September 30, 2013

TOLSONA OIL AND GAS EXPLORATION LICENSE

Written Finding of the Director

Alaska Department of
NATURAL RESOURCES
Division of Oil and Gas

Alaska Department of Natural Resources
Division of Oil and Gas
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Recommended citiation:

ADNR (Alaska Department of Natural Resources). 2013. Tolsona oil and gas exploration license. Written finding of the director. September 30, 2013.

This publication was produced by the Alaska Department of Natural Resources, Division of Oil and Gas. The purpose of this publication is to meet the mandate of AS 38.05.035(e).

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

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Table of Contents

Executive Summary

The State of Alaska, Department of Natural Resources (DNR), through the DNR commissioner, is required by AS 38.05.133(f) to determine whether issuing an oil and gas exploration license serves the state's best interests. The DNR commissioner delegates to the director of Division of Oil and Gas (DO&G) the responsibility to make that determination. This document presents the director's written finding and decision for the disposal and exploration of an oil and gas exploration license in the Tolsona Lake area, located in the Copper River basin. The director reviewed all facts and issues known or made known to him and limited the scope of the finding to the disposal and exploration phases of oil and gas activities and the reasonably foreseeable significant effects of issuing an exploration license (AS 38.05.133(f); AS 38.05.035(e)(1)(A)). The content of a finding is specified in AS 38.05.035(e). The topics that must be considered and discussed are listed in AS 38.05.035(g) and AS 38.05.133(f).

After weighing the facts and issues known to him at this time, considering applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections in place, the director concludes the potential benefits of issuing an exploration license outweigh the possible negative effects. The director finds issuing an oil and gas exploration license to Ahtna, Inc. (Ahtna) is in the best interests of the state of Alaska.

The exploration license area is approximately 46,000 gross acres located within the Copper River Meridian. The license area contains land in which the state owns both the land estate and the mineral estate, and land where the state owns just the mineral estate beneath privately owned land. Only free and unencumbered state-owned mineral estates are included in the oil and gas license. If Ahtna accepts the license and meets its work commitment obligations described in the license (Appendix B), it may request a conversion of the license to leases of up to 5,760 acres each. Appendix C is a sample lease. The terms and conditions of the lease entered into will be based on current statutes, regulations, mitigation measures, and other stipulations.

A. Introduction

The intent of oil and gas licensing is to encourage exploration in areas far from existing infrastructure, with unknown or limited knowledge of hydrocarbon potential, and where there is a higher investment risk to the operator. Though the state holds oil and gas lease sales in the established petroleum provinces of Cook Inlet and the North Slope, an exploration license is intended to initiate oil and gas exploration in other areas of the state. An exploration license will give Ahtna the exclusive right to explore for oil and gas without the initial expense of leasing bonuses. Through exploration licensing, the state receives subsurface geologic information and, should development occur, additional revenue through royalties and taxes. Additionally, any reserves discovered could provide a source of energy for local consumption. Exploration licensing is discussed in further detail in Chapter Two.

Oil and gas activities proceed in phases. The activities of each subsequent phase depend on the completion or initiation of the preceding phase. The exploration license disposal phase is the first step in developing the state's oil and gas resources, subsequent to the director's affirmative written finding. An exploration license grants the licensee the exclusive right to explore for oil and gas and, provided the licensee meets certain conditions, to then convert all or a portion of the license to oil and gas leases. An oil and gas lease grants the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil and gas. A right to drill is not the same as the authority to drill. Before any operations on or in the licensed or leased area can begin, the licensee must present a plan of operations, which is subject to numerous regulatory authorities and permits.

With an exploration license, Ahtna may gather information about the area's petroleum potential. This process may include examining surface geology, completing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. If converted to an oil and gas lease, further exploration may occur. During the development phase, operators evaluate the results of exploratory drilling and formulate plans to bring the discovery into production. Production brings oil or gas to the surface and prepares it for transport.

B. Description of the Area

The study area lies in the Copper River basin and encompasses approximately 950 sq mi situated on T2-5N R1-8W, Copper River Meridian. The exploration license area is within the study area and consists of approximately 72 sq. mi. The exploration license study area is west of Mendeltna, east to Glennallen, and straddles the Glenn Highway. The actual license area is within the study area. This license may affect the communities of Mendeltna, Glennallen, Tazlina, and Copper Center. Additional information about the area and these communities is found in Chapter Three. Lands where mineral estates are owned by other entities are excluded from the license area.

C. Habitat, Fish, and Wildlife

The study area includes terrestrial and freshwater habitats. Freshwater and anadromous fishes may be found in the area's waters. The study area is seasonally inhabited by migratory birds. Terrestrial mammals inhabiting the area include caribou, moose, brown and black bears, wolves, and furbearers. Additional information on the area's species and habitats is found in Chapter Four.

D. Current and Projected Uses

Commercial guiding, fishing, hunting, trapping, and recreation are the major land uses in the study area. Traditional subsistence hunting, trapping, and fishing continue within the study area. Because Glennallen is situated at the intersection of the Glenn and Richardson highways and the Wrangell-St. Elias National Preserve, it attracts travelers and tourists. These uses are discussed in more detail in Chapter Five.

E. Oil and Gas in the Area

Based on the information known, DNR has determined that the exploration license area has moderate-to-low potential for discovery of conventional natural gas. The potential for conventional and unconventional oil appear unlikely. However, Athna's exploration work will add to the state's body of knowledge about the area's resource potential. Discoverable amounts of oil or gas may provide energy to local communities. Phases of development include exploration, conversion of the license to a lease, development, and production. The most likely method of transportation is by pipeline. Petroleum potential, phases of development, and transportation are discussed in Chapter Six.

F. Governmental Powers to Regulate Oil and Gas

All oil and gas exploration activities are subject to numerous federal, state, and local laws and regulations with which Ahtna and its operators must comply. These government agencies have broad authority to regulate and condition activities related to oil and gas. Although some agencies may have overlapping authorities, their roles in the oversight and regulation of activities differ. These agencies include the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game; the Alaska Oil and Gas Conservation Commission; the U.S. Environmental Protection Agency; the U.S. Army Corp of Engineers; the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service. Many of the regulatory and statutory authorities are discussed in Chapter Seven.

G. Reasonably Foreseeable, Significant Cumulative Effects of Licensing and Subsequent Activity

Disposing of an exploration license alone is not expected to have any effects other than to generate revenue for the state. Potential effects of activities subsequent to the disposal can be both positive and negative. Mitigation measures imposed on the exploration license are expected to protect fish and wildlife species, habitats, and their uses; on local uses, residents, and property owners; and on local communities from most potentially negative effects. These measures are listed in Chapter Nine. These measure, laws, and regulations apply to the license, and to subsequent leases, if the license is converted to leases.

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

Oil and gas development could result in increased access to recreation, mining, hunting, and fishing areas due to construction of new roads. This could also increase competition between user groups. Exploration and development could decrease the area's visual quality and attraction to tourists and could restrict local access to the area. However, increased access could benefit recreational and visitor uses by increasing the area available for those uses. Other potential benefits from gas development activity include a potential increase in wage earning opportunities to supplement subsistence activities.

If unregulated, oil and gas activities susequent to the disposal could potentially affect local landowners and surface users, habitats, fish and wildlife, air quality, subsistence, viewshed, recreational, sport, and commercial uses and users of the area's natural resources. Local residents' use of the area requires access to it. Any activity, facility, or structure that restricts access could have an adverse impact on local residents, especially if private property is involved. Local access to the area may not be restricted, except immediately around facilities. Measures included in this written finding, along with laws and regulations imposed by state and federal agencies, are expected to avoid, minimize, and mitigate these potential effects. More information about potential effects is found in Chapter Eight.

Potential cumulative effects of oil and gas activities can be both positive and negative. Positive potential effects are job creation, a small initial contribution to state revenues, and the potential

to use oil and gas to lower energy costs. If Ahtna employs local and Alaska residents and contractors for work in the license area, to the extent they are available and qualified, the multiplier effect may benefit local and state economies.

H. Mitigation Measures

Mitigation measures address protection of private property; water quality and aquifers; air quality; facilities and operations; habitat, fish, and wildlife; subsistence, commercial, and sport harvest activities; drilling muds, cuttings, and produced waters; potential spills of hazardous substances; access; prehistoric, historic, and archaeological sites; and local hire, and communication and training. Mitigation measures are found in Chapter Nine.

Chapter One
Director's Finding and Decisions

This is the director's decision under AS 38.05.133(f) that, after considering the matters required by AS 38.05.035(e) and (g), on balance, disposing of a state interest by issuing an exploration license to Ahtna, Inc. (Ahtna) is in the state's best interest. Issuing the license gives Ahtna the exclusive right to explore for deposits of oil and gas unless the license is terminated or the land is relinquished, removed, or deleted (AS 38.05.132(b)(1)). This is also DNR's approval of the next phase of the project – the exploration phase (AS 38.05.035(e)(1)(C)(ii) and (iii)).

This written finding is based upon all facts and issues known, or made known, including public comments, to the director at the time of review. The director limited the scope of the finding to the disposal phase and the exploration phase, and the reasonably foreseeable significant effects of the disposal and exploration (AS 38.05.035(e)(1)(A)). Conditions for phasing are met under AS 38.05.035(e)(1)(C). At the disposal and exploration phases, the type, location, duration, timing, or level of activity subsequent to disposal and exploration are not precisely known. Therefore, the director has not considered possible specific effects of unknown future development or transportation activities that are outside the scope of this finding. The effects of future development and transportation will be considered at these subsequent phases, when government agencies and the public review permit applications for the proposed specific activities at specific locations in the license area. However, the director did consider, in general terms, the potential effects that may occur subsequent to the disposal and exploration phases.

A. Finding

In making his finding, the director considered and discussed facts and public comments received during his review that address the matters required by AS 38.05.035(g). The discussion of these matters is set out in the accompanying chapters of this written finding. Based on consideration and discussion of the information contained herein, the director finds:

- The Alaska constitution directs the state "to encourage ... the development of its resources by making them available for maximum use consistent with the public interest" (Alaska Constitution, art. III §§1, 2).
- The people of Alaska have an interest in developing the state's oil and gas resources and maximizing the economic and physical recovery of those resources…(AS 38.05.180(a)).
- The intent of oil and gas licensing program (AS 38.05.131 —.134) is to encourage exploration in areas far from existing infrastructure, with relatively low or unknown hydrocarbon potential, and where there is a higher investment risk to the operator.
- On April 5, 2012, DO&G received a timely Exploration License Application from Ahtna, Inc.
- The director requested further information from Ahtna, Inc. on its proposal, and this information was received on June 25, 2012.
- On July 25, 2012, DO&G published a notice of intent to evaluate the proposal, request for comments on exploration licenses in the area, and request for competing proposals. Responses were due by September 5, 2012.
- DO&G received 14 timely comments from agencies, organizations, and individuals. It did not receive competing proposals.

- Most of the public comments concerned the potential impact of oil and gas exploration on fish and wildlife habitat.
- AS 38.05.133(f) requires a written finding addressing all matters set out in AS 38.05.035(e) and (g) after considering proposals and public comment on the proposals.
- AS 38.05.035(e)(1)(C) allows the director to limit a written finding to the disposal phase, which is the issuance of an exploration license, and oil and gas leases if the license is converted.
- Under AS 38.05.035(e)(1)(C)(ii) and (iii), before the next phase - the exploration phase – of the project may proceed, public notice and the opportunity to comment must be provided. These were provided through the July 25, 2012, public notice.
- All oil and gas activities conducted under an exploration license or oil and gas lease are subject to numerous federal, state, and local laws and regulations with which Ahtna, Inc. and its operators must comply.
- Potential effects of activities subsequent to licensing can be both positive and negative.
- Fish and wildlife species that could be affected by the license are salmon, burbot, trumpeter swans, and caribou. Several important subsistence, sport, personal use, and commercial uses of fish and wildlife could be affected by the license as well.
- Discharges of oil, gas, and hazardous substances into the land, water, and air can harm habitats and fish and wildlife populations. Proper handling, storage, and disposal of such substances can eliminate or alleviate impacts.
- Increased use of the area for oil and gas activities could affect subsistence uses. Potential negative effects can be outweighed by potential positive effects such as higher income to offset equipment costs used for subsistence.
- Several communities near the exploration license area could benefit through economic opportunity and lower fuel prices if oil or gas is discovered in paying quantities.
- Most potentially negative effects of oil and gas activities on fish and wildlife species, habitats, and their uses; on local uses, residents, and property owners; and on local communities, if not adequately addressed by federal or state law, may be mitigated through measures imposed on the exploration license and subsequent leases.

B. Disposal Phase Decision

The director has weighed the facts and issues known at this time and has set out his findings. After considering applicable laws and regulations and public comments, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the director finds that the potential benefits of disposing of a state interest through the exploration license outweigh the possible negative effects. The director has determined that issuing an oil and gas exploration license to Ahtna, Inc. serves the best interests of the state of Alaska.

Ahtna, Inc. must comply with all applicable local, state, and federal codes, statutes, and regulations; and additional project-specific and site-specific mitigation measures will be applied as appropriate to future authorizations. These laws and mitigation measures will ensure the

oil and gas activities can be conducted without jeopardizing habitats and fish and wildlife populations of the area, and current and projected uses of the area.

The state is sufficiently empowered through constitutional, statutory, and regulatory regimes, the exploration license, and plans of operation to ensure that Ahtna, Inc. protects the integrity of the environment and maintains opportunities for existing and anticipated uses.

An eligible person affected by this decision may request reconsideration of it, in accordance with 11 AAC 02. Any request for reconsideration must be received within 20 calendar days after the date of issuance of this decision, as defined in 11 AAC 02.040(c) and (d), and may be mailed or delivered to Commissioner, Department of Natural Resources, 550 W. 7th Avenue, Suite 1400, Anchorage, Alaska 99501; faxed to 1-907-269-8918; or sent by electronic mail to dnr.appeals@alaska.gov.

An eligible person must first request reconsideration of this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. If the commissioner does not act on a request for reconsideration within 30 days after issuance of this finding, the request for reconsideration is considered denied and this finding becomes a final administrative order and decision on the 31st day after issuance for the purposes of an appeal to Superior Court. A copy of 11 AAC 02 is available from any regional information office of the Alaska Department of Natural Resources.

Director, Division of Oil and Gas — Date: 9-30-13

Commissioner, Dept. of Natural Resources — Date: 9-30-13

C. Exploration Phase Decision

To provide clarity to the public and Ahtna, Inc. the director is also explicitly stating his decision regarding the exploration phase. The director has weighed the facts and issues known at this time and has set out his findings regarding exploration. After considering applicable laws and regulations and public comments, and balancing the potential positive and negative effects of oil and gas exploration given the mitigation measures and other regulatory protections, the director finds that the potential benefits of approving the exploration phase outweigh the possible negative effects and hereby approves the exploration phase.

Ahtna, Inc. must obtain all required approvals before beginning on-the-ground exploration activities and must comply with all applicable local, state, and federal codes, statutes, and regulations; and additional project-specific and site-specific mitigation measures will be applied as appropriate to future authorizations. These laws and mitigation measures will ensure the oil and gas activities can be conducted without jeopardizing habitats and fish and wildlife populations of the area, and current and projected uses of the area.

The state is sufficiently empowered through constitutional, statutory, and regulatory regimes, the exploration license, and plans of operation to ensure that Ahtna, Inc. protects the integrity of the environment and maintains opportunities for existing and anticipated uses.

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Director, Division of Oil and Gas — 9-30-13
Date

Commissioner, Dept. of Natural Resources — 9-30-13
Date

Chapter Two
Introduction

The Alaska Department of Natural Resources (DNR), Division of Oil and Gas (DO&G) is offering an oil and gas exploration license to Ahtna, Inc. (Ahtna).

The exploration license area is west of Glennallen, and consists of approximately 46,000 gross acres located within the Copper River Meridian. The license area is bounded on the south by Township 4 N., on the east by Township 4 W., on the north by Township 5 N., and on the west by Township 5 W. Only lands for which the state owns the subsurface mineral estate are included in the license. The exploration license grants Ahtna the right to explore for oil and gas, and could subsequently be converted to a lease. The region's geology indicates that the likelihood of a discovery is greatest for conventional gas plays.

A. Authority

The Alaska Constitution says that the state's policy is "to encourage…the development of its resources by making them available for maximum use consistent with the public interest" and that the "legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State…for the maximum benefit of its people" (Alaska Constitution, article VIII, §1 and 2). To comply with this provision, the legislature enacted Title 38 of the Alaska statutes and directed DNR to implement the statutes.

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

B. Exploration Licensing

Exploration licensing supplements the state's conventional oil and gas leasing program by targeting areas outside known oil and gas provinces (the North Slope, Beaufort Sea, Cook Inlet, and Alaska Peninsula).[1] The licensing program encourages exploration in areas far from existing infrastructure, with relatively low or unknown hydrocarbon potential, and where there is a higher investment risk to the operator. Lease sales held in some of these higher-risk areas have attracted little participation because of the bonus money one has to pay to win the lease. Exploration licensing gives the licensee the exclusive right to explore for oil and gas without this initial

1 However, there are lands where the exploration licensing program does not apply. AS 38.05.131 states oil and gas exploration licenses statutes (AS 38.05.132 –.134) do not apply to land:

1) north of the Umiat baseline, and
2) in the vicinity of Cook Inlet that is within the area bounded by
   A) the north boundary of Township 17 North, Seward Meridian;
   B) the Seward Meridian;
   C) the south boundary of Township 7 South, Seward Meridian; and
   D) the west boundary of Range 19 West, Seward Meridian.

expense. Through exploration licensing, the state will receive subsurface geologic information about these regions and, should development occur, additional revenue through royalties and taxes.

The licensing process begins in one of two ways:

i. Annually each April applicants may submit to the DNR commissioner (commissioner) a proposal for exploratory activity within an area they have specified; or

ii. The commissioner can, at any time, request proposals to explore an area he has determined may be subject to the provisions of AS 38.05.132.

Any proposal received by the commissioner must be on a form prescribed by DO&G and must designate how much money the applicant will spend on exploration (the work commitment), the amount of acreage desired, and the term (duration) of the license. An exploration license may range from 10,000 to 500,000 acres, and may have a term of up to 10 years (AS 38.05.132). The proposal need not describe the type of exploration activity. However, before any exploration activity may occur, the proposed activity must first go through the required authorization processes.

Within 30 days of receiving a proposal for an exploration license, the commissioner must either reject it in a written decision or give public notice of DNR's intent to evaluate the acceptability of the proposal. The commissioner must also solicit comments and request competing proposals (AS 38.05.133(d)). If the commissioner decides to evaluate the acceptability of a proposal, DO&G develops a written finding determining whether issuing a license is in the state's best interests. DO&G must consider all comments received during the comment period (AS 38.05.133(f)).

Among other requirements set out in AS 38.05.035(e) and (g), the written finding sets the term of the license and the conditions placed on the license area, however, both may be different than what the applicant proposed. If there are no competing proposals, the finding must also identify the prospective licensee. If competing proposals are submitted and the finding concludes that issuing an exploration license is in the state's best interests, the successful licensee will be determined by a sealed bid process. The successful bidder is the prospective licensee who submits the highest bid in terms of the minimum work commitment dollar amount (AS 38.05.133(h)). The license gives the licensee the exclusive right to explore for deposits of oil and gas or gas only unless the license is terminated or the land is relinquished, removed, or deleted (AS 38.05.132(b)(1)). The licensee must pay a one-time $1.00 per acre license fee, and must annually post a bond equal to the work commitment, less the cumulative expended, divided by the years of the remaining license term (AS 38.05.132(c)). There are no additional charges during the term of the license. Upon fulfilling the work commitment, the bond is released; if the work commitment is not fulfilled, the bond is forfeited to the state.

By the fourth anniversary of the exploration license, if the licensee has not completed at least 25% of the total work commitment, the license will be terminated, and the remainder of the security will be forfeited to the state. If the licensee has completed less than 50% of the total work commitment, 25% of the licensed area would be relinquished, with an additional 10% relinquished each successive year until half of the original acreage has been relinquished (AS 38.05.132(d)).

Once the work commitment has been met (exploration expenditures equal the amount of the winning bid), and if the licensee requests, the commissioner will convert all or a portion of the remaining license area to a standard oil and gas lease (AS 38.05.132(b)(2)). Therefore, this written finding contemplates that Ahtna's license may be converted to a lease.

C. Process

In April 2012, DO&G received a request for an oil and gas exploration license in the Tolsona Lake area. On July 25, 2012, the division issued a "Notice of Intent to Evaluate" this proposal (AS 38.05.133(d)), and requested comments on exploration in the study area and competing proposals. To ensure confidentiality under AS 38.05.035(a)(8), DO&G did not identify the name of the applicant, and identified the area as larger than the area sought in the proposal. Comments received and DNR's responses are in Appendix A. At the same time, additional proposals were solicited (AS 38.05.133(d)). DO&G did not receive a competing proposal. Since DO&G did not receive a competing proposal, it must identify the prospective licensee in this written finding (AS 38.05.133(f)). Ahtna, Inc. (Ahtna) is the prospective licensee.

Following an evaluation of Ahtna's proposal, DO&G began developing its written finding. On September 27, 2012, DO&G issued a Request for Agency Information to state and federal agencies, local governments, and Native corporations. The request asked for publicly available information and data about the area's property ownership, people, economy, current uses, subsistence, historic and cultural resources, fish and wildlife, habitats, other natural resource values, and reasonably foreseeable effects of exploration on the area (AS 38.05.035 (g)). Recipients were given until November 26, 2012, to respond. Fourteen comments were received, including comments from individuals, non-profit organizations, and state and federal agencies. DNR's responses to the comments are in Appendix A. The exploration license statutes (AS 38.05.131—.134) and regulations (11 AAC 82.903—.990) do not require a preliminary written finding.

After issuing the written finding, an eligible individual or organization may request the commissioner to reconsider in accordance with AS 38.05.035(i). The request must be filed within 20 days after publication of the written finding. To file a request for reconsideration, an eligible person must have "meaningfully participated" in the administrative review process and must be affected in some way by the finding. "Meaningfully participated" means that the person (1) timely submitted written comment during a public comment period; or (2) presented oral testimony at a public hearing (AS 38.05.035(i)). The request for reconsideration must specify the basis on which the finding is challenged.

An eligible person may appeal to the superior court only if the person had already requested reconsideration by the agency, and only those points raised in that request for reconsideration may be appealed (AS 38.05.035(l)). By requiring a party to exhaust the administrative review and reconsideration process before appealing to the superior court, the agency has full opportunity to review, analyze, and respond to the appealed concerns before litigation. For the purposes of review, the eligible person appealing must state and prove the defect alleged to exist within the written finding (AS 38.05.035(m)).

1. Written Finding

Alaska statutes 38.05.035 and 38.05.131—.134 govern the issuance of exploration licenses and address public notice requirements. Under AS 38.05.035(e), DNR may not dispose of state land, resources, property, or interests, unless the director first determines in a written finding that a disposal will serve the state's best interests.

a. Requirements

AS 38.05.133(f) describes what the written finding must address, including all matters set out in AS 38.05.035(e) and (g) (except for 38.05.035(g)(1)(B)(xi)). Following are the (g) list topics and their location in this finding:

i. property descriptions and locations (Chapter Three);

ii. petroleum potential of the license area, in general terms (Chapter Six);

iii. fish and wildlife species and their habitats in the area (Chapter Four);

iv. current and projected uses in the area, including uses and value of fish and wildlife (Chapter Five);

v. governmental powers to regulate oil and gas exploration, development, production, and transportation (Chapter Seven);

vi. reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the license area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources (Chapter Eight);

vii. stipulations and mitigation measures, including any measures to prevent and mitigate releases of oil and hazardous substances, to be included in the license and any subsequent leases, and a discussion of the protections offered by these measures (Chapter Nine);

viii. method or methods most likely to be used to transport oil or gas from the license area, and the advantages and disadvantages, and relative risks of each (Chapter Six);

ix. reasonably foreseeable fiscal effects of the exploration license and the subsequent activity on the state and affected municipalities and communities, including the explicit and implicit subsidies associated with the license, if any (Chapter Eight); and

x. reasonably foreseeable effects of oil and gas exploration, development, production, and transportation on the municipalities and communities within or adjacent to the license area (Chapter Eight).

b. Scope of Review

The scope of review for this finding is the matters required by AS 38.05.035(g). Geological and geophysical information about the license area is also provided. In some cases, information about the surrounding area is included in the scope of review because some activities may have effects extending beyond the license area.

The scope of review and written finding are based upon the facts and issues known, or made known, to the director during the review. They 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)). The state legislature decided that for an effect to be "reasonably foreseeable": (1) there must be some cause/result connection between the proposed disposal and the effect to be evaluated; (2) there is a reasonable probability that the effect will occur as a result of the disposal; and (3) the effect will occur within

a predictable time after the disposal. These practical constraints eliminate speculation about potential but improbable future effects and focus the written finding on those effects most likely to occur as a result of the proposed disposal. For example, often at the time DNR prepares a written finding, whether, when, how, and where exploration, development, or production will occur is uncertain. This concept is incorporated in AS 38.05.035(h), which states "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."

A reasonably foreseeable effect must also be "significant." Significant means the reasonably foreseeable effect evaluated must have some known and noticeable impact on or within a reasonable proximity to the area involved in the disposal. Public input assists in providing an inclusive body of information for a finding. Information provided by agencies and the public assists the director in:

- reviewing all of the facts and issues;
- determining which are material to the decision of whether to issue an exploration license;
- establishing the scope of the review for that decision by determining the reasonably foreseeable, significant effects of licensing and subsequent leasing that arise from those material facts and issues; and
- balancing those effects to determine under what conditions, if any, issuing an exploration license for the area will serve the state's best interests.

c. Phased Review

The legislature adopted a phased review under AS 38.05.035(e)(1)(C) to avoid speculation at the disposal phase of a project while ensuring continued public notice, comment, and DNR review at subsequent phases. The legislature provided for phased review "to allow for consideration of those issues when sufficient data are available upon which to make reasoned decisions." Ch. 38, § 1(11), SLA 1994.

Disposal of the Ahtna exploration license is the first phase of a multi-phased project. Since this is a multi-phase project, AS 38.05.035(e)(1)(C) allows the director to limit the scope of this written finding to the applicable statutes and regulations, facts, and issues that pertain to the disposal phase of the project when the:

i. only uses to be authorized by the disposal are part of that phase;

ii. disposal is a disposal of oil and gas, or of gas only, and, before the next phase of the project may proceed, public notice and the opportunity to comment are provided under regulations adopted by the department;

iii. department's approval is required before the next phase may proceed; and,

iv. department describes its reasons for a decision to phase.

The Ahtna exploration license satisfies these requirements for phased review. Condition (i) is met because this written finding authorizes the issuance of an exploration license, which is the full extent of the disposal phase. The license gives Ahtna, subject to the provisions of the license, the exclusive right to conduct geological and geophysical exploration for oil and gas within the licensed area. If the license terms are met, and

Ahtna requests conversion the license be converted to a lease, Ahtna will have the exclusive right to drill for, extract, remove, clean, process, and dispose of any gas they may find on those lands converted to a lease. The license does not, however, give Ahtna authority to proceed with any of those activities; Ahtna must first obtain the necessary approvals.

Condition (ii) is met because the license is for oil and gas, and DNR provided public notice and the opportunity to comment when it issued a "Notice of Intent to Evaluate" this proposal (AS 38.05.133(d)), and requested comments on July 25, 2012.

Condition (iii) is met because DNR's approval is required before the next phase — exploration — may proceed.

Condition (iv) is met by this discussion of the reasons to phase.

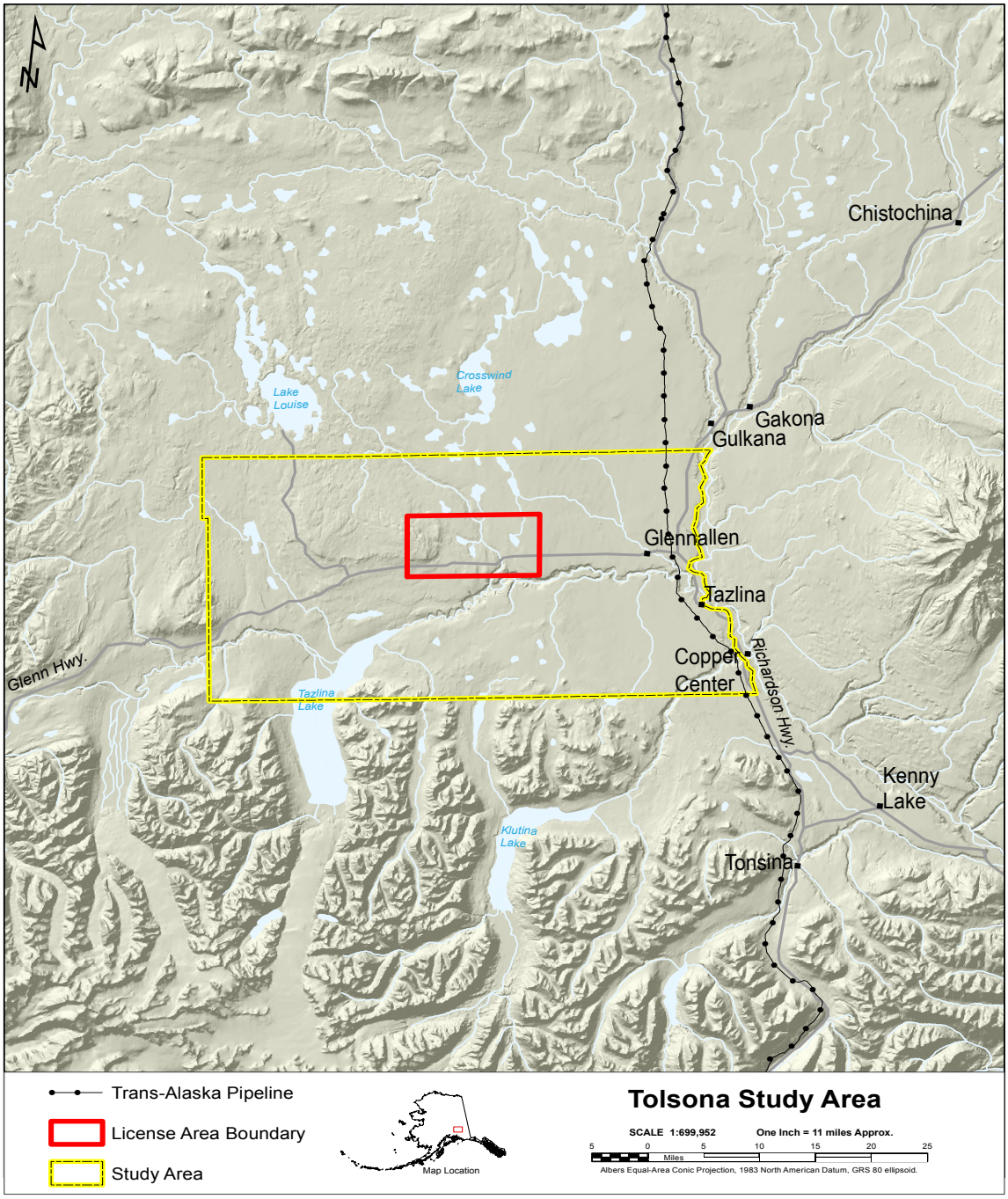
This written finding also provides DNR's explicit approval of the exploration phase, as well as the disposal phase, to make it clear to the public and the licensee that both disposal and exploration phases are approved. DNR did provide public notice and the opportunity to comment on exploration in the study area as required by AS 38.05.035(e)(1)(C)(ii), the director considers herein the exploration phase and exploration activities and approves the exploration phase as required by AS 38.05.035(e)(1)(C)(iii), and thus the exploration phase may proceed.

Ahtna must obtain all required approvals before beginning on-the-ground exploration activities. Ahtna must submit a plan of operations, including the specific measures, design criteria, construction methods, and standards that will be employed to meet the license provisions. This information allows DNR to determine whether the proposed activities are consistent with public and state interests. A plan of operations is subject to extensive technical review by local, state, and federal agencies. In addition to the plan of operations, Ahtna must secure DNR's approval for all applicable permits and required bonding. Before Ahtna can proceed to phases beyond exploration, DNR approval is required.

Chapter Three

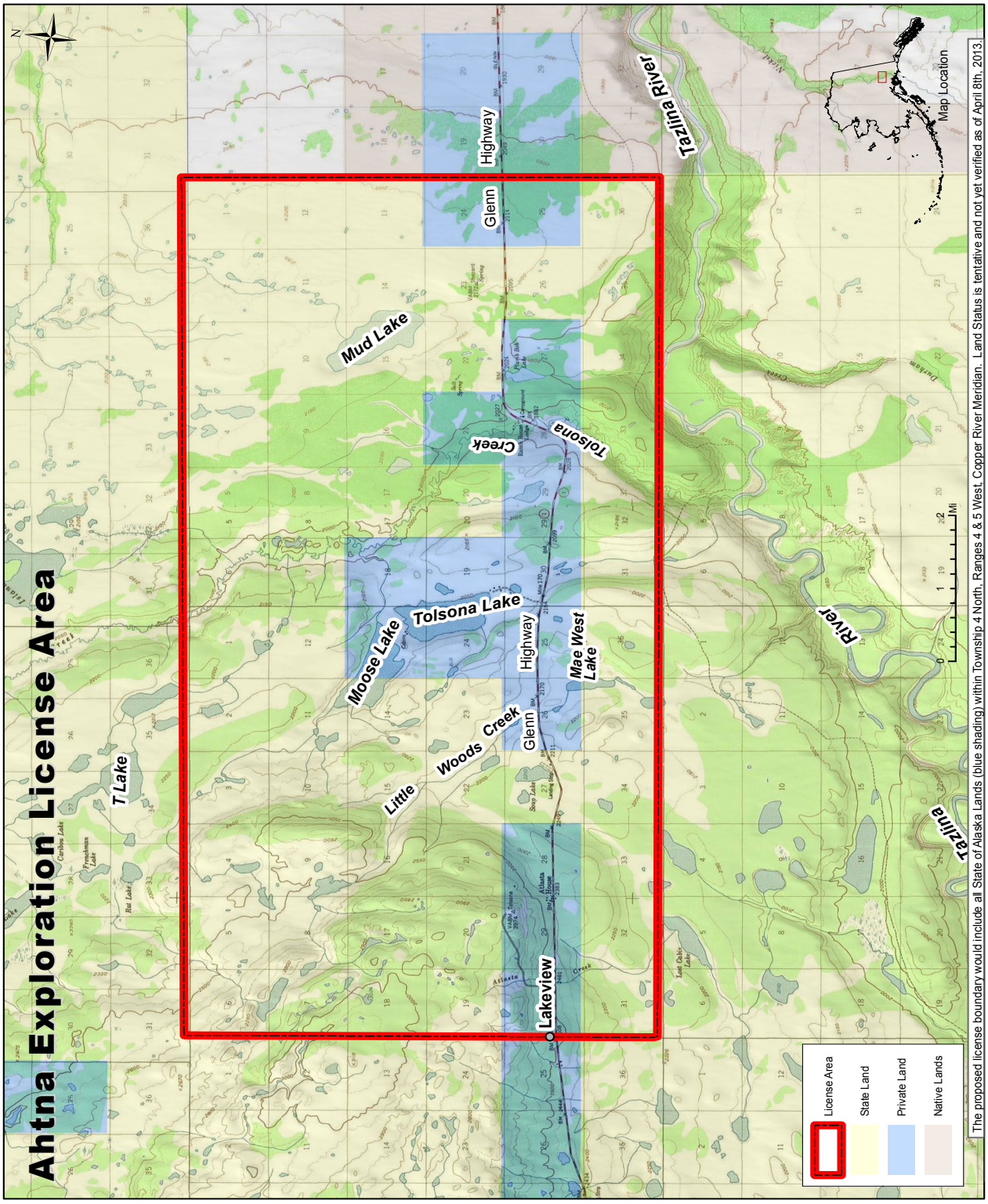
Description of the Study Area

The exploration license area lies within the Tolsona study area as shown in Map 3.1 below. The area is described further on the following pages.



Map 3.1 Overview of Tolsona study area.

A detail of the exploration license area is shown below in Map 3.2. The area is described further on the following pages.



Map 3.2 Detail of exploration license boundary.

A. Property Description

The exploration license area consists of approximately 72 sq. mi in Alaska's Copper River basin. The Copper River is the eastern boundary of the study area. Other rivers flowing through the area include the Tazlina and Nelchina. Prominent waterbodies include Tolsona, Tazlina, and Old Man lakes. The Trans-Alaska Pipeline System runs in a north to south direction along the west side of the study area, closely paralleling the Copper River. The Glenn Highway bisects the study area. Communities within the study area are Glennallen, Mendeltna, Tazlina, and Copper Center. Both Tolsona Creek and Little Nelchina Creek State Recreation Sites are located on the Glenn Highway. A portion of the Nelchina Public Use Area overlaps the study area. Ahtna's exploration license acreage is within the study area.

The exploration license area includes state-selected but unconveyed acreage, which cannot be included in an exploration license until the state receives title. Ahtna may request to have the selected acreage identified in its application either included or excluded from the license if, during the term of the license, state-selected land or mineral estate acreage is conveyed to the state.

B. Access

The primary access routes within the study area are the Glenn and Richardson highways, and their connected road systems. These two state highways provide east west and north south access, respectively. TAPS also traverses the study area roughly parallel to the Richardson Highway.

The Glenn Highway enters the study area east of Tazlina Lodge and intersects the Richardson Highway at Glennallen. Several all-terrain vehicle (ATV) trails provide informal access off of the Glenn Highway, and extensive snow machine access occurs during the winter when snow cover is adequate.

The Richardson Highway enters the study area just south of Gulkana, and exits a few miles south of Copper Center. As with the Glenn Highway, several ATV and snow machine trails provide informal access off of the Richardson Highway.

Several airstrips are located in the study area, such as near Glennallen and Copper Center. In addition, numerous remote airstrips exist in the area and could be used in support of exploration activities.

C. Subsurface Property and the Public Interest

The Statehood Act allowed Alaska to select 104 million acres of federal land as its economic base. The land grants included the subsurface mineral rights underlying these selections. The Act requires the state to retain these mineral interests when conveying interests in the surface estate stating "mineral deposits in such lands shall be subject to lease by the State as the State legislature may direct" (P.L. 85-508, § 6(i)).[1] Additionally, the Act states that if Alaska disposes

1 There are two types of interests or ownership in land: the surface estate and the subsurface or mineral estate. The interests may become separated when an original owner keeps only the surface estate and sells the subsurface, or when an owner sells only the surface and keeps the subsurface to sell or use later. Therefore, the surface and subsurface interests may be separate, and a property or homebuyer could buy land but acquire only the surface estate.

of its mineral estate contrary to the Act, it will have to forfeit that mineral estate to the federal government.

Complying with the intent of the Act, the Alaska Constitution directs the state's policy: "to encourage ... the development of its resources by making them available for maximum use consistent with the public interest" and 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 meet this mandate, the legislature enacted Title 38 of the Alaska statutes and directed DNR to implement these laws. The legislature found the people of Alaska have an interest in developing the state's oil and gas resources and maximizing the economic and physical recovery of those resources (AS 38.05.180(a)). When state surface land is conveyed to an individual citizen, state law requires that the deed reserve mineral rights for the state (AS 38.05.125).

D. Historical Background

The earliest documented inhabitants of the Copper River basin area were Athabascan Indians, primarily consisting of the Tatlatan and Ahtna groups. The large number of known archaeological sites throughout the area indicates the Native people were probably sparsely distributed and mobile (Ahtna 1973).

The semi-nomadic life of the Ahtna was only slightly disrupted by the Russian fur trade, which never established a permanent post in the area. The Ahtna participated to a limited extent in the Russian fur trade by traveling to Russian trading posts in Prince William Sound and Cook Inlet, mainly to obtain iron implements and guns. During this period, the Ahtna obtained most of their food through fishing and hunting. Aspects of useful Russian culture and technology were incorporated into Ahtna life but did not supplant pre-contact Ahtna patterns (Reckord 1979).

The Yukon River gold rush of 1898 altered life in the Copper River basin, and gold mining dominated the region until the 1920s. The Copper River region was settled by prospectors, miners, business entrepreneurs, and government personnel who built roads, trading posts, schools, and mines. Consequences included new transportation corridors, new settlement patterns, and an economy that mixed cash-producing and subsistence activities.

Transportation routes developed at the turn of the century shaped the area's settlement patterns. Trails built from Valdez to the Yukon River at Eagle, and between Valdez and Fairbanks, then the hub of interior mining activity (Reckord 1983), opened the Copper River basin. Today, the region's paved highways generally follow these routes. Roadhouses, spaced about a day's journey apart, sprang up along these early trails and were the origin of many of the Copper River basin communities existing today. Copper mining spurred transportation growth in the area. Construction of the Copper River and Northwestern Railway from 1907 through 1911 linked Cordova and Kennicott, brought hundreds of people to the Chitina River Valley, and established communities such as Chitina, McCarthy, and Kennicott (Reckord 1983).

Alaska Natives who had been living in traditional villages and camps were attracted to these new communities by the availability of technology and other trade goods. The Ahtna became involved in these communities by providing game and fish to mining camps, freighting supplies, working as laborers, guiding, and selling furs, leather products, and firewood. Epidemics and diseases killed an estimated 50% of the Ahtna population between 1896 and

1920. This resulted in the loss of traditional knowledge and further disrupted the traditional social organization (Reckord 1979).

By 1920, mining activity had abated, local populations declined, the economy generally slowed down, and dependence on fish and game resources increased. Trapping was the predominant economic activity through the 1920s (Reckord 1983). Construction of the Alaska and Glenn highways and the Tok Road ushered in another period of development in the Copper River basin in the 1940s (Reckord 1983). Airfields were constructed and communications improved. Completion of the highway system facilitated settlement, made travel to and from Anchorage easier, and encouraged growth of the region's service industry. For the first time since the gold rush, this region experienced the arrival of significant numbers of newcomers (Reckord 1979).

In the 1950s, government agents pressured families to send their children to school. This forced Native families to relocate to communities along the road system, and hampered seasonal movements associated with trapping and other subsistence activities (Reckord 1979; 1983). Many families stopped commercial trapping when they moved from small villages to communities with schools.

After gaining statehood in 1959, state government became a major employer in the region by providing positions with the schools, police, judicial system, social services, fish and game management, and transportation. State and federal governments accounted for more than one-third of the employment opportunities available to area residents. This brought a period of greater economic stability to the region, whose economy had been characterized by a boom-and-bust cycle associated with mining and construction (Reckord1979; 1983). However, government employment did not meet the needs of all those in the region desiring wage employment, and seasonal migration from the area for employment was common. Some households and individuals permanently left the area.

The Copper River basin experienced another boom period during construction of the Trans-Alaska Pipeline between 1973 and 1977. The pipeline parallels the Cooper River in this area and pump station 11 is near Glennallen. Labor migration from the region eased, and many of the young people who sought work in Anchorage returned to the area (Reckord 1979).

E. Local Communities

Nearly all communities within the proposed study area are linked by the two major highways that traverse the Copper River basin: the Glenn and Richardson highways.

Glennallen. Glennallen lies along the Glenn Highway at its junction with the Richardson Highway, 189 road miles east of Anchorage. It is just outside the western boundary of Wrangell-St. Elias National Park. In 2012, the population of Glennallen was 491 people. It is one of the few communities in the region not built on the site of a Native village. Historically, Glennallen has been used by the Ahtna but was not included in ANCSA and is not a federally recognized Native community (ADCCED 2013). Glennallen is the supply hub of the Copper River region. Local businesses serve area residents and Glenn Highway traffic with supplies, services, schools, and medical care. State highway maintenance and federal offices are in Glennallen. RV parks, lodging, fuel, and other services cater to independent travelers. The Bureau of Land Management, Alaska State Troopers, and the Department of Fish and Game have offices located here. There are several small farms in the area. In 2011, two residents held commercial fishing permits, but there is no subsistence or commercial fishing in the area.

Mendeltna. The community is at milepost 154 of the Glenn Highway near Mendeltna River, 30 miles southwest of Glennallen. In 2012 the population was 41people. Mendeltna was not included in ANCSA and is not federally recognized Native community. Mendeltna was originally a stop on a Native trail between Lake Tyone and Tazlina Lake. Gold in the creeks draining from the Chugach Mountains brought prospectors to this area in the late 1800s. The Eureka Lodge was built to serve miners, and the Nelchina area offered several trails into the mountains. The area has a lodge and air taxi services for fly-in fishing and mountaineering. Summer employment, coupled with a subsistence lifestyle, sustains local residents (ADCCED 2013).

Tazlina. The village was thought to be a fishing camp of the Ahtna, who historically moved up and down the Copper River and its tributaries. By 1900, a permanent village had been established on the north and south banks off the Tazlina River near its confluence with the Copper River. Two organizations represent Tazlina: the Native Village of Tazlina and the Association of Tazlina Residents. In 2012, the population was 287 people. The Tazlina village corporation owns 92,160 acres in the area through the ANCSA 12(a) land entitlement provisions (ADCCED 2013). Some residents depend on subsistence fishing and hunting. Local businesses include a combined grocery, liquor, hardware, gas, and sporting goods store, a wholesale bread distributor, a freight service, and an RV park. Prince William Sound Community College, the Division of Forestry, state highway maintenance, Division of State Parks, and Division of Communications have offices located in the area.

Copper Center. Copper Center is located between milepost 101 and 105 of the Richardson Highway. It is on the west bank of the Copper River at the confluence of the Klutina River. It lies just west of the Wrangell-St. Elias National Park. In 2012 its population was 328 people. Copper Center was a large Ahtna village at one time. Copper Center has a federally recognized tribe represented by the Native Village of Kluti-Kaah council. The village corporation owns 115,200 acres in the area selected though the ANCSA 12(a) land entitlement process. It became the principal supply center for miners in the Nelchina-Susitna region. A school was constructed in 1905, which brought Native families to Copper Center. In 1909 it was designated a government agricultural experiment station. The region became more accessible in the late 1930s and early 1940s with the construction of the Richardson and Glenn highways. The economy is based on local services and businesses and highway-related tourism. The National Park Service's Wrangell-St. Elias Visitor Center and the Copper River Princess Wilderness Lodge were completed in 2002. Two RV parks and three river boat charter services operate from Copper Center. Many residents depend on subsistence hunting, fishing, trapping, and gathering. In 2011, five residents held commercial fishing permits (ADCCED 2013).

Population and employment changes in any of these communities might occur depending on the amount of exploration activity and the size of an oil or gas discovery.

F. Historical and Cultural Resources

The National Historic Preservation Act of 1966 created the State Historic Preservation Office (SHPO). The Alaska Office of History and Archaeology carries out the responsibilities of the SHPO. SHPO responsibilities include (DNR 2013):

- statewide historic preservation planning (Alaska's Historic Preservation Plan)
- statewide historic property survey and inventory (Alaska Heritage Resources Survey)
- National Register of Historic Places property nomination

- federal historic preservation grants-in-aid program administration
- historic preservation program development assistance and national program participation certification for local governments (Alaska's Certified Local Government Program)
- federal, state, and local historic preservation project advisement and assistance

Historic and cultural resources can include a range of sites, deposits, structures, ruins, buildings, graves, artifacts, fossils, and some objects of antiquity. Locally, the Ahtna Heritage Foundation manages the Ahtna Culture Center near Copper Center. The purpose of the center is to (Ahtna Heritage Foundation 2013):

- collect, preserve, study, exhibit and stimulate appreciation for the cultural resources of the Ahtna people
- provide a central repository to house Ahtna cultural resources within the Ahtna region

Artifacts recovered on state land belong to the state and are curated in state facilities. These artifacts can be loaned to Ahtna Heritage Foundation or other groups who have appropriate curation and exhibit facilities (AS 41.35.020(b)).

G. Climate

The study area is located in the continental climate zone. Winters are long and cold, and summers are relatively warm. Temperature extremes have been recorded from a low of -74°F to a high of 96°F. Annual snowfall averages 39 inches, and total precipitation averages 9 inches per year (ADCCED 2013).

However, Alaska's average annual statewide temperatures have increased by nearly 4ºF from 1949 to 2005. Increases in mean annual temperature have been greatest in the interior region (USGS 2012). Potential drying of the landscape due to changes in temperature and snowpack may cause a reduction in the availability of water used for snow travel and ice roads (USGS 2012).

H. Geophysical Hazards

The primary geophysical hazards within the Copper River basin study area include earthquakes and faulting, permafrost, and volcanoes. These geophysical hazards could impose constraints to exploration, development, and transportation activities.

1. Earthquakes and Faulting

There are three major faults framing the exploration license study area: the West Fork, Taral, and Border Ranges. The West Fork and Taral faults occur along the northern and eastern edges of the Copper River basin. These two faults are largely covered by surficial deposits, mainly glaciofluvial or glacial lake deposits. They generally trend east-west to southeast, with near vertical dips (Nokleberg et al. 1994). Although these faults are not located in the study area, geologic studies indicate that powerful earthquakes (magnitude 7.8 or greater) have occurred at least once every 525 to 700 years during the past 4,700 years in this area (Davies 1985). On November 3, 2002, a 7.9 magnitude earthquake located

on the Denali fault system shook the region, severely damaging about 28 miles of highway, and local airstrips and houses (Copper River Native Association 2009). It was the strongest earthquake ever recorded in the interior of Alaska (USGS 2003) and the largest inland earthquake in North America in almost 150 years (AEIC 2008).

2. Permafrost

Permafrost underlies most of the Copper River basin (USDA 1990). The basin is characterized by moderately thick to thin permafrost in areas of fine-grained deposits, and by discontinuous or isolated masses of permafrost in areas of coarse-grained deposits (Ferrians 1994).

Permafrost characteristically occurs as ice crystals disseminated throughout the soil. Although not extensive near the soil surface, massive ice wedges and lenses do occur in the subsoil in some areas of the Copper River basin. A perched water table and saturated conditions are common above the permafrost during the summer due to restricted drainage (USDA 1990).

The fire history of the site and the thickness of the insulating organic layer on the soil surface help to control permafrost and water table depth. Disturbance of the organic layer usually results in increased soil temperatures and a lowering of the permafrost level. As permafrost thaws, a large volume of water is released. Variation in the ice content of the permafrost and the rate of thawing results in differential subsidence of the soil surface and slumping on steeper slopes (USDA 1990).

Consequently, permafrost is in a delicate state of equilibrium and, if thawed by minor changes in ground-surface temperatures such as that brought on by most construction projects, considerable surface subsidence may occur (Pewe and Reger 1983). Permafrost degradation is impacting infrastructure and surface-water availability in areas of both discontinuous and continuous ground ice (USGS 2012).

3. Volcanos

At least three mud volcanoes are located in the study area (Pewe and Reger 1983). In general, the term “mud volcano” has been applied to eruptions or surface extrusion of watery mud or clay which is generally accompanied by methane gas, and which commonly tends to build up a solid mud or clay deposit around its orifice, often conical or volcano-like in shape. The activity of a mud volcano is usually mild, but many explosive eruptions have scattered large masses of rock over adjoining areas. These eruptions suggest periodic buildup and release of pressure from the formation of gases (Motyka 1986).

Volcano activity outside of the study area may affect oil and gas activities within the area. Wind direction and speed control the movement of an ash plume. For instance, the strongest and most consistent winds in the vicinity of Mount Spurr volcano, located in the Cook Inlet basin, are from the west, southwest, and northwest. The zone of prevailing winds includes the study area. The study area is most likely to receive ash during an eruption of Crater Peak, a small stratocone on the south flank of Mount Spurr volcano. Any amount of ash fall could be disruptive (USGS 2002).

I. Mitigation Measures

Disposing of an exploration license is not expected to have any effects on the study area other than to generate revenue for the state. However, several geologic hazards exist in the study area that could pose risks to oil and gas activities. As discussed above, these potential hazards include earthquakes, volcanoes, and permafrost. The risks from earthquake damage can be minimized by siting facilities away from potentially active faults and unstable areas, and by designing them to meet or exceed national standards and International Building Code seismic specifications particular to Alaska.

National industry standards, sometimes referred to as "technical standards," establish standard practices, methods, or procedures that have been evaluated, tested, and proven by analysis and application. These standards are intended to ensure the safe design, construction, operation, maintenance, and repair of infrastructure.

Site-specific geotechnical studies to assess local permafrost conditions should occur before any development activities. Permafrost problems can be avoided, minimized, or mitigated through proper siting, design, and construction considerations. Structures, such as drill rigs and permanent facility buildings, should be insulated to prevent heat loss into the substrate. Pipelines can be trenched, backfilled, insulated (if buried), or elevated to prevent undesirable thawing of permafrost.

Because geologic hazards could affect and damage oil and gas infrastructure, state, federal, and local regulations, design and construction standards, and measures in this finding should avoid, minimize, or mitigate those hazards. A complete list of mitigation measures is found in Chapter Nine.

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Chapter Four
Habitat, Fish, and Wildlife

This chapter considers and discusses the study area's habitats and fish and wildlife populations, as required by AS 38.05.035(g)(iii). This chapter is not intended to be an exhaustive examination of all habitats and fish and wildlife species of the area, but rather, the director has limited the scope of the administrative review and finding to considering and discussing those that have important subsistence, recreational, or commercial value (AS 38.05.035(e)(1)(B)).

The landforms, vegetation types and streams and wetlands of the study area provide habitat for fish, birds, and wildlife. Streams and rivers feed directly into the Copper River and ultimately the Copper River Delta. Fish and wildlife of particular importance are salmon, caribou, moose, black and brown bears, wolves, and several furbearer species such as lynx and American marten. Bald eagles and trumpeter swans inhabit the area, as well as other species of birds that are year-round residents, summer residents, or spring-fall migrants.

ADF&G uses the Alaska Wildlife Action Plan to assess needs of species with conservation concerns. There are no endangered species in the study area (ADF&G 2013g).

A. Habitats

The Copper River basin lies within a nearly continuous belt of boreal forest, often referred to as the taiga ecosystem, which extends from Alaska across Canada to the Atlantic Ocean. Within this belt are two main types of forest: lowland spruce hardwood and bottomland spruce-poplar (Selkregg 1974). Other well-drained sites have coniferous forests dominated by white spruce, black cottonwood, or quaking aspen (ADF&G 2006).

Recurring wildfires maintain the ecological integrity, diversity, and productivity of the boreal forest (Viereck and Little 2007). Following forest fires, willow shrub dominates most sites until eventually replaced by forest vegetation (Clark and Kautz 1998). Current fire suppression policies in the Copper Basin Fire Management Plan set aside large portions of the area as limited suppression (let-burn) areas where wildfires will not be suppressed. However, the plan has often been unheeded, and the current level of fire suppression has resulted in fewer fires and reduced seral habitat available as moose browse (Tobey and Schwanke 2010).

Shrub and herbaceous vegetation develop where topographic and soil conditions inhibit tree growth. Seasonally flooded riverwash on the floodplains of major rivers supports dense alder shrub. Willow and ericaceous shrub occupy bogs, ferns, and narrow drainages. Wet sedge meadows are common on the margins of lakes and ponds (Clark and Kautz 1998).

Wetlands are common in low-lying areas, mainly supporting sedge and moss covers (CEC 1997). Wetlands are transitional zones between aquatic and terrestrial habitats that are characterized by poor soil drainage, and are primarily of four types in Alaska: bogs, grass wetlands, sedge wetlands, and marshes (ADF&G 2006). Wetlands and deepwater habitats within the Copper River basin have been mapped by the National Wetlands Inventory based on the classification system by Cowardin et al. (1979). Wetlands make up 36 % of the Copper River Basin including low scrub bog communities with birch and ericaceous shrubs and wet, herbaceous communities dominated by sedges (ADF&G 2006).

Riparian habitats, where terrestrial areas are regularly influenced by fresh water, are also found in the area (Naiman et al. 2005).

Freshwater habitats of the study area include several large river systems; lakes, streams, and wetlands; and seasonal ponds and creeks. Water sources for these habitats include glacial melt, snowmelt, precipitation, and groundwater such as springs and upwelling areas. Lake and pond habitats are influenced by substrate, bathymetry, and geologic structures (ADF&G 2006).

A critical and limiting habitat factor affecting freshwater fish populations is the available suitable habitat in the winter. Fish that overwinter in Arctic freshwaters rely on these protective havens for the success of their populations. Fish of all stages may crowd into the same unfrozen river area for the entire winter (Schmidt et al. 1989). However, different fish species may overwinter in dissimilar habitat types. For example, resident species may be found in the middle and upper rivers, while anadromous species may prefer deep pools and river deltas for overwintering habitats (Schmidt et al. 1989, citing to Craig and McCart 1974).

B. Fish

1. Salmon

Several species of salmon inhabit the study area and surrounding streams and lakes including sockeye (red), Chinook (king), and coho (silver) salmon. These species migrate from the marine waters of Prince William Sound, up the Copper River and its tributaries to spawn each year.

Sockeye salmon of various life stages are widely distributed throughout the Upper Copper River. They are present in approximately 125 of the Upper Copper River tributaries. There are wild and enhanced populations of sockeyes in this region. Spawning is known to occur in the rivers, lakes, and tributaries of the Copper River Basin (Somerville 2013). Most sockeye salmon return to freshwater to spawn in June and July. Eggs hatch in the winter and juveniles usually spend one to three years in freshwater before migrating to the ocean to as smolts (ADF&G 2013b). After moving to the ocean, sockeye salmon migrate through the Gulf of Alaska and into the North Pacific Ocean (Burgner 1991). Sockeye salmon feed on zooplankton and small crustaceans and fish (ADF&G 2013b).

Chinook salmon are found in at least 40 tributaries throughout the Copper River Basin. Chinook salmon return to the Copper River drainage in early May through the Copper River Delta. Their numbers peak during mid-May to mid-June and the return is nearly complete by July 1. They make their way to the Upper Copper River tributaries during June and July and they spawn from mid-July through August (Somerville 2013). After hatching and emerging from the gravel, juvenile Chinook salmon feed on plankton and insects while in freshwater. They spend nearly one year in freshwater until they migrate to the ocean the following spring as smolts. Chinook salmon spend from one to five years feeding in the ocean before returning to freshwater to spawn. Their diet consists of plankton, insects, amphipods, and fish (ADF&G 2013b).

Coho salmon are present in the Upper Copper River during July and August (ADF&G 2013f). Their population in Alaska is considered healthy. Coho salmon deposit eggs that are fertilized by males and then hatch in early spring. Some juveniles leave freshwater to rear in estuarine ponds and then migrate back to freshwater in the fall. They overwinter in off-channel habitats. Coho salmon spend one to three winters in streams and up to five winters in lakes before migrating to the ocean as smolt. They spend six to eighteen months at sea

before returning to freshwater to spawn. Coho salmon eat aquatic insects, fish, and squid (ADF&G 2013b).

The major predators of salmon are marine mammals, land mammals, birds, and humans (ADF&G 2013b).

2. Other Fish Species

Other fish species found in the study area include Dolly Varden, steelhead and rainbow trout, Arctic grayling, burbot, lake trout, whitefish, and longnose sucker (Simeone and Kari 2005). The species of primary importance, Dolly Varden, steelhead and rainbow trout, Arctic grayling, and burbot, are discussed below.

Dolly Varden are found in many rivers and streams throughout the Copper River (Simeone and Kari 2005). They generally spawn in the fall in freshwater streams, hatch in the spring, and rear in the stream for 2-5 years before migrating to the ocean for the first time (Armstrong 1996). The life history pattern of Dolly Varden is highly variable with populations being sea-run (spending time in freshwater and near shore marine waters) or resident (spending their entire life in freshwater), and within the same population some individuals may be sea-run while others are resident. Among freshwater residents, there are lake, stream, and dwarf forms (ADF&G 2013b). Dolly Varden reach sexual maturity between age five to nine years. All forms may spawn more than once, although there is generally a high mortality rate after spawning. Their life span can be up to 18 years, but is usually less than 10 years (Armstrong 1996). In freshwater, Dolly Varden eat unburied salmon eggs and young, insects and crustaceans (Armstrong 1996).

Steelhead trout, an anadromous form of rainbow trout, are found in the Tazlina River drainage, which appears to support the largest spawning aggregation of steelhead trout within the Upper Copper River. The annual run of steelhead trout in the Upper Copper River is estimated to be more than 1,000 fish (Savereide 2008). In 2005, the mean date of passage for steelhead entering the Tazlina River was September 22 (Savereide 2008). In 2007, outmigration dates from the Tazlina River ranged from May 4 to June 20. After hatching, steelhead spend one to four years, but usually about two, in freshwater before migrating to the ocean where they are found throughout the North Pacific (Morrow 1980). Steelhead remain in marine waters for two years before returning to spawn for the first time. They spawn annually, sometimes skipping a year, and continue spawning until the age of 11 years. Some steelhead overwinter in their spawning areas or the outlet of Tazlina Lake (Savereide 2008). Steelhead feed on zooplankton, insects, crustaceans, fish eggs, and other fish (ADF&G 2013b).

Both stocked and naturally-occurring rainbow trout inhabit the study area. ADF&G, Division of Sport Fish operates a hatchery program to ensure adequate numbers of salmon and other species are available to meet sport fishing needs, and to protect wild fish stocks by providing alternate sport fishing opportunities. The only species that ADF&G currently stocks in Tolsona Lake is rainbow trout. The lake was stocked with 1,995 rainbow trout in 2013. The lake was also stocked with rainbow trout in 2012, 2008, 1999, and 13 other years starting in 1982 (ADF&G 2013a).

Unlike steelhead trout, rainbow trout remain in freshwater for their entire life, either in streams or lakes. Rainbow trout spawn in the spring, and many spawn yearly, up to five times (Morrow 1980). The migratory patterns of rainbow trout vary and appear to be related to whether the population is stream or lake resident. Stream resident rainbow trout tend to remain in the same generally short sections of stream, while lake resident populations

migrate to streams to spawn in the spring and then return to the lake within a few weeks (Morrow 1980).

Arctic grayling are freshwater fish with the largest natural range of any sport fish and are found across nearly the entire state of Alaska. Overall, their population is healthy although there are some areas where they are threatened due to overfishing, mining, agriculture, and forestry. Some grayling migrate to spawn, feed, and overwinter while others remain in a short section of a stream for their entire life. Arctic grayling of all ages can be found throughout a stream. Adults tend to live in the cooler upper sections of the river and juveniles prefer the warmer lower reaches of the river. Migratory Arctic grayling move upstream in the spring to spawn, and then migrate to summer feeding areas immediately after spawning (ADF&G 2013b). Arctic grayling seek the deep reaches on lower clear rivers, and can tolerate low oxygen regimes over the winter (Reynolds 1997). Their main food source is insects, but they will also eat smaller fish, voles, and shrews (ADF&G 2013b).

Burbot are found in the streams and lakes of the study area (Simeone and Kari 2005), and the Copper River is host to a robust population of burbot. There was rapid growth in the Interior Alaska burbot fishery from 1979-1985 and they became in danger of being overharvested. A research program began in 1986 to study the life history of Interior Alaska burbot stocks and their population status. Increasingly restrictive regulations were adopted to build up the stocks, eventually resulting in the closure of Tolsona Lake to burbot fishing since 1998. As of 2009 and 2010, the burbot population has apparently achieved the abundance goal (Somerville 2013), and overall, the burbot population in Interior Alaska has recovered and is healthy (ADF&G 2013b).

Burbot spawn in moderately shallow waters of rivers or lakes under the ice in the winter from February through March (Armstrong 1996). They do not build nests for their eggs, but are broadcast spawners. Eggs settle to the bottom and hatch in about 30 days. Burbot become sexually mature at about age six or seven, and can spawn multiple times (ADF&G 2013b). They grow slowly, but have a long life span, up to 24 years. Young burbot feed on invertebrates; as they grow, their diet also includes fish such as slimy sculpin, lampreys, and young salmon; by age 5 their diet is primarily fish (Armstrong 1996).

C. Birds

The thaw lakes and wetlands of the Copper River basin provide excellent stopover and nesting habitats for migratory bird species travelling up the Copper River from the coast. There are also permanent and summer resident breeding populations in the area. Trumpeter swans and bald eagles are of particular concern.

The Copper River basin supports a large population of trumpeter swans. They are known to breed in the north-central region of the basin (ADF&G 2006), and in 2005, 4,430 swans were documented in the study area (Conant et al. 2007). Maintaining the present distribution of trumpeter swans in Alaska, losses of wintering habitat along the Pacific coast, and losses of swans to lead poisoning on the Pacific coast are of continued concern to wildlife managers (Conant et al. 2005). The total North American population of trumpeter swans reached a record high during the most recent survey taken in 2010. The total number of trumpeter swans in the Alaskan flock in 2010 was 25,347 swans. This was a 7 % increase from the 2005 survey. The Alaskan flock may be approaching its carrying capacity in some parts of its range. However growth rates remained high in areas where substantial amounts of previously unoccupied habitat were available (Groves 2012).

Trumpeter swans prefer secluded regions, where they frequent shallow bodies of water and build their nests in extensive areas of marsh vegetation. Most breeding pairs are at their nest sites by early May and the first hatching dates range from June 16 to June 29. In Alaska, young swans are unable to fly until 13 to 15 weeks of age (ADF&G 1985). After leaving the breeding areas, large numbers of trumpeter swans congregate on ponds and marshes along the coast (outside the study area) in late summer and early fall. Most swans depart by mid-October but in some years may remain until freeze-up in November (ADF&G 1985).

Trumpeter swans eat foliage, seeds, and tubers of various marsh plants during the summer, and they feed on crops and seeds from agricultural fields on their wintering grounds in the Lower 48 States (ADF&G 2013a).

Bald eagles are protected by the federal Bald Eagle Act of 1940, which makes possession of an eagle, either alive or dead, illegal (ADF&G 2013a). They are found in a variety of habitats throughout Alaska including lakes and rivers of the Copper River Basin (ADF&G 2013a), but usually near shorelines and river areas, which is probably related to food supply, as well as near prominences which are used for perches and nests (ADF&G 1985). The Copper River is near the limit of their geographical range and the eagle population is susceptible to considerable fluctuations in prey and weather (Steidl et al. 1997). At least 110 nesting pairs have been identified and 125-175 have been estimated to inhabit the Upper Copper River, with concentrations on the Gulkana, mid-Copper, and upper Gakona Rivers. The population of bald eagles in Interior Alaska is small compared to coastal habitats (Ritchie and Ambrose 1996).

Bald eagles start arriving on their breeding grounds in late March and depart in mid- to late-October (Ritchie and Ambrose 1996). They nest in dominant tree stands near shorelines. Ground nesting is uncommon in the Interior. The majority of nests in this region are in upland wetlands (Ritchie and Ambrose 1996). They tend to use and rebuild the same nest. Nest building begins in April, eggs are usually laid by late April, young hatch after about 35 days, and they leave the nest after about 75 days. Bald eagles reach sexual maturity at about four or five years of age (ADF&G 2013a). Bald eagles in the Interior are forced to leave their breeding area for five to six months during the winter due to ice and lack of prey (Ritchie and Ambrose 1996).

Fish are the main diet of bald eagles, including salmon, herring, flounder, and pollock; they also prey on waterfowl, small mammals, sea urchins, clams, crabs, and carrion. They tend to congregate along salmon-spawning streams and shorelines where they search for stranded or dead fish. Bald eagles also take live fish from lakes, streams, and the ocean (ADF&G 2013a).

Although information on other bird species is not available specific to the study area itself, information for the broader Copper River basin and Interior Alaska region is indicative of the study area. Many species of birds inhabit the study region, including summer residents, spring-fall migrants, and occasional visitors (Armstrong 2008; Table 4.1). In addition, thaw lakes and wetlands provide stopover and nesting habitat for migratory birds that travel up the Copper River from the coast (ADF&G 2006).

Table 4.1 Birds and residency commonly found in the Copper River basin and surrounding area.

Common Name	Residency	Common Name	Residency	Common Name	Residency
Common Loon	S	Lesser Yellowlegs	S	Common Raven	R
Horned Grebe	S	Solitary Sandpiper	S	Black-capped Chickadee	R
Trumpeter Swan	S	Spotted Sandpiper	S	Boreal Chickadee	R
Mallard Duck	S	Black Turnstone	R	American Robin	S
Green-winged Teal	S	Common Snipe	S	Hermit Thrush	S
Northern Shoveler	S	Long-billed Dowitcher	S	Swainson's Thrush	S
Canvasback Duck	S	Semipalmated Sandpiper	M	Ruby-crowned Kinglet	S
Redhead Duck	S	Glaucous Gull	S	Water Pipit	S
Greater Scaup	S	Herring Gull	S	Bohemian Waxwing	S
Lesser Scaup	S	Mew Gull	S	Orange-crowned Warbler	S
Barrow's Goldeneye	S	Arctic Tern	S	Yellow Warbler	S
Bufflehead	S	Common Murre	S	Yellow-rumped Warbler	S
Common Merganser	S	Great Horned Owl	R	Northern Waterthrush	S
Red-breasted Merganser	S	Short-Eared Owl	S	Wilson's Warbler	S
Red-tailed Hawk	S	Boreal Owl	R	Rusty Blackbird	S
Swainson's Hawk	S	Belted Kingfisher	S	Common Redpoll	R
Rough-legged Hawk	S	Northern Flicker	S	Savannah Sparrow	S
Bald Eagle	R	Olive-sided Flycatcher	S	Dark-eyed Junco	R
Northern Harrier	S	Horned Lark	S	American Tree Sparrow	S
Spruce Grouse	R	Violet-green Swallow	S	Song Sparrow	S
Willow Ptarmigan	R	Tree Swallow	S	Chipping Sparrow	S
Rock Ptarmigan	R	Bank Swallow	S	White-crowned Sparrow	S
Semipalmated Plover	S	Gray Jay	R	Lapland Longspur	S
Black-bellied Plover	S	Stellers Jay	R	Snow Bunting	M
Lesser Golden Plover	S	Northwestern Crow	R		
Greater Yellowlegs	S	Black-billed Magpie	R		

S-Summer resident and breeder, R-Permanent resident and breeder, M-Seen only during migration periods
Note: “Common” is defined as birds that are regularly seen in the proper habitat(s) during the appropriate time(s) of the year. There are a number of other birds that inhabit the Copper River Basin that are considered uncommon, rare, casual, and accidental residents.
Source: BLM 1989.

D. Wildlife

ADF&G manages and monitors wildlife in the study area, which overlaps two game management subunits, 13A and 13D.

1. Caribou

The Nelchina caribou herd uses the study area for their winter range (ADF&G 2013a). Caribou are found in subalpine habitats that are seldomly used by moose, but they may compete with Dall sheep for winter range (Selinger 2005). They may use ridge tops, frozen lakes and bogs, and other open areas for resting and to avoid predators such as wolves (ADF&G 1985). They also appear to avoid, or are very cautious when entering, riparian willow and other heavy brush, as these may be areas in which they would be more vulnerable to attacks by wolves and bears (ADF&G 1985). Open, gently-sloping terrain with a wide view is used by caribou during calving, probably to avoid predators.

The Nelchina caribou herd has not been surveyed since 2005, but in 2009, the herd was estimated at 33,837 caribou, using a much larger area than the Nelchina herd's range. In 2010, the herd was estimated at 44,985 caribou using a photo census (Schwanke 2011b). Survival during the 2009-2010 winter was very good, and an exceptionally high number of calves was born in 2010. The herd size appears to be increasing, although this is not conclusive because a current survey is not available. The Nelchina caribou herd population is limited by predation of newborn calves by eagles, grizzly bears, and wolves. Wolf predation has a high impact on the Nelchina herd population dynamics (Schwanke 2011b).

Rutting and breeding takes place from the end of August through early September. Female caribou give birth in mid-late May and generally have one calf per year. Females reach sexual maturity by 16 months and usually do not breed until 28 months (ADF&G 2013e).

Caribou are herbivores, feeding on willows, sedges, flowering tundra plants, and mushrooms in the summer. In the winter, they eat lichens, dried sedges, and small shrubs (ADF&G 2013e).

2. Moose

Moose are found throughout the study area, especially along recently burned areas with willow and birch shrubs, on timberline plateaus, and along major rivers (ADF&G 2013e). They are found in both lowland and upland shrub communities and lowland areas with ponds during summer and fall. Moose are year-round residents, although many exhibit seasonal movements related to snow depth and food availability. In winter, moose concentrate in areas of relatively shallow snow depth, frequently along river drainages. (ADF&G 2007). Wintering concentrations of moose within the study area are found at the Tolsona Creek burn area. Moose distribution during the winter is generally dependent on snow depth and predator distribution (Tobey and Schwanke 2010).

The population of moose in Game Management Unit 13 (GMU 13) has increased about 46 % since 2001 (Tobey and Schwanke 2010). The study area is within GMU 13, which encompasses a large area north of the Chugach National Forest, west of Wrangell-St. Elias National Park and Preserve, south of Denali National Park, and east of the Talkeetna and Chickaloon Rivers (ADF&G 2013d). Based on counts of moose between 2001 and 2009, all sex and age categories of moose have increased. The increase is primarily attributed to better control of the wolf population, which has reduced predation. However, wolves remain a dominant year-round predator, and are the most significant source of mortality

to young moose and caribou in the area (Schwanke 2009). Moose have high reproductive potential and can reach the carrying capacity of their range if not limited by predation, hunting and severe weather. Food abundance is an important limiting factor for moose populations (ADF&G 2013e).

Moose breed during the fall and give birth in the spring after a 230-day gestation period. Calves are weaned in the fall when the females begin to breed again. Male moose participate in the rut during the fall for the opportunity to breed with more cows (ADF&G 2013e).

Moose diet consists of twigs during the fall and winter and forbs, shallow pond vegetation, and leaves in the spring and summer (ADF&G 2013e).

3. Black and Brown Bear

Black and brown bears inhabit the study area. Black bears usually live in forested habitats except during the fall and occasionally in the spring when they move into shrubby areas to feed on berries and succulents (Robbins 2011). Black bear population and distribution is dictated by food abundance, weather conditions, and competition and predation by brown bears (Crowley 2011). Brown bears move to riparian habitats to feed on berries and vegetation after their winter hibernation (Schwanke 2011a).

Black bear densities are thought to be similar to those in other portions of Southcentral Alaska. Trends in bear abundance have not been documented (Robbins 2011).

Estimates of brown bear abundance are not available for the study area. Measuring abundance is difficult because of their low density and secretive behavior such as not congregating on salmon streams and wariness of motorized vehicles (Tobey and Schwanke 2009). Despite the lack of population data, it is thought that the brown bear population in GMU 13 is not rapidly declining (Schwanke 2011a).

Black bears hibernate in the winter for seven to eight months. They make their dens in a variety of locations ranging from sea level to alpine regions. Mating takes place during the months of June and July and cubs are born in dens after a seven-month gestation period. Black bears breed every two to three years and commonly give birth to two cubs at a time (ADF&G 2013e).

Brown bears move to dens in the winter when food is scarce and remain there for up to eight months. The mating season occurs in the spring (May to July) and females give birth in their dens in January and February. Females and cubs remain in their dens the longest and families will remain together for two to three years. Females are known to be extremely protective of their young (ADF&G 2013e).

Black bears are omnivores that eat a variety of foods including vegetation, berries, salmon, and moose calves. Other bears, usually brown, are the only predators of black bears (ADF&G 2013e). Brown bears are also omnivores that eat berries, neonatal caribou and moose calves, salmon, a variety of different types of vegetation. They will enter human camps in search of food, garbage, and domesticated animals. Their only predator is other brown bears (ADF&G 2013e).

4. Wolves

Wolves in GMU 13 tend to be found in higher numbers in the lower timbered areas versus alpine tundra. The distribution of wolves has been shown to be directly dependent on that of moose, one of their main food sources (Schwanke 2009). Wolves are highly adaptable

animals and can live in a variety of habitats. They are found in nearly all of their historic range except for urban areas (ADF&G 2013e).

Due to game management efforts, the wolf population has been reduced and has been at the management objective level since 2006 in GMU 13. As of 2006, the spring population was estimated at 135-165 wolves. In 2007, the fall population was estimated at 254 wolves. With the recent decrease in wolf abundance, the moose population has started to increase in GMU 13 (Schwanke 2009).

Wolves usually live in packs of six to seven animals. They are highly territorial and there are only occasional overlaps in the ranges of neighboring packs. In general, one female from the pack has a litter of about seven pups a year. Wolves have a high birth rate, but they rarely become abundant because they also have a high mortality rate. Predation by other wolves, hunting, trapping, disease, and malnutrition all limit the wolf population (ADF&G 2013e).

Wolves are the dominant year-round predator in GMU 13. Their main food source is non-neonate moose and caribou and they will also eat hares (Schwanke 2009).

5. Furbearers

Furbearers that are commonly found in and around the study area include beavers, river otters, wolverines, coyotes, and mink; population estimates are not available for these species. Lynx and American marten are the most commonly trapped furbearers in GMU 13 (Schwanke 2010).

Lynx are found throughout the study area and prefer forested terrain, including spruce and hardwood forests. The best lynx habitat occurs where fires or other factors create a variety of vegetation and an abundance of early successional growth (ADF&G 2013e). The lynx population within GMU 13 is healthy and the cycle is on track, possibly even one to two years ahead. There have been population highs during the past few reporting periods (Schwanke 2010). Breeding season takes place during March and early April. Two to four kittens are born after a 63 day gestation period in shelters such as a spruce felled by wind, a rock ledge, or a log jam. Kitten survival is highly dependent on prey, particularly snowshoe hare, availability. Kittens remain with their mother until late winter usually around the time the next breeding season begins. The lynx's main food source is snowshoe hare. Hares undergo an eight to eleven year cycle of abundance that lynx abundance follows. When hares are scarce, lynx will also prey on grouse, ptarmigan, squirrels, microtine rodents, and even caribou, Dall sheep, and foxes (ADF&G 2013e).

American martens inhabit areas ranging from Southeast Alaska all the way to where the true arctic tundra begins in the northern and western portions of the state. They prefer forested regions with mature and old-growth evergreen trees (ADF&G 2013e). Marten tracks, an indicator of abundance, were common during the winter of 2006-2007, but have declined substantially since then. Trapper surveys indicate low marten numbers in areas where the lynx population is thriving, however there has not been a documented cause and effect between the abundance of the two species (Schwanke 2010). Marten breeding season takes place in July and August and the litter is born in April or May. Juvenile martens leave their mother's territory during the fall and will not breed until they are two years old. The marten's main food sources are meadow voles and red-backed voles or mice. They will also eat berries, small birds, eggs, vegetation, and the remains of wolf kills or salmon carcasses (ADF&G 2013e).

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Chapter Five

Current and Projected Uses in the Area

AS 38.05.035(g)(iv) requires the director to consider and discuss the current and projected uses in the area, including uses and value of fish and wildlife. The area's habitat, fish, birds, and wildlife provide for subsistence and sport fishing and hunting; support personal use and commercial fishing in areas outside the study area; and support recreation and tourism. In addition, the area is used for forestry and oil and gas exploration.

A. Copper River Basin Area Plan

The Copper River Basin Area Plan (CRBAP), within which the study area is located, guides DNR in managing state lands in the Copper River Basin (DNR 2006). The plan identifies surface land disposal locations, land use classifications, administrative designations, and land selections, relinquishments and exchanges. However, AS 38.04.065(i) states an oil and gas lease sale or gas only lease sale is not subject to the section; they are subject to the planning process established under AS 38.05.180.

B. Habitat Uses and Value

Habitats of the area support a diversity of fish, bird, and wildlife species. Wetlands are used by migratory birds along the flyways, are highly productive habitats, and are important in preserving biological diversity (ADF&G 2006). The riparian habitats of the region are important to wildlife, birds, and fish, providing concentrated and diverse habitats, and reserves for other habitats (Naiman et al. 2005). Wildlife seek availability of food, cover, territory, and access to water in riparian areas.

Freshwater habitats of the study area provide habitat for spawning, rearing and overwintering and vegetative cover; are significant sources of detritus; and are frequently migration corridors for wildlife. Fish that overwinter in freshwater may rely on unfrozen deep pools, which may be limited (ADF&G 2006). Numerous rivers, lakes and streams are classified as important for spawning, rearing or migration of anadromous fish. These include the Tazlina River, Old Man Lake, and Moose, Tolsona, Woods, Nickel, Mendeltna, and Durham creeks (Johnson and Blanche 2012).

Several groundwater sites have been identified near the study area and throughout the Upper Copper River Basin (USGS 2013). Groundwater is used to provide public water supplies to residents, businesses, and industry.

In addition to their importance for fish, birds, and wildlife, the habitats of the study area are important for human uses such as subsistence, sport, personal use, and commercial harvesting, recreation and tourism, and resource development. These are described in more detail below.

C. Fish and Wildlife Uses and Value

1. Subsistence

State law defines subsistence use as the noncommercial, customary and traditional use of wild, renewable resources (AS 16.05.940(30)). Subsistence also refers to the production and distribution of wild resources for local use and small-scale exchanges in Alaska (Braund and Moorehead 2009, citing to Wolfe). The Alaska Boards of Fisheries and Game manage subsistence resources on all state-owned lands and waters in Alaska, although in the study area, certain areas are managed under federal regulations as well. Under both state and federal law, subsistence has a priority over other uses (Simeone et. al. 2011).

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, the changing condition of meat, hide or fur, and community needs (Jacobson and Wentworth 1982; ISER 1991).

Common subsistence resources in the study area include fish (especially salmon), large mammals such as moose and caribou, small mammals, and several species of birds (BOG 2011). Salmon make up over 60 percent of the total annual subsistence harvest in the Copper River basin (Simeone and Valentine 2005). Vegetation is also harvested for subsistence (Wolfe 2004).

Although not located within the study area itself, two important subsistence salmon fisheries are located nearby on the upper Copper River. The Glennallen subdistrict fishery is defined as all waters of the mainstem Copper River from the mouth of the Slana River downstream to the downstream edge of the Chitina-McCarthy Bridge (Map 5.1; ADF&G 2013b). This fishery is of statewide importance because all Alaska residents may harvest salmon in this subsistence fishery. Allowable gear types include fishwheel and dipnet (5 AAC 01) (Simone and Valentine 2005; ADF&G 2013b).

For qualified rural area residents, federal subsistence permits for the Glennallen and Chitina subdistricts are also available from the National Park Service. Under federal regulations, only Copper River basin residents may harvest fish and game for subsistence uses (Fall et al. 2009).

In 2011, 1,580 state and federal permits were issued for the Glennallen subdistrict subsistence salmon fishery, up from an average of 1,248 between the years 2001-2005 and 1,421 between 2006-2010 (Botz and Somerville 2011). In 2009, 68 federal permits were issued for the Chitina subdistrict (Fall et al. 2012). Annually, the combined harvest for the two fisheries is about 160,000 sockeye salmon, 4,500 Chinook salmon, and 2,500 coho salmon (Viavant et al. 2013).

Caribou are an important subsistence resource in the study area. Since 1990, Nelchina caribou hunt permits have been issued for state and federal subsistence hunts only, except for a very limited drawing hunt in Unit 14. Because of declining numbers of bulls, harvests were curtailed in 2000 and the number of large bulls has increased to an average of 21 percent since 2002. Projected harvests are expected to be about 1,000-2,200 caribou each year if the herd can be held to 35,000-40,000 animals (Schwanke 2011).

Moose are the second most important subsistence species, in pounds harvested, after sockeye salmon (Wolfe 2004). GMU 13 is a historically important area for moose hunting. Harvests were large during the late 1960s and early 1970s, but moose numbers declined soon after due to severe winters and predation. Stricter regulations were enforced and moose numbers in GMU 13 have been steadily increasing since 2001. A state subsistence moose hunt was initiated in GMU 13 in 1995; it was eliminated before the 2009 season because of an increase in the total harvest of bulls due to predator management. In the 2008-2009 seasons, 62 moose were taken in subsistence hunting (Tobey and Schwanke 2010).

BLM began a subsistence moose hunt on federal lands in 1990. This is a very popular hunt, with more than one thousand permits issued in most years. In the 2008-2009 seasons, 57 moose were taken in that hunt. In the 2009-2010 seasons, 100 moose were harvested in the Ahtna community harvest hunt (Tobey and Schwanke 2010).

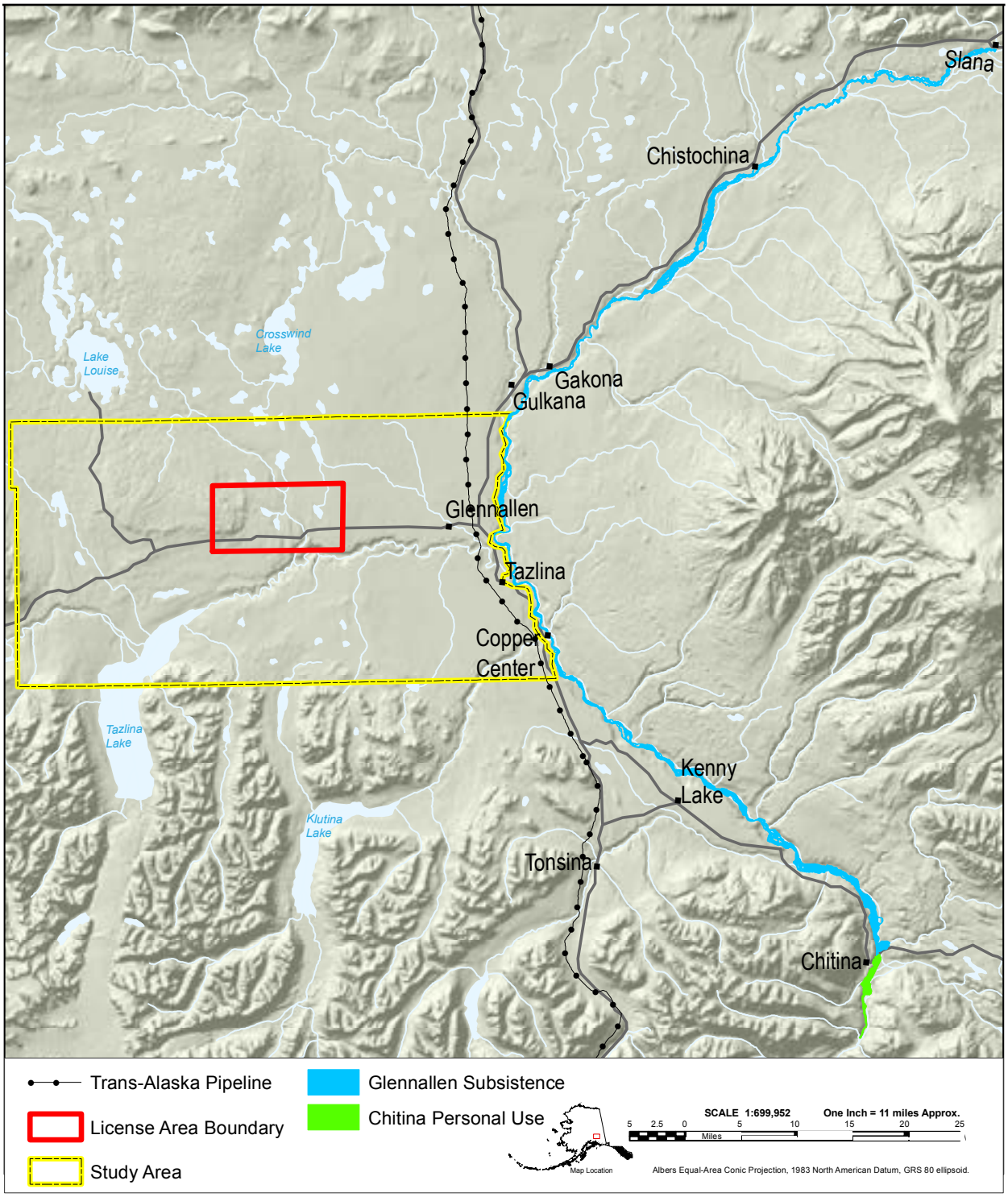
2. Personal Use

The Chitina subdistrict is a state-managed personal use fishery in the mainstem of the Copper River from the downstream edge of the Chitina-McCarthy Bridge to about 200 yd upstream of Haley Creek in Wood Canyon (Map 5.1). Only dipnet fishing is allowed there. All tributaries of the Copper River in this area, including the Chitina River, are closed to personal use fishing. In 2012, over 10,000 permits were issued, and over 129,000 salmon were harvested in the personal use fishery. Sockeye salmon made up most of the harvest (Table 5.1; Somerville 2013).

Table 5.1. Estimated personal use harvests in the Chitina subdistrict.

Year	No. of permits issued	King	Sockeye	Coho	Total
2008	8,041	1,999	81,359	2,711	86,476
2009	7,958	214	90,035	1,712	92,228
2010	9,970	700	138,487	2,013	141,565
2011	9,217	1,067	128,052	1,702	131,265
2012	10,016				129,362

Source: Somerville 2013.



Map 5.1. Glennallen subsistence and Chitina personal use subdistrict fisheries.

3. Sport Fishing

Populations of salmon and other fish species are also important to sport fisheries in the study area. State sport fishing licenses are generally required, which brings in revenue of $24 per annual license for residents and $140 for non-residents. In addition to a fishing license, anglers fishing for Chinook salmon must also purchase a Chinook salmon stamp at an additional cost of $10 for residents and $100 for non-residents (ADF&G 2008).

Current economic estimates for sport fishing specific to the study area are unavailable. However, in 2011, statewide fishing in Alaska generated $639 million in total expenditures, $359 million in salaries and wages, 9,992 jobs, and over $1 billion rippled through the statewide economy as a result of sport fishing in Alaska (USFWS 2012; Southwick Associates 2012). All categories increased since 2006, except jobs (Table 5.2). It should be noted that these estimates, which use data from the U.S. Fish and Wildlife Service's National Survey of Fishing, Hunting and Wildlife-Associated Recreation, may underestimate the total economic impact of sport fishing in Alaska because it does not include expenditures made outside Alaska. For example, fishing equipment purchased in another state used for fishing in Alaska (Southwick Associates et al. 2008).

Table 5.2. Economic impact of sport fishing in Alaska, 2006 and 2011.

Year	Retail Sales	Output	Wages and Salaries	Jobs
2006	$530,165,682	$800,921,744	$252,957,398	8,465
2011	$718,452,401	$1,073,716,980	$358,679,292	9,992

Sources: Southwick Associates 2007, 2012

Many sport anglers, particularly non-residents, use sport fishing guides and charters. In 2012, businesses and guides led 379 freshwater fishing trips in the Upper Copper River Drainage management area, but most of these were not within the study area itself (Sigurdsson and Powers 2013). Communities in the study are may have felt the economic effect through supplies, fuel, and lodging purchases.

d. Sport Hunting and Trapping

The major large mammals that are hunted for sport in the study area are black and brown bears. Some furbearers are also trapped in the area. ADF&G manages and monitors sport harvest of wildlife in the study area, which encompasses part of GMU 13, specifically game management subunits 13A and 13D (Map 5.2). Harvest estimates are not available for the study area itself but are available for GMU 13 in its entirety and for GMU 13A and 13D in some cases. Harvest is estimated by management year, which is defined as July 1 through June 30, or by calendar year.

Hunting guide services are available in the area, and contribute to the local economy. In 2013, 76 large game hunting guides were licensed within GMU 13 (DCED 2013).

During management year 2008-2009, sport hunters harvested 152 black bears and 144 brown bears within GMU 13. In addition, 173 beavers, 993 lynx, 40 wolverines, and 41 otters were harvested during the 2008-2009 game management year (Table 5.3).

Table 5.3. Harvest of large game mammal and furbearer species in GMU 13, by management year (July 1 through June 30).

Species	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	5 Year Average
Black Bear	121	125	146	189	152	147
Brown Bear	135	128	151	159	144	143
Beaver	187	231	228	186	173	201
Lynx	105	155	330	551	993	427
Wolverine	43	43	35	46	40	41
Otter	38	46	38	25	41	38

Sources: Robbins 2011; Schwanke 2010 and 2011; Tobey and Schwanke 2009 and 2010

The majority of hunters in game management subunits 13A and 13D are Alaska residents (ADF&G 2013d). Table 5.4 displays the sport harvest for these game management subunits for the 2012 regulatory year and the residency of the hunters.

Table 5.4. Sport harvests for GMU 13A and 13D during the 2012 regulatory year.

Species	Resident Hunter	Non-Resident Hunter	Unspecified Residency
Black Bear	36	10	0
Goat	2	1	0
Sheep	23	10	4

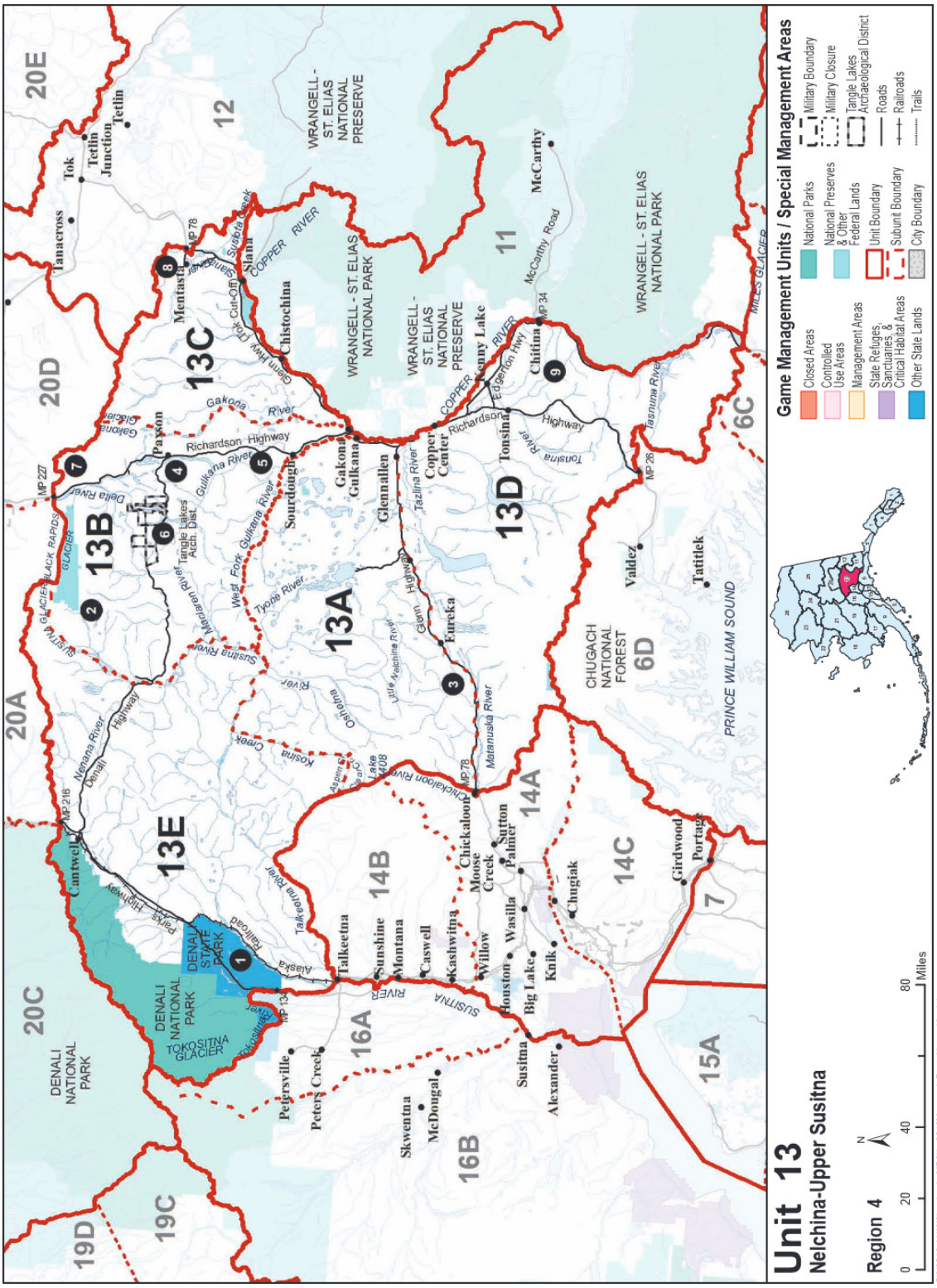
Source: ADF&G 2013d

Furbearer trapping and marketing of pelts also occurs in the study area. Results from trapper questionnaires indicated that 144 lynx were trapped in GMU 13A and 13D during the 2010-2011 seasons (Table 5.5; ADF&G 2012b). Other commonly harvested species in the study area include muskrat, red fox, coyote, and marten. The average prices paid for raw furs are listed in Table 5.6 below.

Table 5.5 Reported harvest of furbearers, 2010-2011 season.

Species	Number Trapped in GMU 13A	Number Trapped in GMU 13D
Beaver	5	2
Coyote	4	10
Ermine	5	2
Lynx	61	83
Marten	19	1
Mink	0	1
Muskrat	25	1
Otter	1	1
Red Fox	35	0
Wolf	3	3
Wolverine	4	3

Source: ADF&G 2012b



Map 5.2. Game management unit 13 (GMU 13).

4. Commercial Fishing

The Copper River Commercial Fishing District is the largest district in Prince William Sound. Although located well outside the study area, stocks of salmon harvested commercially in the district may spawn in study area and other tributaries of the Copper River. Sockeye, coho, and Chinook salmon runs are harvested by about 500 drift gillnet commercial permit holders each year (ADF&G 2013c). In 2012, the harvest in the Copper River District of the Prince William Sound Area commercial fishery was about 1.9 million sockeye salmon, 12,000 Chinook salmon, 124,000 Coho salmon, 6,000 pink salmon, and 29,000 chum salmon (ADF&G 2012a).

D. Recreation and Tourism

The study area offers year-round outdoor recreational activities and opportunities valuable to residents and visitors to the area. Numerous rivers, streams, lakes, valleys, mountains, and trails are used for hiking, dog mushing, fishing, hunting, sightseeing, cross-country skiing, snowmobiling, rafting, boating, camping, and other private and commercial recreational activities. Most of the recreation and tourism activity within the study area occurs during the summer.

Three agencies manage the recreational resources within the Copper River basin: the Alaska Division of Parks and Recreation; the Alaska Department of Transportation and Public Facilities; and the Bureau of Land Management. Parks located in or near the study area include the Little Nelchina State Recreation Area, and the Wrangell-St. Elias National Park and Preserve which is located directly east of the study area. Although some of the recreational areas are not within the boundary of the study area, recreationists must travel through the area when going to or from many of them.

Visitor statistics are available only for the community of Glennallen through the Alaska Visitor Statistics Program (AVSP). However, these are probably a reasonable representation of visitation to the area since most of the visitor traffic to the region flows through Glennallen. According the AVSP, more than 100,000 nonresident visitors traveled to Glennallen during the summer of 2003. A majority (95%) of visitors to Glennallen were independent travelers (Copper River Native Association 2009).

E. Forestry

Alaska has three forest regions as defined by the Alaska Forest Resources and Practices Act. The Transitional Region (Region II) encompasses the study area and consists of spruce/ hardwood trees (DOF 2010).

There are no designated state forests within the study area, although there is land available for forestry activities. There are a number of areas designated for timber sales in and around the study area (DOF 2013a). Timber sales are held to use the State's renewable resources and improve the economy, forest health, and wildlife habitat (DOF 2013b). Currently, there is no schedule available for timber sales in and around the study area, but areas have been designated and discussed in the Division of Forestry's Five Year Schedule. The DOF has issued three prospectuses since 2011 on timber sales within or near the study area, but no actual sales have been held (DOF 2013a). The purpose of a prospectus is to provide potential bidders sufficient information to decide if further investigation of the sale is warranted (DOF 2013b). The three prospectuses were for the Tolsona Bench No. 1 Sale, located within the study area, the Mae West Timber Sale, and the Moose Creek Salvage

F. Oil, Gas, and Mining

Oil and gas resource development is a use of the study area, and the license area itself, dating from the 1950s. Fourteen exploratory oil and gas wells and sidetrack wellbores have been drilled in the Copper River basin since 1953. Chapter Six provides a detailed description of the history of oil and gas exploration in the area.

There was no mining development or production near the study area in 2010, although there was development of industrial minerals and coal and production of industrial minerals in other areas of the Southcentral region (Szumigala et al. 2010).

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Chapter Six

Oil and Gas in the Study Area

This chapter examines the geology, exploration history, petroleum potential of the study area, and likely methods of transportation.

A. Geology

The study area lies in the Copper River basin and encompasses approximately 950 sq mi. The study area includes the villages of Glennallen, Copper Center, and Mendeltna. Ahtna's exploration license area (T4N R4-5W) is located about 3 mi west of Glennallen. The exploration license area is within the study area and consists of approximately 72 sq. mi.

The Copper River basin is a topographic lowland bounded by the Alaska Range to the north, the Chugach Mountains to the south, the Talkeetna Mountains to the west, and the Wrangell Mountains to the east. Less than 1% of the Copper River basin contains more than 3,280 ft of Cenozoic sediment fill (Kirschner 1994). Gravity and magnetic data suggest the southern portion of the basin is asymmetrical in cross-section with the major axis generally oriented east-west. A smaller depocenter might be present northwest of Gulkana. Faults, folds, and other structural features in the basin typically strike east-west to northeast-southwest. Unconformities control the distribution and character of post-Triassic sediments within the basin (Andreasen et al. 1964; Table 6.1). Notable surface features include mud volcanoes and mineralized-water springs, both cool and warm, a number of which release methane, nitrogen, or carbon dioxide gas.

Table 6.1. Geologic Time Scale

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

Source: U.S. Geological Survey Geologic Names Committee (2007) (modified by DO&G).

The Copper River basin is nearly entirely blanketed by surficial deposits of mostly Quaternary glacial, lacustrine, and alluvial sediments. Although Tertiary sedimentary strata reach thicknesses exceeding 3,000 ft, they are only locally exposed. Undifferentiated Eocene to Oligocene strata crop out in relatively extensive exposures along the eastern edge of the Talkeetna Mountains north of the Little Nelchina River (map unit Ttw of Wilson et al. 1998) and undifferentiated Tertiary sedimentary units create scattered outcrops a few miles north of the Glenn Highway in the Slide Mountain and Atlasta Creek/VABM Tolsona areas (map unit Tsu of Wilson et al. 1998). These Cenozoic basin fill units are underlain by mainly Paleozoic and Mesozoic rocks of the Wrangellia composite terrane (WCT), an amalgamation of the Peninsular, Alexander, and Wrangellia terranes, each exhibiting distinct geologic characteristics (Wescott and Turner 1985; Decker et al. 2012; Table 6.1). Since Permian or Triassic time, the WCT has acted as a single, albeit disjointed, terrane rather than as three separate and structurally distinct terranes (Plafker et al. 1994). The WCT was emplaced against the older terranes of interior Alaska during Early to Late Cretaceous time (Plafker and Berg 1994).

Northwest of the study area, strata of the WCT are more than 15,000 ft thick near Butte Creek in the northern Talkeetna Mountains, exposed in the hanging wall of the Talkeetna thrust fault (Eastham and Ridgway 2000). At this location the stratigraphic succession can be divided into three coherent units consisting of nearly 10,000 ft of Triassic-age Nikolai Greenstone, overlain by more than 3,500 ft of Triassic-age Chitistone and Nizina limestone, and capped by nearly 2,000 ft of Triassic- and Jurassic-age argillite (Eastham and Ridgway 2000).

Cretaceous Matanuska Formation and Jurassic to Triassic bedded volcanics of the Talkeetna Formation crop out along the southern edge of the Copper River basin (Wilson et al. 1998). Further south, these are juxtaposed against Jurassic mafic and ultramafic rocks along the Border Ranges fault system, the tectonic boundary between the WCT and the Southern Margin Composite Terrane (Plafker and Berg 1994), which is widely exposed in the Chugach Mountains.

The Middle Jurassic Tuxedni Group, which in the Cook Inlet serves as the primary oil source rock, is mapped at the surface in the southeastern Talkeetna Mountains and is tentatively recognized in the Copper River basin subsurface, but its occurrence is apparently much sandier than its Cook Inlet equivalent and as a result it is not as oil-prone (Magoon and Valin 1995). In fact, there have been no live oil shows reported in the Copper River basin and aside from a fetid oil smell reported in outcrop in the Lower Cretaceous Nelchina Formation (a carbonaceous and siliceous shallow marine deposit) there have been no indications of oil in the basin (Magoon and Valin 1995).

Before uplift of the Talkeetna and Chugach mountain ranges in the Early Tertiary, present day upper Cook Inlet and Copper River basins constituted an expansive and connected marine depocenter located adjacent to the active convergent plate margin. As a result, genetically related Jurassic and Cretaceous rock units such as the Talkeetna, Tuxedni, Chinitna, Naknek, Nelchina, and Matanuska Formations, or their equivalents, are found in both basins today (Jones and Silberling 1979).

Methane constitutes 25% to 72% of associated gas at several mineral springs and mud volcanoes in the Copper River basin (Nichols and Yehle 1961). In addition, carbon dioxide, helium, and nitrogen are also present. Gases emitted from the Klawasi mud volcanoes, located within the Wrangell-St. Elias National Park and Preserve, are thought to have a volcanic mantle

source due to relatively high helium concentrations not present in gases emitted from the Tolsona mud volcanoes located west of Glennallen. The Tolsona mud volcanoes, situated in the central portion of the study area, bear carbon isotope signatures indicative of thermogenic gas generation, interpreted to have been sourced from coal and lignite beds in the Lower and Middle Cretaceous formations underlying the basin (Motyka et al. 1986; Wescott and Turner 1985; Map 6.1). Temperatures at the Klawasi and Tolsona groups are anomalously high, relative to background, suggesting some geothermal potential in the region may be possible, particularly near the Klawasi mud volcanoes, where high surface water temperatures and anomalous helium concentrations could indicate a potentially viable volcanic geothermal heat source (Wescott and Turner 1985).

B. Exploration History

Fourteen exploratory oil and gas wells and sidetrack wellbores have been drilled in the Copper River basin since Aledo Oil Company drilled Eureka #1 on the southwestern edge of the basin in 1953. Although Eureka #1 was drilled atop an anticlinal structure to a depth of 4,818 ft measured depth (MD) and bottomed in the Cretaceous-age Matanuska Formation, it encountered no oil, gas, or water. Nearly the entire drilled stratigraphic section was composed of shale, which wreaked havoc with drilling fluids, lacked effective porosity, and inhibited fluid flow.

In 1962, Aledo Oil Company drilled Eureka #2, situated approximately 1 mi southwest of Eureka #1, to a depth of 8,546 ft MD. In the same year, Unocal drilled Tazlina #1 to a depth of 8,837 ft MD in the west-central portion of the basin where gravity data indicate thicker sedimentary fill (Map 6.1). Neither of these wells encountered oil or gas.

The Moose Creek Unit #1 well was drilled by Pan American Petroleum Corporation in 1963 to a depth of 7,869 ft MD (Map 6.1). Although gas production testing was not performed, fresh water flow with some gas was encountered at 5,430 ft MD within the Matanuska Formation during drilling and mud weights had to be increased from 11.1 pounds per gallon (ppg) to 19.1 ppg in order to contain the increased pressure. Again at 6,075 ft MD, within the Nelchina Formation, water flowed to the surface and mud weights were increased to contain the pressure. The cause of this overpressure is not well understood, however two possible explanations are that thermal pressuring of semi-confined formation waters (Motyka et al. 1986) or trapped methane gas derived from buried coal deposits. Wescott and Turner (1985) report gases from the Tolsona mud volcanoes, located approximately 5 mi to the west, contain up to 48 % methane gas, likely derived from buried coal deposits.

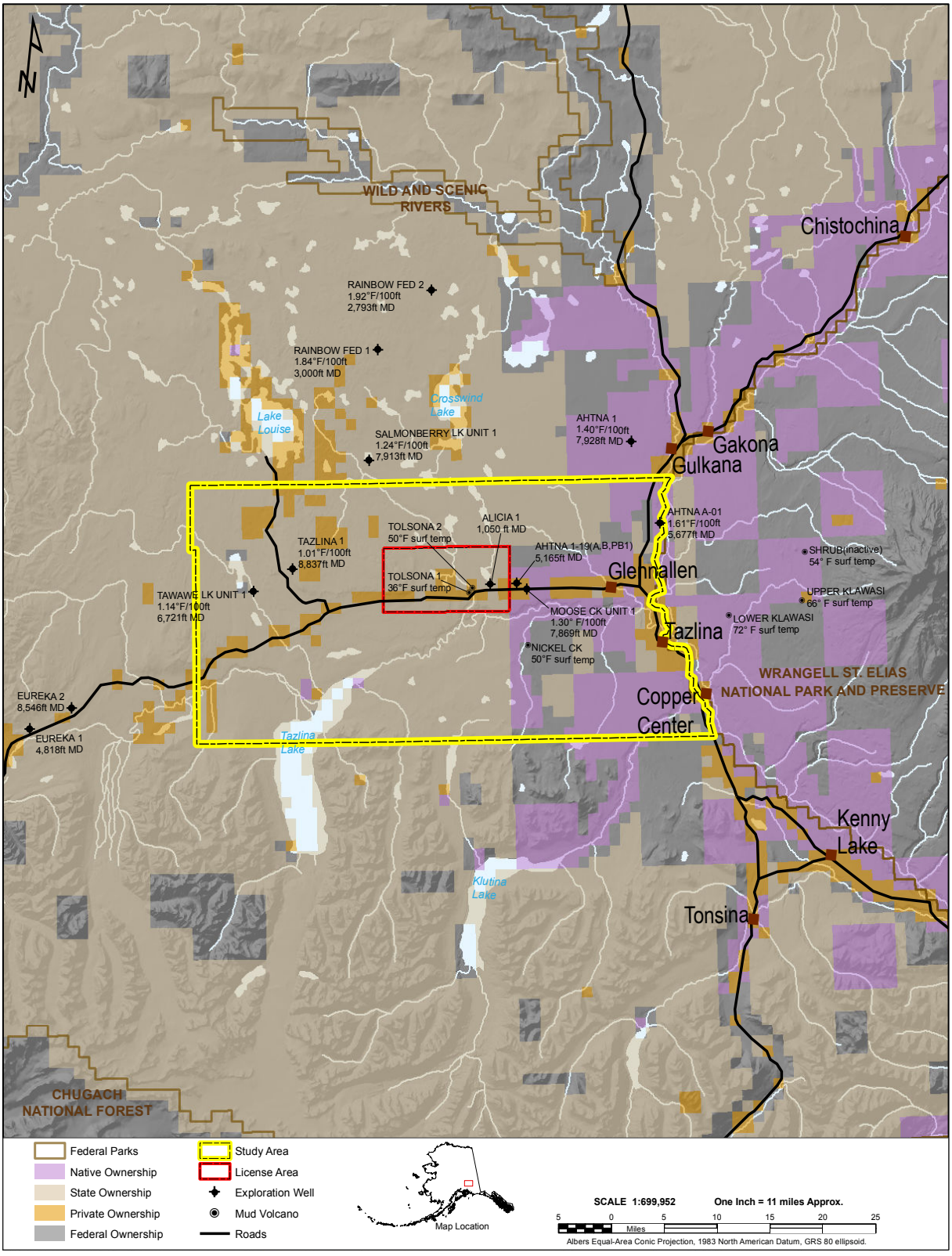
The Salmonberry Lake Unit #1 well, drilled by Mobil Oil in 1963 to a depth of 7,913 ft MD showed multiple zones of high total organic carbon (TOC) content ranging from 2.1 to11.9 % with associated methane gas measured between 2,600 and 3,900 ft MD (Map 6.1). The formation represented by this interval is not identified, but the organic-rich zones with gas shows may be carbonaceous mudstones and coals of the lower Matanuska Formation. Salt water flow to surface occurred over the same depths and heavier mud weights were needed to control the flow. No flow rate was measured and no further well testing was performed.
From 1965 to 1976, four additional exploratory wells were drilled in the Copper River basin. The Rainbow Fed #1 and Rainbow Fed #2 wells drilled by Atlantic Refining in 1965-66 to total depths of 3,000 and 2,793 ft MD, respectively, encountered no shows of oil, gas, or water. No mudlog record exists for either well. The Tawawe Lake Unit #1 well, drilled to 6,721 ft MD by Consolidated Oil in 1969, encountered very minor amounts (2 %) of oil suggesting oil had at one time migrated through the rock. The Alicia #1 well, drilled to a depth of 1,070 ft MD

by Copper Valley Machine Works in 1976, was reported as a dry hole with minimal cuttings descriptions, no logs of any sort, and no significant zones encountered (Map 6.1).

In 1979 and1980, Amoco Production Company drilled the Ahtna, Inc. #1 and Ahtna, Inc. #A-01 wells, the northeastern-most penetrations of the Copper River basin (Map 6.1). The Ahtna, Inc. #1 well, drilled to 7,928 ft MD, tested the Talkeetna and lower Matanuska formations. Fluid was recovered in three of the five drill-stem tests (DSTs) attempted. DST #3 in the Talkeetna Formation recovered 2,766 ft of salt water and 4,278 ft of fresh water. DST #4 in the lower Matanuska Formation recovered 200 ft of drilling fluid with a trace of gas (1.3 cu ft). DST #5, in a shallower zone of the same formation, encountered low and depleting pressures, recovering 294 ft of fresh water. The Ahtna, Inc. #A-01 well, drilled to 5,677 ft MD, encountered high pressures resulting in salt water flow to the surface that required 15-17 ppg mud weights to contain. Neither well encountered significant hydrocarbon shows and each well was plugged and abandoned.

The most recent drilling activity in the Copper River basin occurred between 2005 and 2009 with the drilling of the Ahtna 1-19, Ahtna 1-19A, and Ahtna 1-19B wells by Rutter & Wilbanks. These wells were drilled on private (Ahtna) lands on the northeastern boundary of the study area (Map 6.1) and, as of this writing, most of the data gathered in these wells remains confidential. Information available through the AOGCC and reports in Petroleum News indicate that the Ahtna 1-19 well was drilled to 5,165 ft MD, encountering anomalously strong overpressures at depths of only 1,100 to1,200 ft and a suspected gas resource in the Nelchina Formation at depths of about 4,300 ft. Mud weights approaching 20 ppg were needed to control the overpressure and were thought to have caused extensive formation damage, potentially preventing the well from producing gas. The Ahtna 1-19A sidetrack, drilled to 4,450 ft MD, also reportedly encountered gas shows near 4,300 ft, accompanied by excessive high-pressure water flow that prohibited viable testing. A second sidetrack, the Ahtna 1-19B was drilled to 4,558 ft MD and tested from inside 2-inch tubing, a technically challenging operation that yielded more of the same high-pressure water flow. All three boreholes were plugged and abandoned.

In summary, drilling in the Copper River basin tested the Lower Jurassic Talkeetna Formation, a volcaniclastic rock with andesitic flows, the Lower Cretaceous Nelchina Formation, a shallow marine carbonaceous and siliciclastic deposit, and the Upper Cretaceous Matanuska Formation, a deep water turbidite. Oil was not encountered in any of these formations. A few wells report mudlog shows of methane, but none yielded significant gas on flow tests.



Map 6.1. Exploration wells in the study area.

C. Petroleum Potential

1. Conventional Resource Potential

To date, no commercially producible oil or gas accumulations have been discovered, nor are there any quantitative assessments of undiscovered, technically recoverable resources available for the Copper River basin as there are for Alaska's established petroleum basins. The 14 wells drilled to date have encountered no known shows of live oil.

Several potential gas accumulations have been encountered and tested, but none have been capable of sustained production due to rapidly diminishing pressures or excessive high-pressure water influx during testing. However, as a relatively sparsely explored basin, a petroleum systems approach is useful for evaluating its undiscovered resource potential. This methodology considers and quantifies each of the interdependent elements of the overall geologic framework that together create producible conventional accumulations of oil and gas. There are three basic elements of functioning petroleum systems: *effective source rocks* to generate oil and gas in the thermally mature area of the basin (referred to as the petroleum "kitchen"), *effective reservoir rocks* with pore space to store them in, and *effective traps*, the sealed compartments that contain hydrocarbon fluids, preventing their escape. Each of these three components must be physically connected to the others at the *critical moment*, the brief episode during the system's geologic history when hydrocarbons are generated, migrate out of their source rock, and in favorable outcomes, encounter reservoirs in trapping configurations.

Source rock presence and effectiveness

The most likely candidate as an oil source rock in the Copper River basin would be shales and siltstones of the Middle Jurassic Tuxedni Group, well established as the oil source for virtually all commercial oil encountered to date in Cook Inlet. However, as noted above, Middle Jurassic formations in the Talkeetna Mountains and Copper River basin region are notably sandier and less organic rich than their counterparts exposed hundreds of miles to the southwest on the west side of Lower Cook Inlet. These characteristics are unfavorable for source rock quality, and are the likely explanation for the lack of oil shows encountered in exploratory drilling in the Copper River basin to date. In short, there is no indication of a petroleum system for oil in the Copper River basin.

Conversely, there are clearly gas-prone source rocks in the basin, as demonstrated by the methane gas emanating from mud volcanoes and mineral springs and by gas shows encountered in wells. Motyka et al. (1986) analysis of naturally escaping gases in the basin includes carbon isotope data that strongly suggests most of the methane originated by thermogenic maturation of coals from Cretaceous strata, most likely the Matanuska Formation. However, one of the samples in their study yielded a much lighter methane carbon isotope signature indicating a bacterial source, consistent with coaly sources at lower thermal maturity, potentially either in the Cretaceous or Tertiary stratigraphic section. This leaves the possibility of either thermogenic of biogenic gas accumulations in the Copper River basin, but exploration to date has not demonstrated producible accumulations of either variety.

Reservoir rock presence and effectiveness

Stratigraphic correlations are very difficult in the Copper River basin subsurface due to the scarcity and vintage of available well logs, lithology logs, and biostratigraphic control. As a result, it remains unclear how much of either the Tertiary or Mesozoic interval comprises potential reservoir lithologies (sandstone, conglomerate, and perhaps limestone). Furthermore, there is little hard data from within the basin with which to assess reservoir quality (effectiveness); outcrop observations in the Matanuska Valley and Talkeetna Mountains provide much of the best insight.

In general, the expectation is that reservoir quality of Tertiary strata would exceed that of the Mesozoic units, but both may be challenged due to their compositional and textural immaturity, high matrix content, susceptibility to diagenetic and compactional porosity loss, and locally severe structural deformation. A limited suite of sandstone samples collected by DNR geologists yields maximum porosities ranging from 3 to 8 %, with permeabilities mostly between 0.003 and 0.17 millidarcies. These sandstones are considered marginal to ineffective reservoirs, and if saturated, would probably require successful stimulation to flow hydrocarbons at commercial rate.

Trap presence and effectiveness

The scarcity of outcrop and publicly available seismic data in the Copper River basin makes it difficult to predict the location and geometry of subsurface structural and stratigraphic traps. Extrapolation of structural trends from the nearest Mesozoic outcrops in the Talkeetna Mountains, Matanuska Valley, and Chugach Mountains strongly suggest that Mesozoic units in the basin are at least moderately deformed in a combination of compressional and strike-slip structural styles. If structures exposed on the basin margin are a reliable indication of what is beneath Cenozoic cover in the basin's interior, traps can be expected to be of modest size, with the risk of failed containment due to repeated deformation.

From an oil and gas perspective, it would be commercially favorable to encounter somewhat lower degrees of deformation, represented by anticlinal traps with gently dipping rather than steeply dipping limbs, fault-assisted traps without extensive fault compartmentalization, and top seals that have not been breached by restructuring after hydrocarbon accumulation. Stratigraphic trap configurations may exist in any of the formations, especially in the heterogeneous alluvial and fluvial depositional system associated with the Tertiary formations. In such strata, seal integrity is most likely in the deeper portion of the basin, where mudstones may have undergone sufficient compaction to confine an exploitable hydrocarbon column.

Summary of conventional petroleum potential

Considering the available data using a petroleum systems approach, the conventional petroleum potential of the Copper River basin is interpreted to be moderate to low for gas and low for oil. Both thermogenic and biogenic natural gas appear to be present, though not abundant. Nonmarine Tertiary sedimentary units may retain sufficient porosity and permeability to serve as reservoir units, particularly for gas, although more work is needed to understand the distribution and quality of potential reservoirs in the subsurface. Trapping configurations are probably present, almost certainly in the Mesozoic strata, but potential traps may be challenged by limited size, complexity, and seal integrity.

2. Unconventional Resource Potential

Potential unconventional petroleum resources include source-reservoired oil and gas, including coal bed methane (CBM), shale gas, and shale oil. Tertiary strata contain coal in individual seams up to 30 ft thick (Crick and Lian 1970), some of which release gas shows during drilling. Under appropriate conditions, coal seams may serve as gas reservoirs that can only be exploited using depressurization and dewatering techniques. At the normally elevated pore fluid pressures associated with subsurface burial, methane molecules are dissolved in the formation water and adsorb onto the coal, and can be released through desorption when formation pressure is decreased through water pumping. Although coals may be extensive throughout much of the Tertiary section in the Copper River basin, individual seams seldom exceed 30 ft in thicknesses and coal rank seldom exceeds lignite (Crick and Lian 1970; Decker et al. 2012). Adsorbed methane content and the development of cleats (permeable fractures) both increase with coal rank, and lignites are generally considered incapable of sustaining viable production (Helmold and Clough 2012). It is likely that coal bed methane production would yield at best only small volumes of microbial gas from these shallow and thermally immature coals. Not enough is known about the coals in the Matanuska Formation, but their limited thickness, uncertain thermal maturity, unknown gas content, potential structural complexity, and the hazards associated with drilling in coals all contribute risk to the viability of the play concept.

Shale-hosted unconventional oil and gas resources have not been quantitatively assessed in Alaska outside of the North Slope. Although the Middle Jurassic Tuxedni Formation has been tentatively identified in wells in the central Copper River basin, the lack of oil shows in the basin – even in the potential source rock interval – bodes poorly for the viability of a shale oil resource play. The possibility of shale gas resources is more difficult to rule out based on the minimal available subsurface seismic and well data. More information is needed regarding the potential Middle Jurassic source rock interval, such as its extent, thickness, organic richness, thermal maturity, natural fracture network, and structural complexity. This information will only follow from a significant increase in drilling activity, which would most likely focus on evaluating conventional gas prospects.

In summary, unconventional resource potential is considered low for both CBM and shale resource plays, although much of the data needed to reliably evaluate these resources is simply unavailable in this still lightly explored region. Unconventional resources are more technologically and economically challenging to develop than conventional plays, and are typically exploited later in the development life cycle.

3. Overall Summary of Petroleum Potential

The available geologic and geophysical information indicate the Copper River basin's greatest petroleum resource potential is for conventional natural gas plays, either biogenic or thermogenic, in either Tertiary or Mesozoic formations. Natural gas production is considered moderate to low overall, based on the absence of sustained production in previously drilled exploration wells to date, and considering the economic challenges due to the remoteness of the study area from existing petroleum infrastructure and gas markets. Any discovered resource needs to be of sufficient size to economically justify production. To date, this has not been the case.

The lack of oil indications in any of the wells or surface seepages makes oil resource development in the Copper River basin appear unlikely under any circumstance, whether

from conventional or unconventional reservoirs. Unconventional gas resource development appears unlikely from either CBM or shale resource plays, but cannot be entirely ruled out from the presently available information. The data needed to fully understand these potential unconventional resources will likely only become available if the basin sees significant increases in exploratory drilling in pursuit of conventional gas.

While the petroleum potential is currently estimated to be moderate to low, is does not mean there is no potential. A complete understanding of the potential is not available. Additional data is desired in this region where current technical understanding is limited by a lack of data. Oil and gas exploration activities conducted under an exploration license benefits the state by providing valuable information about resource potential.

D. Phases of Oil and Gas Activities

License and lease-related activities proceed in phases. After disposal and issuance of an exploration license, there are three phases of industrial activity: exploration, development, and transportation. Subsurface storage may also occur. Only exploration may occur under a license. Various activities may occur at each of these phases, depending on the specifics of a project, and each subsequent phase's activities depend on the initiation or completion of the preceding phase.

Until discoveries are made, precise location and level of associated activities is unknown. Implementation of any exploration, development, or development program must meet a myriad of requirements of regulatory agencies before approval. Permit requirements must be evaluated in light of the particular activity proposed, and plans of operation must be conditioned with appropriate project-specific and site-specific safeguards.

Generally, the process for evaluating a prospect is lengthy. It may involve shallow geophysical surveys, core hole test wells, pilot projects, water disposal plans, field development, and gas transportation. Review by a variety of governmental agencies, public commenting periods, and permitting processes are required.

1. Exploration Phase

The exploration license will grant Ahtna the exclusive right to explore for oil and gas within the license area (AS 38.05.132). The license will have a maximum term of 5 years, unless terminated. There is a non-refundable fee of $1 per acre.

Ahtna's license is conditioned on a specific work commitment of spending $415,000 over the 5-year term of the license. Ahtna must complete at least 25% of that commitment ($103,000) by the fourth anniversary of the license, and must post bond and annually renew it. Allowable expenditures for the work commitment are cash expenses such as labor costs, equipment, materials, supplies, and contractors, with the goal of gathering exploration data or drilling one or more exploration wells.

Oil and gas resource exploration begins with gathering information about the petroleum potential of an area by examining surface geology, researching data from existing wells, performing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. The surface analysis includes the study of surface topography or the natural surface features, and near-surface structures revealed by examining and mapping nearby exposed rock layers. Geophysical surveys, primarily seismic, help reveal the characteristics of the subsurface geology.

Issuance of the license is independent of permits required for exploration activities. A land use permit from DNR is required for geophysical exploration (11 AAC 96).

a. Geophysical Exploration

Seismic surveys are the most common type of geophysical exploration. Energy is emitted at the survey location into the subsurface and reflected seismic waves are recorded at the surface geophones and/or hydrophones (vibration-sensitive devices). Different rock layers beneath the surface have different velocities and densities. This results in a unique seismic profile that can be analyzed by geophysicists to interpret subsurface structures and petroleum potential. Advancements in seismic sensors and recording systems technology have resulted in higher definition and greater productivity. In addition, it is anticipated this will create greater efficiency in exploration with an increased emphasis on the environment (New Developments in Upstream Oil and Gas Technologies 2011).

Geophysical exploration activities are regulated by 11 AAC 96, and DNR tailors each permit approval to the specifics of a proposed project. Restrictions imposed on permits depend on the duration, location, and intensity of the project. It also depends on the potential effects the activity may have on vegetation, fish, and wildlife resources or human use in the area. The extent of effects varies, depending on the survey method and the time of year the operation is conducted.

b. Drilling Exploratory Wells

Exploratory drilling may occur under a license and under a lease. It often occurs after seismic surveys are conducted, and review of the seismic and geologic data indicates possible oil and gas prospects. Exploration drilling, which proceeds only after obtaining the appropriate permits, is the best way to learn whether a prospect contains commercial quantities of gas, and helps determine whether to proceed with development. Drilling operations collect well logs, core samples, cuttings, and a variety of other data. A well log is compiled by lowering measuring instruments in a well bore and taking measurements at various depths. Well logs can also be recorded while drilling. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled.

One way to take readings is through Measurements While Drilling (MWD) technology. Tools at the end of the drilling apparatus may include gyroscopes, magnetometers, and accelerometers. These provide real-time drilling information such as wellbore position, drillbit information, directional data, and borehole inclination and azimuth during drilling. These data are transmitted to the surface through pulses through the mud column and electromagnetic telemetry. Data are decoded at the surface and transmitted to an offsite location. This allows drilling engineers to make important decisions while drilling (Rigzone 2013).

If the exploratory well is successful, the operator may drill additional wells to delineate the extent of the discovery and gather more information about the field. The licensee needs to know the quantity of gas, and the quality of the rocks or coal in which it is found, to determine whether to proceed to convert to a lease, and whether to proceed with further exploration and/or the development phase.

2. Conversion to Leases

If Ahtna meets the work commitment, it may request conversion of the license to leases of up to 5,760 acres each. The leases are subject to a production royalty of 12.5% and an annual rental of $3 per acre until the state's royalty income exceeds rental income. A lease is for a maximum period of 10 years and is automatically extended if, and for so long as, oil or gas is produced in paying quantities from the lease or if the lease is committed to a unit.

Conversion to leases is independent of permits required for further exploration and subsequent development and production. If the license is converted to leases, further exploration may occur, with either or both geophysical exploration or drilling one or more wells.

3. Development Phase

Whether or not exploration and eventual development will occur depends on several factors, such as the subsurface geology of the area, a company's worldwide exploration strategy, the projected price of oil and gas and their market demand, and other economic, environmental and logistical factors. Geology dictates the extent of exploration. Several dry holes (no substantial hydrocarbons encountered) can discourage further exploration in an area. Exploration of an area may depend on the area's priority when weighed against the company's other worldwide commitments. If extensive exploration does occur in an area, and an accumulation is discovered, development and production will only proceed if the company finds the risks acceptable, given the potential costs. This depends on the price of oil and gas, the lessee's development costs, and the cost of getting the oil and gas to market. During development, operators evaluate exploratory drilling results 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. The fluids undergo operations to purify, measure, test and transport. Pumping, storage, handling, and processing are typical production processes (Van Dyke 1997). Until exploration occurs what a full development scenario will entail is unknown because the final project parameters will depend on the surface location, size, depth, and geology of a specific commercial discovery.

After exploration wells have been drilled, a process called extended reach drilling (ERD) may be used during production. ERD can be used for both onshore and offshore reservoirs. ERD is already being used in Prudhoe Bay, Alaska to access offshore reservoirs using drilling rigs from land (New Developments in Upstream Oil and Gas Technologies 2011). ERD not only reduces wellsite footprints and minimizes environmental effects, but also improves reservoir drainage at the least cost (Schlumberger 2013).

Production facilities contain oil and gas production equipment located within their boundaries (EPA 2011). On the well site, these may include processing facilities to remove some of the water produced with the petroleum, water and sewage treatment equipment, power generators, drilling rigs, and support buildings and housing for workers. Support facilities may include a production facility to receive and treat or transport the oil and gas to markets, refineries, or shipment to other processing facilities located in the lower 48 states and elsewhere. Other support facilities may include a supply base and transportation system for cement, mud, water, food, and other necessary items.

a. Subsurface Gas Storage

Under AS 38.05.180(u), the DNR commissioner may authorize the subsurface storage of oil or gas to avoid waste or to promote conservation of natural resources. In Alaska, depleted reservoirs with established well control data are preferred storage zones. Subsurface storage must comply with all applicable local, state, and federal statutes and regulations, and with any terms imposed in the authorization or in any subsequent plan of operation approvals, or in the AOGCC Storage Injection Order.

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

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

4. Transportation Phase

AS 38.05.035(g) requires that written findings will consider and discuss the method or methods most likely to be used to transport oil or gas from the area, and the advantages, disadvantages, and relative risks of each. Because natural gas is more likely to be encountered in commercial quantities than oil in the exploration area, transportation of gas from the area would probably involve the construction of a pipeline transmission system.

Strategies used to transport potential gas resources depend on many factors, most of which are unique to an individual discovery. The location and nature of gas deposits determine the type and extent of facilities necessary to develop and transport the resource. DNR and other state, federal, and local agencies will review the specific transportation system when it is actually proposed. Modern gas transportation systems usually include the following major components: 1) pipelines; 2) marine terminals; and 3) tank vessels.

If the license is eventually converted to leases, no oil or gas will be transported from the lease area 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, the federal government has jurisdiction over various aspects of any transportation alternative.

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

a. Pipelines

There are various options for transporting natural gas to market. These include pipeline systems, liquefied natural gas (LNG), compressed natural gas (CNG), gas to solids (GTS), such as hydrates, gas to power (GTP), such as electricity, and gas to liquids (GTL).

A pipeline consists of all the components of a total system of pipe to transport natural gas for delivery, storage, or further transportation. It includes all pipe, pump or compressor stations, station equipment, tanks, valves, access roads, bridges, airfields, terminals and terminal facilities, operations control center, and all other facilities used or necessary for an integral line of pipe transportation (AS 38.35.230).

Pipelines may be onshore or offshore. Onshore pipelines may be buried or unburied. Buried pipelines, over which the ground is normally reseeded, are advantageous because they do not pose an obstacle to wildlife or result in scenic degradation. However, buried pipelines are more expensive to install and to maintain than unburied pipelines. This is especially true in regards to inspection, repair and maintenance (SPCO 2011). Spills may result from pipeline leaks in either buried or unburied pipelines, and leak detection systems play a primary role in reducing discharges of oil from either system. Elevated pipelines offer more ways to monitor the pipeline such as ground inspection, visual air inspections, ground-based infrared (IR) and airborne forward-looking infrared (FLIR) surveys. In-Line Inspection (ILI) can be used for both aboveground and belowground crossings, but is the only practical method for belowground installations (SPCO 2011).

Offshore pipelines usually do not hinder water circulation and minimally affect fish and wildlife habitat. Weighted pipelines are used in areas where tidal currents are exceptionally strong. Marine arctic pipelines are usually trenched and buried (C-CORE 2008). This technique is advantageous because it may offer a way to avoid creating a navigational hazard or being damaged by ship anchors, by sea ice, or by trapping fishing nets. In deeper water, weighted pipelines may disadvantageous because they may become silted-in or self-buried. A disadvantage of sub-sea pipelines is that they are expensive to build and maintain. They can be difficult to monitor for leaks, defects, and corrosion problems, however significant advances have been made in recent years.

Sophisticated monitoring methods now available can overcome many disadvantages of subsea pipelines. Some of these include:

- Volumetric flow measurement
- Pressure monitoring
- Pressure measurement with computational analysis
- External (adjacent to pipe) oil detection
- Remote sensing (airborne or satellite)
- Geophysical sensing techniques
- Pressure or proof testing
- Pipe integrity checking (ie., smart pigging)
- Visual inspection
- Through-ice borehole sampling

Many of these methods are considered to be proven technology while others are still under development (C-CORE 2008).

E. Hazardous Spill Risk, Prevention, and Response

1. Risk

Any time hazardous substances are handled during oil and gas activities there is a risk that a spill might occur. Oil spills associated with the exploration, development, production, storage and transportation of crude oil may occur from well blowouts or pipeline or tanker accidents. Petroleum activities may also generate chronic low volume spills involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels and other facilities for gathering, processing, loading, and storing of crude oil. Spills may also be associated with the transportation of refined products to provide fuel for generators, marine vessels and other vehicles used in exploration and development activities.

The risks associated with producing and transporting oil and gas can never be reduced to zero. There is always some chance that spills will result from exploration, production, storage, and transportation. However, these risks can be mitigated through prevention and response plans such as the Unified Plan and Subarea Contingency Plans (DEC 2010a, 2010b).

2. Prevention

DEC, Division of Spill Prevention and Response (SPAR) protects public health, safety and the environment by preventing and mitigating the effects of oil and hazardous substance release and ensuring their cleanup (SPAR 2013). Learning from past spills and their consequences, prevention has become more important than simply response. Contingency planning, exercise and practice programs, improved safety standards, and other measures have helped reduce U.S. spillage (Etkin 2001).

3. Response

Response plans in relation to the proposed lease sale are included in the Alaska Federal/ State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases (Unified Plan) and the Cook Inlet Subarea Contingency Plan (CI SACP) (DEC 2010a, 2010b).

A Unified Command structure of the Incident Command System (ICS) is the basis for government response and organization in the State of Alaska. The Unified Command brings together the Federal On-Scene Coordinator (FOSC), the State On-Scene Coordinator (SOSC), and the Responsible Party's Incident Commander into one governing unit. If an immediate threat still exists to the health and safety of the local populace, the Local On-Scene Coordinator (LOSC) will also be brought in (DEC 2010a, 2010b).

Response objectives include (DEC 2010a, 2010b):

- Ensure safety of responders and the public
- Stop the source of the spill
- Deploy equipment to contain and recover the spilled product

- Protect sensitive areas (environmental, cultural, and human use)
- Track the extent of the spill and identify impacted areas
- Cleanup contaminated areas and properly dispose of wastes
- Notify and update the public. Provide avenues for community involvement where appropriate.

Federal response action priorities/strategies general guidelines include (DEC 2010a, 2010b):

- Safety of life
- Safety of vessel/Facility and Cargo
- Control sources of discharge
- Limit spread of pollution
- Mitigate effects of pollution.

SPAR is responsible for ensuring facilities prevent spills and take proper response actions when spills occur. One of their programs is the Prevention and Emergency Response Program (PERP). Its mission statement is as follows (DEC 2011):

> Protect public safety, public health and the environment by preventing and mitigating the effects of oil and hazardous substance releases and ensuring their cleanup through government planning and rapid response.

Because of statutory requirements, the State of Alaska implemented the following Response Objectives (DEC 2010a, 2010b, 2011):

- Safety—Ensure the safety of all persons involved in a response or exposed to the immediate effects of the incident.
- Public health—Ensure the protection of public health from the direct or indirect effects of contaminated drinking water, air or food.
- Environment—Ensure the protection of the environment, including natural and cultural resources, from the direct or indirect effects of contamination.
- Cleanup—Ensure adequate containment, control, cleanup and disposal by the responsible party, or take over the response when cleanup is judged inadequate.
- Restoration—Ensure the assessment of damages from contamination and the restoration of property, natural resources and the environment.
- Cost recovery—Ensure the recovery of costs and penalties for reimbursement to the Oil and Hazardous Substance Release Prevention and Response Fund for use in Future emergency response actions.

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Chapter Seven

Governmental Powers

All exploration license and subsequent lease phases — exploration, development, and transportation — are subject to federal, state, and local laws, regulations, ordinances, and policies with which the lessee must comply. An exploration license grants Ahtna, Inc. the right to explore, but does not allow it to begin any operations. The exploration work is subject to the permitting processes of the agencies involved. Should exploration lead to development, foreseeable consequences include building new facilities and infrastructure, and extracting, removing, cleaning, processing and disposing of oil, gas and associated substances.

This chapter is not a comprehensive description of all of the laws and regulations that may apply to such activities. It provides a broad overview of the laws and regulations that pertain to oil and gas activities. Because every project is different, actual processes, terms and conditions will vary with time-certain, site-specific operations.

Each of the regulatory agencies has a different role in the oversight and regulation of oil and gas activities; some agencies may have overlapping authorities. Ahtna, Inc. is responsible for knowing and complying with all applicable state, federal, and local laws, regulations, ordinances, and policies.

In addition to existing laws and regulations applicable to oil and gas activities, DO&G's standard license and lease contracts require that licenses and leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the license or lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or lease to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

State of Alaska

A. Department of Natural Resources (DNR)

DNR, through DO&G, DMLW, OPMP, OHA, and SPCO review, coordinate, condition, and approve plans of operations and other permits as required before oil and gas activities may take place. DNR requires a plan of operations to identify the specific measures, design criteria, and construction methods and standards to be employed to comply with the lease terms. Each plan of operations is site-specific and is tailored to the activity requiring the permit. Applications for other state or federal agency authorizations or permits must be submitted with the plan of operations. The department makes field inspections to monitor and assess compliance.

1. Plan of Operations Approval (DO&G)

Land use activities are regulated under 11 AAC 83.158, and in the lease. They require the licensee to prepare plans of operations that must be approved by DO&G before the licensee begins work. All permit applications and plans are available for public review and public notices will be issued when required by statute.

Currently, 11 AAC 83.158(d) states:

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 or licensed 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 or licensed 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 or licensed area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas.

When it considers a plan of operations, DO&G often requires stipulations in addition to the mitigation measures developed through the written finding. These additional stipulations address site-specific concerns directly associated with the proposed project. The license stipulations are attached to the plan of operations approval and are binding on the lessee. The license also requires the licensee keep the license area open for inspection by authorized state officials. DNR, DEC, ADF&G, and AOGCC monitor field activities for compliance with each agency's permit terms. In addition, each permittee must post a bond before beginning operations (11 AAC 83.160).

2. Geophysical Exploration Permit (DO&G)

The geophysical exploration permit is a land use permit issued by DO&G under 11 AAC 96.010. Seismic surveys related to oil and gas development are the most common activity authorized by this permit. Submission of seismic exploration and stratigraphic test data to the state is a permit condition (11 AAC 96.210). Under AS 38.05.035(a)(8)(C), this information is held confidential if requested by the person supplying the information. If the seismic survey is part of an exploration well program, the permit will be reviewed as part of the exploration well permit package. The application must contain the following information in sufficient detail to allow evaluation of the planned activities' effects on the land:

(1) … a map at a sufficient scale showing the general location of all activities and routes of travel of all equipment for which a permit is required;

(2) a description of the proposed activity, any associated structures, and the type of equipment that will be used (11 AAC 96.030(a)).

Maps showing the precise location of the survey lines must also be provided; this information may be held confidential. The department may require security depending on the applicant's history of compliance and potential risk to the state (11 AAC 96.060).

A geophysical exploration permit is usually issued for a single survey season, but may be extended. If extended, the director may modify existing terms or add new ones. A permit remains in effect for the term issued, but may be revoked. A permit is immediately revoked for cause for (1) a violation of a permit provision or (2) a violation of 11 AAC 96. A permit is revocable at will if the department determines that revocation is in the state's interest. The department will give 30 days' notice before revoking a permit at will (11 AAC 96.040(a)).

3. Pipeline Rights-of-Way

The State Pipeline Coordinator's Office (SPCO) administers the Alaska Right-of-Way Leasing Act and issues leases on state lands for pipeline rights-of-way (AS 38.35.010). Most oil and gas transportation facilities within the license area or beyond its boundaries must be authorized by SPCO. As prescribed by AS 38.35.010, SPCO issues leases on state land for pipeline rights-of-way.

4. Alaska Petroleum Systems Integrity Office (PSIO)

The PSIO is the lead state agency for oversight of facilities, equipment, and infrastructure for the sustained production and transportation of oil and natural gas resources in the state. The PSIO was established in 2007 by executive order of the governor to:

(1) ensure that oil and gas infrastructure is designed and maintained in a safe and environmentally sound manner in compliance with state law;

(2) minimize economic impacts of unplanned interruptions in oil and gas production to the ongoing functions of state government;

(3) avoid premature abandonment of oil and gas infrastructure and waste of state resources; and

(4) ensure efficient and effective oversight of oil and gas industry practices by utilizing existing state government structures and processes to the maximum extent possible.

Through designated agency liaisons, PSIO leads interagency efforts to evaluate industry system integrity performance. Designated agencies, to the extent authorized by state regulations, require oil and gas producers and operators to provide comprehensive descriptions of current practices of quality control, quality assurance, monitoring, and inspection used to ensure the integrity and reliability of oil and natural gas facilities, equipment, infrastructure and activities.

The goal of PSIO is to provide a comprehensive and cost-effective approach to statewide oil and gas oversight activities, and to address any gaps in oversight. PSIO is tasked with ensuring that overarching quality management programs are in place and followed, both within industry and involved state agencies. The PSIO makes recommendations to the commissioner of DNR regarding gaps, findings and issues that address the reliability and system integrity of oil and gas infrastructure.

5. Temporary Water Use Authorization (DMLW)

Exploration may require a temporary water use authorization. DMLW administers temporary water use authorizations as required under 11 AAC 93.035 before (1) the temporary use of a significant amount of water, (2) if the use continues for less than five consecutive years, and (3) the water applied for is not otherwise appropriated. The volume of water to be used and permitted depends upon whether it is for consumptive or non-consumptive uses, and the duration of use. The authorization may be extended one time for good cause for a period of time not to exceed five years.

The authorization may be suspended or terminated if necessary to protect the water rights of other persons or the public interest. Information on lake bathymetry, fish presence, and fish species may be required when winter water withdrawal is proposed to calculate the appropriate withdrawal limits.

6. Permit and Certificate to Appropriate Water (DMLW)

Industrial or commercial water use requires a Permit to Appropriate Water under 11 AAC 93.120. The permit is issued for a period of time consistent with the public interest and adequate to finish construction and establish full use of water. The maximum time period for this permit is five years, unless the applicant proves or the commissioner independently determines that a longer period is required. The commissioner may issue a permit subject to terms, conditions, restrictions, and limitations necessary to protect the rights of others, and the public interest. Under 11 AAC 93.120(e), permits are subject to conditions to protect fish and wildlife habitat, recreation navigation, sanitation or water quality, prior appropriators, or any other purpose the department determines is in the public interest.

A Certificate of Appropriation will be issued under 11 AAC 93.130 if the permit holder:

(1) submits a statement of beneficial use stating that the means necessary for the taking of water have been developed and the permit holder is beneficially using the quantity of water to be certified, along with the required fee; and

(2) has substantially complied with all permit conditions.

7. Land Use Permits (DMLW)

DMLW issues land use permits and may require them for oil and gas activities unless the activities are otherwise approved under a plan of operations. Land use permits can be issued for periods up to five years, depending on the activity.

11 AAC 96.025 a generally allows uses listed in 11 AAC 96.020 subject to the following conditions:

(1) activities employing wheeled or tracked vehicles must be conducted in a manner that minimizes surface damage;

(2) vehicles must use existing roads and trails whenever possible;

(3) activities must be conducted in a manner that minimizes

(A) disturbance of vegetation, soil stability, or drainage systems;

(B) changing the character of, polluting, or introducing silt and sediment into streams, lakes, ponds, water holes, seeps, and marshes; and

(C) disturbance of fish and wildlife resources;

(4) cuts, fills, and other activities causing a disturbance listed in (3)(A) - (C) of this section must be repaired immediately, and corrective action must be undertaken as may be required by the department;

(5) trails and campsites must be kept clean; garbage and foreign debris must be removed; combustibles may be burned on site unless the department has closed the area to fires during the fire season;

(6) survey monuments, witness corners, reference monuments, mining location posts, homestead entry corner posts, and bearing trees must be protected against destruction, obliteration, and damage; any damaged or obliterated markers must be reestablished as required by the department under AS 34.65.020 and AS 34.65.040;

(7) every reasonable effort must be made to prevent, control, and suppress any fire in the operating area; uncontrolled fires must be immediately reported;

(8) holes, pits, and excavations must be repaired as soon as possible; holes, pits, and excavations necessary to verify discovery on prospecting sites, mining claims, or mining leasehold locations may be left open but must be maintained in a manner that protects public safety; and

(9) on lands subject to a mineral or land estate property interest, entry by a person other than the holder of a property interest, or the holder's authorized representative, must be made in a manner that prevents unnecessary or unreasonable interference with the rights of the holder of the property interest.

8. Material Sale Contract (DMLW)

If the operator proposes to use state-owned gravel or other materials for construction of pads and roads, DMLW requires a material sale contract (11 AAC 71). The contract must include, at a minumum, a description of the sale area; the volume of material to be removed from the sale area; the method of removal of the material; the bonds and deposits required of the purchaser; and, the purchaser's liability under the contract. The material sale contract must also include the purchaser's site-specific operating requirements.

The contract must state the last day material will be extracted. A contract may be extended before its expiration if the director determines the delay in completing the contract is due to unforeseen events beyond the purchaser's control, or the extension is in the state's best interests.

In connection with a material sale, the DMLW director may require the purchaser to provide a performance bond that guarantees performance of the terms of the contract. If required, the performance bond amount will be based on the total value of the sale. The performance bond must remain in effect for the duration of the contract unless released in writing by the director.

9. Office of History and Archaeology (OHA)

OHA does the work of the State Historic Preservation Office (SHPO). In accordance with the state's Historic Preservation Plan, OHA follows the state's Historic Preservation Plan in maintaining the Alaska Heritage Resources Survey (AHRS), an inventory of all reported historic

and prehistoric sites within the state. This inventory includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction. Before beginning a project, information regarding important cultural and historic sites should be obtained by contacting the OHA. The AHRS data sets are "restricted access documents" and specific site location data should not appear in final reports or be distributed to others.

It is unlawful for a person to appropriate, excavate, remove, injure, or destroy, without a permit from the Commissioner, any historic, prehistoric, or archaeological resources of the state (AS 41.35.200(a)).

A person may be charged with criminal mischief in the third degree (AS 11.46.482(a)(3)) if the person knowingly (A) defaces, damages, or desecrates a cemetery or the contents of a cemetery or a tomb, grave or memorial regardless of whether the tomb, grave, or memorial is in a cemetery or whether the cemetery, tomb, grave, or memorial appears to be abandoned, lost, or neglected; (B) removes human remains or associated burial artifacts from a cemetery, tomb, grave, or memorial regardless of whether the cemetery, tomb, grave, or memorial appears to abandoned, lost, or neglected.

A person convicted of violating a provision of AS 41.35.010 –.240 is guilty of a class A misdemeanor. In addition to other penalties and remedies provided by law, a person who violates a provision of AS 41.35.010 —.240 is subject to a maximum civil penalty of $100,000 for each violation.

B. Department of Environmental Conservation (DEC)

DEC has statutory responsibility to conserve, improve, and protect Alaska's natural resources and environment, by regulating air, land, and water pollution, and oil spill prevention and response. DEC implements and coordinates several federal regulatory programs in addition to state laws.

1. Air Quality Permits

DEC administers the federal Clean Air Act (42 USC 85 §§7401-7761q) and the state's air quality program under a federally-approved State Implementation Plan (AS 46.14; 18 AAC 50). Through this plan, the state is responsible for compliance with the Clean Air Act requirements found in the National Ambient Air Quality Standards (NAAQS), New Source Review (NSR), New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), and Prevention of Significant Deterioration (PSD). Additionally, DEC monitors air quality and compliance.

The NAAQS limits pollutants considered harmful to public health and the environment. Limits have been defined for principal pollutants, or criteria pollutants: carbon monoxide, lead, nitrogen dioxide, particulate matter (PM10), particulate matter (PM2.5), ozone, and sulfur dioxide. NSR, a permitting program required for new construction projects, ensures that air quality is not degraded by the new project, and that large new or modified industrial sources will be as clean as possible. NSPS promotes use of the best air pollution control technologies available, and it accounts for the cost of technology and any other non-air quality, health, and environmental impact and energy requirements. NESHAPs are set for air pollutants that are not covered by NAAQS, but that may be harmful. The standards are categorized by type of source, and require the maximum degree of reduction in emissions that is achievable, as determined by the EPA.

The two primary types of permits issued to meet these requirements are Title I Construction Permits and Title V Operation Permits. Permits specify what activities are allowed, what emission limits must be met, and may specify how the facility must be operated. Permits may contain monitoring, recordkeeping, and reporting requirements for assessing whether the applicant meets the permit requirements.

a. Title I (NSR) Construction Permits

Title I permits use air quality requirements for the PSD as well as other requirements of the Clean Air Act. This permit must be obtained before onsite construction can begin. Title I permits are required for projects that are new major sources for pollutants, or major modifications at existing sources. PSD requires installation of the "Best Available Control Technology (BACT)"; an air quality analysis; an additional impacts analysis; and public involvement.

The permitting process includes a pre-application meeting between the applicant and DEC, several DEC reviews, a Technical Analysis Report, and a 30-day public comment period, after which DEC may issue a final permit. The final permit includes a final Technical Analysis Report and response to comments. The Title I process can take up to 3 years, depending on the amount of meteorological data collection required.

b. Title V Operation Permits

The EPA has authority under the Clean Air Act to limit point-source emissions — emissions from a single source, such as a power plant. EPA regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit to operate the facility, known as a Title V permit. In Alaska, DEC issues Title V permits and inspects for compliance (AS 46.14; 18 AAC 50). The permit limits the type and amount of emissions allowed, establishes requirements for pollution control devices and prevention activities, and for monitoring and record keeping.

Operators have one year after beginning operations to submit their completed Title V permit application Operations can continue while DEC processes the application. However, significant revisions to an existing and permitted facility cannot be made until DEC approves the permit revision. Processing time for permit revisions can take up to 6 months. Title V permits and revisions can be processed concurrently with Title I permits.

2. Solid Waste Disposal Permit

DEC regulates solid waste storage, treatment, transportation, and disposal under 18 AAC 60. EPA administers the Resource Conservation and Recovery Act (RCRA) relating to hazardous wastes and UIC Class I injection wells. A different state agency, the AOGCC, regulates UIC Class II oil and gas waste management wells.

DEC requires a comprehensive disposal plan for all solid waste disposal facilities it regulates. Solid waste disposal permit applications are reviewed for compliance with air and water quality standards, wastewater disposal, and drinking water standards, and their consistency with the Alaska Historic Preservation Act before approval.

Non-drilling related solid waste must be disposed of in an approved municipal solid waste landfill (MSWLF). MSWLFs are regulated under 18 AAC 60.300 —.398. All other solid waste — except for hazardous materials— must be disposed of in an approved monofill (18 AAC 60.400—.495).
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).

All produced waters must be reinjected down well or treated to meet Alaska Water Quality Standards before discharge.

Hazardous substances to be disposed have a separate permitting and review process by both DEC under 18 AAC 62 and 63 and the EPA.

3. Wastewater Disposal Permit

Domestic graywater must be disposed of properly at the surface and requires a wastewater disposal permit (18 AAC 72). Monitoring records must be available for inspection, and a written report may be required upon completion of operations.

4. APDES Discharge Permits and Certification

DEC administers the Alaska Pollution Discharge Elimination System (APDES) program. This program regulates discharges of pollutants into U.S. waters by "point sources," such as industrial and municipal facilities. Permits are designed to maximize treatment and minimize harmful effects of discharges.

APDES covers a broad range of pollutants, which are defined as "any type of industrial, municipal, and agricultural waste discharged into water".

There are two basic types of APDES permits: general permits and individual permits. General permits cover multiple facilities that are similar. Individual permits are issued for a defined time period, not exceeding five years, and the facility must reapply for the permit before it expires.

5. Industry Oil Discharge Prevention and Contingency Plans

DEC regulates spill prevention and response under AS 46.04.030. ADF&G and DNR support DEC in these efforts by providing expertise and information. Contingency plans (C-plans) must be filed with DEC before beginning operations. DNR reviews and comments to DEC regarding the adequacy of these C-plans.

C-plans for exploration facilities must include a description of methods for responding to and controlling blowouts, the location and identification of oil spill cleanup equipment, the location and availability of suitable drilling equipment, and an operations plan to mobilize and drill a relief well. Holders of approved plans are required to have sufficient oil discharge containment, storage, transfer, cleanup equipment, personnel, and resources to meet the response-planning standards for the particular type of facility, pipeline, tank vessel, or oil barge (AS 46.04.030(k)). If development and production follow, additional contingency plans must be filed for each facility before beginning work.

Discharges of oil or hazardous substances must be reported to DEC recording the volume released, whether the release is to land or to water, and whether the release has been contained by a secondary containment or structure. The discharge must be cleaned up to DEC's satisfaction. DEC will modify proposed cleanup techniques or require additional cleanup techniques for the site as DEC determines to be necessary to protect human health, safety, and welfare, and the environment (18 AAC 75.335(d)).
C-Plans must describe existing and proposed means of detecting oil discharge, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation (AS 46.04.030; 18 AAC 75.425(e)(2)(E)). C-plans must include: a Response Action Plan, a Prevention Plan, and Supplemental Information to support the

response plan, including a Best Available Technology Section (18 AAC 75.425). Operators must also provide proof of financial ability to respond to damages (AS 46.04.040).

6. Interference with Salmon Spawning Permit

DEC is responsible for granting or denying permits for activities that interfere with salmon spawning streams and waters. If a person plans to obstruct, divert, or pollute waters of the state utilized by salmon in the propagation of the species, they must first apply for and obtain a permit before beginning any activities (AS 16.10.010).

Permits may be granted if ADEC finds the purpose of the permit is to develop power, obtain water for civic, domestic, irrigation, manufacturing, mining, or other purposes tending to develop the state's natural resources. The applicant may also be required to construct and maintain adequate fish ladders, fishways, or other means by which fish may pass over, around, or through the dam, obstruction, or diversion in the pursuit of spawning.

C. Department of Fish and Game (ADF&G)

1. Fish Habitat Permit

Under AS 16.05.871(b) a fish habitat permit is required before doing any work that would affect an anadromous fish stream, including operating vehicles or equipment in the stream bed, or using, diverting, obstructing, polluting or changing the natural flow or bed of an anadromous river, lake or stream. Under AS 16.05.841, a permit is required to ensure that any stream frequented by any fish is not obstructed in any way that would block fish passage.

2. Hazing Permit

Under AS 16.05.920, a permit to haze that may include the actual taking of some species may be issued for public safety or spill response. These permits may not be required if the lessee is a member of Alaska Clean Seas.

3. Special Area Permit Application

Any land or water use activities that may impact fish, wildlife, habitats, or existing public use may require a permit (5 AAC 95.420).

D. Oil and Gas Conservation Commission (AOGCC)

The Alaska Oil and Gas Conservation Act, AS 31.05, created the Alaska Oil and Gas Conservation Commission (AOGCC). AOGCC was established to prevent waste, protect correlative rights, improve ultimate recovery, and protect underground freshwater.

Among its other duties, the Commission issues permits and orders, and administers the Underground Injection Control (UIC) Program for the State of Alaska, as the delegated authority of the federal Safe Drinking Water Act.

1. Permit to Drill

A permit to drill from AOGCC is often the last step in the overall approval process, and usually occurs after all of the other agencies have given their approval. The application must be accompanied by the items set out in 20 AAC 25.005(c).

AOGCC will notify the applicant if there are any deficiencies in the application. The operator will either supplement the original application with revised or additional information, or, in the event that substantive changes are needed, resubmit the entire application.

2. Underground Injection Control Program (UIC)

The AOGCC regulates Class II wells in Alaska through a Memorandum of Understanding with the EPA. The goal of the UIC program is to protect underground sources of drinking water from contamination by oil and gas (Class II) injection activities. The three types of Class II wells are oilfield waste disposal wells, enhanced oil recovery (EOR) wells, and hydrocarbon storage wells. AOGCC reviews and takes appropriate action on proposals for the underground disposal of Class II oil field wastes (20 AAC 25.252). Before receiving an approval, an operator must demonstrate that injected fluids will not move into freshwater sources. Disposal or storage wells must be cased and the casing cemented so it will isolate the disposal or storage zone and protect oil, gas, and freshwater sources.

Once approved, liquid waste from drilling operations may be injected through a dedicated tubing string into the approved subsurface zone. The pumping of drilling wastes through the annular space of a well is an operation incidental to drilling the well, and is not a disposal operation subject to regulation as a Class II well.

3. Annular Disposal of Drilling Waste

An AOGCC permit is required if waste fluid is to be injected into a well annulus. The material must be muds and cutting incidental to the drilling of a well. In making its decision, AOGCC considers the volume, depth, and other physical and chemical characteristics of the formation designated to receive the waste. Annular disposal is not permitted into water bearing zones where dissolved solids or salinity concentrations fall below predetermined threshold limits. Waste not generated from a hydrocarbon reservoir cannot be injected into a reservoir.

4. Disposal Injection Orders

Operators may apply for disposal injection orders to dispose of waste in individual wells. After the public review process and Commission analysis, an order may be issued that approves the proposed disposal project.

5. Area Injection Orders

Injection orders may be issued on an area basis rather than for individual wells in areas where greater activity is anticipated. The area injection orders describe, evaluate, and approve subsurface injection for enhanced oil recovery and disposal purposes.

E. Department of Labor and Workforce Development (DOLWD)

The Alaska Department of Labor and Workforce Development (DOLWD) administers the Alaska Employment Security Act under AS 23.30 and 8 AAC 85.

DOLWD also administers some delegated authorities of the Occupational Safety and Health Administration (OSHA), PL-91-596, 1970. Section 18 of the law, State Jurisdiction and State Plans, allows states to obtain approval to assume responsibility for development and

enforcement of federal occupational safety and health standards. DOLWD has obtained approval from OSHA for administration of some of the federal OSHA standards.

Federal

F. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) implements, administers, or oversees programs and federal environmental regulations. These programs, some of which are delegated to the states, safeguard the nation's air, land, and water.

1. Air Quality Permits

The DEC administers the federal Clean Air Act and the air quality program for the State of Alaska under a federally-approved State Implementation Plan (see Section B.)

2. Hazardous Waste (RCRA) Permits

The federal Resource Conservation and Recovery Act (RCRA) manages hazardous wastes. Regulations set the parameters for transporting, storing, and disposing of hazardous wastes, and for designing and operating treatment, storage, and disposal facilities safely. Regulations are enforced through inspections, monitoring of waste handlers, taking legal action for noncompliance, and providing compliance incentives and assistance.

Some states may receive authorization to administer parts of the program, which requires that state standards be at least as strict as federal standards. EPA administers the RCRA program in Alaska.

3. NPDES Discharge Permit

DEC administers this EPA program, now titled APDES (see Section B). Permits specify the type and amount of pollutant, and include monitoring and reporting requirements, so that discharges do not harm water quality and human health.

4. Underground Injection Control (UIC) Class I and II Injection Well Permits

EPA regulates injection wells used to dispose of fluid wastes pumped into the well. Authorized as part of the federal Safe Drinking Water Act of 1974, EPA's Underground Injection Control (UIC) program protects underground sources of drinking water from being contamination by the waste injected in the wells. Injection wells are categorized into five classes; Classes I and II are most common in the oil and gas industry. EPA administers the program for Class I wells in Alaska, and authority for Class II oil and gas wells has been delegated to AOGCC (see Section D.).

All injections falling into Class I must be authorized through EPA's UIC Class I program. Class I wells operate under a permit that is valid for up to 10 years. Permits stipulate requirements for siting, construction, operation, monitoring and testing, reporting and record keeping, and closure. Requirements differ among wells depending on whether they accept hazardous or non-hazardous wastes.

G. U.S. Army Corps of Engineers (COE)

1. Section 10 and Section 404 Permits

The COE regulates construction, excavation, or deposition of materials in, over, or under navigable waters of the United States, or any work which would affect the course, location, condition, or capacity of those waters (Rivers and Harbors Acts of 1890 [superseded] and 1899 [33 USC 401, et seq.; Section 10 [33 USC 403). Section 10 permits cover oil and gas activities, including exploration drilling from jack-up drill rigs and installation of production platforms.

Section 404 of the Clean Water Act regulates discharge of dredged and fill material into United States waters and wetlands. This program is administered by COE, which is authorized to issue Section 404 permits for discharging dredge and fill materials.

Permits for specific projects are the basic type of permit issued. General permits (including programmatic, nationwide, and regional general permits) authorize activities that will result in minimal individual and cumulative adverse effects. General permits carry a standard set of stipulations and mitigation measures. Letters of permission, another type of project authorization, are used when the proposed project will not have significant individual or cumulative environmental impact, and appreciable opposition is not expected.

Section 404 and Section 10 permits follow a similar three-step review process: pre-application consultation for major projects, formal project review, and decision making.

In making a final decision to issue a permit, COE considers conservation, economics, aesthetics, wetlands, cultural values, navigation, fish and wildlife values, water supply, water quality, and other factors judged important to the needs and welfare of the people.

The process for letters of permission is shorter. In this situation, the proposal is coordinated with fish and wildlife agencies and adjacent property owners who might be affected by the project, but the public is not notified.

DEC reviews Section 404 and 10 permit application for compliance with Alaska water quality standards. If the applications comply, DEC approves the permit.

Permits may also be reviewed by other agencies, such as USFWS and NMFS, to ensure compliance with the Endangered Species Act, the National Environmental Policy Act, and Essential Fish Habitat Provisions of the Magnuson-Stevens Act.

H. Pipeline and Hazardous Materials Safety Administration

The Federal Office of Pipeline Safety (OPS) in the Pipeline and Hazardous Materials Safety Administration (PHMSA), an agency of the U.S. Department of Transportation, regulates the movement of hazardous materials by pipeline. Federal PHMSA inspectors review technical issues on hazardous liquid pipelines in Alaska. The 2006 PIPES Act requires hazardous liquid pipeline operators are required to develop integrity management programs for transmission pipelines.

I. Fish and Wildlife Service (USFWS)

The USFWS is a part of the Department of the Interior and dedicated to the conservation of natural resources. It has management authority for migratory birds, threatened and endangered species, the national wildlife refuge system, and, on lands under their jurisdiction, landscape conservation and aquatic resources. USFWS issues permits related to migratory birds, and endangered species, with the goal of managing risks and benefits of projects by using best available science and expertise. Permits can authorize activities consistent with conservation, protection and enhancement of wildlife, plants, and their habitats.

J. Regulation of Oil Spill Prevention and Response

Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC §9605), and §311(c)(2) of the Clean Water Act, as amended (33 USC §1321(c)(2)) require environmental protection from oil spills. CERCLA and the Clean Water Act require a National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR §300; 33 USC §1321(d)). Under these regulations, the violator must plan to prevent and immediately respond to oil and hazardous substance spills and be financially liable for any spill cleanup. If the pre-designated Federal On-Scene Coordinator (FOSC) determines that the response is neither timely nor adequate, the federal government will respond to the spill and then seek to recover cleanup costs from the responsible party.

The Oil Pollution Act of 1990 (OPA 1990) requires the development of facility and tank vessel response plans and an area-level planning and coordination structure to coordinate federal, regional, and local government planning efforts with the industry. OPA 1990 amended the Clean Water Act (§311(j)(4); 33 USC §1231(j)) and established regional citizen advisory councils (RCACs) and area contingency plans as the main parts of the national response planning structure.

The Alaska Regional Response Team (ARRT) is an advisory board to the FOSC. It provides for participation by federal, state and local governmental agencies to participate in response-to-pollution incidents. The Unified Plan is the State of Alaska's plan.

K. Native Allotments

Licensees 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 lands subject to a pending or approved Native allotment, lessees must contact the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM) and obtain approval to enter.

Chapter Eight

Reasonably Foreseeable, Significant Effects of Licensing and Subsequent Activity

A. Introduction

This chapter considers and discusses reasonably foreseeable significant effects that the license and subsequent activities could have on the study area. Also included are potential effects on historic and cultural resources, fiscal effects, and effects on local communities.

For this administrative review and written finding, the director has limited the scope to considering and discussing those effects on the important subsistence, sport, personal use, and commercial species and uses described in Chapters Four and Five (AS 38.05.035(e)(1)(B)). As explained in Chapter Two, the director has limited the administrative review for this exploration license to the disposal and exploration phases. Although the license issuance itself is not expected to have any effects other than to provide initial revenue to the state, potential cumulative significant effects that could occur in the study area as a result of subsequent activity are included below, as required by AS 38.05.035(g). Also included in the scope of review are concerns raised in public comments on the license application (AS 38.05.035(g)(1)(A)), including potential effects on water and air quality, fish and wildlife habitat, and subsistence. In addition to being addressed in this chapter, specific responses to the comments are provided in Appendix A.

Alaska statutes specify that speculation about possible future effects is not required (AS 38.05.035(h)). However, in the case of this exploration license, the director can reasonably foresee some significant potential future effects subsequent to issuing the license. Identification of the potential significant foreseeable effects, both positive and negative, of oil and gas activities on communities and villages in and near the study area, subsistence uses, fisheries, and habitats is based on three sources:

First, Ahtna submitted a project plan with its license proposal. At this time, Ahtna plans to conduct seismic testing over the license area and to drill one or more exploratory wells if the seismic test results are positive. Although the work commitment is for a dollar amount and the actual work performed may differ from the proposal, the director is generally knowledgeable of the types of activities Ahtna plans to conduct. Exploration license statute AS 38.05.132(f)(2) states “work commitment” includes the drilling of one or more exploration wells or the gathering of data from activities described in (1) of this subsection, or both. AS 38.05.132(f)(1) describes the actvitities as permitting, mobilization, conducting demobilizations, and evaluation of geophysical and geological surveys, or the drilling, logging, coring, testing, and evaluation of oil and gas wells.

Second, based on this information, the director has generally identified the potential future effects of those activities in the study area. The study area is about 46,000 acres. The exploration license area, contained within the study area, is relatively homogenous with a limited number of habitats, species, and uses. Thus, the director has general knowledge of the potential future effects of seismic testing and drilling activities in this area.

Finally, although not always specific to the study area itself, a large body of research on the effects of oil and gas exploration and development is available to the director, much of which is applicable to the study area. In particular, many studies are available on the effects of oil and gas development for arctic habitats and wildlife, as well as concerning industrial development in boreal forests of Canada. Although the study area may differ from these areas in some respects, the study area shares much in common with arctic environments and Canadian boreal forests, thus much of this body of knowledge is applicable to the study area.

The potential effects of oil and gas activities in the area will also be considered again before Ahtna begins phases beyond exploration, at which time the department's approval is required, and public notice and an opportunity to comment will be provided.

DO&G will have more specific information about the nature and location of proposed activities when Ahtna submits a plan of operations for approval and applies for needed permits. Additional protections can be added during the plan of operations and permit processes.

This chapter is divided into terrestrial ecosystems and freshwater ecosystem discussions to address the reasonably foreseeable cumulative effects of oil and gas activities on wildlife, fish, and habitats. Within these broad ecosystems, effects are considered and discussed in general categories because a certain activity could result in effects across multiple habitats, species, and uses. A large body of research addresses potential effects of oil and gas development on caribou; therefore these caribou are separately considered and discussed. The protections offered by mitigation measures are discussed as well (AS 38.05.035(g)(vii)).

B. Terrestrial Habitats, Wildlife, and Birds

This section considers and discusses potential cumulative effects on terrestrial habitats, wildlife, and birds. First, an overview of the general types of activities that could occur in terrestrial areas and the corresponding potential effects are considered and discussed. Next, potential effects resulting from unintended occurrences such as gas blowouts, oil spill releases, and drilling waste releases, are considered and discussed. Finally, further detail about potential effects is provided for caribou where species-specific information is available.

1. Potential Cumulative Effects

a. Construction and Other General Activities

In arctic environments, the largest effects of oil and gas activities are from physical disturbances (Huntington 2007). During the initial exploration phases, disturbances caused by cross-country travel and construction are the most significant (Hanley et al. 1983). Other activities that may induce impacts include installation of pile foundations in permafrost areas, construction of gravel roads, ice roads, ice pads and ice bridges, and general terrain disturbance (Hanley et al. 1981). Potential impacts can occur at all phases, but most are likely to occur during development and production. Disturbances related to construction for oil field development and pipeline construction may be the most significant disturbances (Hanley et al. 1983). Potential ecological effects of roads include physical disturbance, habitat loss, reduction in populations of species in close proximity to roads, dispersal of wildlife, and mortality of wildlife. Habitat fragmentation may be a result, which may impact biological diversity (Spellerberg and Morrison 1998).

Land surface disturbances may change and destroy vegetation, and can alter soil characteristics. Types of land surface disturbances may include vegetation clearing, slash disposal, altered soil characteristics, hydraulic erosion, altered surface hydrology, above

ground obstructions and filled areas (Hanley et al. 1983). Construction activities relating to petroleum extraction can cause impacts from the following: off-road transportation; road, pad and airstrip construction techniques; pile foundations in permafrost; below-ground pipelines and impacts to permafrost; ice roads; and terrain disturbance (Hanley et al. 1981).

Human activities can damage or remove the vegetative cover, leading to soil erosion (Hanley et al. 1981). The effects can alter the terrestrial habitat, and cause siltation of nearby freshwater habitats. Disturbance to permafrost areas removes the natural insulation, inducing thermal and hydraulic erosion, particularly in poorly drained, fine grain sediments. Disturbance can cause melting, erosion, heaving, slumping and subsidence (Hanley et al. 1981). The active layer of soil can undergo changes that cause settling, and can cause draining of areas previously frozen. Growth of depressions can cause more thawing and further subsidence, and potential deepening of Arctic lakes (Hanley et al. 1981, citing to Lawson 1986 and Waelbroeck 1993). Searching for adequate construction materials can also cause removal of gravel and disturbance of habitats (Hanley et al. 1983).

Some effects of constructing production pads, roads, and pipelines may include direct loss of habitat acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. Construction of roads and gravel pads can interrupt surface water sheet flow and stream flows (NRC 2003). Prior identification of sensitive areas can support the construction of infrastructure away from sensitive habitats. A study of the impacts to habitats from the construction of the Trans-Alaska Pipeline System found that the greatest % loss of habitat was from gravel material sites used for construction materials, with the work pad areas and road causing the next greatest habitat loss %ages (Pamplin 1979). A secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth (McKendrick 2000, Truett and Johnson 2000).

The effects upon the ecosystems impacted by roads include potential chemical input from roads to water bodies and to the airshed, and bioaccumulation in soils. Roads can impact fluvial dynamics, sediment transport and floodplain ecology. When roads alter habitats, plant species can be changed or removed, and nonnative plants can be introduced. Additional wildlife habitat impacts from roads can change the density, composition of animal species and populations (NRC 2003).

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 plant species, and species composition may also change after disturbance from construction activities (Linkins et al. 1984).

The effects of roads can also include physical disturbance, habitat loss or fragmentation, and threatening or extinction of populations and species near the road edge, mortality of wildlife on roads, the use of road edges as habitat, and dispersal of wildlife along road networks (Spellerberg and Morrison 1998). Human use of land with denning sites can force animals to move (Eberhardt 1977). A study of the effects of roads on brown bears in British Columbia and Montana found that bears used areas within 100 m of roads significantly less than areas farther from the roads, but this behavior change did not translate into a demonstrable effect on the population (McLellan and Shackleton 1988). A study of the frequency and distribution of highway crossings by brown bears on the Kenai Peninsula found that highways affected brown bear travel patterns (Graves et al. 2006).

The presence of linear pipelines may affect moose habitats, causing disruption in migration movements. A study of the effect of the Trans-Alaska pipeline on moose

habitats suggested that moose are physically prevented from crossing under pipe structures that are less than 4 ft above ground level (Van Ballenberghe 1978). During shallow snow conditions about 60 % of all moose crossings occurred when distances were between 6 to 8 ft high. Three-quarters of all crossings occurred where the pipe was 8 ft or less above ground, and more than 90 % used crossing locations that were less than 10 ft high. Open ditches of 10 ft or more in depth deflected moose migration (Van Ballenberghe 1978).

Studies conducted about the human effects of the habitats of the Pacific loon in or near oil fields report that disturbances are caused by construction of gravel roads and pad and human activity. Disturbance of nest sites, reduced availability of food sources, and abundance of predators may affect the bird populations (Kertell 2000, citing to Kertell 1996, 1997). The common eider and Lapland longspurs sometimes select gravel fill for nesting sites (McKendrick 2000). Changing the water regime with impoundments and limiting movement among wetlands may compromise access to birds' food supply (Kertell 2000, citing to Walker et al. 1987).

The tundra swan habitats in or near oil fields have experienced some human impacts and habitat loss due to the construction of gravel roads, pads, material sites and other permanent infrastructure (Ritchie and King 2000). The selection of nesting habitat has been more important than oil field facility avoidance (Ritchie and King 2000). Road noise and human presence, including pedestrians, on roads have caused some swans to nest farther from the road than they had previously (>100 to 200 m) (Ritchie and King 2000, citing to Murphy and Anderson 1993). Although these studies only deal with tundra swans, it is thought that they may be applicable to trumpeter swans, which inhabit the study area.

Disturbance is most likely to have an impact to bird habitat during those periods when birds have difficulty in meeting their daily energy requirements, especially when food intake needs to be high to enable birds to build up nutrient reserves in advance of periods of high demand (MMS 2008).

Effects of aircraft traffic on birds have been studied for several species, locations, and types of aircraft with varying results. Studies regarding the impact of low altitude overflights by helicopter or other aircraft traffic can adversely affect birds by causing stress and the flushing of habitats and nests (Rojek et al. 2007). Research relating to aircraft disturbances of common murres along the California coast showed that aircraft noise and the presence of aircraft flying below 1,000 ft altitude caused head-bobbing behavior or flushing of part or all of a bird colony (Rojek et al. 2007). Helicopters can cause more disturbance due to their low altitude capabilities (Rojek et al. 2007). Flushing and displacing adults and/or broods from preferred habitats during prenesting, nesting, and brood rearing and migration can cause disruption of courtship, chick loss, egg breakage, and predation by predators (Rojek et al. 2007).

Other research by Ward and Sharp (1974) evaluated the impacts of helicopters to moulting sea ducks on Herschel Island, Canada. They found that helicopter disturbances at 100 m height had an immediate impact, but that bird behavior showed no lasting effects. Helicopter disturbances did not drive birds from the habitat, and helicopter overflights at 300 m did not affect bird behavior (Ward and Sharp 1974).

In a 4-year study by Ward et al. (1999), they observed the effects of aircraft overflights on Pacific brant and Canada geese in Izembek Lagoon, located in Southcentral Alaska. The findings showed that 75 % of the Pacific brant and 9 % of the Canada geese flew in response to overflights. The Pacific brant were more reactive to helicopter rotary wing aircraft (51 %) and louder aircraft (49 %), as compared to fixed-wing (33 %) and low-noise aircraft (40 %) (Ward et al. 1999). The Canada geese were more reactive to

helicopter rotary wing aircraft (41 %) and louder aircraft (43%), as compared to fixed-wing (20 %) and low-noise aircraft (31 %) (Ward et al. 1999). The greatest response was to flights at intermediate altitudes of about 1,000 to 2,300 ft. Lateral distance from the birds was also a critical factor in determining the amount of disturbance to the birds (Ward et al. 1999).

Finally, Larned et al. (1997) found contrasting results about bird impacts from helicopters compared to fixed wing aircraft. They found that eiders tolerated close passes by helicopters at 150 m with mild alarm responses, while fixed wing aircraft caused the entire flock to leave with approaches within 150 to 200 m (Larned et al. 1997).

Also of concern to wildlife managers is the potential for increased interactions of animals with humans. Of particular concern is bear-human interactions and potential subsequent high non-hunting mortality of bears resulting from those interactions (ADF&G 2007; Suring and Del Frate 2002). The proper management of wastes and landfills may reduce availability of anthropogenic foods to the bear population (Shideler and Hechtel 2000). If food is present, human activity serves as an attractive nuisance, attracting foraging bears, especially to refuse disposal areas. This may pose a threat to human safety and the potential need to remove "problem" animals (NRC 2003). Foxes readily habituate to human activity, and this can lead to human-animal encounters, the foxes' use of human structures, and attraction to anthropogenic food sources. Foxes are especially attracted to human activity because of potential scavenging sources (Burgess 2000, citing to Wrigley and Hatch 1976; Eberhardt 1977). During construction of the Dalton Highway and TAPS, wolves readily accepted handouts from construction workers. When wolves approached humans, they were sometimes shot (McNay 2002).

On the other hand, although wolverines are primarily scavengers, they are cautious and wary of humans (Krott 1960) and apparently are not attracted to garbage (USFWS 1986). Van Zyll de Jong (1975) reported that evidence of declining wolverine populations in Canada was found in areas of relatively dense human populations. The human hunting and exploitation of wolverines were thought to be the direct or indirect causes of decline of the wolverine population in those areas (Van Zyll de Jong 1975). Habitat destruction can also affect wolverine populations (Magoun 1985).

b. Seismic Surveys

Winter seismic surveys can affect tundra vegetation, depending on snow depth, vehicle type, traffic pattern, and vegetation type. Soil-water content, and the freezing and thawing cycles impact soil strength. Water that freezes in the soils impedes the movement of soil particles. In contrast, low soil-water content does not increase soil strength upon (Lilly et al. 2008). Lilly et al. showed that while freezing, the soil temperatures colder than -2°C did not cause an appreciable increase in frozen soil water, and found that the difference in frozen soil-water content between -2° C and -5°C in early spring was less than autumn freezing conditions (Lilly et al. 2008).

Effects from seismic surveys during any season could be substantial if operations are conducted improperly. Vehicles can leave visible tracks in the tundra, but they should disappear with the recovery of the vegetation within a few years, especially in moist or wet vegetation areas. Vehicles using tight turning radii have sheared off upper layers of vegetation, but left rhizomes intact, so those plants would probably recover. Dry, snowless ridges and vegetated sand dunes are at higher risk of damage. Damage was observed to shrubs, forbs and tussocks (Guyer and Keating 2005). More significant impacts were observed on higher, drier sites, with little to no evidence of damage observed in wetlands (Guyer and Keating 2005).

Activities such as seismic surveys that require creation of linear corridors may affect habitat and behavior of wildlife. Traditional seismic lines leave a long-lasting footprint

in boreal forests. However, surveys now use global satellite positioning instruments, making the past practice of long clear-cuts through forests for line-of-sight measurements unnecessary. Plant communities on seismic lines are significantly different from adjoining forests, and seismic lines show little change for up to 30 years (MacFarlane 2003). The slow recovery rate may be due to factors such as damage to root systems by bulldozers and competition from grass species (Schneider 2002). Heavy equipment may result in soil compaction and erosion, and cratering may occur from improperly filled shot holes (Schneider 2002). Increased access for all-terrain vehicles, snow machines, and off-road trucks, and continued use of the lines by these vehicles may also contribute to extended recovery times (Schneider 2002). Studies have shown that low impact lines do not recover any faster, and the length of time for natural plant communities to be restored on low impact lines is unknown (MacFarlane 2003). Bog habitats that have been disturbed may take many years to return to their pre-disturbance state naturally (ADF&G 2006).

Loss of forest habitat that occurs when seismic lines are cleared is magnified by fragmentation, which reduces the usefulness of the habitat, and by avoidance of intact habitat in the area of the seismic lines by some species such as caribou (Schneider 2002). (See section below, Effects on Caribou Populations and Their Habitats, for additional discussion specific to caribou.) Habitat fragmentation, which could create "island populations", displacement, reduction of habitat quality, and potential increased frequency of high energy-cost flight responses have been identified as a concern for some brown bear populations (ADF&G 2002; ADF&G 2007).

Seismic lines may alter predator-prey interactions. In boreal forests, tracked radio-collared wolves were significantly closer to linear corridors, and they traveled faster along linear seismic corridors than in the forest (James 1999). Travel speed was unrelated to whether the seismic line was packed or unpacked, so it is suspected that the visual stimulus of a long distance influences wolves to stay and follow the corridor when they intersect it. Caribou mortalities from wolf predation were closer to linear corridors relative to locations of live caribou, but the sample size of tracked caribou was only five animals (James 1999). Researchers speculate that creation of linear corridors may increase caribou mortality by facilitating wolf movement, but this has not been proven conclusively through research (James 1999).

Clearing operations to prepare seismic lines, and explosions that occur during seismic surveys, may disturb wildlife. Birds and wildlife are particularly sensitive during nesting and calving periods (Schneider 2002). Repeated disturbances can result in increased movement rates of wildlife and subsequent significant energy losses, which can be particularly problematic during winter when food supplies may be scarce (Schneider 2002). However, one study found that, with the exception of ovenbirds, abundance of 41 species of songbirds, and location and size of their territories, were unaffected by seismic lines in boreal forests of the Northwest Territories (Machtans 2006). Seismic activity that occurs in winter may disturb denning bears. Studies have found that radio-collared bears in their dens were affected by seismic activities within 1.2 mi 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 (Reynolds et al. 1986).

c. Discharges from Exploration, Development, and Production

Discharges from exploration, development, and production may be intentional, such as permitted discharges regulated by the NPDES, or unintentional, such as gas blowouts, leakages, and spills. However, in the circumpolar Arctic, 80-90 % of petroleum hydrocarbons entering the environment originate from natural seeps (Huntington 2007). Excluding oil spills, activities related to oil and gas exploration, development, and production are minor contributors of petroleum hydrocarbons to the environment (Huntington 2007).

i. Gas Blowouts

During drilling, shallow gas pockets of natural gas may be encountered. Gas can get trapped in soils, water, and ice in permafrost environments. Sediments in which gas has accumulated are potential hazards for drilling that penetrates them in Arctic environments (Natural Resources Canada 2010, citing to Hyndman and Dallimore 2001).

Explosions and resultant fires may occur during a natural gas blowout. Gas vapors from an explosion are lighter than air and may migrate downwind where they are readily dispersed. Blowouts occur only if hydrogen sulfide is present and can also cause a toxic cloud to accumulate at shallow depths. Condensates, a low-density mixture of hydrocarbon liquids present in raw natural gas, that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations.

ii. Hazardous Spills

Hazardous spills can have toxic effects on vegetation, soils, wildlife, birds and fish. Effects spills depend on time of year, vegetation, and terrain. Oil spilled on the tundra would migrate both horizontally and vertically. The characteristics of the soil, such as porosity, permeability, texture, degree of water saturation and organic matter content, would affect substance movement (Jorgenson and Cater 1996).

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 seasons (Linkins et al. 1984). Hydrogen degrading bacteria and fungi can act as decomposers of organic material, and under the right conditions can assist in the breakdown of hydrocarbons in soils. Natural or induced bioremediation using microorganisms can also occur (Linkins et al. 1984; Jorgenson and Cater 1996). Natural recovery in wet habitats may occur in time durations of 10 years or less, if aided by cleanup activities and additions of fertilizer (McKendrick 2000).

Oil leaks or spills in boreal forests can have a range of potential effects, including killing plants directly, slowing growth of plants, inhibiting seed germination, and creating conditions in which plants cannot receive adequate nutrition (Robertson et al. 2007). Although a single addition of PHCs does not appear to limit microbial communities in the long term, species richness often decreases. The persistence of chemicals in the soil depends on several factors, including the type and quality of clay particles, type and concentration of solutes, organic content and composition, pH, and temperature (Robertson et al. 2007).

At low concentrations, petroleum hydrocarbons can stimulate plant growth (Robertson et al. 2007). Heterotrophic bacteria and fungi in most natural microbial communities apparently have an inherent ability to degrade organic pollutants, and usually, biological processes eventually degrade or transform most organic compounds. Although mycorrhizal ecosystems may be harmed by oil spills or leaks, they are also used for bioremediation (Robertson et al. 2007).

Oil may cause harm to wildlife through physical contact, ingestion, inhalation and absorption. As food sources are impacted by oil, larger animals, fish, mammals and humans can in turn be affected (USFWS 2004). Impacts to birds from oil releases may foul plumage and destroy insulation value, and resultant loss of buoyancy or hypothermia can kill birds (Burger and Fry 1993). While cleaning plumage, birds can ingest or inhale the oil, causing damage to lungs, liver, kidneys and death. Non-lethal effects to birds can include impaired reproduction or suppression of the immune system (USFWS 2004). Individual animals in the immediate vicinity and the associated nearby habitat and food sources may be impacted. Wildlife species may be

disturbed or displaced. Additional efforts may need to divert wildlife from access to the impacted area.

Oil weathers over time, and organisms may be able to tolerate the presence of oil while it is naturally degrading (Jorgenson and Cater 1996). The long term effects of oil may persist in the sediments for many years. Shifting population structure, species abundance, diversity and distribution can be long term effects, especially in areas that are sheltered from weathering processes (USFWS 2004).

iii. Releases of Drilling Muds and Produced Water

During exploration, well drilling muds and cuttings are stored on-site, in holding tanks, or in a temporary reserve pit, and then hauled to an approved solid waste disposal site, or are reinjected into the subsurface at an approved injection well. Common drilling fluids contain water, clay, and chemical foam polymers. Drilling additives may include petroleum or other organic compounds to modify fluid characteristics during drilling (National Driller 2010). The down-hole injection of drilling muds and cuttings are unimportant if they are not placed into a subsurface drinking water aquifer (NRC 2003). This injection technique for mud and cutting disposal has greatly reduced the potential adverse impacts caused by releases of drilling muds and reserve pit materials (NRC 2003).

d. Effects on Caribou Populations and Their Habitats

Direct habitat loss could result from construction of well pads, pipelines, roads, airfields, processing facilities, housing, and other infrastructure. Effects of constructing pads, roads, and pipelines on caribou habitats could include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. The long term avoidance of human activities in oil fields by caribou constitutes a form of habitat loss, as well (Ballard et al. 2000, citing to Cameron 1995).

In comparison, other research showed that caribou are attracted to oil field infrastructure for insect relief (Ballard et al. 2000, citing to Ballard et al. 2000; Murphy and Lawhead 2000). Joly et al. (2006) conclude that oil development on Alaska's North Slope has not adversely affected caribou. Effects to individual animals may or may not represent net impacts to the caribou herd population overall, and those impacts may be positive or negative.

Some limited information is available concerning effects of support facilities. For example, in one study, caribou used habitat near roads less than habitat farther away, ranging from zero % of expected use in closed coniferous wetlands in late winter to about 34 % during summer in open coniferous wetlands (Dyer et al. 2001). Caribou also avoided well sites at some distances and seasons, although expected use was greater than 100 % for others (Dyer et al. 2001). Cumulative effect of avoidance of all industrial development was a potential loss of 48 % of the 617,204 ha study area (Dyer et al. 2001). However, studies of caribou in northern Alaska before and after construction of a road showed no significant differences in densities of caribou near the road (Noel et al. 2004), and pipelines elevated ≥1.5 m were found to not cause changes in caribou use or delay migrations (Noel et al. 2006). In addition, despite concerns that oil and gas development and infrastructure such as roads may displace caribou, sizes of caribou herds in northern Alaskan oilfields have increased from 5,000 to 32,000 animals since oilfield development began, and recent studies indicate that negative effects from displacement are absent or negligible (Noel et al. 2004; Haskell et al. 2006).

i. Effects on Caribou Calving and Post-calving

Cronin et al. (1994) found that caribou cow and calf groups are most sensitive to human disturbance just before calving and post-calving, but Haskell et al. (2006)

found that caribou with or without calves became habituated to development after the calving period. Cameron et al. (2005) reported that caribou shifted calving inland, away from Milne Point, as infrastructure density increased. Ground vehicle traffic, aircraft, and human presence near cows with newborn calves also affect individuals as they migrate. 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 area varies from year to year. 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 higher value calving habitat could be lower calf survival or calves with smaller mass and size (Arthur and DelVecchio 2009). On the other hand, high populations would force the caribou into lower nutrition areas anyway.

As discussed above, a secondary effect of construction activities may be dust deposition, which may reduce photosynthesis and plant growth. Plants eliminated by dust along roads include sphagnum, acidophilus mosses and willow. If dust accumulation persists, all vascular plants may be eliminated. Caribou may be impacted by dust accumulation due to reduction in foraging plants, such as willow (McKendrick 2000, citing to Walker and Everett 1987; Ballard et al. 2000, citing to White et al. 1975 and White and Trudell 1980). In comparison, it has also been suggested that this dust shadow along roads allows for early melting of snow, increasing the earlier availability of forage vegetation to caribou in these locations (Cronin et al. 1994, citing to Lawhead and Cameron 1988).

ii. Effects of Roads

The use of roads has varying impacts on caribou. Caribou habituate to oil field structures, and habituate more slowly to vehicular traffic (Cronin et al. 1994). The observed density of caribou adjacent to roads showed that there was a significant decline in caribou in the zone of up to 0.6 mi from the road (Cronin et al. 1994). Caribou density increased at distances further than 0.6 mi, with an observed tripling of density in areas 2.5 to 3.7 mi from the road (Cronin et al. 1994).

During road construction in the Milne Point oil field, the estimated number of caribou within 2 km of the road declined by more than two-thirds during 1982-1987 (Nellemann and Cameron 1996). In contrast, Valkenburge and Davis (1986) reported that the Fortymile caribou herd moved to a new calving area, and chose a new area for several years duration (Valkenburg and Davis 1986). Although human activity may affect choice of calving areas, there is considerable natural variation in where calving occurs without human intervention (Valkenburg and Davis 1986).

Although aerial surveys of radio-collared females conducted between 1978 and 1987 indicate that parturient females ready to birth calves can be displaced by road systems (Cameron et al. 1992), more recent analysis suggests that calving and adult caribou distribution is not strongly influenced by the presence of the Milne Point Road (Noel et al. 2004). In the 1992 study, 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. A Noel et al. (2004) study of recent post-road calf densities reported that densities within 1 km of the Milne Point Road were higher than intervals farther from the road. In addition, the densities of all caribou were not lower closer to the road than at greater distances, as reported by other researchers. Roads without adjacent pipelines with heavy levels of vehicle traffic appear to impede caribou movement (Cronin et al. 1994).

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 and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field.

iii. Effects of Pipelines

Cronin et al. (1994) have found that caribou readily cross under elevated pipelines under most conditions. Elevated pipelines with adjacent roads with less than five vehicles per hour showed similar movement by caribou as areas with no vehicle traffic. Elevated pipelines and adjacent roads with moderate to heavy levels of vehicle traffic have been shown to impede caribou movements. Buried pipelines allow free passage of caribou. Noel et al. (2004) found that pipelines do not delay caribou travel to the coast.

Above-ground pipelines can restrict caribou movement and deter them from seeking preferred habitat unless provisions are made to allow for their free passage. It was found that pipelines elevated at least 5 ft allow for effective crossing by caribou, except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles per hour) (Cronin et al. 1994). Facilities and pipelines built earlier in the development of the Arctic oil fields and the Trans-Alaska Pipeline System likely created impediments to caribou movements (Shideler 1986). Group size of caribou affects the success of crossing linear structures, with larger groups showing lower success in crossings than do smaller groups (Shideler 1986). Flow and gathering pipelines were elevated only 1 to 4 ft above the ground, effectively barring caribou from 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, where elevating pipelines to a minimum of 5 ft above ground, and separating pipelines from roads with traffic, have allowed caribou to move freely through the oil field.

iv. Caribou Behavior for Insect Relief

The movements and behavior of caribou are strongly influenced by mosquitoes and flies. Caribou are harassed by mosquitoes (Aedes spp.) from late June to late July, and by oestrid flies (Hypoderma tarandi and Cephenomyia trompel) from mid-July through August (Ballard et al. 2000, Truett and Johnson 2000, citing to Dau 1986; Pollard et al. 1996). To escape mosquitoes, caribou move from inland feeding areas to windswept, vegetation free coastal areas, where they rely on various coastal habitats for relief from insect pests (White et al. 1975; Dau and Cameron 1986).

A variety of natural land features are used by caribou for insect relief (Roby 1978; Dau and Cameron 1986; Pollard et al. 1996, Ballard et al. 2000, citing to Pollard et al. 1996). Flies are less tolerant of shade, so when oestrid flies dominate, caribou favor shade created by industrial buildings and pipelines (Ballard et al. 2000; Murphy and Lawhead 2000). Gravel pads are also favored habitat for relief from both mosquitoes and flies (Ballard et al. 2000; Murphy and Lawhead 2000). Researchers found that ambient air temperatures were lower, wind speeds higher, and poor insect cover habitat likely made mosquitoes less abundant on gravel pads than on the tundra (Pollard et al. 1996).

v. Effects of Seismic Activities and Wells

A study in Alberta, Canada found that seismic lines did not act as barriers to caribou, and that roads were semi-barriers to animal movements. Maximum animal avoidance

distances from well sites were reported to be 1,000 m, and avoidance distances from seismic lines and roads were 250 m (Dyer 1999).

vi. Effects of Aircraft Traffic

Caribou can be briefly disturbed by low flying aircraft, which can result in disruption of habitat use, with highly variable animal reactions, ranging from none to violent escape. Reactions depend upon distance from human activity; speed of approaching disturbance source; altitude of aircraft; frequency of disturbance; sex, age, and physical condition of the animals; size of caribou group; and season, terrain, and weather. Caribou in some herds appear to be habituated to aircraft; other herds respond with panicked running. Flights greater than 2,000 ft above sea level (asl) during calving, and flights greater than 1,000 ft asl at other times appears to cause little or no caribou reaction (Shideler 1986). In contrast, Calef et al. (1976), stated that during the spring and fall migrations, caribou react to aircraft flying less than 200 ft in altitude, and that above this height, disturbances were observed in less than 20 % of all groups observed. They also found that during calving, there were strong panic and escape animal behaviors during overflights of less than 500 ft height (Calef et al. 1976). Panic reactions can cause animals to collide and injure themselves, with young calves being particularly susceptible to injury (Calef et al. 1976).

vii. Summary of Effects on Caribou

Caribou herds of Alaska's North Slope have grown considerably during the period of oil field development, but researchers disagree about the impact of industry activity on caribou populations. Still, research indicates that caribou can accommodate and habituate to most oil field activities, although questions remain regarding the impact of high intensity or frequent disturbances (Murphy and Lawhead 2000, citing to Curatolo and Murphy 1986, 1987). Based upon comparisons with other herds, there have been no apparent effects of oil field development on the growth of the Central Arctic herd. 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).

2. Mitigation Measures and Other Regulatory Protections

Mitigation measures in this written finding, along with regulations imposed by other state, federal and local agencies, will mitigate potential negative cumulative effects of the disposal and subsequent activities on bird and wildlife populations and terrestrial habitats of the area.

Mitigation measures address negative cumulative effects by requiring that activities and infrastructure minimize negative effects. For example, negative effects from disturbances caused by construction, seismic surveys, and other on-the-ground activities can be mitigated with appropriate measures, such as road edge management, containment of water run-off, and siting roads to minimize habitat fragmentation and loss (Spellerberg and Morrison 1998).

Other regulatory agencies already have in place many protective measures with which Ahtna, Inc. must comply. For example, standard DMLW land use permit conditions protect surface habitat from damage by vehicles and other disturbances, and from garbage and foreign debris. DEC requirements also protect wildlife, birds, and terrestrial habitats from solid wastes, and many DEC requirements address handling, spills, and contingency plans for oil and gas and other hazardous substances. Ahtna, Inc. must also comply with the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald Eagle Act of 1940, all

of which provide broad protections to birds from potential effects of oil and gas activities. See Chapter Seven for an overview of protections offered by other regulatory agencies.

In addition to the requirements of other agencies, this written finding includes mitigation measures that will further protect the habitats and bird and wildlife populations of the area. By specifying how exploration activities must be supported, and how roads, gravel mining sites, facilities, and pipelines must be sited, mitigation measures address habitat loss avoidance; protection of wetland and riparian habitats; disturbance avoidance; and free passage and movement of wildlife. Through seasonal and location restrictions, mitigation measures also protect moose and caribou calving and wintering areas, trumpeter swan nesting and fall staging areas, and other important waterfowl habitat. A suite of mitigation measures protects bears and will help minimize human-bear interactions. Mitigation measures also address negative effects from unintended discharges of fuel and hazardous substances by specifying how they must be stored and transferred, and how equipment must be stored and maintained.

A complete listing of mitigation measures is found in Chapter Nine.

C. Freshwater Habitats and Fish

This section considers and discusses potential cumulative effects on freshwater habitats and fish. First, an overview of the general types of activities that could occur in freshwater and the corresponding potential effects are considered and discussed. Next, potential effects resulting from unintended occurrences such as gas blowouts, oil spill releases, and drilling waste releases, are considered and discussed.

1. Potential Cumulative Effects

a. Construction and Other General Activities

Potential effects of unregulated general construction activities could include degradation of stream banks and erosion; reduction of or damage to overwintering areas; habitat loss due to gravel removal; high impact facility siting; effects due to water removal; siltation; impediments to fish passage and migration; and fish kills due to oil spills or freshwater habitat contamination. Excavation of gravel construction materials can disturb floodplains and habitats. Construction activities can also cause erosion of river banks, siltation, bottom substrate disturbance, reduced water volumes, altered water quality, barriers to fish passage, and elimination of habitat (Hanley et al. 1983).

Erosion is a potential impact of all phases of exploration and development. If activities associated with oil and gas exploration and development, such as gravel removal, heavy equipment operations, and siting of support facilities, are unregulated, they could increase stream sedimentation and erosion, impede fish passage, alter drainage patterns, and have other negative effects on freshwater habitats, fish, and other aquatic organisms (Schneider 2002). Erosion can increase sedimentation and turbidity of aquatic habitats, which can cause decreased primary production, resulting in depleted food for zooplankton, insects, freshwater mollusks, and fish. This can lead to direct mortality, reduced physiological function, and depressed growth rates and reproduction in aquatic organisms (Henley et al. 2000). Excess turbidity and sedimentation can also decrease recreation value (USGS 2008).

A potentially limiting factor for fish populations in extremely cold environments is overwintering habitat. Removal of water from lakes, ponds and rivers where fish overwinter may affect the viability of overwintering fish, and longer-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. Water depths of 7 ft or more are considered the minimum for supporting overwintering freshwater fish (ConocoPhillips Alaska Inc. 2010). Oxygen depletion, caused by overcrowding or over-demand by biological and chemical processes, can result in fish mortality (Schmidt et al. 1989; Reynolds 1997).

The construction of roads across rivers and streams may also affect the ability of fish to reach habitat and overwintering areas by blocking movement and causing direct loss of overwintering habitat. Blockage of movement could also occur from the improper installation of culverts and fish crossings in streams for permanent roads. The blockage of passage, siltation of streams and destruction of spawning habitat were the main problems associated with construction of fish passage crossings along the Trans-Alaska Pipeline System (Gustafson 1977).

b. Seismic Surveys

The principle impacts to freshwater habitats attributed to seismic surveys involve the acoustic energy pulses emitted by airguns. Seismic surveys typically cover a relatively small area and only stay in a particular area for hours, thereby posing transient disturbances. The airgun firing overpressures the water, and the fish react to the airgun, where fish immediately swim in an intense effort to flee from the sound. A number of studies have investigated the effects of seismic surveys on fish.

In a study conducted in the Sagavanirktok River, broad whitefish were first observed in their natural state and were sedentary and showed minimal movement. When an airgun was fired in close proximity, the broad whitefish fled the immediate area, and after 2 minutes slowed their swimming speed, and were observed to school as a group back at the original water location (Morris and Winters 2005). Repeated firing of the airgun revealed that this pattern was consistent, and fish returned to a sedentary posture at the original water location each time. The authors concluded that there was little evidence that energy from the airguns harmed the fish observed (Morris and Winters 2005). In a related study, the internal conditions of the fish were assessed after airgun firing to observe any organ damage that may have occurred from the disturbance. In another study, airguns were fired in close proximity to Arctic char within a flooded gravel pit at Duck Island mine site on the North Slope. Results showed that no fish deaths occurred as a direct result of airgun noise, no bleeding of the gills was noted, but internal injuries were observed in some fish. No swim bladder damage was observed. Eye injuries were noted at rates ranging from 0.009 to 0.07, and body tissue injuries were noted at rates ranging from 0.06 to 0.12 in the fish. Fish eye injury was the injury with the highest frequency occurrence (Morris and Winters 2005).

Popper et al. (2005) measured the effects of seismic airgun firing on broad whitefish and found that the firing of airguns had no apparent effect on hearing. The results also showed that the lake chub species experienced only temporary hearing loss, and hearing of northern pike returned after 18 hours.

In a study of a rocky reef off Scotland, fish response from seismic airguns showed minor behavioral responses to airgun emissions. The researchers found there were no permanent changes in behavior, and no fish appeared to leave the reef habitat. There were no indications of observed damage to the reef animals (Popper and Hastings 2009, citing to Wardle et al. 2001). It should be noted that these studies occurred in marine waters, which are not present in the study area.

Vessel traffic in rivers may disturb some fish resources and their habitat during operations. However, vessel noise is usually transient. Fish in the immediate vicinity of such vessels

are believed likely to avoid such noise perhaps by as much as several hundred meters. Adverse effects from seismic activities to the migration, spawning, and hatchling survival of fish most likely would be temporary and localized (MMS 2007).

c. Discharges from Exploration, Development, and Production

i. Gas Blowouts

If a natural gas blowout occurs the initial explosion and possibility of fire are possible hazards, and vapors may migrate downwind. Blowouts can also cause a toxic cloud of hydrogen sulfide that accumulates close to the ground (Van Dyke 1997). Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations.

ii. Oil Spills

Oil spills could range from small chronic leaks from equipment or facilities to catastrophic pipeline failures or, however unlikely, a blowout. The effects of oil spills on fish habitats would depend on many factors, including the time of year, size of the spill, and water body affected.

Fish can be impacted by oil uptake by the gills, ingestion of oil or oiled prey, and disruption of access to and changes to habitats (USFWS 2004). The impacts of the toxins in oil to freshwater invertebrates and fish are of concern (Jorgenson and Cater 1996). Potential adverse effects include direct uptake of oil by the gills, ingestion of oil, ingestion of oiled plankton or prey, effects on survival of eggs and larvae, and ecosystem changes in freshwater habitats. Adult fish may be affected by reduced growth, enlarged livers, heart and respiration rate changes and effects to reproduction. Due to toxic compounds in oil, spawning success may be reduced, and mortality of eggs and larvae could occur in spawning or nursery areas. Floating oil can also affect plankton, such as algae, fish eggs and invertebrate larvae (USFWS 2004). Sublethal effects may also reduce fitness and impair an individual's ability to endure environmental stress. The long term effects to ecosystems impacted by oil spills due to persistence of toxic substances and chronic exposures may continue to affect wildlife (Peterson et al. 2003).

Some of the freshwater habitats that were affected by the Exxon Valdez oil spill in 1989 were evaluated relating to the adverse effects of oil on pink salmon embryos in the streams impacted by the spill. Bue et al. (1998) found that there was a significant embryo mortality rate from 1989 to 1993, but this elevated mortality rate was not repeated in 1994 or 1995. Bue et al. (1998) concluded the elevated embryo mortality was either caused by the toxicity of persisting oil or their germ lines were damaged from exposure to oil. The study was based on observational data and Bue et al (1998) did not definitively prove oil was the cause.

Research about the effects of oil to embryos in freshwater habitats demonstrated that water borne oil can kill pink salmon embryos downstream from oil sources. It was also found that the effects were varied, and that there was a potential for sublethal effects due to exposure to oil to impact fish later in their lifecycle (Heintz et al. 1999). The findings of a study to assess the delayed effects of crude oil in freshwater environments on pink salmon showed that there may be a relationship between impacts experienced by embryos exposed to crude oil and the long term survival rate of fish in the marine environment. Pink salmon exposed to crude oil as embryos had a 15 % decrease in marine survival as compared to unexposed salmon (Heintz et al. 2000).

iii. Releases of Drilling Muds and Produced Water

Unregulated releases of drilling muds, cuttings, produced waters, and other effluents from oil and gas exploration, development, and production can have short- and long-term negative effects on aquatic life, including fish and benthic organisms (Olsgard and Gray 1995). Lethal or sub-lethal effects may subtly reduce or impair physiological and reproductive fitness (Davis et al. 1984). Type and extent of effects depends on a myriad of factors including habitat involved, species, life history stage, migration patterns, nursery areas, season, type of chemical, amount and rate of release, time of release, duration of exposure, measures used for retaining of the chemical, and use of counteracting or dispersing agents (Davis et al. 1984).

Common drilling fluids contain water, clay, and chemical foam polymers. Drilling additives may include petroleum or other organic compounds to modify fluid characteristics during drilling (National Driller 2010). Releases to water environments that have concentrations above the concentration considered acceptable for aquatic life could cause toxic conditions (Woodward et al. 1988). Significant accumulation of drilling mud in wetlands can potentially impact benthic habitats and can blanket fish spawning grounds (Schmidt et al. 1999, citing to Falk and Lawrence 1973; and citing to Friedheim; Sprague and Logan 1979). Some research shows that bentonite mud may increase and improve the water holding capacity of soil (Schmidt et al. 1999, citing to Luginbuhl 1995). Suspended solids in aquatic habitat can have adverse effects on egg and larval development of amphibians (Schmidt et al. 1999, citing to Richter 1995). Produced waters may contain hydrocarbon and chemical constituents in volumes that may be toxic to microorganisms and mysid shrimp (Mysidopsis bahia) (Brown et al. 1992).

d. Groundwater

Activities from oil and gas exploration, development, and production may have cumulative effects on groundwater in the study area. Water use from groundwater wells may be required for the construction and maintenance of ice roads and pads, for blending drilling muds in drilling activities, and for potable and domestic water uses at drilling camps (NRC 2003; Van Dyke 1997). Industrial use of groundwater could draw down the elevation of the water table in the vicinity of the industrial well or wells, and could affect nearby domestic well water depths. These effects are usually insignificant and temporary as other hydraulically connected groundwater sources replace pumped volume.

Byproducts of drilling and production activities include muds and cuttings, produced water, and associated wastes. Improper disposal or accidental releases of drilling muds, cuttings, produced waters, and other effluents from oil and gas exploration, development, and production could have short- and long-term negative effects on water resources. Cumulative impacts from exploration and development activities may affect water quality.

Technological advances in drilling mud systems have developed mud systems less toxic to the environment. Newer synthetic-based muds are formulated from synthetic organics base fluids. They produce even less waste, improve drilling efficiency, are reusable, and have advantages in environmental protection over oil or water-based muds. Synthetic muds can be reconditioned instead of discharged as waste (Wojtanowicz 2008).

Produced water contains naturally occurring substances such as clay, sand, oil, water, metals, and gas. These substances are found in the subterranean strata. Produced waters are usually saline with some level of hydrocarbons and naturally occurring solids and bacteria. They may also contain chemicals added to inhibit corrosion, as well as emulsifiers, coagulants, flocculants, clarifiers and solvents. Produced waters from gas production also can include

condensed water, dehydration chemicals, hydrogen sulfide removal agents and chemicals that inhibit formation of hydrates (Veil et al. 2004). Produced waters may contain hydrocarbon and chemical constituents in volumes that may be toxic to microorganisms and mysid shrimp (Mysidopsis bahia) (Brown et al. 1992).

Associated wastes are other production fluids such as tank bottom sludge, well work-overs, gas dehydration processes, tank wastewater, and other residues that are considered non-hazardous (low-toxicity) by the EPA.

Most drilling wastes from onshore operations are disposed of under Alaska Department of Environmental Conservation's (DEC) solid waste disposal program. DEC administers the oil and gas reserve pit closure program (18 AAC 60.200), for sites that previously used an on-site holding pit for drilling waste fluids. Re-injection is the preferred method for disposal of drilling fluids. Disposal of drilling muds and cuttings requires permit approval. Most oil field wastes are considered non-hazardous and waste fluids are recycled, filtered, and treated before reinjection or disposal. Cuttings and waste fluids must be made non-hazardous before injection. Produced water is treated using heat, gravity settling, and gas flotation devices to remove hydrocarbons. After treatment, produced water is reinjected into either the oil-bearing formation to maintain pressure and enhance recovery or into an approved disposal well. Cuttings disposal is done through grinding and injecting on-site, or cuttings are transported to an approved disposal site. Cuttings disposal can cost more than the total cost to drill a well. Wastewater, including sanitary and domestic graywater, is also treated to meet effluent guidelines before discharge. All disposal wells inject fluids deep beneath any drinking water aquifers.

The AOGCC functions as the regulatory agency overseeing the underground operation of the Alaska oil industry on private and public lands and waters, and ensures proper and safe handling and disposal of drilling wastes. AOGCC administers the Underground Injection Control (UIC) Program for oil and gas Class II wells, acts to prevent waste of oil and gas resources and ensures maximum recovery, and protects subsurface property rights.

2. Mitigation Measures and Other Regulatory Protections

Mitigation measures in this written finding, along with regulations imposed by other state, federal and local agencies, will mitigate potential negative cumulative effects of the disposal and subsequent activities on fish and aquatic habitats of the area, including groundwater.

Other regulatory agencies already have in place many protective measures with which Ahtna, Inc. must comply. For example, potential negative effects on aquatic habitats and fish populations are minimized through DMLW's authorization process for water usage in which DMLW considers water rights of other persons, local demand, lake bathymetry, species of fish present, and the public interest. Before an authorization is granted, applicants may be required to conduct aquifer yield studies. Permits may contain stipulations on the use and quantity of water to protect recreation activities, navigation, water rights, or any other substantial public interest. Water use may also be subject to conditions, including suspension and termination of exploration activities, in order to protect fish and wildlife habitat, the public health, or the water rights of other persons.

Disposal and discharge of oil, hazardous substances, and wastewater into water bodies is already highly regulated by DEC, offering significant existing protection to aquatic habitats and fish populations. Other DEC requirements also protect fish and aquatic habitats from solid wastes through requirements that address handling, spills, and contingency plans for oil and gas and other hazardous substances.

ADF&G protects aquatic habitats and fish populations through its permitting requirements for any work that would affect an anadromous fish stream or that might block fish passage. Aquatic habitats and fish populations are also protected by DMLW land use permits and gravel contracts which specify how surface activities must be conducted to avoid changing the character of, polluting, or introducing silt and sediment into streams, lakes, ponds, water holes, seeps, and marshes, and to avoid disturbing fish resources.

See Chapter Seven for an overview of protections offered by other regulatory agencies. In addition to the requirements of other agencies, this written finding includes mitigation measures that will further protect aquatic habitats and fish populations of the area. To protect riparian areas, buffers are required along all fish-bearing streams and surface drinking water sources, and wide buffers are required along several rivers and creeks that are particularly important for aquatic habitat and fish. Habitat and fish passage are protected, and disturbances are avoided, by specifying how roads, gravel mining sites, facilities, and pipelines must be sited.

A complete listing of mitigation measures is found in Chapter Nine.

D. Air Quality

1. Potential Cumulative Effects

Oil and gas activities may produce emissions that potentially affect air quality. Gases may be emitted to the air from power generation, flaring, venting, well testing, leakage of volatile petroleum components, supply activities, shuttle transportation boilers, diesel engines, drilling equipment, flares, glycol dehydrators, natural gas engines and turbines, and fugitive emissions, which are leaks from sealed surfaces associated with process equipment (MMS 2004a, b; Arctic Council 2009).

On-road and off-road vehicles, heavy construction equipment, and earth-moving equipment could produce emissions from engine exhaust and dust. Sources of air emissions during drilling operations include rig engines, camp generator engines, steam generators, waste oil burners, hot-air heaters, incinerators, and well test flaring equipment. Emissions could 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. Emissions could also be produced by engines, turbines, and heaters used for oil/gas production, processing, and transport. In addition, aircraft, supply boats, personnel carriers, mobile support modules, as well as intermittent operations such as mud degassing and well testing, could produce emissions (MMS 2008).

Other sources of air pollution include evaporative losses of volatile organic compounds from oil/water separators, tanks, pump, compressor seals, and valves. Venting and flaring could be an intermittent source of volatile organic compounds and sulfur dioxide (MMS 2008). Gas blowouts, evaporation of spilled oil, and burning of spilled oil may also affect air quality. Should a gas or oil blowout ignite, a light, short-term coating of particulates could be deposited over a localized area. (DEC et al. 2008).

Loading operations may result in emissions caused when vapor space in the receiving cargo hold is displaced by the liquid product. Emissions may include carbon monoxide (CO); nitrogen oxides (NOx); sulfur dioxide (SO2); particulate matter-10 (PM10), PM2.5; volatile organic compounds (VOC); ozone (O3); and greenhouse gases including carbon dioxide (CO2), methane (CH4), and nitrous oxide (N20) (MMS 2004b).

The volume of 2002 emissions from the large stationary sources within the oil and gas industry in Alaska was 15.26 million metric tons of gross carbon dioxide equivalent. This is estimated as 7 % of the total Title V large source emissions reported, and about 29 % of all reported emissions in Alaska (DEC 2008). The Alaskan overall oil and natural gas industry historical trend projection for emissions was an estimated 3.0 million metric tons of greenhouse gases statewide in 2005, contributing about 6 % of the state's total greenhouse gas emissions (Roe et al. 2007). This is a projected decrease from 1990 and 2000, and continued decreases are expected through 2020. These estimates are for fugitive emissions, including methane and carbon dioxide released from leakage and venting at oil and gas fields, processing facilities, and pipelines. Estimates of emissions resulting from fuel combustion are only available for residential, commercial, and all industries combined, and are not available for the oil and gas industry separately. For this reason, there are significant uncertainties with these estimates (Roe et al. 2007).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities could potentially affect air quality, federal and state air quality regulations, particularly the Clean Air Act (42 USC §§ 7401-7671), 18 AAC 50, AS 46.03, and AS 46.14, will mitigate those potential effects. Therefore, additional mitigation measures are not included in this written finding because air quality regulations are under the jurisdiction of DEC.

Because industrial emissions such as those listed above can have negative environmental effects, the federal Clean Air Act of 1970 and subsequent amendments regulate air quality across the U.S., including in Alaska (EPA 2010). Although the EPA is the primary federal agency responsible for controlling air pollution, monitoring air quality, and inspecting facilities (EPA 2010), many of these authorities in Alaska have been delegated to DEC under a federally-approved State Implementation Plan (DEC 2010b). State and federal regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit: new facilities are required to obtain a permit before construction (Title I, NSR permit); existing facilities must have an operating (Title V) permit (DEC 2010a). Permits are legally binding and include enforceable conditions. The permit limits the type and amount of emissions and requires pollution control devices, prevention activities, monitoring, and record keeping.

DEC also operates ambient air quality monitoring networks under the provisions of the Prevention of Significant Deterioration Program to assess compliance with the NAAQS for: carbon monoxide, particulates, nitrogen dioxide, sulfur oxide, and lead; assesses ambient air quality for ambient air toxics level; provides technical assistance in developing monitoring plans for air monitoring projects; and issues air advisories to inform the public of hazardous air conditions (DEC 2010b).

Operators in Alaska are required to minimize the volume of gas released, burned, or permitted to escape into the air (20 AAC 25.235(c)). Operators must report monthly to AOGCC any flaring event lasting over an hour. AOGCC investigates these incidents to determine if there was unnecessary waste (AOGCC 2004).

In-situ burning of spilled oil must be pre-approved by DEC and EPA and/or the U.S. Coast Guard (DEC et al. 2008). Controlled in-situ burning of spilled oil is only allowed if it is located a safe distance from populated areas. Approved burn plans require removal of particulates.

Additional information about air quality regulations and permits is found in Chapter Seven.

E. Subsistence Uses

1. Potential Cumulative Effects

Potential oil and gas activities that could have cumulative effects on subsistence uses of the study area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production.

Subsistence uses of the study area depend on the area's fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and transportation on the area's fish, wildlife, and habitats could also affect subsistence uses. Potential cumulative effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on subsistence uses are discussed below.

Oil and gas activities could result in increased access to hunting and fishing areas. For example, in other areas of Alaska, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for Tyonek and Beluga residents in the Cook Inlet area, who travel to subsistence areas primarily by truck (Braund 2007). However, increased public access to hunting, fishing, and trapping areas due to construction of new roads could also increase competition between user groups for fish and wildlife resources. Roads can also raise concerns among subsistence users that increased traffic is affecting distribution of wildlife (Braund 2007).

Oil and gas activities can raise other concerns among subsistence users. For example, Tyonek and Beluga residents have expressed concerns that disturbance from oil rigs has contributed to decline in beluga and seals; that pollution from oil rigs has resulted in fish diseases and declines in clam abundance; and that oil development has changed bear distribution and waterfowl habitat (Braund 2007). However, independent research corroborating these concerns is not always available.

A major oil spill could decrease resource availability and accessibility, and create or increase concerns about food safety which could result in significant effects on subsistence users, effects which could linger for many years. For example, subsistence harvests of fish and wildlife by residents of fifteen predominately Alaska Native communities, as well as by residents in larger rural communities, declined by as much as 70 % after the 1989 Exxon Valdez oil spill (Fall 1999). Within two years of the spill, subsistence harvests and participation had returned to pre-spill levels, although communities closest to the spill lagged behind. However, concerns remained about food safety, availability of many species was reduced, efficiency was reduced, and opportunities to teach subsistence skills to young people were lost (Fall 1999). By 2003, harvest levels were higher than pre-spill levels, or were within the range of other rural communities. However, harvest composition remained different from the pre-spill composition, and concerns about the safety of some shellfish species remained (Fall 2006). There is limited information available on whether, after an oil spill, spatial redistribution of a species affects harvest and the time required to for a successful hunt (NRC 2003).
Additional complex factors may confound effects of an oil spill, including demographic changes in communities, increased competition for fish and wildlife resources by other user groups, predators, and increased awareness about other contaminants (Fall 2006). Because many subsistence resources affected by the spill had not fully recovered, subsistence in areas affected by the Exxon Valdez oil spill was still not considered to have fully recovered in 2006 (EVOSTC 2006) .

Although the oil and gas industry has the potential to provide jobs and income to subsistence users, work in the oil and gas industry may reduce the time available for subsistence activities (Stanek et al. 2007; EDAW/AECOM 2007). Some studies have found that "higher levels of household cash income were directly correlated with peoples' commitment to, and their returns from, natural resource harvesting" (EDAW/AECOM 2007, citing to Kruse 1986, and to National Research Council 1999). Other studies have shown that young men in Inupiaq communities balance wage employment with seasonal subsistence activities, even when there are large numbers of high paying job opportunities (EDAW/AECOM 2007, citing to Kleinfeld et al. 1983). The availability of time-saving technologies, such as ATVs, snow machines, and outboard motors, has counter-balanced decreased availability of time, and "cash derived from wage employment did not replace subsistence but underwrote it" (EDAW/AECOM 2007, citing to Lonner 1986).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities could potentially affect subsistence uses, primarily as secondary effects from effects on habitat, fish, or wildlife, mitigation measures in this written finding, along with regulations imposed by other state, federal and local agencies, are expected to mitigate those potential effects.

In addition to the mitigation measures in this written finding that address fish, wildlife, and habitat, other mitigation measures protect subsistence uses of fish, wildlife, and birds by specifically addressing avoidance of harvest interference, and public access. In addition, a plan of operations must include a training program to inform the persons working on the project of environmental, social, and cultural concerns.

A complete listing of mitigation measures is found in Chapter Nine.

F. Sport, Personal Use, and Commercial Fishing, and Hunting

1. Potential Cumulative Effects

In addition to subsistence, other important uses of fish and wildlife populations in the study area include sport, personal use and commercial fishing; and sport hunting. Potential oil and gas activities that could have cumulative effects on these uses of the area include seismic surveys, discharges from well drilling and production, construction of road and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production.

Sport, personal use, and commercial fishing and hunting in the study area depend on the area's habitats for wildlife and fish. Therefore, potential cumulative effects from oil and gas activities on the area's terrestrial and freshwater habitats and fish and wildlife populations could also affect these uses. Potential effects to the area's habitats and fish and wildlife populations are discussed in the preceding sections.

Oil and gas activities could result in increased access to hunting and fishing areas. For example, as discussed above, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for the Cook Inlet area (Braund 2007), which would likely be true for sport hunting and fishing user groups in other areas of Alaska as well. However, increased public access to

hunting and fishing areas due to construction of new roads could also increase competition between user groups for wildlife and fish resources.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities could potentially have cumulative effects on uses of wildlife and fish populations, such as sport hunting and fishing, primarily as a result of secondary effects from effects on habitats, wildlife or fish. Mitigation measures in this written finding, along with regulations imposed by other state, federal and local agencies, will mitigate those potential effects. In addition to mitigation measures addressing habitats, wildlife, and fish, other mitigation measures specifically address access and harvest interference avoidance.

A complete listing of mitigation measures is found in Chapter Nine.

G. Historic and Cultural Resources

1. Potential Cumulative Effects

The exploration study area has documented occurrences of historical and cultural resources. The potential impacts to these resources may be from accidental oil spills, erosion and vandalism (Dekin et al. 1993).

Potential impacts and disturbance to historic and cultural resources could be associated with exploration activities, installation, and operation of oil and gas facilities, including drill pads, roads, airstrips, pipelines, processing facilities, and any other ground disturbing activities. Damage to archaeological sites may include: direct breakage of cultural objects; damage to vegetation and the thermal regime, leading to erosion and deterioration of organic sites; shifting or mixing of components in sites resulting in loss of association between objects; and damage or destruction of archeological or historic sites by oil spill cleanup crews collecting artifacts (USFWS 1986).

Effects on archaeological resources from an oil spill are uncertain. However, during the Exxon Valdez oil spill and subsequent cleanup activities, the greatest effects to cultural resources came from vandalism and direct disturbance during cleanup activities (Bittner 1996) . Oil spills may also have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon C-14 dating methods (USFWS 1986).

2. Mitigation Measures and Other Regulatory Protections

Various mitigation measures used to protect archaeological sites during oil spill cleanups include avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, artifact collection, and cultural resource awareness programs (Bittner 1996).

Because historic and cultural resources are irreplaceable, caution is necessary in order to not disturb or impact them. AS 41.35.200 addresses unlawful acts concerning cultural and historical resources. It prohibits the appropriation, excavation, removal, injury or destruction of any state owned cultural site. In addition, all field based response workers are required to adhere to historic properties protection policies that reinforce these statutory requirements, and to immediately report any historic property that they see or encounter (AHRS 2010).

Although oil and gas activities could potentially have cumulative effects on historic and cultural resources, mitigation measures in this written finding, along with regulations imposed by other state, federal and local agencies, will mitigate those potential effects. Additional mitigation measures in this written finding address education and protection of historic and archeological sites.

A complete listing of mitigation measures is found in Chapter Nine.

H. Fiscal Effects

This section considers and discusses the fiscal effects, both statewide and local, of licensing activities, as required by AS 38.05.035(g)(1)(B)(ix). Licensing and subsequent activity may generate income for state government, with some possible fiscal benefits including increased revenue sharing, creation of new jobs, and indirect income multiplier effects. Fiscal effects may be statewide and local.

1. Statewide Effects

Alaska's economy heavily depends on revenues related to oil and gas production and government spending resulting from those revenues. Oil and gas revenues fund education and the state's operating and capital budgets.

The primary source of state revenues is North Slope oil production, although oil and gas are also produced from Cook Inlet. In FY 2012, oil and gas revenues totaled $9.9 billion and comprised approximately 93 % of the state's general fund unrestricted revenue. The Alaska Department of Revenue (DOR) forecasts FY 2013 oil revenue at $8.0 billion and the forecast for FY 2014 is $7.3 billion (DOR 2013). However, North Slope and Cook Inlet production are declining. Alaska North Slope production peaked at 2.006 million barrels per day in FY 1988, declining to 0.579 million bbls per day in FY 2012 (DOR 2013). DOR anticipates volumes will decline by 4.5 % in FY 2013 to about 0.553 million bbls per day, declining further to 0.538 million bbls per day in FY 2014. Cook Inlet oil fields produced 0.011 million bbls per day in FY 2012 and have an FY 2013 projection of producing 0.010 million bbls per day (DOR 2013).

If a discovery is made, this project will contribute to state revenues. The level of that contribution is unknown and will depend on many factors. In comparison to the state's total revenue from oil and gas activities, revenue from Ahtna's exploration license is expected to be small. However, even relatively small discoveries that can contribute to the energy needs of a village or community could relieve the state of providing energy subsidies to some extent.

The exploration license may provide other long-term contributions to the state's fiscal wellbeing. Exploration licensing supplements the state's long-standing conventional oil and gas leasing program for areas such as the North Slope and Cook Inlet, by targeting areas outside known oil and gas provinces. The intent of licensing is to encourage exploration in areas far from existing infrastructure, with relatively low or unknown hydrocarbon potential, where there is a higher investment risk to the operator. Through exploration licensing, the state receives valuable subsurface geologic information on these regions regardless of whether revenue is ever generated. Further, because the upfront capital for obtaining an exploration license is generally less than for obtaining leases, new, smaller companies may be encouraged to begin operating in Alaska. And, even relatively small successes can spur additional activity and investment in exploring and developing Alaska's oil and gas resources.

2. Local Effects

Most of the communities discussed in Chapter Three are in an unincorporated area of the state, and none are individually incorporated as municipalities under state law. Unlike incorporated municipalities such as the North Slope and Cook Inlet, royalties, rents, license fees, and other revenues generated by licensing or oil or gas production in the unincorporated portion of the study area will not directly return to the area unless a municipal government entity is established in the unincorporated area. If incorporated, the revenues from oil or gas production could fund education, health, and public safety programs, and transportation system improvements throughout the study area. Additionally, local incorporated municipalities may generate significant revenue through property taxes on infrastructure required for oil and gas development and production.

Relative to other fiscal effects, economic activity associated with oil and oil or gas exploration, development, and transportation may increase other economic activity in the study area, but benefits to the economies of the local communities may be smaller than for the larger state economy. In rural Alaska communities, where there are typically smaller economies, the multiplier is 1.3. The economic multiplier associated with dollars injected into a community depends upon the size of the local market. A small market means the multiplier is small and most of the money that comes into the community leaves almost immediately in the purchase of goods and services somewhere outside the community (Colt et al. 2003).

I. Effects on Communities

The following sections describe the potential effects of activities associated with oil and gas exploration, development, and transportation on employment, population, income, utilities, and other resources in the communities of the area.

1. Employment

Oil and gas jobs already in the area include maintenance, inspection, and other activities related to the Trans Alaska Pipeline System (TAPS), which runs along the eastern border of the study area and passes near Glennallen. Ahtna generates employment through its subsidiaries offering pipeline support services. For example, Ahtna Construction performs pipeline maintenance work for the TAPS, provides oil spill response, and conducts mainline integrity investigations. Other lines of business include general highway construction, building construction, electrical and mechanical services, rock crushing, and the sale of processed materials (Ahtna Construction 2013). Residents of the study area would likely benefit from the development of oil or gas resources in the area through increased job opportunities in the oil and gas industry, especially because there is already an oilfield services provider in the area. Other employment directly related to the oil and gas industry could include environmental and wildlife studies, planning and design activities, materials acquisition, facility construction, seismic surveys, drilling, transportation, and logistics. In 2010, the estimated unemployed adults living in area were: Glennallen, 6%; Copper Center, 16%; and Tazlina, 13%. The 2010 estimated population living below the poverty line in the area was: Glennallen, 0%; Copper Center, 24%; and Tazlina, 15% (ADCRA 2013a). The exploration license may create additional employment opportunities in the service, transportation, utilities, and retail sectors of the local economy. Short-term job opportunities could arise during the exploration phase. The long-term employment benefits of the exploration license in the study area will depend on the subsequent production of commercial quantities of oil or gas.

The local labor force may not be able to meet demands for some technical positions. As a result, these jobs may be filled by workers from the service support industry that is active in other regions of the state, or outside Alaska. However, Ahtna and its contractors are encouraged to hire local and Alaska residents to the extent they are qualified and available.

2. Energy Costs

Electricity is provided by Copper Valley Electric Association. Power is generated from several sources: the Solomon Gulch hydroelectric facility (50%), the Cogeneration Project (25%), and the diesel plants in Glennallen and Valdez (25%) (CVEA 2011). A new diesel engine was added to the diesel plant in Glennallen in 2010, adding 2.865 megawatts of capacity to the CVEA system. In 2012, heating fuel cost $4.15 per gal in Glennallen (ADCRA 2013b). Thus a potential effect of a commercially viable oil or gas discovery may result in lower energy costs for residential and commercial users in the area.

3. Access and Land Use

Communities adjacent to exploration activities may experience increased use of transportation systems, such as air charter services, airstrips, or roads, for transportation of personnel or construction equipment. Winter ice and snow roads could be constructed to provide access to more remote areas. Other effects include disturbance due to increased air traffic, machinery noise, and loss of privacy due to the presence of project workers. The extent of these effects depends on the size of exploration projects and the proximity of facilities, and utility, pipeline, and transportation corridors to the affected community.

These effects may interfere with land estate owners in the area use of their property. Some portions of the area could be developed from existing roads or access routes; however, much of the acreage is remote from existing infrastructure. Currently, oil and gas industry infrastructure is limited to the TAPS corridor. Some use of existing roads and trails may occur during exploration license activities.

4. Mitigation Measures

Although oil and gas activities could potentially have negative effects on local communities, mitigation measures in this written finding, along with regulations imposed by other state, federal and local agencies, will mitigate those potential effects.

Many regulations already protect local communities. For example, state regulations require Ahtna, Inc. to contact the surface owner of lands where activities are proposed and to make a good faith effort to negotiate a surface use agreement. If agreement cannot be reached, Ahtna, Inc. may be required to post a bond. See Chapter Seven for an overview of protections offered by other regulatory agencies.

Additional mitigation measures in this written finding will further protect local communities by not allowing public access within the license area to be restricted or blocked, except in the immediate vicinity of drill sites, buildings, and related facilities.

A complete listing of mitigation measures is found in Chapter Nine.

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Chapter Nine
Mitigation Measures

Agency abbreviations used in this chapter are:

Abbreviation	Agency Name	Abbreviation	Agency Name
ADF&G	Alaska Department of Fish and Game	DO&G	Division of Oil and Gas (DNR)
ADEC	Alaska Department of Environmental Conservation	DPOR	Division of Parks and Recreation
DNR	Alaska Department of Natural Resources	USACOE	U.S. Army Corps of Engineers
DMLW	Division of Mining, Land, and Water (DNR)	USFWS	U.S. Fish and Wildlife Service

To ensure that this disposal is in the state's best interest ((AS 38.05.035(e)), and in approving the exploration phase, operations will be conditioned by mitigation measures found in Section A of this chapter, for those occurring under the license, and in Section B for operations under a lease if Ahtna, Inc. (Ahtna) converts all or a part of the license area into leases. These measures were developed to mitigate potential effects of license- and lease-related activities, considering the information found in the preceding chapters and issues identified during the public comment period. Additional measures may be imposed when Ahtna submits a proposed plan of operations. Ahtna must also comply with all applicable local, state, and federal laws and regulations, as amended.

The director may grant exceptions to these mitigation measures. Exceptions will only be granted upon a showing by Ahtna that compliance with the mitigation measure is not practicable and that Ahtna will undertake an equal or better alternative to satisfy the intent of the mitigation measure. Requests and justifications for exceptions must be included in the plan of operations. Decisions of whether to grant exceptions will be made during the plan of operations review.

A. Exploration Phase Mitigation Measures

1. Facilities and Operations

a. Exploration activities must be supported by air service, an existing road system, ice roads, or by off-road vehicles that do not cause significant damage to the ground surface or vegetation. Construction of temporary drill pads, airstrips, and roads may be allowed.

b. A plan of operations must be submitted and approved before conducting exploration and must describe Ahtna's plans to eliminate or minimize impacts on residential, commercial, and recreational areas, Native allotments and subsistence use areas. At the time of application, Ahtna must submit a copy of the proposed plan of operations to all surface owners whose property will be entered.

c. Permanent facilities will not be constructed during the exploration phase.

d. Impacts to identified wetlands must be minimized to the satisfaction of the director, in consultation with ADF&G and ADEC. Further, certain activities within wetlands require permission from the USACOE.

2. Fish and Wildlife Habitat

a. Before beginning any activities, Ahtna will consult with ADF&G to identify the locations of known bear den sites that are occupied in the season of the proposed activities. Exploration activities started between October 15 and April 30 may not be conducted within one-half mile of known occupied brown bear dens, unless alternative mitigation measures, as described in a bear-human interaction plan, are approved by the director, in consultation with ADF&G. Discovery of an occupied bear den not previously identified by ADF&G must be reported to ADF&G, within 24 hours. Mobile activities will avoid such discovered occupied dens by one-half mile unless alternative mitigation measures, as described in a bear-human interaction plan, are approved by the director in consultation with ADF&G. Non-mobile facilities will not be required to be relocated.

b. The director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of important moose and caribou calving and wintering areas.

c. The director, in consultation with ADF&G, may impose seasonal restrictions on activities located in important waterfowl habitat during the plan of operations approval stage.

d. Surface entry is prohibited within one-quarter mi of trumpeter swan nesting sites between April 1 and August 31. USFWS will identify trumpeter swan nesting sites at Ahtna's request.

e. Aircraft flying over the trumpeter swan fall staging areas at Old Man Lake must maintain a minimum altitude of 1,500 feet above ground level or a horizontal distance of one mile from April 1 to October 31. Human safety will take precedence over this provision.

f. Pesticide use is prohibited in the exploration license area.

3. Subsistence and Sport Harvest Activities

a. License and lease-related use will be restricted if the director determines it is necessary to prevent unreasonable conflicts with subsistence activities. In enforcing this term DO&G, during review of plans of operation, will work with other agencies and the public to identify and avoid potential conflicts. In order to avoid conflicts with subsistence and sport harvest activities, restrictions may include alternative site selection, directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the director.

b. Traditional and customary access to subsistence areas will be maintained unless reasonable alternative access is provided to subsistence users. "Reasonable access" is access using means generally available to subsistence users.

c. Exploratory drilling operations may be restricted during the fall caribou migration

(August 1 through October 31) when caribou are present to allow for subsistence hunting.

d. Exploration activities may be restricted during fall caribou migration (August 1 through October 31).

4. Fuel and Hazardous Substances

a. Ahtna will provide secondary containment for the storage of fuel or hazardous substances. Secondary containment means an impermeable diked area or portable impermeable containment structure capable of containing 110% of the volume of the largest independent container. Double walled tanks do not qualify as secondary containment unless an exception is granted for a particular tank.

b. Containers with a storage capacity larger than 55 gallons that contain fuel or hazardous substances will not be stored within 100 feet of a water body or within 1,500 feet of a current surface drinking water source. Secondary containment shall be provided for the storage of fuel or hazardous substances 55 gallons or more, up to the minimum DEC volume requirements, and comply with 18 AAC 75.065 through 18 AAC 75.075.

c. During equipment storage or maintenance, the site will be protected from leaking or dripping fuel and hazardous substances by the placement of drip pans or other surface liners designed to catch and hold fluids under the equipment, or by creating an area for storage or maintenance using an impermeable liner or other suitable containment mechanism.

d. During fuel or hazardous substance transfer, secondary containment or a surface liner must be placed under all container or vehicle fuel tank inlet and outlet points, hose connections, and hose ends. Appropriate spill response equipment, sufficient to respond to a spill of up to 5 galllons, must be on hand during any transfer or handling of fuel or hazardous substances. Trained personnel will attend transfer operations at all times.

e. Vehicle refueling will not occur within the annual floodplain, except as addressed and approved in the plan of operations.

f. All independent fuel and hazardous substance containers will be marked with the contents and Ahtna's or its contractor's name using paint or a permanent label.

5. Waste Disposal

a. Waste from operations must be reduced, reused, or recycled to the maximum extent practicable. Garbage and domestic combustibles remaining after reuse or recycling must be incinerated whenever possible or disposed at an approved site in accordance with DEC regulations. Proper disposal of garbage and putrescible waste is essential to minimizing attraction of wildlife. Ahtna must use the most appropriate and efficient method to achieve this goal.

b. On-site temporary storage of waste will not be permitted for longer than six months; the operator will exclude people, domestic animals and wildlife from solid waste disposal areas using fencing or other barriers approved by DO&G. Open pit solid

waste storage is not allowed in residential areas. In these areas, solid waste must be stored in a closed container.

c. Wherever practicable, the preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection, as regulated by AOGCC. Other methods of disposal will be allowed only upon approval by the director, in consultation with DEC and ADF&G.

d. New solid waste disposal sites will not be approved or located on state property during exploration license activities. Exceptions may be provided for drilling waste if the facility complies with DEC regulations

6. Access

a. Public access to, or use of, the license area may not be restricted except within the immediate vicinity of drill sites, buildings, and other related facilities. Areas of restricted access must be identified in the plan of operations. Facilities and operations will not be located so as to block access to or along navigable or public waters as defined in AS 38.05.965.

7. Prehistoric, Historic, and Archeological Sites

a. Before the construction or placement of any gravel or other structure, road, or facility resulting from exploration, development, or production activities, Ahtna must conduct an inventory of prehistoric, historic, and archeological sites within the area affected by an activity. The inventory must include consideration of literature provided by nearby communities, Native organizations, and local residents; documentation of oral history regarding prehistoric and historic uses of such sites; evidence of consultation with the Alaska Heritage Resources Survey and the National Register of Historic Places; and site surveys. The inventory must also include a detailed analysis of the effects that might result from the activity.

b. The inventory of prehistoric, historic, and archeological sites must be submitted to the director, and to DPOR Office of History and Archaeology who will coordinate with the local government for review and comment. If a prehistoric, historic, or archeological site or area could be adversely affected by an activity, the director, after consultation with DPOR Office of History and Archaeology, will direct Ahtna as to the course of action to take to avoid or minimize adverse effects.

c. If a site, structure, or object of prehistoric, historic, or archaeological significance is discovered during operations, Ahtna must report the discovery to the director as soon as possible. Ahtna must make reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the director, after consultation with the DPOR Office of History and Archaeology, has directed the Ahtna as to the course of action to take for its preservation.

8. Local Hire, Communication, and Training

a. Ahtna is encouraged to employ local and Alaska residents and contractors for work performed in the license area to the extent they are available and qualified. Ahtna will submit, as part of the plan of operations, a proposal detailing the means by which the Ahtna will comply with this measure. The proposal must include a description of

the operator's plans for partnering with local communities to recruit, train, and hire local and Alaska residents and contractors. In formulating this proposal, Ahtna is encouraged to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

b. A plan of operations application must describe Ahtna's past and prospective efforts to communicate with local communities and interested local community groups.

c. A plan of operations application must include a training program for all project personnel, including contractors and subcontractors. The program must be designed to inform each person working on the project of environmental, social, and cultural concerns that relate to that person's job. The program must use methods to ensure that personnel understand and use techniques necessary to preserve geological, archeological, and biological resources. In addition, the program must be designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating.

B. Development and Transportation Phases Mitigation Measures

1. Facilities and Operations

a. A plan of operations must be submitted and approved before conducting development or production activities, and must describe the Ahtna's plans to avoid or minimize impacts on residential, commercial, and recreational areas, Native allotments and subsistence use areas. At the time of application, Ahtna must submit a copy of the proposed plan of operations to all surface owners whose property will be entered.

b. Facilities must be designed and operated to avoid or minimize sight and sound impacts in areas of high residential, commercial, recreational, and subsistence use and important wildlife habitat. Methods may include providing natural buffers and screening to conceal facilities, sound insulation of facilities, or by using alternative means approved by the director, in consultation with ADF&G.

c. The siting of facilities other than docks, roads, and utility and pipeline crossings is prohibited within 500 feet of all fish-bearing streams and water bodies and 1,500 feet from all current surface drinking water sources. Additionally, siting of facilities is prohibited within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Facilities may be sited within any of these buffers if Ahtna demonstrates to the satisfaction of the director, in consultation with ADF&G, that a site location inside the buffer is environmentally preferred. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses.

d. Impacts to identified wetlands must be minimized to the satisfaction of the director, in consultation with ADF&G and ADEC. The director will consider whether facilities are sited in the least sensitive areas. Further, certain activities within wetlands require permission from the USACOE.

e. Pipelines must use existing transportation corridors where conditions permit. Pipelines and gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Pipelines must be located on the upslope side of roadways and construction

pads unless an alternative site is environmentally acceptable, as determined by the director, in consultation with DMLW. Wherever possible, pipelines must be buried where soil and geophysical conditions permit. All pipelines, including flow and gathering lines, must be designed, constructed and, maintained to maximize integrity against climatic conditions, geophysical hazards, corrosion and other hazards as determined on a case-by-case basis.

f. Pipelines will be designed and constructed to minimize alteration of caribou and other large ungulate movement and migration patterns in areas known to contain significant numbers of these animals. At a minimum, above-ground pipelines will be elevated 10 ft (ground to bottom of pipe) for a distance of at least 60 feet, at maximum intervals of one-half mile, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage. Ahtna will consider increased snow depth in the sale area in relation to pipe elevation to ensure adequate clearance for wildlife. DNR may, after consultation with ADF&G, require additional measures to mitigate impacts to wildlife movement and migration.

g. Dismantlement, Removal and Rehabilitation (DR&R): Upon abandonment of material sites, drilling sites, roads, buildings, or other facilities, such facilities must be removed and the site rehabilitated to the satisfaction of the director, unless the director, in consultation with DMLW, ADF&G, and DEC, determines that such removal and rehabilitation is not in the state's interest.

h. Gravel mining sites required for exploration and development activities is restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage. Where practicable, gravel sites must be designed and constructed to function as water reservoirs for future use, unless the director approves a proposed alternative. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless DMLW, after consultation with ADF&G, approves a proposed alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.

2. Fish and Wildlife Habitat

a. Before beginning any activities, Ahtna will consult with ADF&G to identify the locations of known bear den sites that are occupied in the season of the proposed activities. Development activities started between October 15 and April 30 may not be conducted within one-half mile of known occupied brown bear dens, unless alternative mitigation measures, as described in a bear-human interaction plan, are approved by the director in consultation with ADF&G. Discovery of an occupied bear den not previously identified by ADF&G must be reported to ADF&G, within 24 hours. Mobile activities will avoid such discovered occupied dens by one-half mile unless alternative mitigation measures, as described in a bear-human interaction plan, are approved by the director in consultation with ADF&G. Non-mobile facilities will not be required to be relocated.

b. The director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important moose and caribou calving and wintering areas.

c. The director, in consultation with ADF&G, may impose seasonal restrictions on activities located in important waterfowl habitat during the plan of operations approval stage.

d. Surface entry is prohibited within one-quarter mile of trumpeter swan nesting sites between April 1 and August 31. The siting of permanent facilities, including roads, material sites, storage areas, powerlines, and above-ground pipelines is prohibited within one-quarter mile of known nesting sites. USFWS will identify trumpeter swan nesting sites at Ahtna's request.

e. Aircraft flying over the trumpeter swan fall staging areas at Old Man Lake must maintain a minimum altitude of 1,500 feet above ground level or a horizontal distance of one mile from April 1 to October 31. Human safety will take precedence over this provision.

f. Pesticide use is prohibited in the lease area.

g. Pipelines that must cross fish bearing streams will be constructed beneath those streams using directional drilling techniques, unless the director, in consultation with ADF&G, approves an alternative method.

h. Ahtna is required to prepare and implement a human-bear interaction plan designed to minimize conflicts between bears and humans. The plan will include measures to:

   i. minimize attraction of bears to facility sites, including garbage and food waste;

   ii. organize layout of buildings and work areas to minimize interactions between humans and bears such as including the use of electric fencing;

   iii. warn personnel of bears near or on facilities and the proper actions to take;

   iv. if authorized by ADF&G, deter bears from the drill site;

   v. provide contingencies in the event bears do not leave the site;

   vi. provide for proper storage and disposal of materials that may be toxic to bears; and

   vii. document and communicate the sighting of bears onsite or in the immediate area to all shift employees.

3. Subsistence and Sport Harvest Activities

a. Lease-related use will be restricted if the director determines it is necessary to prevent unreasonable conflicts with subsistence activities. In enforcing this term DO&G, during review of plans of operation or development, will work with other agencies and the public to identify and avoid potential conflicts. In order to avoid conflicts with subsistence and sport harvest activities, restrictions may include alternative site selection, directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the director.

b. Traditional and customary access to subsistence areas will be maintained unless reasonable alternative access is provided to subsistence users. "Reasonable access" is access using means generally available to subsistence users.

c. Exploratory drilling operations may be restricted during the fall caribou migration (August 1 through October 31) when caribou are present to allow for subsistence hunting.

d. The siting of permanent facilities, except for roads or pipelines, are prohibited unless Ahtna demonstrates to the satisfaction of the director, that the development will not preclude reasonable subsistence user access to caribou.

4. Fuel and Hazardous Substances

a. Ahtna will provide secondary containment for the storage of fuel or hazardous substances. Secondary containment means an impermeable diked area or portable impermeable containment structure capable of containing 110% of the volume of the largest independent container. Double walled tanks do not qualify as secondary containment unless an exception is granted for a particular tank.

b. Containers with a storage capacity larger than 55 gallons that contain fuel or hazardous substances will not be stored within 100 feet of a water body or within 1,500 feet of a current surface drinking water source. Secondary containment shall be provided for the storage of fuel or hazardous substances 55 gallons or more, up to the minimum DEC volume requirements, and comply with 18 AAC 75.065 through 18 AAC 75.075.

c. During equipment storage or maintenance, the site will be protected from leaking or dripping fuel and hazardous substances by the placement of drip pans or other surface liners designed to catch and hold fluids under the equipment, or by creating an area for storage or maintenance using an impermeable liner or other suitable containment mechanism.

d. During fuel or hazardous substance transfer, secondary containment or a surface liner must be placed under all container or vehicle fuel tank inlet and outlet points, hose connections, and hose ends. Appropriate spill response equipment, sufficient to respond to a spill of up to five gallons, must be on hand during any transfer or handling of fuel or hazardous substances. Trained personnel will attend transfer operations at all times.

e. Vehicle refueling will not occur within the annual floodplain, except as addressed and approved in the plan of operations.

f. All independent fuel and hazardous substance containers will be marked with the contents and Ahtna's or its contractor's name using paint or a permanent label.

5. Waste Disposal

a. Waste from operations must be reduced, reused, or recycled to the maximum extent practicable. Garbage and domestic combustibles remaining after reuse or recycling must be incinerated whenever possible or disposed at an approved site in accordance with DEC regulations. Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. Ahtna must use the most appropriate and efficient method to achieve this goal.

b. On-site temporary storage of waste will not be permitted for longer than six months; the operator will exclude people, domestic animals and wildlife from solid waste disposal areas using fencing or other barriers approved by DO&G. Open pit solid

waste storage is not allowed in residential areas. In these areas, solid waste must be stored in a closed container.

c. Wherever practicable, the preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection, as regulated by AOGCC. Other methods of disposal will be allowed only upon approval by the director, in consultation with DEC and ADF&G.

d. New solid waste disposal sites will not be approved or located on state property during exploration activities. Exceptions may be provided for drilling waste if the facility complies with DEC regulations

6. Access

a. Public access to, or use of, the lease area may not be restricted except within the immediate vicinity of drill sites, buildings, and other related facilities. Areas of restricted access must be identified in the plan of operations. Facilities and operations will not be located so as to block access to or along navigable or public waters as defined in AS 38.05.965.

7. Prehistoric, Historic and Archaeological Sites

a. Before the construction or placement of any gravel or other structure, road, or facility resulting from development or production activities, Ahtna must conduct an inventory of prehistoric, historic, and archeological sites within the area affected by an activity. The inventory must include consideration of literature provided by nearby communities, Native organizations, and local residents; documentation of oral history regarding prehistoric and historic uses of such sites; evidence of consultation with the Alaska Heritage Resources Survey and the National Register of Historic Places; and site surveys. The inventory must also include a detailed analysis of the effects that might result from the activity.

b. The inventory of prehistoric, historic, and archeological sites must be submitted to the director, and to DPOR Office of History and Archaeology who will coordinate with the local government for review and comment. If a prehistoric, historic, or archaeological site or area could be adversely affected by an activity, the director, after consultation with DPOR Office of History and Archaeology, will direct Ahtna as to the course of action to take to avoid or minimize adverse effects.

c. If a site, structure, or object of prehistoric, historic, or archaeological significance is discovered during operations, Ahtna must report the discovery to the director as soon as possible. Ahtna must make reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the director, after consultation with the DPOR Office of History and Archaeology, has directed the Ahtna as to the course of action to take for its preservation.

8. Local Hire, Communication and Training

a. Ahtna is encouraged to employ local and Alaska residents and contractors for work performed in the license area to the extent they are available and qualified. Ahtna will submit, as part of the plan of operations, a proposal detailing the means by which Ahtna will comply with this measure. The proposal must include a description of the operator’s plans for partnering with local communities to recruit, train, and hire

local and Alaska residents and contractors. In formulating this proposal, Ahtna is encouraged to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

b. A plan of operations application must describe Ahtna's past and prospective efforts to communicate with local communities and interested local community groups.

c. A plan of operations application must include a training program for all project personnel, including contractors and subcontractors. The program must be designed to inform each person working on the project of environmental, social, and cultural concerns that relate to that person's job. The program must use methods to ensure that personnel understand and use techniques necessary to preserve geological, archeological, and biological resources. In addition, the program must be designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating.

C. Definitions

Facilities are any structure, equipment, or improvement to the surface, whether temporary or permanent, including, but not limited to, roads, pads, pits, pipelines, power lines, generators, utilities, airstrips, wells, compressors, drill rigs, camps and buildings.

Geophysical hazard means the following natural processes or adverse conditions that present a threat to life or property in the area of operations: flooding, earthquakes, active faults, landslides, ice formations, snow avalanches, and erosion.

Hazardous substance is (A) an element or compound that, when it enters into or on the surface or subsurface land or water of the state, presents an imminent and substantial danger to the public health or welfare, or to fish, animals, vegetation, or any part of the natural habitat in which fish, animals, or wildlife may be found; or (B) a substance defined as a hazardous substance under 42 USC 9601 - 9675 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980); "hazardous substance" does not include uncontaminated crude oil or uncontaminated refined oil (AS 46.09.900).

Identified wetlands are those areas that have been identified as wetlands by the USACOE under Section 404 of the Clean Water Act.

Minimize is to reduce adverse impacts to the smallest amount, extent, duration, size, or degree reasonable in light of the environmental, social, or economic costs of further reduction.

Permanent facility is a facility that will remain at a single location for a period in excess of six months, excluding exploration wells.

Plan of operations is a license or lease plan of operations under 11 AAC 83.158, and a unit plan of operations under 11 AAC 83.346.

Practicable means feasible in light of overall project purposes after considering cost, existing technology, and logistics of compliance with the mitigation measure.

Reasonable access is access using means generally available to subsistence users.

Appendix A: Summary of Comments and Responses

AS 38.05.035(e)(7)(B) requires that written findings include a summary of agency and public comments received and the department's responses to those comments. This appendix summarizes agency and public comments timely received in response to DO&G's request for comments on the Tolsona area exploration license.

A. Agencies

1. United States, Dept. of Interior (Rosenkrans, Danny)

Comment Summary: Mr. Rosenkrans comments that oil and gas exploration and development may affect the park resources (fish and water quality) of Wrangell-St. Elias National Park and Preserve.

DNR Response: While the study area border abuts the Wrangell-St. Elias National Park and Preserve, the exploration license area is several miles west of Glennallen. Exploration activities are not expected to impact the fish and water quality of the park and preserve. Mitigation measures (Chapter Nine) and governmental powers (Chapter Seven) are expected to protect fish, wildlife, and habitat from the impacts of oil and gas activities in the exploration license area. Additionally, further restrictions may be imposed in the plan of operations.

2. State of Alaska, Office of History and Archaeology (Bittner, Judith)

Comment Summary: Ms. Bittner states there are approximately 71 recorded cultural sites and historic properties within the proposed exploration area. She states that previously unidentified resources may be discovered during the duration of the exploration license. She notes that her office must be notified so that it may evaluate whether the resources should be preserved in the public interest.

DNR Response: Mitigation measures discussed in Chapter Nine are expected to protect the cultural sites and historic properties in the area from the impact of oil and gas actvities. Specifically, Chapter Nine, Prehistoric, Historic, and Archeological Sites, states that if a site, structure, or object of prehistoric, historic, or archaeological significance is discovered during license operations, the licensee must report the discovery to the director as soon as possible. The licensee must make reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the director, after consultation with the DPOR Office of History and Archaeology, has directed the licensee as to the course of action to take for its preservation.

B. Organizations

1. Copper Basin Sanitation Service Co. (Daniel, Sharon)

Comment Summary: Ms. Daniel, business administrator for the Copper Basin Sanitation Service Company states that the company has no objection to issuing an exploration license in the area.

DNR Response: Comment noted.

2. Copper Country Alliance (McHenry, Ruth)

Comment Summary: Ms. McHenry, volunteer staff, Copper Country Alliance (CCA) states that oil and gas development in the Copper Basin is not in the long-term best interests of Copper Basin residents. However, she states that if the license is granted, CCA would like the license to be granted to an entity most likely to provide training and jobs for Native and non-Native residents, avoid drilling near residences, and protect human health and natural resources. She lists some of the natural resources that could be impacted by oil and gas exploration and development in the area: Tazlina Lake/Tazlina River, Nelchina River system; Copper River; clean air; viewshed; Nelchina caribou herd; moose; sharp-tailed grouse; and trumpeter swans. CCA suggests mitigation measures to ensure buffers around the exploration area; controls for hydraulic fracturing operations; spill plan requirements; monitor possible contamination of water, air, fish, and habitat; adequate bonding; closing roads and routes to public use; prevent spread of invasive plant species; protect sharp-tailed grouse and their leks; and avoid working when Nelchina caribou herd is migrating through area.

DNR Response: The licensee is Ahtna, Inc. an Alaska Native Corporation. Local hire is discussed in Chapter Nine, Mitigation Measures. To the extent they are available and qualified, the licensee is encouraged to employ local and Alaska residents and contractors for work performed in the license area. Ahtna is required to submit, as a part of its operations plan, a proposal to include plans for partnering with local communities to recruit and hire local and Alaska residents and contractors.

The mitigation measures in Chapter Nine are designed to protect human health and natural resources. DEC has statutory responsibility to conserve, improve, and protect Alaska's natural resources and environment, by controlling air, land, and water pollution, and oil spill prevention and response. DEC implements and coordinates several federal regulatory programs in addition to state laws. A discussion of DEC's role and authority is found in Chapter Seven, Governmental Powers.

Chapter Nine, Mitigation Measures, states that DNR, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or traveling through or overflight of, important moose, caribou, and waterfowl habitat. Surface entry is prohibited within one-quarter mile of trumpeter swan nesting sites between April 1 and August 31. The siting of permanent facilities, including roads, material sites, storage areas, powerlines, and above-ground pipelines is prohibited within one-quarter mile of known nesting sites. ADF&G will identify trumpeter swan nesting sites at the request of the licensee. Aircraft flying over the trumpeter swan fall staging areas at Old Man Lake must maintain a minimum altitude of 1,500 ft above ground level or a horizontal distance of one mile from April 1 to October 31.

The mitigation measures proposed by CCA are addressed through current statutes, regulations, and mitigation measures in this finding.

3. Copper River Watershed Project (Carpenter, Kristin)

Comment Summary: Ms. Carpenter, executive director of the Copper River Watershed Project, states that the group believes oil and gas development in this region is not in the long-term best interest of Copper River Basin residents. She states an oil spill in the Tazlina Lake could flow into the Copper River. The group recommends mitigation measures to address fuel, lubricant, and other substance spills. She states that the fisheries are a critical contribution to the upriver economy and culture, and that river and lake buffers are critical for protecting water quality in the Tazlina River drainage.

DNR Response: Tazlina Lake is several miles south of the exploration area. However, the same measures, laws, and regulations that protect the license area will protect adjacent areas. Mitigation measures addressing fuel, lubricant, and other substance spills are addressed in Chapter Nine, Fuel and Other Substances. Other mitigation measures provided in this finding, combined with evaluation and approval authority for all plans of operation will provide protection for fish and fish habitats. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on plans of operation approvals when specific activities are proposed.

4. Cordova District Fishermen United (Cooper, Alexis)

Comment Summary: Ms. Cooper, executive director, Cordova District Fishermen United (CDFU) states that oil and gas exploration may impact fish and fish habitat in the area. She states that the fisheries depend on long term sustainability and health of the salmon resources. Ms. Cooper states that exploration activities may cause pollution and habitat degradation that could be harmful to fish and habitat. CDFU insists licensees adhere to stringent mitigation practices to minimize exploration effects on the ecosystem.

DNR Response: Federal and state laws and mitigation measures will protect for fish and fish habitats from oil and gas activities. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on plans of operation approvals when specific locations have been proposed.

5. Eyak Preservation Council (Stolarcyk, Emily)

Comment Summary: Ms. Stolarcyk, project manager, Eyak Preservation Council (EPC) states that hydraulic fracturing in the Copper River watershed puts wild salmon and Alaskan livelihoods at risk.

DNR Response: AOGCC regulates hydraulic fracturing. It is proposing new regulations to define hydraulic fracturing, require notice to nearby owners and operators before beginning hydraulic fracturing, require water sampling and analysis, require disclosure of hydraulic fracturing fluids, increase wellbore integrity, and ensure containment of hydraulic fracturing fluids.

C. Individuals

1. Berglund, Kimm

Comment Summary: Ms. Berglund states she opposes oil development on or near the Copper River because of the importance of keeping the fishery healthy for Cordova's economy and subsistence.

DNR Response: The exploration area is several miles away from the Copper River. However, oil and gas activities in the exploration license area may affect surrounding areas. Mitigation measures discussed in Chapter Nine and federal and state laws discussed in Chapter Seven are designed to protect the impact of oil and gas activities on the area. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on plans of operation approvals when specific locations are proposed.

2. Cook, Jonathan

Comment Summary: Mr. Cook states that he opposes issuing any oil or gas well drilling permits or licenses on the Copper, Klutina, and Tazlina rivers and Lake Louise areas. He requests an extension of the comment period and a public hearing, and the publication of companies' names bidding or proposing for the drilling lease.

DNR Response: The exploration license area does not include the Copper, Klutina, and Tazlina rivers or the Lake Louise area. However, mitigation measures discussed in Chapter Nine and federal and state laws discussed in Chapter Seven are designed to protect the impact of oil and gas activities on the surrounding area. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on plans of operation approvals when specific locations are proposed. The statutory public comment period provided adequate opportunity for the public to submit comments on the proposed exploration license. Requests for public hearing and to extend the public comment deadline are denied. The proposal is for an exploration license, not a lease. If the work commitment is completed, the licensee may request conversion of the license to lease. AS 38.05.035(a)(1)(8)(A) says that, if requested, the name of the person applying for a disposal of land by competitive bidding will be kept confidential. Since no competing proposals were received, competitive bidding will not take place. Ahtna, Inc. is the licensee.

3. Goetzinger, Karl and Kurt

Comment Summary: Messrs. Goetzinger state that the area includes spawning and rearing streams for commercial, subsistence, and recreational salmon fisheries. They state it is unclear the damage that will be done to this area during 10 years of oil and gas exploration. Additionally, the Goetzingers state the following safeguards must be implemented if the license is issued:

- On-site state inspectors must be present when any road building, drilling, or construction activity is in progress.
- ADF&G designed salmon habitat safeguards (no use of culverts, maintenance of steam set-backs, etc.) must be installed/maintained.
- The wildlife protection requirements must have heavy fines levied for any violations of the license.

- A certain number of violations (per year and total) of license environmental requirements will result in the license being revoked.

DNR Response: Laws, regulations, and mitigation measures are expected to protect the area from adverse effects of oil and gas exploration. DNR addresses the commenters' suggested safeguards:

- On-site inspectors: Chapter Seven, Governmental Powers, sets out the governmental powers to oversee and regulate oil and gas activities. While on-site inspectors may not be in place for every activity, DNR monitors activities through field inspections, and DEC and AOGCC make compliance inspections.

- Salmon habitat safeguards: Alaska laws protect salmon streams. ADF&G develops and enforces the laws. It has determined that culverts, when properly designed, sized, and installed can safely pass weak swimming fish. ADF&G will determine whether culverts are appropriate for use in small streams in the exploration license area. Additionally, Chapter Nine, Mitigation Measures, states that the siting of temporary and permanent facilities other than docks, roads, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes.

- License violations: Permit violators can be subject to fines. For instance, ADF&G may assess a fine for damage of fishways (AS 16. 05.841—.861). DNR may terminate an exploration license whenever a licensee fails to comply with a provision of an oil and gas license, applicable statutes, regulations, or stipulations (11 AAC 82.975).

4. King, Rita

Comment Summary: Ms. King states that the proposal is not sound planning. She notes human error and natural phenomenon compound the risk of oil and gas exploration, transport, and extraction activities.

DNR Response: This finding includes mitigation measures to protect local communities, habitat, and species from adverse effects of oil and gas activities. Additional measures may be imposed in the plan of operations, when a specific project is proposed. The licensee is also subject to state and federal laws and regulations.

5. Lowney, Pete

Comment Summary: Mr. Lowney states that he opposes issuing any oil or gas well drilling permits or licenses on the Copper, Klutina, and Tazlina rivers and Lake Louise areas. He requests an extension of the comment period and a public hearing, and the publication of companies' names bidding or proposing for the drilling lease.

DNR Response: The exploration license area does not include the Copper, Klutina, and Tazlina rivers or the Lake Louise area. However, mitigation measures discussed in Chapter Nine and federal and state laws discussed in Chapter Seven are designed to protect the surrounding area from the impact of oil and gas activities. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on a plan of operation approval when a specific location is proposed. The statutory public comment period provided adequate opportunity for the public to submit comments on the proposed exploration

license. Requests for public hearing and to extend the public comment deadline are denied. The proposal is for an exploration license, not a lease. If the work commitment is completed, the licensee may request conversion of the license to lease. AS 38.05.035(a)(1)(8)(A) says that, if requested, the name of the person applying for a disposal of land by competitive bidding will be kept confidential. Since no competing proposals were received, competitive bidding will not take place. Ahtna, Inc. is the licensee.

6. Pond, Jordan

Comment Summary: Mr. Pond states he owns property on Klutina Lake. He states he is concerned that oil and gas exploration in the area will destroy wildlife, potentially poison spawning grounds, alter landscapes, and spills may leech into waterways.

DNR Response: The exploration license study area does not include Klutina Lake. However, mitigation measures discussed in Chapter Nine and federal and state laws discussed in Chapter Seven are designed to protect the area from the impact of oil and gas activities. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on a plan of operation approvals when specific locations are proposed.

7. Rolde, David

Comment Summary: Mr. Rolde states that he opposes issuing any oil or gas well drilling permits or licenses on the Copper, Klutina, and Tazlina rivers and Lake Louise areas. He requests an extension of the comment period and a public hearing, and the publication of companies' names bidding or proposing for the drilling lease.

DNR Response: The exploration license area does not include the Copper, Klutina, and Tazlina rivers or the Lake Louise area. However, mitigation measures discussed in Chapter Nine and federal and state laws discussed in Chapter Seven are designed to protect the impact of oil and gas activities on the surrounding area. For example, the siting of facilities other than roads, docks, and utility and pipeline crossings is prohibited within 500 ft of all fishbearing streams and lakes and within one-half mile of the banks of the Copper, Klutina, and Tazlina rivers, Mendeltna and Tolsona creeks, and Moose, Tolsona, and Mud lakes. Temporary and permanent facilities other than docks, roads, and utility and pipeline crossings are also prohibited within 500 ft of all fish bearing water bodies and 1,500 ft of all current surface drinking water sources (Mitigation Measures, Chapter Nine). DNR may impose additional conditions on plan of operation approvals when specific locations are proposed. The statutory public comment period provided adequate opportunity for the public to submit comments on the proposed exploration license. Requests for public hearing and to extend the public comment deadline are denied. The proposal is for an exploration license, not a lease. If the work commitment is completed, the licensee may request conversion of the license to lease. AS 38.05.035(a)(1)(8)(A) says that, if requested, the name of the person applying for a disposal of land by competitive bidding will be kept confidential. Since no competing proposals were received, competitive bidding will not take place. Ahtna, Inc. is the licensee.

Oil and Gas Exploration License
Form #DOG 2013-09

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

Tolsona Exploration License
ADL 392209

THIS OIL AND GAS EXPLORATION LICENSE is issued by the State of Alaska, Department of Natural Resources ("the state" or "the department") to

AHTNA, INC.

("the licensee") whether one or more, whose address for purposes of notification is set out in Paragraph 17.

In consideration of the nonrefundable Oil and Gas exploration license fee, work commitment, and performance bond, and subject to the provisions of this exploration license ("license"), including the attached schedules, and by reference, incorporated into this license, the state and the licensee agree as follows.

1. GRANT. (a) Subject to the provisions contained in this license, the state grants to the licensee the exclusive right to explore for Oil and Gas on the state lands described in Schedule 1 ("licensed land"), unless this license is terminated in whole or part under the provisions of this license or applicable statutes and regulations.

(b) This license may be converted to one or more Oil and Gas Leases under the provisions of AS 38.05.134 and 11 AAC 82.978.

(c) If the state's ownership interest in the Oil and Gas in the licensed land is less than an entire and undivided interest, the grant under this license is effective only as to the state's interest in that Oil and Gas.

(d) The state makes no representations or warranties, express or implied, as to title, or access to, or quiet enjoyment of, the licensed land. The state is not liable to the licensee for any deficiency in title to the licensed land, nor is the licensee or any successor in interest to the licensee entitled to any refund due to deficiency in title for work commitments or other expenditures made under this license.

2. RESERVED RIGHTS. (a) The state, for itself and others, reserves all rights not expressly granted to the licensee. These reserved rights include, but are not limited to:

(1) the right to dispose of to others the surface of the licensed land subject to the license, and the right to authorize others by grant, lease, or permit, subject to the license;

(2) the right to explore for Oil or Gas by geological or geophysical means including the drilling of shallow core holes or stratigraphic tests to a depth of not more than 1,000 feet;

(3) the right to explore for, develop, and remove natural resources other than Oil or Gas on or from the licensed land;

(4) the right to non-exclusive easements and rights-of-way for any lawful purpose, including shafts and tunnels necessary or appropriate for working of the licensed land or other land for natural resources other than Oil or Gas;

(5) the right to well sites and well bores of wells drilled from or through the licensed land to explore for or produce Oil, Gas, and Associated Substances in and from other land; and

(6) the right to undertake any other purpose authorized by law and not inconsistent with the rights under the license.

(b) Reserved rights may be exercised by the state, or by any person or entity acting under authority of the state, in any manner that does not unreasonably interfere with or endanger the licensee's operations under this license.

3. TERM. This license is issued for a term of **5** years from the Effective Date.

4. WORK COMMITMENT. This license is conditioned upon the performance of a work commitment, as required under AS 38.05.132, of **$415,000.00**. Failure of the licensee to timely meet this work commitment will result in the relinquishment, removal, or deletion of the licensed land, termination of this license, and forfeiture of the bond under the provisions of AS 38.05.132 and 11 AAC 82.903—11AAC82.990.

5. GEOLOGIC AND GEOPHYSICAL DATA. (a) On or before each Anniversary Date of the Effective Date of this license, the licensee shall submit to the department all geologic and geophysical data, as defined in 11 AAC 82.990, in accordance with 11 AAC 82.981 and 11 AAC 82.984.

6. DATA SUBMITTAL. (a) The lessee shall submit to the state, at the Department of Natural Resources, Division of Oil & Gas (Division), all geological, geophysical, and engineering data obtained from the license within 30 days following completion, abandonment, or suspension of each well, pilot hole, and plugged back well bore. The licensee shall also submit to the Division, on behalf of the state, data acquired subsequent to completion, abandonment, or suspension of each well, pilot hole, and plugged back well bore within 30 days following acquisition of those data. The Division, on behalf of the state, may waive receipt of operational data from some development, service, or injection wells, and will inform the operator of the waiver in writing prior to data submittal.

Data shall be submitted according to the instructions set out in Attachment 1.

Submission of data under this paragraph does not affect any statutory or regulatory obligation to submit data or other information to the state or any of its agencies.

(b) Any data submitted to the state, at the Department of Natural Resources, Division of Oil & Gas will be available at all times for use by the state and its agents, and will be held confidential as provided in AS 38.05.035(a)(8) and its applicable regulations. In accordance with AS 38.05.035(a)(8)(C), in order for geological, geophysical, and engineering data to be held confidential, the licensee must request confidentiality at the time of submission and mark the data "CONFIDENTIAL" in compliance with applicable regulations.

7. BONDING. (a) On or before the Effective Date of this license the licensee shall post, and during the term of this license the licensee shall maintain, a performance bond or other security in accordance with AS 38.05.132 and 11 AAC 82.945. The form to be used for bond calculations is incorporated as Schedule 2 to this license.

8. FORCE MAJEURE. (a) If by the fourth anniversary of this license the state determines that the licensee has been prevented by Force Majeure from performing an act that would maintain this license, the Effective Date of this license will be extended by adding the time lost as result of the Force Majeure.

(b) If Force Majeure occurs after the fourth anniversary and before the expiration of the term of this license, the term of this license will be extended by adding the period of time lost as a result of the Force Majeure.

9. AUDIT. The commissioner will, in the commissioner's discretion, audit expenditures as set out in 11 AAC 82.960. The licensee shall keep and have in its possession books and records showing all expenditures regarding the licensee's direct exploration expenditures, reports, data, or other information relevant to the drilling of an Oil and Gas exploration well or the gathering of geologic or geophysical data, whether or not that information is confidential. The licensee shall permit the state or its agents to examine these books and records at all reasonable times. Upon request by the state, the licensee's books and records must be made available to the state at the state office designated by the state. These books and records must employ methods and techniques that will ensure the most accurate figures reasonably available. The licensee shall use generally accepted accounting procedures consistently applied.

10. PLAN OF OPERATIONS. Before operations may be undertaken on the licensed land, the licensee shall comply with the applicable statutes and regulations in effect on the date the proposed activity is scheduled to commence, including the provisions of AS 38.05.130 and 11 AAC 82.951.

11. INSPECTION. The licensee shall keep open at all reasonable times, for inspection by any duly authorized representative of the State of Alaska, the licensed land, all wells, improvements, machinery, and fixtures on the licensed land, and all reports and records relative to operations and surveys or investigations on or with regard to the licensed land or under this license. Upon request, the licensee shall furnish the State of Alaska with copies of and extracts from any such reports and records.

12. ASSIGNMENT. This license, or an interest in this license, may be assigned or otherwise transferred in accordance with 11 AAC 82.966, 11 AAC 82.969, and 11 AAC 82.972.

13. SURRENDER. The licensee may, at any time, file with the state a written surrender of rights under the provisions of 11 AAC 82.957.

14. TERMINATION. The commissioner will, in the commissioner's discretion, terminate this license under the provisions of 11 AAC 82.975 for the licensee's failure to comply with any of its provisions, applicable statutes, regulations, or stipulations.

15. RIGHTS UPON SURRENDER OR TERMINATION. Upon the surrender or termination as to all or any portion of the licensed land, the state will direct the licensee in writing and the licensee will have the right at any time within a period of one year after the surrender or termination, or any extension of that period as the state may grant, to remove from the licensed land or portion of the licensed land 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 licensee has not removed from the licensed land or portion of the licensed land become the property of the state or may be removed by the state at the licensee'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 licensee to the satisfaction of the state, or be left intact and the licensee absolved of all further responsibility as to their maintenance, repair, and eventual abandonment and rehabilitation. Subject to the above conditions, the licensee shall deliver the licensed land or those portions of the licensed land in good condition.

16. DAMAGES AND INDEMNIFICATION. (a) The licensee 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 license by or on behalf of the licensee. The licensee 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.

(b) The licensee expressly waives any defense to an action for breach of a provision of this license or for damages resulting from an oil spill, well blow-out, or other harm to the environment that is based on an act or omission committed by an independent contractor in the licensee's employ. The licensee expressly agrees to assume responsibility for all actions of its independent contractors.

17. AUTHORIZED REPRESENTATIVES. The Director of the Division of Oil and Gas, Department of Natural Resources, State of Alaska, and the person executing this license on behalf of the licensee will be authorized representatives for their respective principals for the purposes of administering this license. The state or the licensee 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 17 below. When activities under a plan of operations are underway, the licensee shall also designate, by notice under Paragraph 17 below, by name, job title, and address, an agent who will be present in the state during all license activities.

18. NOTICES; PROTEST. (a) Any notices required or permitted under this license 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 1100
ANCHORAGE, ALASKA 99501-3563

TO THE LICENSEE:

KATHRYN MARTIN, VICE PRESIDENT OF LAND AND RESOURCES
AHTNA, INC.
P.O. BOX 649
GLENNALLEN, ALASKA 99588

(b) Any notice given under this paragraph will be effective when delivered to the above authorized representative.

19. APPEALS. The licensee shall appeal decisions of the commissioner related to this license in accordance with 11 AAC 82.963.

20. STATUTES AND REGULATIONS. This license is subject to all applicable state and federal statutes and regulations in effect on the Effective Date of this license, and to all statutes and regulations placed in effect after the Effective Date of this license. A reference to a statute or regulation in this license includes any future change in that statute or regulation whether by amendment, repeal and replacement, or other means. This license 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 licensee or its agents in connection with this license or the value of the interest held under this license. In case of conflicting provisions, statutes and regulations take precedence over this license.

21. INTERPRETATION. This license 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 license and are inserted only for convenience. The state and the licensee expressly agree that the law of the State of Alaska will apply in any judicial proceeding affecting this license.

22. WAIVER OF CONDITIONS. The state reserves the right to waive any breach of a provision of this license, but any waiver extends only to the particular breach 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 license 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 license unless it does so in writing.

23. SEVERABILITY. If it is finally determined in any judicial proceeding that any provision of this license is invalid, the state and the licensee may jointly agree by a written amendment to this license that, in consideration of the provisions in that written amendment, the invalid portion will be treated as severed from this license and that the remainder of this license, as amended, will remain in effect.

24. NONDISCRIMINATION. The licensee and the licensee'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 licensee and its contractors and subcontractors shall, on beginning any operations under this license, post in a conspicuous place notices setting out this nondiscrimination provision.

25. DEFINITIONS. To the extent that the words and phrases used in this license are defined in 11 AAC 82.990, those definitions will apply to this license. With respect to all other words and phrases used in this license, they will be interpreted in accordance with AS. 01.10.040. However, the following words have the following meanings unless the context unavoidably requires otherwise.

(1) "Anniversary Date" means the date in each successive calendar year following the Effective Date that is the same as the Effective Date.

(2) "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 license as Oil or Gas;

(3) "Effective Date" means the first day of the month following the date on which the exploration license or, if an extension is granted, the extension was signed on behalf of the state or, upon written request, on the first day of the month in which it was signed on behalf of the state.

(4) "Force Majeure" means war, riots, acts of God, unusually severe weather, or any other cause beyond the licensee'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.

(5) "Gas" means all natural gas (except helium gas) and all other hydrocarbons produced that are not defined in this license as Oil;

(6) "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.

26. EFFECTIVE DATE. This license takes effect on

BY SIGNING THIS LICENSE, the state and the licensee agree to be bound by its provisions.

STATE OF ALASKA

By: _____
W. C. Barron
Director, Division of Oil and Gas

STATE OF ALASKA)
) ss.
Third Judicial District)

On , before me appeared W. C. Barron of the Division of Oil and Gas of the State of Alaska, Department of Natural Resources, and who executed this license 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 _____

LICENSEE: _____

Signature: _____

Printed Name/Title: _____

INSERT NOTARY ACKNOWLEDGMENT OF LICENSEE'S SIGNATURE HERE

Attachment 1. Alaska Department of Natural Resources, Division of Oil & Gas
Submittal of Well Data Required by DNR License

Data shall be submitted to the Division in a digital format, generally in PDF. For spreadsheets, include the original Excel document. For images such as maps or charts, include a high-resolution TIFF or JPEG. For logs, see formats specified below, but include a graphical image file of the logs as a PDF or TIFF in addition to the final merged data file of the log curves. Data may be submitted on CD, DVD or USB mass storage device (include any necessary cables). Required data shall include any and all of the following:

1. A copy of the well completion report (AOGCC Form 10-407) for each well bore.
2. Daily drilling reports or a summary report of daily drilling.
3. Latitudinal and longitudinal coordinates for each well, pilot hole, and plugged back well bore with completed surface and bottom hole locations. Coordinates can be based upon either the NAD 83 or NAD 27 geodetic datum as long as the datum used is clearly specified.
4. Directional survey for each well, pilot hole, and plugged back well bore.
5. A list of all logs run and the depth interval covered for each well, pilot hole, and plugged back well bore.
6. A list of formations and other geologic markers encountered and the measured depths (MD) and true vertical depths (TVD) of each, for each well, pilot hole, and plugged back well bore.
7. Summary of cored intervals (conventional and sidewall), including depth, formation name, lithology, presence of oil, gas, gas hydrates, and water, porosity, fractures and apparent dips; indicate "**none**" on completion report or in an attachment if no cores were taken.
8. Core reports including lab analyses of lithology, porosity, permeability (vertical and horizontal, air and liquid), density, capillary pressure, and fluid saturation, if available.
9. Conventional and sidewall core photos (plain light and ultraviolet), if applicable.
10. Identified formation names and corresponding depths for oil, gas, and gas hydrate shows. Indicate "**none**" on the completion report or in an attachment if no shows were observed.
11. Identified depth zones of abnormal pressure. Indicate "**none**" on the completion report or in an attachment if none were observed.
12. A synopsis or summary of testing and all fluid recovery efforts, including production tests (IP), drill stem tests (DST), wireline formation tests (i.e. repeat formation tests (RFT) and modular dynamics tests (MDT)), and any other production and formation testing data; the summary should include test date, time, depth, formation name, method of operation, recovered fluid type(s) and amount(s), fluid rate, gas-oil ratio (GOR), oil gravity, pressure, and choke size, when available. If no tests were undertaken, indicate "**none**" where appropriate on the completion report or in an attachment, if tests were undertaken but failed to recover fluids indicate "**no recovery**".
13. Pressure build-up and fluid PVT analyses, if applicable.
14. Open flow potential test reports and report attachments to AOGCC Forms 10-421.
15. Well test procedures, field chronologies, and field data; including details necessary for evaluation (intervals open to test; volumes of oil, gas, water, mud, and other borehole substances; API gravity; gas density; wellhead and down hole pressure; and formation and wellhead temperature).
16. Geochemical and formation fluid analyses and reports, if applicable.
17. Down hole and surface fluid sampling procedures, field chronologies, raw data, and laboratory test results for all water and hydrocarbon-bearing zones (oil, gas, gas hydrates) sampled; including details sufficient to fully evaluate quality of sample data.
18. Permit to drill (AOGCC form 10-401) and the survey as-built of the well location.
19. LAS Version 2, TAP, TIF, LIS and DLIS (if available) files of final merged open-and cased-hole log data, including specialty logs (such as Schlumberger's cyberlook, formation microscanners and dipmeter logs), measured-while-drilling (MWD) and logged-while-drilling (LWD) logs. Include a graphical image file of the 2-inch MD & TVD logs as a PDF or TIFF in addition to the log data file.
20. LAS Version 2 of final composite mudlog or lithology log curves. Include a graphical image file of the final 2-inch MD & TVD logs, with lithology display, oil, gas, and gas hydrate show indicators, mud properties, and cuttings descriptions and report as a PDF or TIFF in addition to the log data file.
21. Clear, legible files of all well data and reports including, but not limited to, paleontology, palynology, petrography (including point-count analyses), X-ray diffraction analyses, SEM micrographs, thermal maturity, vitrinite reflectance, total organic carbon, RockEval pyrolysis, geochronology, fission track analyses, fluid inclusion analyses, Mercury injection capillary pressure analyses, chemical analyses (EPMA, XRF, ICP, etc.), isotope analyses, water chemistry, burial and temperature history analyses, strain analyses, acoustic analyses, gas hydrate analyses and well pressure and temperature survey analyses.

22. Final reports of velocity, checkshot or VSP surveys (an ASCII format digital version of the above data shall also be submitted), including seismic profile data in SEG-Y format. Indicate "none" in your response to this request if no velocity, checkshot or VSP surveys were undertaken. Submission of velocity, checkshot, and VSP surveys is always required by DNR under the operator surface-use permit obligations.
23. All coalbed core, gas, and water quality reports including lab analyses of core lithology, coal rank, vitrinite reflectance, maceral composition, total organic carbon, ash, sulfur and BTU content, moisture content, cleating, adsorption/desorption data, residual gas measurements, porosity and permeability analyses, core photos, if available.
24. Any other geoscience- and engineering-related data sets from the well(s).

Please note: Physical samples of well cuttings or cores specified in 20 AAC 25.071(b)(2) and 20 AAC 25.071(b)(4) should be sent to AOGCC, not to the Division.

All material should be either hand-carried by bonded courier or mailed by registered mail to:

Resource Evaluation Section
Alaska Department of Natural Resources, Division of Oil & Gas
550 West 7th Avenue, Suite 1100
Anchorage, AK 99501-3510
Email: DOG.REdata@alaska.gov

SCHEDULE 1

Legal Description
Tolsona Exploration License
ADL 392209

Legal Tract: 1

T. 4 N., R. 4 W., Tract B, Copper River Meridian, Alaska.

Section 1, Unsurveyed, All, 640.00 acres;
Section 2, Unsurveyed, All, 640.00 acres;
Section 3, Unsurveyed, All, 640.00 acres;
Section 10, Unsurveyed, All, including the bed of Mud Lake, 640.00 acres;
Section 11, Unsurveyed, All, 640.00 acres;
Section 12, Unsurveyed, All, 640.00 acres;
Section 13, Unsurveyed, All, 640.00 acres;
Section 14, Unsurveyed, All, including the bed of Mud Lake, 640.00 acres;
Section 15, Unsurveyed, All, including the bed of Mud Lake, 640.00 acres;

This Tract (1) contains 5,760.00 acres, more or less.

Legal Tract: 2

T. 4 N., R. 4 W., Tract B, Copper River Meridian, Alaska.

Section 4, Unsurveyed, All, 640.00 acres;
Section 5, Unsurveyed, All, 640.00 acres;
Section 6, Unsurveyed, All, 598.00 acres;
Section 7, Unsurveyed, All, 599.00 acres;
Section 8, Unsurveyed, All, 640.00 acres;
Section 9, Unsurveyed, All, 640.00 acres;
Section 16, Unsurveyed, All, 640.00 acres;
Section 17, Unsurveyed, All, 640.00 acres;
Section 18, Unsurveyed, All, including U.S. Survey 5680 Lot 3, 592.42 acres;

This Tract (2) contains 5,629.42 acres, more or less.

Legal Tract: 3

T. 4 N., R. 4 W., Copper River Meridian, Alaska.

Section 19, Surveyed, Fractional, Lots 3 through 7, E1/2, NE1/4NW1/4, 454.11 acres;
Section 29, Surveyed, Fractional, Lots 1 and 3 through 10, NE1/4NE1/4, N1/2NW1/4, SE1/4SW1/4, SE1/4, including the bed of the unnamed lake, 606.43 acres;
Section 30, Surveyed, Fractional, Lots 1 through 8, NE1/4, SE1/4NW1/4, E1/2SW1/4, 514.50 acres;
Section 31, Surveyed, Fractional, Lots 1 through 6, S1/2NE1/4, E1/2W1/2, SE1/4, 567.21 acres;
Section 32, Surveyed, Fractional, Lot 1, E1/2, E1/2NW1/4, SW1/4NW1/4, SW1/4, 626.03 acres;

T. 4 N., R. 4 W., Tract B, Copper River Meridian, Alaska.

Section 20, Unsurveyed, All, 640.00 acres;
Section 21, Unsurveyed, All, including U.S. Survey 5642, 519.87 acres;
Section 28, Unsurveyed, All, 574.00 acres;
Section 33, Unsurveyed, All, Including the bed of the Tazlina River, 640.00 acres;

This Tract (3) contains 5,142.15 acres, more or less.

Legal Tract: 4

T. 4 N., R. 4 W., Tract B, Copper River Meridian, Alaska.

Section 22, Unsurveyed, All, 640.00 acres;
Section 23, Unsurveyed, All, 640.00 acres;
Section 24, Unsurveyed, All, 490.70 acres;
Section 25, Unsurveyed, All, 632.30 acres;
Section 26, Unsurveyed, All, including U.S. Survey 5503 Lot 3, 640.00 acres;
Section 27, Unsurveyed, All, including U.S. Survey 5503 Lot 3 and excluding Plumb Bob Lake, 603.14 acres;
Section 34, Unsurveyed, All, including the bed of the Tazlina River, 640.00 acres;
Section 35, Unsurveyed, All, 640.00 acres;
Section 36, Unsurveyed, All, 640.00 acres;

This Tract (4) contains 5,566.14 acres, more or less.

Legal Tract: 5

T. 4 N., R. 5 W., Tract A, Copper River Meridian, Alaska.

Section 1, Unsurveyed, All, 640.00 acres;
Section 2, Unsurveyed, All, 640.00 acres;
Section 3, Unsurveyed, All, 640.00 acres;
Section 10, Unsurveyed, All, 640.00 acres;
Section 11, Unsurveyed, All, including U.S. Survey 5680 Lot 1, 618.74 acres;
Section 12, Unsurveyed, All, 640.00 acres;
Section 15, Unsurveyed, All, 640.00 acres;

T. 4 N., R. 5 W., Copper River Meridian, Alaska.

Section 13, Surveyed, Fractional, Lots 3 and 7 through 16, S1/2SW1/4, 231.04 acres;
Section 14, Surveyed, Fractional, Lots 1 through 5, W1/2, W1/2SE1/4, SE1/4SE1/4, 538.65 acres;

This Tract (5) contains 5,228.43 acres, more or less.

Legal Tract: 6

T. 4 N., R. 5 W., Tract A, Copper River Meridian, Alaska.

Section 4, Unsurveyed, All, 640.00 acres;
Section 5, Unsurveyed, All, 640.00 acres;
Section 6, Unsurveyed, All, 598.00 acres;
Section 7, Unsurveyed, All, 599.00 acres;
Section 8, Unsurveyed, All, 640.00 acres;
Section 9, Unsurveyed, All, 640.00 acres;
Section 16, Unsurveyed, All, 640.00 acres;
Section 17, Unsurveyed, All, 640.00 acres;
Section 18, Unsurveyed, All, 601.00 acres;

This Tract (6) contains 5,638.00 acres, more or less.

Legal Tract: 7

T. 4 N., R. 5 W., Tract A, Copper River Meridian, Alaska.

Section 19, Unsurveyed, All, 603.00 acres;
Section 20, Unsurveyed, All, 640.00 acres;
Section 21, Unsurveyed, All, 640.00 acres;
Section 28, Unsurveyed, All, 452.76 acres;
Section 29, Unsurveyed, All, 556.99 acres;
Section 30, Unsurveyed, All, excluding that portion between U.S. Survey 3121 and the centerline of the Glenn Highway, 332.16 acres;
Section 31, Unsurveyed, All, 607.00 acres;
Section 32, Unsurveyed, All, including the bed of Lost Cabin Lake, 640.00 acres;
Section 33, Unsurveyed, All, 640.00 acres;

This Tract (7) contains 5,111.91 acres, more or less.

Legal Tract: 8

T. 4 N., R. 5 W., Tract A, Copper River Meridian, Alaska.

Section 22, Unsurveyed, All, 640.00 acres;
Section 25, Unsurveyed, That portion of the bed of Mae West Lake, 0.86 acres;
Section 26, Unsurveyed, All, including the beds of Mae West Lake and the unnamed creek, 640.00 acres;
Section 27, Unsurveyed, All, including the bed of Soup Lake, 636.72 acres;
Section 34, Unsurveyed, All, 640.00 acres;
Section 35, Unsurveyed, All, including the bed of Mae West Lake, 640.00 acres;
Section 36, Unsurveyed, All, including the bed of Mae West Lake, 640.00 acres;

T. 4 N., R. 5 W., Copper River Meridian, Alaska.

Section 23, Surveyed, All, 640.00 acres;
Section 24, Surveyed, Fractional, Lots 1 and 6 through 11, NE1/4NW1/4, W1/2W1/2, 356.89 acres;
Section 25, Surveyed, Fractional, Lots 1 through 5, NW1/4, N1/2SW1/4, SE1/4SW1/4, SE1/4, 581.54 acres;

This Tract (8) contains 5,416.01 acres, more or less.

Aggregating 43,492.06 acres, more or less.

SCHEDULE 2

Annual Bonding Calculation

(This schedule must be updated and submitted annually to the Division of Oil & Gas)

1.	Enter	Beginning Work Commitment	$ _____
2.	Enter	Cumulative Direct Exploration Expenditures	$ _____
3.	Line 1 Minus Line 2	Balance of Remaining Work Commitment	$ _____
4	Enter	# of Years Remaining in Term of License	_____
5	Line 3 Divided by Line 4	Annual Bond Due	$ _____

Oil and Gas Conversion Lease
Form #DOG 201309 CL

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

Tolsona Oil and Gas Exploration License Conversion 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 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 sixty days 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 the lease is not automatically extended under subsections (a) – (c) above, the state may approve a one-time extension of the primary term of the lease upon written application by the lessee if the state finds that the

extension is in the best interest of the state. A lessee requesting a one-time extension must send the request to the state at least 180 days before the expiration date of the primary term of the lease. The length of the primary term of the lease combined with the term of the one-time extension may not exceed a total of 10 years. The state shall consider the funds expended by the lessee to explore and develop the lease, the types of work completed by or on behalf of the lessee, and any other relevant information in deciding whether to extend the lease. The state may condition a lease extension on posting of a performance bond by the lessee, meeting a minimum work commitment, or both. The work commitment, if required, must be expressed in terms of money to be spent or type and amount of work to be performed.

(e) 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.

(f) 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.

(g) 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.

(h) 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 of $3.00 per acre or fraction of an acre, provided that the state may increase the annual rental rate as provided by law upon extension of this lease beyond the primary term.

(b) Annual rental paid in advance is a credit on the royalty or net profit share due under this lease for that year.

(c) The lessee shall pay the annual rental to the State of Alaska (or any depository designated by the state with at least 60 days notice to the lessee) in advance, on or before the annual anniversary date of this lease. The state is not required to give notice that rentals are due by billing the lessee. If the state's (or depository's) office is not open for business on the annual anniversary date of this lease, the time for payment is extended to include the next day on which that office is open for business. If the annual rental is not paid timely, this lease automatically terminates as to both parties at 11:59 p.m., Alaska Standard Time, on the date by which the rental payment was to have been made.

6. RECORDS. The lessee shall keep and have in its possession books and records showing the development and production (including records of development and production expenses) and disposition (including records of sale prices, volumes, and purchasers) of all oil, gas, and associated substances produced from the leased area. The lessee shall permit the State of Alaska or its agents to examine these books and records at all reasonable times. Upon request by the state, the lessee's books and records shall be made available to the state at the state office designated by the state. These books and records of development, production, and disposition must employ methods and techniques that will ensure the most accurate figures reasonably available without requiring the lessee to provide separate tankage or meters for each well. The lessee shall use generally accepted accounting procedures consistently applied.

7. APPORTIONMENT OF ROYALTY FROM APPROVED UNIT. The landowners' royalty share of the unit production allocated to each separately owned tract shall be regarded as royalty to be distributed to and among, or the proceeds of it paid to, the landowners, free and clear of all unit expense and free of any lien for it. Under this provision, the state's royalty share of any unit production allocated to the leased area will be regarded as royalty to be distributed

to, or the proceeds of it paid to, the state, free and clear of all unit expenses (and any portion of those expenses incurred away from the unit area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing oil, gas, or associated substances for transportation off the unit area, and free of any lien for them.

8. PAYMENTS. All payments to the State of Alaska under this lease must be made payable to the state in the manner directed by the state, and unless otherwise specified, must be tendered to the state at:

DEPARTMENT OF NATURAL RESOURCES
550 WEST 7TH AVENUE, SUITE 1410
ANCHORAGE, ALASKA 99501-3561
ATTENTION: FINANCIAL SERVICES SECTION

or in person at either of the Department's Public Information Centers located at

550 W. 7th Ave., Suite 1260
Anchorage, Alaska

3700 Airport Way
Fairbanks, Alaska

or to any depository designated by the state with at least 60 days notice to the lessee.

9. PLAN OF OPERATIONS. (a) Except as provided in (b) of this section, a plan of operations for all or part of the leased area must be approved by the commissioner before any operations may be undertaken on or in the leased area.

(b) A plan of operations is not required for:

(1) activities that would not require a land use permit; or

(2) operations undertaken under an approved unit plan of operations.

(c) Before undertaking operations on or in the leased area, the lessee shall provide for full payment of all damages sustained by the owner of the surface estate as well as by the surface owner's lessees and permittees, by reason of entering the land.

(d) An application for approval of a plan of operations must contain sufficient information, based on data reasonably available at the time the plan is submitted for approval, for the commissioner to determine the surface use requirements and impacts directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

(1) the sequence and schedule of the operations to be conducted on or in the leased area, including the date operations are proposed to begin and their proposed duration;

(2) projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations;

(3) plans for rehabilitation of the affected leased area after completion of operations or phases of those operations; and

(4) a description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas.

(e) In approving a lease plan of operations or an amendment of a plan, the commissioner will require amendments that the commissioner determines necessary to protect the state's interest. The commissioner will not require an amendment that would be inconsistent with the terms of sale under which the lease was obtained, or with the terms of the lease itself, or which would deprive the lessee of reasonable use of the leasehold interest.

(f) The lessee may, with the approval of the commissioner, amend an approved plan of operations.

(g) Upon completion of operations, the lessee shall inspect the area of operations and submit a report indicating the completion date of operations and stating any noncompliance of which the lessee knows, or should reasonably know, with requirements imposed as a condition of approval of the plan.

10. PLAN OF DEVELOPMENT. (a) Except as provided in subparagraph (d) below, within 12 months after completion of a well capable of producing oil, gas, or associated substances in paying quantities, the lessee shall file two copies of an application for approval by the state of an initial plan of development that must describe the lessee's plans for developing the leased area. No development of the leased area may occur until a plan of development has been approved by the state.

(b) The plan of development must be revised, updated, and submitted to the state for approval annually before or on the anniversary date of the previously approved plan. If no changes from an approved plan are contemplated for the following year, a statement to that effect must be filed for approval in lieu of the required revision and update.

(c) The lessee may, with the approval of the state, subsequently modify an approved plan of development.

(d) If the leased area is included in an approved unit, the lessee will not be required to submit a separate lease plan of development for unit activities.

11. DATA SUBMITTAL. (a) The lessee shall submit to the state, at the Department of Natural Resources, Division of Oil & Gas (Division), all geological, geophysical, and engineering data obtained from the lease within 30 days following completion, abandonment, or suspension of each well, pilot hole, and plugged back well bore. The lessee shall also submit to the Division, on behalf of the state, data acquired subsequent to completion, abandonment, or suspension of each well, pilot hole, and plugged back well bore within 30 days following acquisition of those data. The Division, on behalf of the state, may waive receipt of operational data from some development, service, or injection wells, and will inform the operator of the waiver in writing prior to data submittal.

Data shall be submitted according to the instructions set out in Attachment 1.

Submission of data under this paragraph does not affect any statutory or regulatory obligation to submit data or other information to the state or any of its agencies.

(b) Any data submitted to the state, at the Department of Natural Resources, Division of Oil & Gas will be available at all times for use by the state and its agents, and will be held confidential as provided in AS 38.05.035(a)(8) and its applicable regulations. In accordance with AS 38.05.035(a)(8)(C), in order for geological, geophysical, and engineering data to be held confidential, the lessee must request confidentiality at the time of submission and mark the data “CONFIDENTIAL” in compliance with applicable regulations.

12. DIRECTIONAL DRILLING. This lease may be maintained in effect by directional wells whose bottom hole location is on the leased area but that are drilled from locations on other lands not covered by this lease. In those circumstances, drilling will be considered to have commenced on the leased area when actual drilling is commenced on those other lands for the purpose of directionally drilling into the leased area. Production of oil or gas from the leased area through any directional well surfaced on those other lands, or drilling or reworking of that directional well, will be considered production or drilling or reworking operations on the leased area for all purposes of this lease. Nothing contained in this paragraph is intended or will be construed as granting to the lessee any interest, license, easement, or other right in or with respect to those lands in addition to any interest, license, easement, or other right that the lessee may have lawfully acquired from the state or from others.

13. DILIGENCE AND PREVENTION OF WASTE. (a) The lessee shall exercise reasonable diligence in drilling, producing, and operating wells on the leased area unless consent to suspend operations temporarily is granted by the state.

(b) Upon discovery of oil or gas on the leased area in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geologic structure at another location with a reasonable profit to the operator, the lessee must drill those wells as a reasonable and prudent operator would drill, having due regard for the interest of the state as well as the interest of the lessee.

(c) The lessee shall perform all operations under this lease in a good and workmanlike manner in accordance with the methods and practices set out in the approved plan of operations and plan of development, with due regard for the prevention of waste of oil, gas, and associated substances and the entrance of water to the oil and gas-bearing sands or strata to the destruction or injury of those sands or strata, and to the preservation and conservation of the property for future productive operations. The lessee shall carry out at the lessee's expense all orders and requirements of the State of Alaska relative to the prevention of waste and to the preservation of the leased area. If the lessee fails to carry out these orders, the state will have the right, together with any other available legal recourse, to enter the leased area to repair damage or prevent waste at the lessee's expense.

(d) The lessee shall securely plug in an approved manner any well before abandoning it.

14. OFFSET WELLS. The lessee shall drill such wells as a reasonable and prudent operator would drill to protect the state from loss by reason of drainage resulting from production on other land. Without limiting the generality of the foregoing sentence, if oil or gas is produced in a well on other land not owned by the State of Alaska or on which the State of Alaska receives a lower rate of royalty than under this lease, and that well is within 500 feet in the case of an oil well or 1,500 feet in the case of a gas well of lands then subject to this lease, and that well produces oil or gas for a period of 30 consecutive days in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geological structure at an offset location with a reasonable profit to the operator, and if, after notice to the lessee and an opportunity to be heard, the state finds that production from that well is draining lands then subject to this lease, the lessee shall within 30 days after written demand by the state begin in good faith and diligently prosecute drilling operations for an offset well on the leased area. In lieu of drilling any well required by this paragraph, the lessee may, with the state's consent, compensate the state in full each month for the estimated loss of royalty through drainage in the amount determined by the state.

15. UNITIZATION. (a) The lessee may unite with others, jointly or separately, in collectively adopting and operating under a cooperative or unit agreement for the exploration, development, or operation of the pool, field, or like area or part of the pool, field, or like area that includes or underlies the leased area or any part of the leased area whenever the state determines and certifies that the cooperative or unit agreement is in the public interest.

(b) The lessee agrees, within six months after demand by the state, to subscribe to a reasonable cooperative or unit agreement that will adequately protect all parties in interest, including the state. The state reserves the right to prescribe such an agreement.

(c) With the consent of the lessee, and if the leased area is committed to a unit agreement approved by the state, the state may establish, alter, change, or revoke drilling, producing, and royalty requirements of this lease as the state determines necessary or proper to secure the proper protection of the public interest.

(d) Except as otherwise provided in this subparagraph, where only a portion of the leased area is committed to a unit agreement approved or prescribed by the state, that commitment constitutes a severance of this lease as to the unitized and nonunitized portions of the leased area. The portion of the leased area not committed to the unit will be treated as a separate and distinct lease having the same effective date and term as this lease and may be maintained only in accordance with the terms and conditions of this lease, statutes, and regulations. Any portion of the leased area not committed to the unit agreement will not be affected by the unitization or pooling of any other portion of the leased area, by operations in the unit, or by suspension approved or ordered for the unit. If the leased area has a well certified, under 11 AAC 83.361, as capable of production in paying quantities as defined in 11 AAC 83.395(4) on it before commitment to a unit agreement, this lease will not be severed. If any portion of this lease is included in a participating area formed under a unit agreement, the entire leased area will remain committed to the unit and this lease will not be severed.

16. INSPECTION. The lessee shall keep open at all reasonable times, for inspection by any duly authorized representative of the State of Alaska, the leased area, all wells, improvements, machinery, and fixtures on the leased area, and all reports and records relative to operations and surveys or investigations on or with regard to the leased area or under this lease. Upon request, the lessee shall furnish the State of Alaska with copies of and extracts from any such reports and records.

17. SUSPENSION. The state may from time to time direct or approve in writing suspension of production or other operations under this lease.

18. ASSIGNMENT, PARTITION, AND CONVERSION. This lease, or an interest in this lease, may, with the approval of the state, be assigned, subleased, or otherwise transferred to any person or persons qualified to hold a lease. No assignment, sublease, or other transfer of an interest in this lease, including assignments of working or royalty interests and operating agreements and subleases, will be binding upon the state unless approved by the state. The lessee shall remain liable for all obligations under this lease accruing prior to the approval by the state of any assignment, sublease, or other transfer of an interest in this lease. All provisions of this lease will extend to and be binding upon the heirs, administrators, successors, and assigns of the state and the lessee. Applications for approval of an assignment, sublease, or other transfer must comply with all applicable regulations and must be filed within 90 days after the date of final execution of the instrument of transfer. The state will approve a transfer of an undivided interest in this lease unless the transfer would adversely affect the interests of Alaska or the application does not comply with applicable regulations. The state will disapprove a transfer of a divided interest in this lease if the transfer covers only a portion of the lease or a separate and distinct zone or geological horizon unless the lessee demonstrates that the proposed transfer of a divided interest is reasonably necessary to accomplish exploration or development of the lease, the lease is committed to an approved unit agreement, the lease is allocated production within an approved participating

area, or the lease has a well capable of production in paying quantities. The state will make a written finding stating the reasons for disapproval of a transfer of a divided interest. Where an assignment, sublease, or other transfer is made of all or a part of the lessee's interest in a portion of the leased area, this lease may, at the option of the state or upon request of the transferee and with the approval of the state, be severed, and a separate and distinct lease will be issued to the transferee having the same effective date and terms as this lease.

19. SURRENDER. The lessee at any time may file with the state a written surrender of all rights under this lease or any portion of the leased area comprising one or more legal subdivisions or, with the consent of the state, any separate and distinct zone or geological horizon underlying the leased area or one or more legal subdivisions of the leased area. That surrender will be effective as of the date of filing, subject to the continued obligations of the lessee and its surety to make payment of all accrued royalties and to place all wells and surface facilities on the surrendered land or in the surrendered zones or horizons in condition satisfactory to the state for suspension or abandonment. After that, the lessee will be released from all obligations under this lease with respect to the surrendered lands, zones, or horizons.

20. DEFAULT AND TERMINATION; CANCELLATION. (a) The failure of the lessee to perform timely its obligations under this lease, or the failure of the lessee otherwise to abide by all express and implied provisions of this lease, is a default of the lessee's obligations under this lease. Whenever the lessee fails to comply with any of the provisions of this lease (other than a provision which, by its terms, provides for automatic termination), and fails within 60 days after written notice of that default to begin and diligently prosecute operations to remedy that default, the state may terminate this lease if at the time of termination there is no well on the leased area capable of producing oil or gas in paying quantities. If there is a well on the leased area capable of producing oil or gas in paying quantities, this lease may be terminated by an appropriate judicial proceeding. In the event of any termination under this subparagraph, the lessee shall have the right to retain under this lease any and all drilling or producing wells for which no default exists, together with a parcel of land surrounding each well or wells and rights-of-way through the leased area that are reasonably necessary to enable the lessee to drill, operate, and transport oil or gas from the retained well or wells.

(b) The state may cancel this lease at any time if the state determines, after the lessee has been given notice and a reasonable opportunity to be heard, that:

(1) continued operations pursuant to this lease probably will cause serious harm or damage to biological resources, to property, to mineral resources, or to the environment (including the human environment);

(2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and

(3) the advantages of cancellation outweigh the advantages of continuing this lease in effect.

Any cancellation under this subparagraph will not occur unless and until operations under this lease have been under suspension or temporary prohibition by the state, with due extension of the term of this lease, continuously for a period of five years or for a lesser period upon request of the lessee.

(c) Any cancellation under subparagraph (b) will entitle the lessee to receive compensation as the lessee demonstrates to the state is equal to the lesser of:

(1) the value of the cancelled rights as of the date of cancellation, with due consideration being given to both anticipated revenues from this lease and anticipated costs, including costs of compliance with all applicable regulations and stipulations, liability for clean-up costs or damages, or both, in the case of an oil spill, and all other costs reasonably anticipated under this lease; or

(2) the excess, if any, over the lessee's revenues from this lease (plus interest on the excess from the date of receipt to date of reimbursement) of all consideration paid for this lease and all direct expenditures made by the lessee after the effective date of this lease and in connection with exploration or development, or both, under this lease, plus interest on that consideration and those expenditures from the date of payment to the date of reimbursement.

21. RIGHTS UPON TERMINATION. Upon the expiration or earlier termination of this lease as to all or any portion of the leased area, the lessee will be directed in writing by the state and will have the right at any time within a period of one year after the termination, or any extension of that period as may be granted by the state, to remove from the leased area or portion of the leased area all machinery, equipment, tools, and materials. Upon the expiration of that period or extension of that period and at the option of the state, any machinery, equipment, tools, and materials that the lessee has not removed from the leased area or portion of the leased area become the property of the state or may be removed by the state at the lessee's expense. At the option of the state, all improvements such as roads, pads, and wells must either be abandoned and the sites rehabilitated by the lessee to the satisfaction of the state, or be left intact and the lessee absolved of all further responsibility as to their maintenance, repair, and eventual abandonment and rehabilitation. Subject to the above conditions, the lessee shall deliver up the leased area or those portions of the leased area in good condition.

22. DAMAGES AND INDEMNIFICATION. (a) No rights under the AS 38.05.125 reservation may be exercised by the lessee until the lessee has provided to pay the owner of the land, his lessees and permittees, upon which the AS 38.05.125 reserved rights are sought to be exercised, full payment for all damage sustained by the owner by reason of entering the land. If the owner for any reason does not settle the damages, the lessee may enter the land after posting a surety bond determined by the state, after notice and an opportunity to be heard, to be sufficient as to form, amount, and security to secure to the owner, his lessees and permittees, payment for damages, and may institute legal proceedings in a court of competent jurisdiction where the land is located to determine the damages which the owner of the land may suffer. The lessee agrees to pay for any damages that may become payable under AS 38.05.130 and to indemnify the state and hold it harmless from and against any claims, demands, liabilities, and expenses arising from or in connection with such damages. The furnishing of a bond in compliance with this paragraph will be regarded by the state as sufficient provision for the payment of all damages that may become payable under AS 38.05.130 by virtue of this lease.

(b) The lessee shall indemnify the state for, and hold it harmless from, any claim, including claims for loss or damage to property or injury to any person caused by or resulting from any act or omission committed under this lease by or on behalf of the lessee. The lessee is not responsible to the state under this subparagraph for any loss, damage, or injury caused by or resulting from the sole negligence of the state.

(c) The lessee expressly waives any defense to an action for breach of a provision of this lease or for damages resulting from an oil spill or other harm to the environment that is based on an act or omission committed by an independent contractor in the lessee's employ. The lessee expressly agrees to assume responsibility for all actions of its independent contractors.

23. BONDS. (a) If required by the state, the lessee shall furnish a bond prior to the issuance of this lease in an amount equal to at least $5 per acre or fraction of an acre contained in the leased area, but no less than $10,000, and must maintain that bond as long as required by the state.

(b) The lessee may, in lieu of the bond required under (a) above, furnish and maintain a statewide bond in accordance with applicable regulations.

(c) The state may, after notice to the lessee and a reasonable opportunity to be heard, require a bond in a reasonable amount greater than the amount specified in (a) above where a greater amount is justified by the nature of the surface and its uses and the degree of risk involved in the types of operations being or to be carried out under this lease. A statewide bond will not satisfy any requirement of a bond imposed under this subparagraph, but will be considered by the state in determining the need for and the amount of any additional bond under this subparagraph.

(d) If the leased area is committed in whole or in part to a cooperative or unit agreement approved or prescribed by the state, and the unit operator furnishes a statewide bond, the lessee need not maintain any bond with respect to the portion of the leased area committed to the cooperative or unit agreement.

24. AUTHORIZED REPRESENTATIVES. The Director of the Division of Oil and Gas, Department of Natural Resources, State of Alaska, and the person executing this lease on behalf of the lessee shall be authorized representatives for their respective principals for the purposes of administering this lease. The state or the lessee may change the designation of its authorized representative or the address to which notices to that representative are to be sent by a notice given in accordance with Paragraph 25 below. Where activities pursuant to a plan of operations are underway, the lessee shall also designate, pursuant to a notice under Paragraph 25 below, by name, job title, and address, an agent who will be present in the state during all lease activities.

25. NOTICES; PROTEST. (a) Any notices required or permitted under this lease must be by electronic media producing a permanent record or in writing and must be given personally or by registered or certified mail, return receipt requested, addressed as follows:

TO THE STATE:

DIRECTOR, DIVISION OF OIL AND GAS
DEPARTMENT OF NATURAL RESOURCES
550 WEST 7TH AVENUE, SUITE 1100
ANCHORAGE, ALASKA 99501-3563

TO THE LESSEE:

(b) Any notice given under this paragraph will be effective when delivered to the above authorized representative.

(c) A lessee who wishes to protest the amount of money due the state under the lease or any action of the state regarding a provision of this lease must file a written protest with the Division of Oil and Gas within 30 days after the mailing date of the state's notice or bill. A lessee who fails to file a protest within the required time waives any further right to protest. The state will establish the administrative appeal procedure to be followed and will inform the lessee of the procedure no later than 30 days after the filing of the written protest.

26. STATUTES AND REGULATIONS. This lease is subject to all applicable state and federal statutes and regulations in effect on the effective date of this lease, and insofar as is constitutionally permissible, to all statutes and regulations placed in effect after the effective date of this lease. A reference to a statute or regulation in this lease includes any change in that statute or regulation whether by amendment, repeal and replacement, or other means. This lease does not limit the power of the State of Alaska or the United States of America to enact and enforce legislation or to promulgate and enforce regulations affecting, directly or indirectly, the activities of the lessee or its agents in connection with this lease or the value of the interest held under this lease. In case of conflicting provisions, statutes and regulations take precedence over this lease.

27. INTERPRETATION. This lease is to be interpreted in accordance with the rules applicable to the interpretation of contracts made in the State of Alaska. The paragraph headings are not part of this lease and are inserted only for convenience. The state and the lessee expressly agree that the law of the State of Alaska will apply in any judicial proceeding affecting this lease.

28. INTEREST IN REAL PROPERTY. It is the intention of the parties that the rights granted to the lessee by this lease constitute an interest in real property in the leased area.

29. WAIVER OF CONDITIONS. The state reserves the right to waive any breach of a provision of this lease, but any such waiver extends only to the particular breach so waived and does not limit the rights of the state with respect to any future breach; nor will the waiver of a particular breach prevent cancellation of this lease for any other cause or for the same cause occurring at another time. Notwithstanding the foregoing, the state will not be deemed to have waived a provision of this lease unless it does so in writing.

30. SEVERABILITY. If it is finally determined in any judicial proceeding that any provision of this lease is invalid, the state and the lessee may jointly agree by a written amendment to this lease that, in consideration of the provisions in that written amendment, the invalid portion will be treated as severed from this lease and that the remainder of this lease, as amended, will remain in effect.

31. LOCAL HIRE. The lessee is encouraged to hire and employ local and Alaska residents and companies, to the extent they are available and qualified, for work performed on the leased area. Lessees shall submit, with the plans of operations, a proposal detailing the means by which the lessee will comply with this measure. The lessee is encouraged, in formulating this proposal, to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

32. CONDITIONAL LEASE. If all or a part of the leased area is land that has been selected by the state under laws of the United States granting lands to the state, but the land has not been patented to the state by the United States, then this lease is a conditional lease as provided by law until the patent becomes effective. If for any reason the selection is not finally approved, or the patent does not become effective, any rental, royalty, or other production or profit-based payments made to the state under this lease will not be refunded.

33. NONDISCRIMINATION. The lessee and the lessee's contractors and subcontractors may not discriminate against any employee or applicant because of race, religion, marital status, change in marital status, pregnancy, parenthood, physical handicap, color, sex, age, or national origin as set out in AS 18.80.220. The lessee and its contractors and subcontractors must, on beginning any operations under this lease, post in a conspicuous place notices setting out this nondiscrimination provision.

34. DEFINITIONS. All words and phrases used in this lease are to be interpreted where possible in the manner required in respect to the interpretation of statutes by AS 01.10.040. However, the following words have the following meanings unless the context unavoidably requires otherwise:

(1) "oil" means crude petroleum oil and other hydrocarbons, regardless of gravity, that are produced in liquid form by ordinary production methods, including liquid hydrocarbons known as distillate or condensate recovered by separation from gas other than at a gas processing plant;

(2) "gas" means all natural gas (except helium gas) and all other hydrocarbons produced that are not defined in this lease as oil;

(3) "associated substances" means all substances except helium produced as an incident of production of oil or gas by ordinary production methods and not defined in this lease as oil or gas;

(4) "drilling" means the act of boring a hole to reach a proposed bottom hole location through which oil or gas may be produced if encountered in paying quantities, and includes redrilling, sidetracking, deepening, or other means necessary to reach the proposed bottom hole location, testing, logging, plugging, and other operations necessary and incidental to the actual boring of the hole;

(5) "reworking operations" means all operations designed to secure, restore, or improve production through some use of a hole previously drilled, including, but not limited to, mechanical or chemical treatment of any horizon, plugging back to test higher strata, etc.;

(6) "paying quantities" means production in quantities sufficient to yield a return in excess of operating costs, even though drilling and equipment costs may never be repaid and the undertaking considered as a whole may ultimately result in a loss; and

(7) "force majeure" means war, riots, acts of God, unusually severe weather, or any other cause beyond the lessee's reasonable ability to foresee or control and includes operational failure of existing transportation facilities and delays caused by judicial decisions or lack of them.

35. ROYALTY ON PRODUCTION. Except for oil, gas, and associated substances used on the leased area for development and production or unavoidably lost, the lessee shall pay to the state as a royalty percent in amount or value of the oil, gas, and associated substances saved, removed, or sold from the leased area and of the gas from the leased area used on the leased area for extraction of natural gasoline or other products.

36. VALUE. (a) For the purposes of computing royalties due under this lease, the value of royalty oil, gas, or associated substances shall not be less than the highest of:

(1) the field price received by the lessee for the oil, gas, or associated substances;

(2) the volume-weighted average of the three highest field prices received by other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices reported by other producers, the volume-weighted average will be calculated using the lesser number of prices received by other producers in the field or area;

(3) the lessee's posted price in the field or area for the oil, gas, or associated substances; or

(4) the volume-weighted average of the three highest posted prices in the same field or area of the other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices posted by other producers, the volume-weighted average will be calculated using the lesser number of prices posted by other producers in the field or area.

(b) If oil, gas, or associated substances are sold away from the leased or unit area, the term "field price" in subparagraph (a) above will be the cash value of all consideration received by the lessee or other producer from the purchaser of the oil, gas, or associated substances, less the lessee's actual and reasonable costs of transportation away from the leased or unit area to the point of sale. The "actual and reasonable costs of transportation" for marine transportation are as defined in 11 AAC 83.229(a), (b)(2), and (c) – (l).

(c) In the event the lessee does not sell in an arm's-length transaction the oil, gas, or associated substances, the term "field price" in subparagraphs (a) and (b) above will mean the price the lessee would expect to receive for the oil, gas, or associated substances if the lessee did sell the oil, gas, or associated substances in an arm's-length transaction, minus reasonable costs of transportation away from the leased or unit area to the point of sale or other disposition. The lessee must determine this price in a consistent and logical manner using information available to the lessee and report that price to the state.

(d) The state may establish minimum values for the purposes of computing royalties on oil, gas, or associated substances obtained from this lease, with consideration being given to the price actually received by the lessee, to the price or prices paid in the same field or area for production of like quality, to posted prices, to prices received by the lessee and/or other producers from sales occurring away from the leased area, and/or to other relevant matters. In establishing minimum values, the state may use, but is not limited to, the methodology for determining "prevailing value" as defined in 11 AAC 83.227. Each minimum value determination will be made only after the lessee has been given notice and a reasonable opportunity to be heard. Under this provision, it is expressly agreed that the minimum value of royalty oil, gas, or associated substances under this lease may not necessarily equal, and may exceed, the price of the oil, gas, or associated substances.

37. ROYALTY IN VALUE. Except to the extent that the state elects to receive all or a portion of its royalty in kind as provided in Paragraph 38 below, the lessee shall pay to the state that value of all royalty oil, gas, and associated substances as determined under Paragraph 36 above. Royalty paid in value will be free and clear of all lease expenses (and any portion of those expenses that is incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area. All royalty that may become payable in money to the State of Alaska must be paid on or before the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances are produced. The amount of all royalty in value payments which are not paid when due under this lease or the amount which is subsequently determined to be due to the state or the lessee as the result of a redetermination will bear interest from the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances were produced, until the obligation is paid in full. Interest shall accrue at the rate provided in AS 38.05.135(d) or as may later be amended. Royalty payments must be accompanied by such information relating to valuation of royalty as the state may require which may include, but is not limited to, run tickets, evidence of sales, shipments, and amounts of gross oil, gas, and associated substances produced.

38. ROYALTY IN KIND. (a) At the state's option, which may be exercised from time to time upon not less than 50 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, 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 100 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: _____
W. C. Barron
Director, Division of Oil and Gas

STATE OF ALASKA)
) ss.
Third Judicial District)

On , before me appeared _____ of the Division of Oil and Gas of the State of Alaska, Department of Natural Resources, and who executed this lease and acknowledged voluntarily signing it on behalf of the State of Alaska as lessor.

_____
Notary public in and for the State of Alaska
My commission expires _____

LESSEE: _____

Signature: _____

Printed Name/Title: _____

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: _____

Signature: _____

Printed Name/Title: _____

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: _____

Signature: _____

Printed Name/Title: _____

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

Attachment 1. Alaska Department of Natural Resources, Division of Oil & Gas
Submittal of Well Data Required by DNR Lease

Data shall be submitted to the Division in a digital format, generally in PDF. For spreadsheets, include the original Excel document. For images such as maps or charts, include a high-resolution TIFF or JPEG. For logs, see formats specified below, but include a graphical image file of the logs as a PDF or TIFF in addition to the final merged data file of the log curves. Data may be submitted on CD, DVD or USB mass storage device (include any necessary cables). Required data shall include any and all of the following:

1. A copy of the well completion report (AOGCC Form 10-407) for each well bore.
2. Daily drilling reports or a summary report of daily drilling.
3. Latitudinal and longitudinal coordinates for each well, pilot hole, and plugged back well bore with completed surface and bottom hole locations. Coordinates can be based upon either the NAD 83 or NAD 27 geodetic datum as long as the datum used is clearly specified.
4. Directional survey for each well, pilot hole, and plugged back well bore.
5. A list of all logs run and the depth interval covered for each well, pilot hole, and plugged back well bore.
6. A list of formations and other geologic markers encountered and the measured depths (MD) and true vertical depths (TVD) of each, for each well, pilot hole, and plugged back well bore.
7. Summary of cored intervals (conventional and sidewall), including depth, formation name, lithology, presence of oil, gas, gas hydrates, and water, porosity, fractures and apparent dips; indicate "**none**" on completion report or in an attachment if no cores were taken.
8. Core reports including lab analyses of lithology, porosity, permeability (vertical and horizontal, air and liquid), density, capillary pressure, and fluid saturation, if available.
9. Conventional and sidewall core photos (plain light and ultraviolet), if applicable.
10. Identified formation names and corresponding depths for oil, gas, and gas hydrate shows. Indicate "**none**" on the completion report or in an attachment if no shows were observed.
11. Identified depth zones of abnormal pressure. Indicate "**none**" on the completion report or in an attachment if none were observed.
12. A synopsis or summary of testing and all fluid recovery efforts, including production tests (IP), drill stem tests (DST), wireline formation tests (i.e. repeat formation tests (RFT) and modular dynamics tests (MDT)), and any other production and formation testing data; the summary should include test date, time, depth, formation name, method of operation, recovered fluid type(s) and amount(s), fluid rate, gas-oil ratio (GOR), oil gravity, pressure, and choke size, when available. If no tests were undertaken, indicate "**none**" where appropriate on the completion report or in an attachment, if tests were undertaken but failed to recover fluids indicate "**no recovery**".
13. Pressure build-up and fluid PVT analyses, if applicable.
14. Open flow potential test reports and report attachments to AOGCC Forms 10-421.
15. Well test procedures, field chronologies, and field data; including details necessary for evaluation (intervals open to test; volumes of oil, gas, water, mud, and other borehole substances; API gravity; gas density; wellhead and down hole pressure; and formation and wellhead temperature).
16. Geochemical and formation fluid analyses and reports, if applicable.
17. Down hole and surface fluid sampling procedures, field chronologies, raw data, and laboratory test results for all water and hydrocarbon-bearing zones (oil, gas, gas hydrates) sampled; including details sufficient to fully evaluate quality of sample data.
18. Permit to drill (AOGCC form 10-401) and the survey as-built of the well location.
19. LAS Version 2, TAP, TIF, LIS and DLIS (if available) files of final merged open-and cased-hole log data, including specialty logs (such as Schlumberger's cyberlook, formation microscanners and dipmeter logs), measured-while-drilling (MWD) and logged-while-drilling (LWD) logs. Include a graphical image file of the 2-inch MD & TVD logs as a PDF or TIFF in addition to the log data file.
20. LAS Version 2 of final composite mudlog or lithology log curves. Include a graphical image file of the final 2-inch MD & TVD logs, with lithology display, oil, gas, and gas hydrate show indicators, mud properties, and cuttings descriptions and report as a PDF or TIFF in addition to the log data file.
21. Clear, legible files of all well data and reports including, but not limited to, paleontology, palynology, petrography (including point-count analyses), X-ray diffraction analyses, SEM micrographs, thermal maturity, vitrinite reflectance, total organic carbon, RockEval pyrolysis, geochronology, fission track analyses, fluid inclusion analyses, Mercury injection capillary pressure analyses, chemical analyses (EPMA, XRF, ICP, etc.), isotope

analyses, water chemistry, burial and temperature history analyses, strain analyses, acoustic analyses, gas hydrate analyses and well pressure and temperature survey analyses.

22. Final reports of velocity, checkshot or VSP surveys (an ASCII format digital version of the above data shall also be submitted), including seismic profile data in SEG-Y format. Indicate "none" in your response to this request if no velocity, checkshot or VSP surveys were undertaken. Submission of velocity, checkshot, and VSP surveys is always required by DNR under the operator surface-use permit obligations.
23. All coalbed core, gas, and water quality reports including lab analyses of core lithology, coal rank, vitrinite reflectance, maceral composition, total organic carbon, ash, sulfur and BTU content, moisture content, cleating, adsorption/desorption data, residual gas measurements, porosity and permeability analyses, core photos, if available.
24. Any other geoscience- and engineering-related data sets from the well(s).

Please note: Physical samples of well cuttings or cores specified in 20 AAC 25.071(b)(2) and 20 AAC 25.071(b)(4) should be sent to AOGCC, not to the Division.

All material should be either hand-carried by bonded courier or mailed by registered mail to:

Resource Evaluation Section
Alaska Department of Natural Resources, Division of Oil & Gas
550 West 7th Avenue, Suite 1100
Anchorage, AK 99501-3510
Email: DOG.REdata@alaska.gov