuisance effects of improper solid waste disposal practices and to operate a solid waste disposal facility.
18 AAC 60.520	General requirement for containment structures used for disposal of drilling wastes.
18 AAC 72	Requires a Wastewater Disposal Permit in order to prevent water pollution (and public health problems) due to unsafe wastewater disposal systems and practices.
18 AAC 75	Provides for oil and hazardous substance pollution control including oil discharge contingency plan (18 AAC 75.305-.395).
18 AAC 75.005-025	Requirements for oil storage facilities for oil pollution prevention.
18 AAC 75.065-075	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.

**DGC**

AS 44.19.155	Establishes and empowers the Alaska Coastal Policy Council.
AS 46.40	Establishes the Alaska Coastal Management Program.
6 AAC 50	Requires the sale to be consistent with the ACMP, including approved district programs.
6 AAC 80.070(b)(3)	Requires that facilities be consolidated to the extent feasible and prudent.
6 AAC 80.070(b)(10)	Requires that facilities be sited to the extent feasible and prudent where development will necessitate minimal site clearing, dredging, and construction.
6 AAC 80.070(b)(11) and(12)	Requires that facilities be sited to the extent feasible and prudent to allow for the free passage and movement of fish and wildlife.
6 AAC 80.130(c)(3)	Requires that wetlands and tideflats be managed to assure adequate water flow, avoid adverse effects on natural drainage patterns, and the destruction of important habitat.
6 AAC 85	Establishes guidelines for district coastal management programs.
AS 26.23.195	Establishes the State Emergency Response Commission.
AS 39.50.20	Establishes Hazardous Substance Spill Technology Review Council within State Emergency Response Commission for research, testing spill technologies, and to serve as a clearinghouse for containment and cleanup technology.

AS 24.20.600 Citizens Oversight Council established a five-member council to serve as watchdog of state and federal agencies having responsibility for prevention of and response to oil spills, to help ensure compliance with environmental laws and regulations

**NSB**

19.06 - 19.70.060 North Slope Borough land management regulations, planning, and permitting powers.

**Federal Laws and Regulations**

Clean Water Act (CWA) - 33 U.S.C. §§ 1251-1387

§ 1343 - Corps permit required to excavate, fill, alter, or modify the course or condition of navigable or U. S. waters.

§ 1344 - Discharge of Dredge and Fill

Oil Spill and Hazardous Substances Pollution Contingency Plan - 40 C.F.R. § 300

EPA Regulations - 40 C.F.R.

§ 109 - Criteria for Oil Removal Contingency Plans

§ 110 - Discharge of Oil

§ 112 - Oil Pollution Prevention. 112.7 - Guidelines for implementation of SPCC plan

§ 113 - Liability Limits for Small Onshore Oil Storage Facilities

§ 114 - Civil Penalties for Violation of Oil Pollution Regulations

§ 116 - Designation of Hazardous Substances

§ 117 - Determination of Reportable Quantities for Hazardous Substances

Coast Guard Regulations - 33 C.F.R. §§ 153-157 Oil Spill Regulation

§ 153 - Reporting Oil Spills to Coast Guard

§§ 155-156 - Vessels in Oil Transfer Operations

Water Quality:

EPA Regulations - 40 C.F.R.

§ 121 - State Certification of Activities Requiring a Federal Permit

§ 136 - Test Procedures for Analysis of Pollutants

NPDES Permit System:

EPA Regulations - 40 C.F.R.

§ 122 - NPDES Permit Regulations

§ 125 - Criteria and Standards for NPDES Permits

§ 129 - Toxic Pollutant Effluent Standards

§ 401 - General Provisions for Effluent Guidelines and Standards

§ 435.10-435.12 - Offshore Oil & Gas Extraction Point Source Category

Ocean Dumping:

EPA Regulations - 40 C.F.R.

§§ 220-225, 227-228 - Ocean Dumping Regulations and Criteria

EPA Regulations - 40 C.F.R.

§ 230 - Discharge of Dredged or Fill Material into Navigable Waters  
§ 231 - Disposal Site Determination

Army Corps of Engineers (Corps) Regulations - 33 C.F.R.

§ 209 - Navigable Waters  
§§ 320-330 - Permit Program Regulations  
§ 323 - Discharge of Dredge and Fill

The Fish and Wildlife Coordination Act - 16 U.S.C. §§ 661-666(c)

Allows comment on § 404 permit applications by USF&WS, NMFS, and EPA.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 42 U.S.C. §§ 9601-9675

EPA Plans - 40 C.F.R.

§ 300 - National Oil and Hazardous Substances Pollution Contingency Plan

Safe Drinking Water Act - 42 U.S.C. § 300

EPA Regulations - 40 C.F.R.

§ 144 - Permit Regulations for the Underground Injection Control Program  
§ 146 - Criteria and Standards for Underground Injection Control Program  
§ 147 - State Underground Injection Control Program

Coastal Zone Management Act (CZMA) - 16 U.S.C. §§ 1451-1464

NOAA Regulations - 15 C.F.R.

§ 930 - Federal Consistency with Approved Coastal Management Programs  
§ 931 - Coastal Energy Impact Program

Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act (RCRA) - 42 U.S.C. §§ 6901-6991

Clean Air Act (CAA) - 42 U.S.C. §§ 7401-7642

Toxic Substances Control Act - 15 U.S.C. §§ 2601-2655

National Ocean Pollution Planning Act - 33 U.S.C. §§ 1701-1709

National Environmental Policy Act (NEPA) - 42 U.S.C. §§ 4321-4347

Council on Environmental Quality (CEQ) Regulations - 40 C.F.R.

§§ 1500-1508 - Implementing NEPA Procedures

Endangered Species Act (ESA) - 16 U.S.C. §§ 1531-1543

USF&WS Regulations - 50 C.F.R.

§ 17 - Endangered & Threatened Species

§ 402 - Interagency Cooperation

Fish and Wildlife Coordination Act - 16 U.S.C. §§ 661-666(c)

Marine Protection, Research and Sanctuaries Act - 33 U.S.C. §§ 1401-1445

Marine Mammal Protection Act - 16 U.S.C. §§ 1361-1407

Migratory Bird Treaty Act - 16 U.S.C. §§ 703-711

National Historic Preservation Act - 16 U.S.C. § 470

Leases and Permits on Restricted Properties - 25 C.F.R. § 162



Competitive Oil and Gas Lease  
Form #DOG 200004

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 7<sup>TH</sup> AVENUE, SUITE 1410  
ANCHORAGE, ALASKA 99501-3561  
ATTENTION: FINANCIAL SERVICES SECTION

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 certification 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 as capable of production in paying quantities 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 certified as 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 quantities sufficient to yield a return in excess of operating costs, even if drilling and equipment costs may never be repaid and the undertaking considered as a whole may ultimately result in a loss; quantities are insufficient to yield a return in excess of operating costs unless those quantities, not considering the costs of transportation and marketing, will produce sufficient revenue to induce a prudent operator to produce those quantities; 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 reasonable costs of transportation away from the leased or unit area to the point of sale. The "reasonable costs of transportation" are as defined in 11 AAC 83.228 and 11 AAC 83.229 as those regulations exist on the effective date of this lease.

(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: \_\_\_\_\_  
Kenneth A. Boyd  
Director, Division of Oil and Gas

STATE OF ALASKA        )  
                                  ) ss.  
Third Judicial District    )

On \_\_\_\_\_, before me appeared Kenneth A. Boyd 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.

**Appendix C: Sample Oil and Gas Lease**

---

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.



## Appendix D: Directional and Extended-Reach Drilling

Directional drilling is the ability to steer the drill-stem and bit to a desired bottomhole location. Directional wells are initially 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 is usually accomplished with the use of a fluid-driven downhole motor (Gerding, 1986), which turns the drill bit. 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 (See Figure D.1). 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.

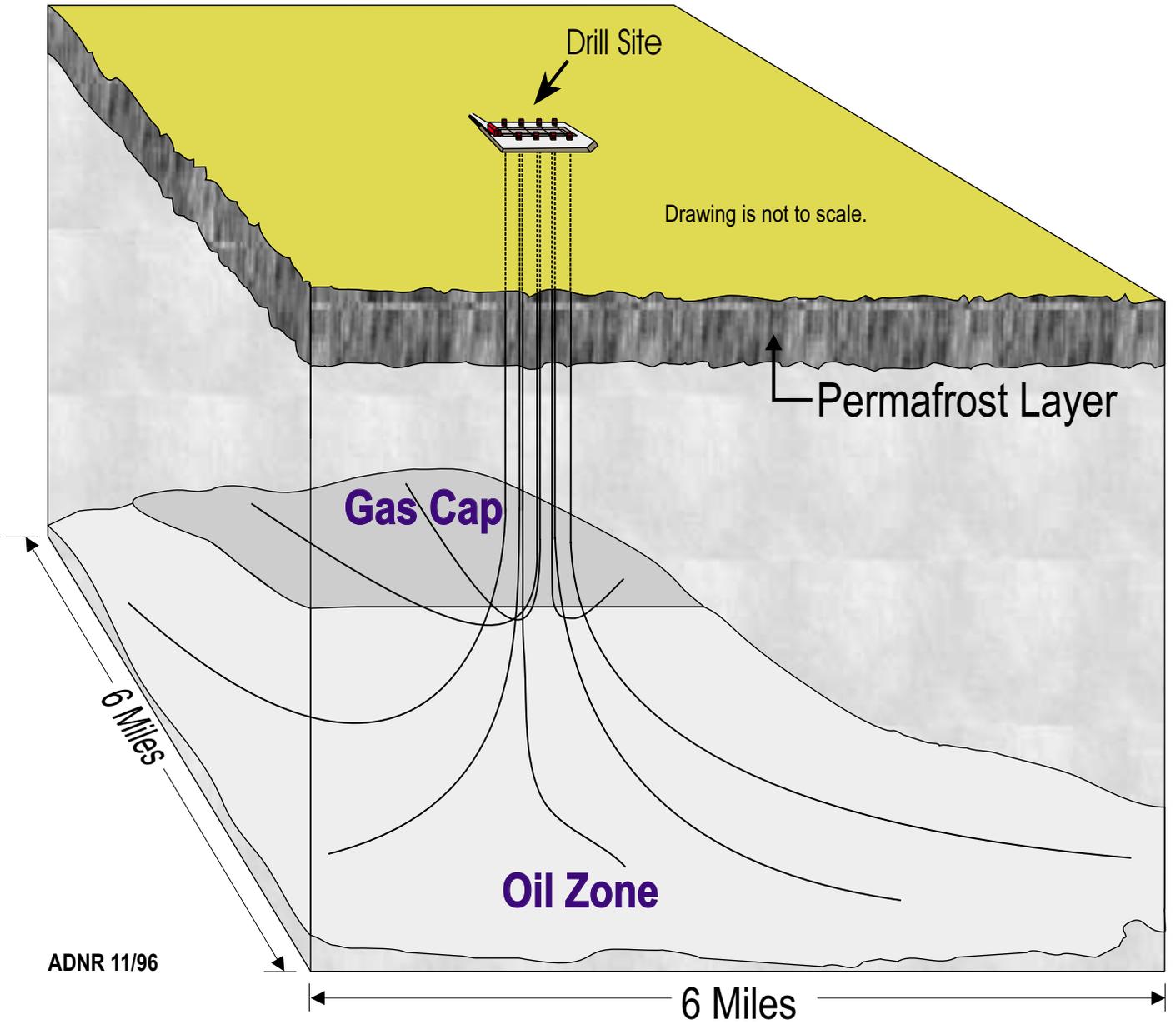
The limitations of directional drilling are primarily dependent upon maximum hole angle, rate of angle change, and torque or friction considerations. In directional drilling, it is now common for the horizontal displacement of the bottom hole location to be twice the vertical depth of the well. That is, a well with a vertical depth of 7,000 feet could have a bottom hole horizontal displacement of 14,000 feet 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).

The type of geology or rock that must be drilled in order to reach a target may also limit directional drilling. Coal and shale deposits tend to collapse and cause the drill string to get stuck. This is more likely to happen in wells that take longer to drill and the downhole formations are exposed to the drilling mud and drill string longer. Faults are difficult to track and if a fault is crossed by the drill bit, 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 was being drilled or could be intersected again (Schmidt, 1994). Stuck pipe can also occur in directional wells when the borehole becomes oval from the drill pipe constantly laying on the downside part of the wellbore. 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)

Collisions with neighboring wells can be a problem 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, 1993:55).

Perhaps the greatest limitation on directional drilling is cost. Although directional drilling may be technically possible it is not always economically feasible. Factors such as where the oil or gas deposit is in relation to the drilling rig, the size and depth of the deposit, and the geology of the area, are all important elements in determining whether directional drilling is cost effective (Winfrey, 1994). The environment and the cost of multiple pads or locations are also considerations in determining the cost-effectiveness of directional drilling.

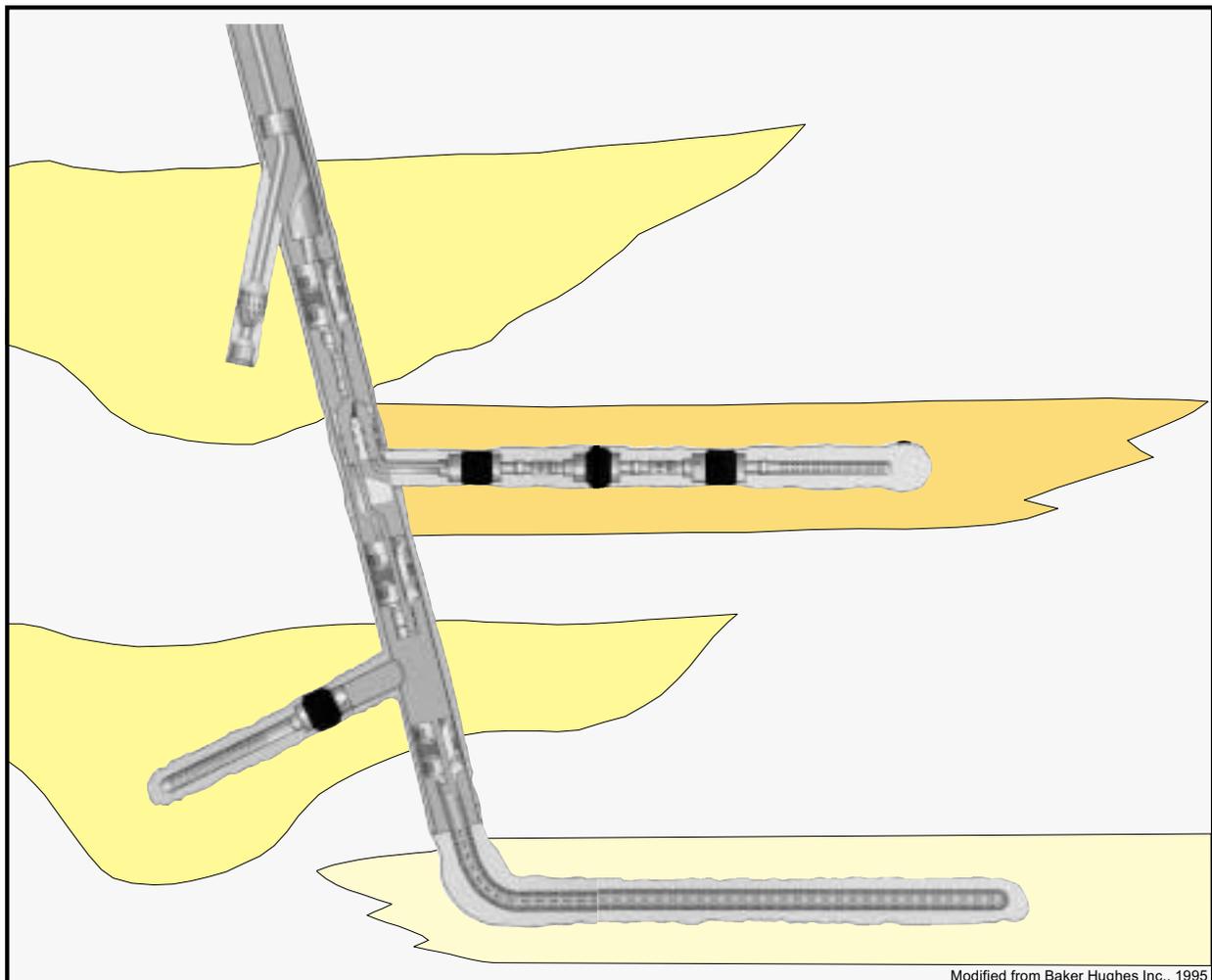
FIGURE D.1 Drill Site Block Diagram



Horizontal drilling, a more specialized type of directional drilling, allows a single wellbore at the surface to penetrate oil-or gas-bearing reservoir strata at horizontal or near horizontal to the dip of the strata. The wellbore 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 (Winfrey, 1994). The fundamentals of drilling horizontal wells can include underbalanced drilling, coiled tubing, bit steering, continuous logging (measurement-while-drilling), multi-lateral 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 lithologies that will not collapse, and careful cost control (PTTC, 1996).

Extended-Reach Drilling (ERD) has evolved from simple directional drilling to horizontal, lateral, and multi-lateral step-outs (See Figure D.2). 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 of 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., 1997:2).

FIGURE D.2 Multi-Lateral Wellbore Completions



Modified from Baker Hughes Inc., 1995

Constraints to successful ERD include downhole drill string and casing movement, applying weight to the drill bit, possible buckling of casing or drill string, and running casing successfully to the bottom of the well. Tension may be a primary concern in vertical wells, but in ERD, 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, 1994a). Torque can be significantly reduced with the use of non-rotating 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, more generated power and oil-based drilling fluids (Judzis, et al., 1997). ERD requires longer hole sections, which requires longer drilling times; the result is increased exposure of destabilizing fluids to the wellbore (JPT, 1994a). The superiority of oil-based muds versus water-based muds in ERD is widely recognized (Payne, et al., 1995). Water-based muds may not provide the inhibition or confining support of oil-based muds (JPT, 1994a).

Extended-reach drill string design involves a) determining expected loads, b) selecting drill string components, c) verifying each component's condition, d) setting operating limits for rig team, and e) monitoring condition during drilling. Economic issues in drill string planning include availability, logistics, and cost. Rig and logistics issues include storage space, setback space, accuracy of load indicators, pump pressure/volume capacity, and top drive output torque. Hole issues include hole cleaning, hole stability, hydraulics, casing wear, and directional objectives (Judzis, et al., 1997).

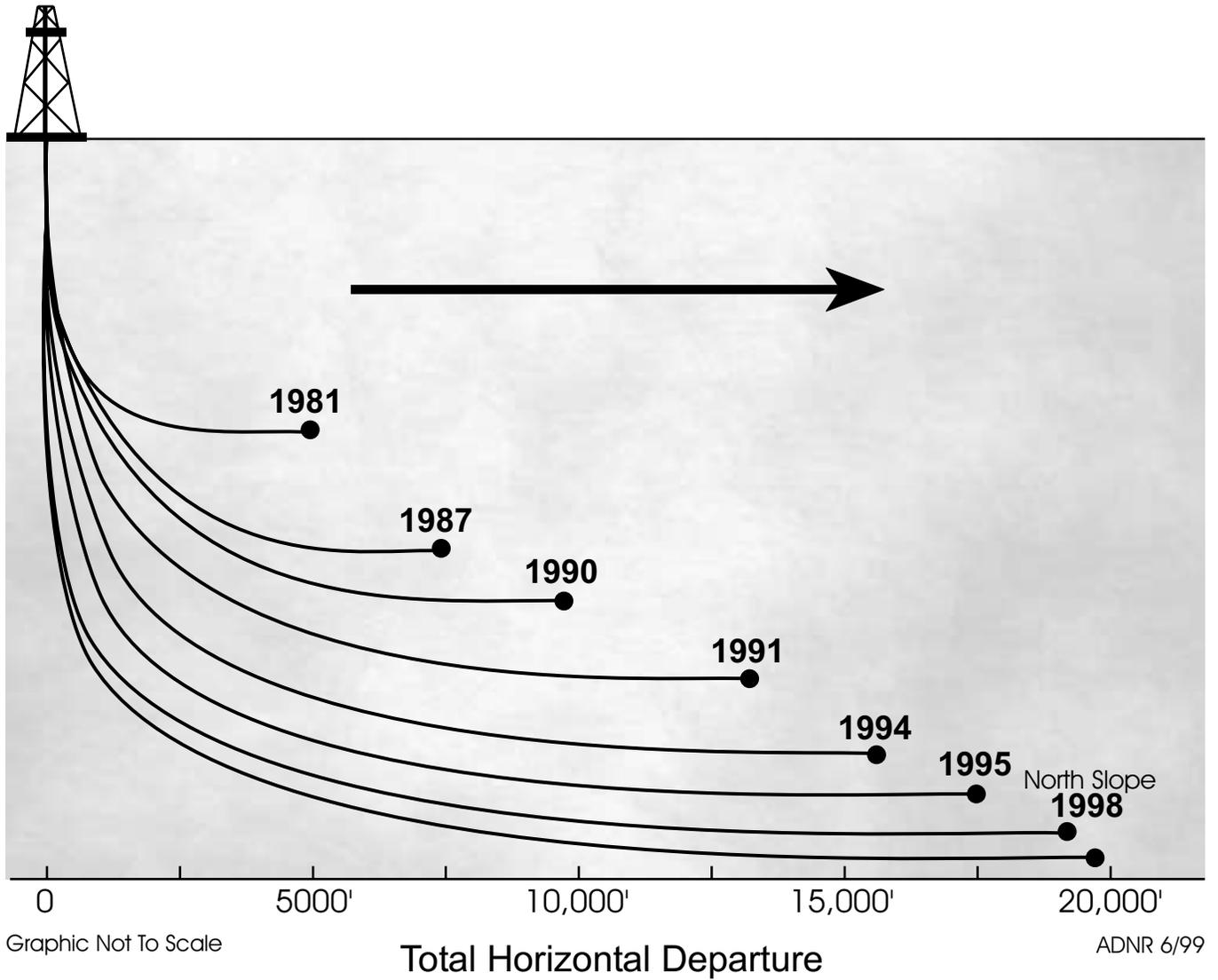
The working relationship between various components of a drill string must be carefully analyzed. Conventional drill stems are about 30 feet long and are made up of a bit, stabilizer, motor, a measurement-while-drilling (MWD) tool, drill collars, more stabilizers, and jars. There are more than 1,600 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, 1994a).

In a few cases, ERD technology has been used instead of platform installation off 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, 1994a). Other successes with ERD include the North Sea, Gulf of Mexico, South China Sea, and at Milne Point, Badami, Point McIntyre, and Niakuk fields in Alaska (Judzis, et al., 1997).

While a 6.6-mile horizontal displacement was accomplished in 1999 at Cullen Norte 1 well in Argentina (Halliburton, 1999), horizontal displacements (departure from vertical) of one-half mile to two miles are typical. In October of 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 (See Figure D.3). Despite its \$6 million price, the well represents a cost saving over the other drilling alternative—construction of an offshore artificial gravel island (AJC, 1996).

It is possible that exploration wells within the sale area may be directionally drilled due to 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 sale area is unknown. Most development wells will be directionally drilled because of the cost savings realized in pad and construction, and in required facilities. Although high

FIGURE D.3 Well "Reach" vs Time (In Alaska)



Departure ERD wells recently have been planned for some new field developments, the most common ERD applications applied to date occur after initial developments have been installed. This is due in part because drilling mechanics and performance are highly variable. Long departure wells show promise in applicability of ERD in Alaska, however equal consideration should be given to local ERD experience and rig capability in assessing the potential for ERD (Judzis, et al., 1997).

Many surface use conflicts can be avoided through directional and ERD. However, some reservoirs are located or sized such that directional drilling cannot eliminate all possible conflicts.

## Appendix E: References

### ABR (Alaska Biological Research, Inc.)

- 1993 Lisburne Terrestrial Monitoring Program, The Effects of the Lisburne Development Project on Geese and Swans, 1985-1989, Final Synthesis Report, February.

### ADCED (Alaska Department of Community and Economic Development)

- 2000 Alaska Community Information Summary ([http://www.dced.state.ak.us/mra/CF\\_CIS.htm](http://www.dced.state.ak.us/mra/CF_CIS.htm)). March.  
1993 Alaska Visitor Patterns, Opinions and Planning, Summer 1993. Alaska Department of Commerce and Economic Development, Division of Tourism, Alaska Visitor Statistics Program, Prepared by the McDowell Group, Juneau.

### ADCRA (Alaska Department of Community and Regional Affairs)

- 1978 Planning for Offshore Oil Development Gulf of Alaska OCS Handbook.

### ADF&G (Alaska Department of Fish and Game)

- 2000 Memorandum from Al Ott, Regional Supervisor, Habitat Division, to James Hansen, Lease Sales Manager, DO&G, regarding North Slope Foothills Areawide 2001, January 10.  
2000a Annual Performance Reports, Division of Wildlife Conservation, January 19.  
2000b Memorandum from Al Ott, Regional Supervisor, Habitat Division, to James Hansen, Lease Sales Manager, DO&G, regarding North Slope Foothills Areawide 2001 PBIF, September 5.  
1996b Alaska Wildlife Harvest Summary, 1994-1995. Alaska Department of Fish & Game, Division of Wildlife Conservation, Information Management Section, Wildlife Information Data Base Project, March 6.  
1996c Alaska Hunting Regulations, No. 37. Alaska Department of Fish and Game, Division of Wildlife Conservation, Effective Dates July 1, 1996-June 30, 1997.  
1995 Community Profile Database, Volume 5: Arctic Region. Division of Subsistence, Alaska Department of Fish and Game, Juneau, September.  
1994 Wildlife Notebook Series  
1991 Blasting Standards.  
1986a Alaska Habitat Management Guide, Arctic Region, Volume I, "Life Histories and Habitat Requirements of Fish and Wildlife."  
1986b Alaska Habitat Management Guide, Arctic Region, Volume II: Distribution, Abundance, and Human Use of Fish and Wildlife. Division of Habitat, Juneau.

### ADGC (Alaska Division of Governmental Coordination)

- 1995 Classification of State Agency Approvals: ABC List, Volumes I & II. State of Alaska, Office of the Governor, Division of Governmental Coordination, May.

### ADOL, (Alaska Department of Labor)

- 1998 Employment and Earnings for North Slope Borough.

### ADOR (Alaska Department of Revenue)

- 2000 Alaska North Slope and Cook Inlet Production, <http://www.revenue.state.ak.us/tax/production/FY00prod/Mar00.htm>. March.  
2000a Fall 2000 Revenue Sources Book, December 12.  
1999 Fall 1999 Revenue Sources Book, December 8.

Alyeska Pipeline Service Company

- 1999 Personal Communication from Tracy Green, Alyeska Pipeline Service Company, to Tom Bucceri, DO&G, September 21.  
1999a Trans Alaska Pipeline System, September.

ADN Anchorage Daily News

- 1996 Biologists seek OK to thin Nelchina caribou herd. Anchorage Daily News, March 27; B3.

Anderson B.A., Murphy, S.M., Jorgenson, M.T., Barber, D.S., and Kugler, B.A.

- 1992 GHX-1 Waterbird and Noise Monitoring Program. Report by Alaska Biological Research, Inc. and BBN systems and Technologies Corp. for ARCO Alaska Inc., Anchorage.

Anderson, Cheryl

- 2000 Personal communication from Cheryl Anderson, MMS to Tom Bucceri, DO&G regarding the most recent draft oil spill statistics.

AJC (Alaska Journal of Commerce)

- 1996 Productivity: North Slope Drilling Costs Come Down. Tim Bradner, Alaska Oil & Gas Reporter, March 18, p. 18.  
1996b Alaska Companies Test Remediation in Cold Weather. Alaska Journal of Commerce, January 22, p.9.

AEIDC (Arctic Environmental Information and Data Center, University of Alaska)

- 1975 Alaska Regional Profiles, Arctic Region

ARCO Alaska, Inc.

- 1998 Aircraft Mounted Forward Looking InfraRed Sensor System for Leak Spill Detection, Spill response, and Wildlife Imaging.

Baker, Bruce

- 1987 Memorandum from Acting Director, Habitat Division, ADF&G, to Jim Eason, Director, DO&G, regarding Sale 54, February 24.

Bittner, J. E.

- 1993 "Cultural Resources and the Exxon Valdez Oil Spill." In Exxon Valdez, Oil Spill Symposium Abstract Book, Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska, February.

BPX BP Exploration, Alaska, Inc..

- 1990 Letter from Steven D. Taylor, Manager, Environmental and Regulatory Affairs, Alaska, to Jean Marx, U. S. Army Corps of Engineers, Alaska District, and Dan Robison, U.S. Environmental Protection Agency, Alaska Operations Office, Alaska, regarding Comments on Colville River Delta Advanced Site Identification, January 31.

Cameron, et al

- 1995 Abundance and Movements of Caribou in the Oil field Complex near Prudhoe Bay, Alaska. R.D. Cameron, E.A. Lenart, D.J. Reed, K.R. Whitten, and W.T. Smith, Alaska Department of Fish and Game, Rangifer, 15(1):p.3-7.  
1992 Distribution and Productivity of the Central Arctic Caribou Herd in Relation to Petroleum Development: Case History Studies with a Nutritional Perspective. Federal Aid in Wildlife Restoration Research Progress Report, Project W-23-5, Study 3.35. November.

Campbell, et al.

- 1973 Response of Alaska Tundra Microflora to a Crude Oil Spill. W.B. Campbell, R.W. Harris, and R.E. Benoit in *The Impact of Oil Resource Development on Northern Plant Communities*, B.H. McCown and D.R. Simpson, eds., University of Alaska Fairbanks, Institute of Arctic Biology, 1973, pp. 53-62.

Carroll, Geoff

- 1996 Personal communication with Geoff Carroll, Area Biologist, Alaska Department of Fish and Game to Brian Havelock, DO&G, May 5.

Carruthers, D. R., and R. D. Jakimchuk, and S. H. Ferguson

- 1984 *The Relationship between the Central Arctic Caribou Herd and the Trans-Alaska Pipeline*. Prepared for Alyeska Pipeline Service Company by Renewable Resources Consulting Services Ltd. April.

City Council of Anaktuvuk Pass,

- 2000 Letter from the City Council of Anaktuvuk Pass to James Hansen, Leasing Manager, regarding the Preliminary Best Interest Finding, North Slope Foothills Area-wide 2001, September 8.

Cronin, M. A., Ballard, W.B., Truett, J., and Pollard, R.

- 1994 *Mitigation of the effects of oil field development and transportation corridors on caribou*. Final Report to the Alaska Steering Committee. Prepared by LGL, Alaska Research Associates, Inc. Anchorage.

Curatolo, James A. and Reges, Amy E.

- 1985 *Caribou Use of Pipeline/Road Separations and Ramps for Crossing Pipeline/Road Complexes in the Kuparuk Oil field, Alaska*.

Dale, Rachel, Joan

- 2000 Memorandum from Joan Dale, Division of Parks, office of History and Archaeology, to Tom Bucceri, DO&G, April 7.

Derksen, et al.

- 1992 *Effects of aircraft on the behavior and ecology of molting black brant near Teshekpuk Lake, Alaska*. D.V. Derksen, K.S. Bollinger, D. Esler, K.C. Jensen, E.J. Taylor, M.W. Miller, and M.W. Weller. Unpubl. Rep. USF&WS, Anchorage.

Farmer, Edward J., P. E.

- 1989 *A New Approach to Pipe Line Leak Detection*, Pipe Line Industry, June.

Fink, Mark

- 1999 Personal Communication from Mark Fink, Habitat Biologist, ADF&G Habitat Division to Tom Bucceri, DO&G, January 4.

Fowler, Bill

- 2000 Personal communication between Bill Fowler, Senior Permit Coordinator for the Colville Development, ARCO Alaska Inc., and Tom Bucceri, DO&G, March 29.

George, John C., and Benjamin P. Nageak

- 1986 *Observations on the Colville River Subsistence Fishery at Nuiqsut, Alaska, for the period 4 July - 1 November 1984*. Department of Wildlife Management, North Slope Borough, July.

Gubser, Nicholas, J.

- 1965 *The Nunamiut Eskimos: Hunters of Caribou*.

Hall, Edwin, S. et al.

1985 In the National Interest: A Geographically Based Study of Anaktuvuk Pass Inupiat Subsistence Through Time, April.

Halliburton Energy Services

1999 Baroid helps set extended reach drilling records. Company press release, May 17.

Hart Crowser Inc.

2000 Estimation of Oil Spill Risk From Alaska North Slope, Trans-Alaska Pipeline, and Arctic Canada Oil Spill Data Sets, OCS Study MMS 2000-007, April.

Hazen, Beez

1997 Use of Ice Roads and Ice Pads for Alaskan Arctic Oil Exploration Projects. Beez Hazen, Northern Engineering & Scientific, In NPR-A Symposium Proceedings: Science, Traditional knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska, sponsored by the Bureau of Land Management and Minerals Management Service, OCS Study MMS 97-0013, April 16-18.

Haynes, Terry

2000 Personal communication between Terry Haynes, ADF&G Subsistence Division and Tom Bucceri, DO&G, June 8.

Hoffman, David, David Libbey, and Grant Spearman

1988 Nuiqsut: Land Use Values Through Time in the Nuiqsut Area. North Slope Borough and The Anthropology and Historic Preservation Section of the Cooperative Park Studies Unit, University of Alaska, Fairbanks, Occasional Paper Number 12, 1978, Rev. 1988.

Houle, Julie

2000 Memorandum from Julie Houle, Petroleum Geologist, DO&G, to Jim Hansen, Leasing Manager, DO&G regarding the geology of the North Slope Foothills sale area, February 29.

ISER,

1990 Institute of Social and Economic Research, University of Alaska Anchorage, Fiscal Policy Paper No. 5, October.

Jacobson, Michael, J., and Cynthia Wentworth

1982 Kaktovik Subsistence: Land Use Values Through Time in the Arctic National Wildlife Refuge Area. USF&WS, Northern Alaska Ecological Services, Fairbanks.

Janes, Eddie

2000 Memorandum to file, personal communication between Eddie Janes, Department of Education and Tom Bucceri, DO&G, April 11.

Johnson, C. B. and Lawhead, B. E.

1989 Distribution, Movements, and Behavior of Caribou in the Kuparuk Oil field, Summer. Alaska Biological Research Inc., Fairbanks, May.

Johnson, Stephen R. and Herter, Dale R.

1989 The Birds of the Beaufort Sea, Bridgetown Printing, June.

Jorgenson, Janet C., and Martin, Philip

1997 Effects of Winter Seismic Exploration on Tundra Vegetation and Soils. Janet C. Jorgenson and Philip Martin, USF&WS, In NPR-A Symposium Proceedings: Science, Traditional knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska, sponsored by the Bureau of Land Management and Minerals Management Service, OCS Study MMS 97-0013, April 16-18.

JPT (Journal of Petroleum Technology)

1994a Designer Wells: Extended-reach or "Designer" Wells Stretch the Limits of Equipment and Materials. Journal of Petroleum Technology, September, p. 744-745.

1994b Experts Share Views on Formation Damage Solutions: Five Authorities Discuss Formation Damage Issues, Including Engineering Solutions to Damage in Horizontal Wells. Journal of Petroleum Technology, November, p. 936-940.

Judzis, et al.

1997 Extended-Reach-Drilling: Managing Networking, Guidelines, and Lessons Learned. A. Judzis, BP Exploration (Alaska); K. Jardaneh; and C. Bowes, BP Exploration Operating Co. Ltd., SPE Paper 37573 presented at the 1997 SPE/IADC Drilling Conference, Amsterdam, March 4-6.

Kidd, et al.

1997 Ecological Restoration of the North Prudhoe Bay State No. 2 Exploratory Drill Site, Prudhoe Bay Oil field, Alaska, 1995: Fourth Annual Report. Janet G. Kidd, Laura L. Jacobs, Timothy C. Cater, and M. Torre Jorgenson, ABR Environmental Research & Services, Inc., Prepared for ARCO Alaska Inc., April.

Lawhead, et al.

1997 Caribou Distribution, Abundance, and Calf Production in the Kuparuk Oil Field During the 1996 Calving Season. Brian E. Lawhead, Charles B. Johnson, Ann M. Wildman, and John R. Rose, ABR Inc., prepared for ARCO Alaska, Inc., and Kuparuk River Unit, April.

Lawhead, B.E., and R.D. Cameron

1984 Distribution Movements of the Central Arctic Caribou Herd During Calving and Insect Season. Alaska Biological Research, Inc. Fairbanks.

Linkins, et al.

1984 Oil Spills: Damage and Recovery in Tundra and Taiga. Arthur E. Linkins, Department of Biology, Virginia Polytechnic Institute and State University; L.A. Johnson, U.S. Army Cold Regions Research Engineering Laboratory; K.R. Everett, Institute of Polar Studies and Department of Agronomy, Ohio State University; and R.M. Atlas, Biology Department, University of Louisville. In Restoration of Habitats Impacted by Oil Spills, John Cairns, Jr. & Arthur L. Buikema, Jr., eds. Butterworth Publishers.

LGL Limited, Environmental Research Associates

1984 Habitat Use and Behavior of Nesting Common Eiders and Molting Oldsquaws at Thetis Island, Alaska During a Period of Industrial Activity, March.

LL Bean Park Search

- 2000 LL Bean Park Search Website, Noatak National Preserve  
<http://www.llbean.com/parksearch/parks/html/15029gd.htm>

MacKay, et al.

- 1974 Crude Oil Spills of Northern Terrain. D. MacKay, M.E. Charles, and C.R. Phillips, Environmental Serial Program, Northern Pipelines Task Force on Northern Oil Development, Ottawa: Information Canada, Report 73-42.

McConnell, Sarah

- 2001 Personal communication from Sarah McConnell, Fairbanks, to Tom Bucceri, DO&G, January 2.

Mekiana, Gladys

- 2001 Personal communication from Gladys Mekiana, Anaktuvuk Pass, to Tom Bucceri, DO&G, January 9.

MMS (Minerals Management Service)

- 2000 Northstar Oil Spill Probability White Paper, June 12.  
1998 Northeast National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement, USDO, August.  
1996 OCS Sale 144 Final Environmental Impact Statement, May.  
1996a Cook Inlet Planning Area, Oil and Gas Lease Sale 149, Final EIS, Vol. 1. January 1996.  
1996b Beaufort Sea Planning Area, Oil and Gas Lease Sale 144, Final EIS, May, MMS 96-0012.  
1995 Cook Inlet Planning Area, Oil and Gas Lease Sale 149, Draft EIS, Vol. 1. January 1995.  
1995a An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska OCS Study MMS-95-014, March.  
1991 Contamination of U.S. Arctic Ecosystems by Long-Range Transport of Atmospheric Contaminants. In Federal Arctic Research Information Workshop: Workshop Proceedings, Presented by Dixon Landers, Environmental Protection Agency, MMS OCS Study 91-0053, July.  
1987 Beaufort Sea Sale 97, Alaska Outer Continental Shelf, Final Environmental Impact Statement, Volume 1, June, MMS 87-0069.

Murphy, S.M. and Anderson, B.A.

- 1993 Lisburne Terrestrial Monitoring Program: The Effects of the Lisburne Development Project on Geese and Swans, 1985-1989. Report by Alaska Biological Research, Inc. for ARCO, Alaska, Inc.

National Parks Service

- 2000 National Park Service website, Gates of the Arctic National Park and Preserve  
<http://www.nps.gov/gaar/pphtml/activities.html>

Nelson, Mautner and Bane,

- 1982 Tracks in the Wildland, A Portrayl of kokukon and Nanamiut Subsistence.

Nessim, M. A. and Jordan, I. J.

- 1986 Arctic submarine pipeline protection is calculated by optimization model. Oil & Gas Journal, January 20.

Noel, Lynn E., and Pollard, Robert H.

- 1996 Yukon Gold Ice Pad Tundra Vegetation Assessment: Year 3. LGL Alaska Research Associates, Inc., Draft Final Report, January 10.

NRC (National Research Council)

1985 Oil in the Sea: Inputs, Fates and Effects. Washington DC.

NSB (North Slope Borough)

- 2000 Memorandum to file, personal communication between Todd Heinrichs, and John Ames of the NSB and Tom Bucceri, DO&G, April 11.
- 1996 North Slope Borough Subsistence Documentation Project: Data for Anaktuvuk Pass, Alaska for the period July 1, 1994 to June 30, 1995. Prepared by Harry K. Brower, Jr., and Raynita "Taquilik" Opie, NSB Department of Wildlife Management, September 16.
- 1993 North Slope Borough 1993/94 Economic Profile and Census Report, Vol. VII. North Slope Borough, Department of Planning & Community Services.
- 1979 Nuiqsut Heritage: A Cultural Plan. Prepared for the Village of Nuiqsut and the North Slope Borough Planning Commission and Commission on History and Culture, February.

NSBCMP

1984 North Slope Borough Coastal Management Program Background Report. Maynard & Partch, Woodward-Clyde Consultants.

O'Hara, Todd

1996 Personal Communication with Todd O'Hara, North Slope Borough, Department of Wildlife Management to Brian Havelock, DO&G, November 19.

Ott, Alvin G.

- 1997 Memorandum from Regional Supervisor, Habitat and Restoration Division, Alaska Department of Fish & Game, to James Hansen, Division of Oil & Gas, regarding Proposed Oil & Gas Lease Sale 87, March 5, 1997.
- 1996 Memorandum from Regional Supervisor, Department of Fish and Game, to James Hansen, Division of Oil and Gas, regarding Sale 86, Beaufort Sea, November 15.
- 1992 Memorandum from Regional Supervisor, Department of Fish and Game, to James Hansen, Division of Oil and Gas, regarding Sale 80, Shaviovik, April 27.

Parametrix, Inc.

1996 Alpine Development Project Environmental Evaluation Document. Prepared by Parametrix, Inc. for U.S. Army Corps of Engineers and ARCO, Alaska Inc., October.

Payne, M.L., D.A. Cocking, and A.J. Hatch

1995 Brief: Critical Technologies for Success in Extended-Reach Drilling. M.L. Payne, SPE, Arco British Ltd.; D.A. Cocking, BP Exploration; and A.J. Hatch, SPE, Anadrill/Schlumberger, SPE Paper 30140, Journal of Petroleum Technology, February, p. 121-122.

Philo, L. M., et al.

1993 Movements of Caribou in the Teshekpuk Lake Herd as Determined by Satellite Tracking, 1990-1993. Lee M. Philo, Department of Wildlife Management, North Slope Borough; Geoffrey M. Carroll, Alaska Department of Fish & Game; and David A. Yokel, Arctic District Office, U.S. Bureau of Land Management, November.

Pedersen, Sverre

- 2000 Personal communication between Sverre Pederson, ADF&G Subsistence Division and Tom Bucceri, DO&G, December 20.
- 1997 Personal communication between Sverre Pederson, ADF&G Subsistence Division and Tom Bucceri, DO&G, July 7.

- 1979 Regional Subsistence Land Use, North Slope Borough, Alaska.  
Occasional Paper No. 21, June.
- Pedersen, Sverre, Coffing, Michael W., and Thompson, Jane.  
1985 Subsistence Land Use Baseline for Kaktovik, Alaska. Division of Subsistence, Alaska Department of Fish and Game, Technical Paper No. 109.
- Pinny, D. S., and R. A. Combellick  
2000 Geologic Hazards in and Near Proposed State of Alaska Oil and Gas Sale, North Slope Foothills, March 15.
- Powers, A. D.  
1989 Letter from MMS Regional Director, to Jeffery Petrich, Subcommittee on Water, Power and Offshore Energy Resources, U. S. House of Representatives, April 14/
- PNA (Petroleum News Alaska)  
2000 News Bulletin, Central Arctic caribou herd numbers highest ever, December 22.
- PTTC (Petroleum Technology Transfer Council)  
1996 Overview of Horizontal Drilling. In The Best of PTTC Workshops, Horizontal Drilling Workshop, Illinois State Geological Survey, Grayville, Illinois, March 16, Petroleum Technology Transfer Council, Web Site.
- Schlumberger Anadrill  
1993 People and Technology, Directional Drilling Training.
- Schmidt, G. Russell  
1994 Personal Communication from G. Russell Schmidt, Unocal to Tom Bucceri, DO&G, April 22.
- Schultz, Gary  
1996 Memorandum to Matt Rader, DO&G, from Gary Schultz, DO&G, regarding Colville Delta Seismic activity, July 30.
- Smith, Louise, L.C. Byrne, C.B. Johnson, A.A. Stickney  
1993 Wildlife Studies on the Colville River Delta, Alaska, 1992.
- Smith, Walter T. and Cameron, R. D.  
1991 Caribou responses to development infrastructures and mitigation measures implemented in the Central Arctic region. In T. R. McCabe, D. B. Griffith, N. E. Walsh, and D. D. Young. (eds) Terrestrial research 1002 area - Arctic National Wildlife Refuge, Interim Rep. 1988-90, USF&WS, Anchorage.
- Shideler, Richard, T.  
1986 Impacts of Human Developments and Land Use on Caribou: A Literature Review, Volume II. Impacts of Oil and Gas Development on the Central Arctic Herd. Technical Report No. 86-3, ADF&G, Division of Habitat.
- Sousa, Patrick  
1997 USF&WS, letter to James Hansen, Division of Oil and Gas, regarding state Oil and Gas Lease Sale 86, March 28.

1992 USF&WS, letter to James Hansen, Division of Oil and Gas, regarding state Oil and Gas Lease Sale 80, April 29.

Steihn, Lynn, and Hayes, Helen

1996 Personal communications with Lynn Steihn and Helen Hayes, Arctic Development Council, and Brian Havelock, DO&G, October 25 and November 1.

TERA (Troy Ecological Research Associates)

1993 Bird Use of the Prudhoe Bay Oil Field. Report for BP Exploration (Alaska) Inc., Anchorage.

1990 The Fate of Birds Displaced by the Prudhoe Bay Oil Field: The Distribution of Nesting Birds Before and After P-Pad Construction. Report for BP Exploration (Alaska) Inc., Anchorage, December.

Toopetlook, Debbie,

2001 Personal communication from Debbie Toopetlook, Anaktuvuk Pass, to Tom Bucceri, DO&G, January 9.

USACE (U.S. Army Corps of Engineers)

1984 Endicott Development Project, Final EIS.

USDOl, (U. S. Department of the Interior, USF&WS)

1987 ANWR, Coastal Plain Resource Assessment Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement.

1986 Final Report Baseline Study of the Fish, Wildlife, and their Habitats, Section 1002C, Alaska National Interest Lands Conservation Act.

Whitten, Kenneth R.

1995 Results of the 1995 Central Arctic Caribou Herd Photo-census. Memorandum from Kenneth R. Whitten, Acting Research Coordinator, ADF&G to Wayne Regelin, Director, Division of Wildlife Conservation, October 20.

Weber, Vera

2001 Personal communication from Vera Weber, Anaktuvuk Pass, to Tom Bucceri, DO&G, January 9.

Winfree, Mike,

1994 Personal communication from Mike Winfree, ARCO Alaska Inc., to Tom Bucceri, DO&G, April 25.

Winters, Jack

2000 Personal communication from Jack Winters, Habitat Biologist, ADF&G, to DO&G regarding maps of Dolly Varden Overwintering Areas, February 15.

Yoon, M. S., and Mensik, M.

1988 "Spillage Minimization through Real-Time Leak Detection." A Technical report by Navacorp international Consulting Ltd., Calgary, Alberta, Canada, February.

Yoon, M. S., Mensik, M., and Luk, W. Y.

1988 "Canadian pipeline installs leak detection system." Oil and Gas Journal, May 30.