May 17, 2018

HOUSTON WILLOW OIL AND GAS EXPLORATION LICENSE

Revised Written Finding of the Director

Alaska Department of
NATURAL RESOURCES
DIVISION OF OIL & GAS

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Revised Written Finding of the Director

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

May 17, 2018

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Chapter One: Director's Written Finding and Decision

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Chapter One: Director's Written Finding and Decision

The State of Alaska encourages oil and gas exploration through the issuance of oil and gas exploration licenses on state lands outside known hydrocarbon basins under AS 38.05.131–134. This final finding 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), disposing of a state interest by issuing the Houston Willow Oil and Gas Exploration License (License) to Samuel H. Cade and Daniel K. Donkel (Licensees) as described in this best interest finding is in the best interests of the state. Issuing the license gives the licensee the exclusive right to explore for deposits of oil and gas subject to the terms of the license (AS 38.05.132(b)(1)). If the licensee accepts the license and meets the work commitment obligations described in the license (Appendix B), the licensee may request a conversion of the license to a lease.

The license may be converted to a lease with no other written findings required, provided work commitment obligations are met. Therefore, any language referring to the "License" or "licensing" in this written finding will also refer to any subsequent leases.

All relevant facts and issues within the scope of review that were known or made known to the Director were reviewed. The Director established the scope of the administrative review and finding to be the reasonably foreseeable significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(e)(1)(A)). Conditions for phasing are met under AS 38.05.035(e)(1)(C).

A. Director's Written Finding

In making this finding, the Director considered applicable laws and regulations, weighed the facts and public comments received during public review that address the matters required by AS 38.05.035(g) and balanced positive and negative effects of potential oil and gas activities. The discussion of these matters is set out in the accompanying chapters of this final 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. VIII § 1).
- 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)).
- AS 38.05.035(e)(1)(A) allows the Director to establish the scope of the administrative review on which the Director's determination is based, and the scope of the written finding supporting that determination.
- AS 38.05.035(e)(1)(B) allows the Director to limit the scope of an administrative review and finding for a proposed disposal to a review of applicable statutes and regulations, and facts pertaining to the land, resources, property, or interest in them that the Director finds are material to the written finding and are known or available to the Director during the

administrative review. AS 38.05.035(h) provides that in preparing a written finding under AS 38.05.035(e)(1), the Director may not be required to speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use for which a written finding is required is more specifically defined.

- The intent of the 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 May 9, 2016, DO&G issued the Final Director's Determination of State Lands Subject to Oil and Gas Exploration Licensing for the Southcentral Region of Alaska which includes the Houston Willow License Area ("License Area"). The Final Determination stated that all state-owned acreage in the Southcentral determination area will be available for oil and gas exploration licensing subject to the provisions of AS 38.05.132.
- AS 38.05.133(f) requires a written finding addressing all matters set out in AS 38.05.035(e) and (g), except for AS 38.05.035(g)(1)(B)(xi), 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.
- The commissioner determines the term for an oil and gas exploration license in accordance with AS 38.05.132 (11 AAC 82.906).
- AS 38.05.134(g) states that the prospective licensee has 30 days after issuance of this finding to accept or reject the issuance of the exploration license as limited or conditioned by the terms contained within this finding.
- Oil and gas activities conducted under an exploration license or oil and gas lease are subject to all applicable laws and regulations.
- 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, various species of waterfowl, black bear, brown bear, and moose. Salmon are more sensitive to blasting from seismic testing, and salmon eggs are extremely sensitive to the shock caused by blasting. Mitigation measures include and address disturbance avoidance, seismic activities, and siting of facilities.
- Several other important subsistence, sport, personal use, and commercial uses of fish and wildlife could be affected by the license as well. Mitigation measures address harvest interference avoidance, public access, road construction, and oil spill prevention.
- Discharges of oil, gas, and hazardous substances into the land, water, and air can harm habitats and fish and wildlife populations. Improved design, construction, operating techniques, proper handling, storage, spill prevention measures, and disposal of such substances can mitigate impacts.
- Increased use of the area for oil and gas activities could affect subsistence uses. However, potential negative effects may be outweighed by potential positive effects such as higher

incomes that offset equipment costs and other subsistence activities. Roads and transportation corridors may also lead to increased access for hunting, fishing, and trapping, which could have both negative and positive effects.

- Communities near the License Area such as Houston, Willow, and Wasilla could see economic benefits through jobs, increased property taxes, and associated business opportunities and patronage. Royalty and rental payment benefit all Alaska residents through payments to the General Fund and Permanent Fund.
- 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 lease activities.
- The Alaska Department of Natural Resources (DNR) possesses a body of knowledge covering oil and gas activities in Alaska and around the world which demonstrates the potential cumulative effects that could occur in the License Area because of subsequent activity.

B. Houston Willow Application and Exploration License

Following the public notice and comment period, the Division of Oil and Gas (DO&G) began developing its written finding. To ensure confidentiality under AS 38.05.035(a)(8), and at the applicant's request under AS 38.05.133(e), DO&G kept confidential the name of the applicant throughout the comment period. Because this final finding concludes that the state's best interest would be served by issuing an exploration license, this finding must identify the prospective licensee (AS 38.05.133(f)). The initial applicants were Mr. Samuel H. Cade, Mr. Daniel K. Donkel, and LAPP Resources, Inc.

LAPP Resources, Inc. has been removed from the application and no exploration license will be issued to LAPP Resources, Inc. because it was dissolved as a corporation in the State of Alaska on December 7, 2012 and is no longer qualified to hold an interest in a lease or license. Since the corporation no longer exists as a legal entity, removing the corporation from the application is a change from the initiating proposal and is required to make the issuance of the exploration license conform to the best interests of the state (AS 38.05.133(f)).

- On April 30, 2007, DO&G received a timely Exploration License Application from Mr. Samuel H. Cade, Mr. Daniel K. Donkel, and LAPP Resources, Inc.
- The License Area consists of approximately 18,698 acres.
- On May 30, 2007, DO&G requested additional information from the applicant under AS 38.05.133(e) about the nature and purpose of the proposed exploration project, the specific work planned, and the exploration target dates. On June 28, 2007, the applicant provided additional information to DO&G.
- On December 17, 2007, DO&G published a notice of intent to evaluate the proposal and request for competing proposals. Responses were due by January 17, 2008. Competing proposals were due by February 18, 2008.

- DO&G did not receive any responses or competing proposals in the allotted time.
- On April 14, 2008, DO&G published a request for comments on exploration licenses in the area. Comments were due by June 13, 2008. On June 13, 2008, DO&G published an extension for the public comment period on exploration licenses in the area. Comments were due by July 14, 2008.
- DO&G received eight comments from organizations and members of public in the allotted time.
- On April 30, 2008, DO&G requested agency information about the region and on proposed gas only exploration in the area. Information submissions were due by June 30, 2008.
- DO&G received five responses to the request for agency information from state and federal agencies and local governments in the allotted time.
- On December 7, 2012, while the application was pending, LAPP Resources, Inc. was dissolved.
- On April 4, 2012, DO&G corresponded with Daniel K. Donkel and Samuel H. Cade and they confirmed that they were still interested in pursuing their application after the dissolution of LAPP Resources Inc.
- On November 2, 2015, Daniel K. Donkel and Samuel H. Cade submitted a written request to amend their application to include oil and gas for this exploration license.
- On January 19, 2016, DO&G published a request for comments on oil and gas exploration licenses in the area. Comments were due by February 26, 2016.
- DO&G received six comments in the allotted time.
- On May 1, 2018, DO&G issued a final written finding of the director.
- On May 17, 2018, DO&G issued an amended written finding of the director to include discussion of changes to certain terms and conditions of the initiating proposal per AS 38.05.133(f)(1).

C. Decision

The Director has weighed the facts and issues known at this time and has set out findings. The Director considered applicable laws and regulations and balanced the potential positive and negative effects given the mitigation measures and other regulatory protections. The Director determined that a shorter term for the license, five years, is in the state's best interests to encourage efficient exploration of the state resources covered by the license. Additionally, the Director established a $750,000 work commitment for this exploration license to reflect the work proposed by the licensees and the expanded scope of the licensees' 2015 proposal. Therefore, the Director finds that the potential benefits of issuing the exploration license outweighs the potential negative effects, and that the Houston Willow Oil and Gas Exploration License issued, as modified, will best serve the interests of the state of Alaska.

The state is sufficiently empowered through constitutional, statutory, and regulatory authority, and its interests are bolstered through the exploration license, and plans of operations to ensure that the

licensee conducts their activities safely and in a manner that protects the environment and maintains opportunities for existing and anticipated uses.

Pursuant to AS 38.05.134(g) the Licensees have 30 days from the issuance of this finding to accept or reject the Exploration License, as limited and conditioned by the terms of this finding. The Licensees' acceptance or rejection of the Exploration License must be submitted in writing.

A person affected by this decision who provided timely written comment on this decision may appeal in accordance with 11 AAC 02. Any appeal 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 appeal this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. If the commissioner does not act on an appeal within 30 days after issuance of this decision, the appeal is considered denied and this decision becomes a final administrative order and decision by the 31st day after issuance for the purposes of an appeal to Superior Court. A copy of 11 AAC 02 may be obtained from any regional information office of the Department of Natural Resources.

Director, Division of Oil and Gas

Chapter Two: Authority and Scope of Review

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Chapter Two: Authority and Scope of Review

The Alaska Department of Natural Resources (DNR), Division of Oil and gas (DO&G) is offering the Houston Willow oil and gas exploration license to Mr. Samuel H. Cade and Mr. Daniel K. Donkel.

Exploration licensing is a program intended to encourage oil and gas exploration in areas far from existing infrastructure with unknown potential and that are outside of the known oil and gas provinces of the North Slope and Cook Inlet regions. The Houston Willow License Area covers approximately 18,698 acres located north of the community of Houston and generally east of the Parks Highway. The License Area consists of state-owned, unencumbered land within Township 18–19 N., Range 3–4 W., Seward Meridian. Only free and unencumbered state-owned subsurface mineral estates are included in the oil and gas exploration license. The exploration license grants the licensee the exclusive right to explore for oil and gas, and could subsequently be converted to an oil and gas lease. A more detailed description of the License Area is found in Chapter Three.

This written finding of the Director is written under the authority of the Alaska Constitution, statutes, and regulations that authorize disposal of oil and gas. As required by AS 38.05.035(e), this chapter establishes the scope of the administrative review and scope of the written finding for the License Area.

A. Constitutional and Statutory Authority

The Alaska Constitution provides that the general policy of the state 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). The legislature has been empowered to make all policy decisions to carry out these general goals, as well as to provide the policies and procedure for the lease, sale, and granting of state-owned land (Alaska Constitution Article VIII, §§ 8, 9, and 12). The Alaska Land Act guides the land management and disposal policy of the state. The Act, codified at AS 38.05, provides the Commissioner of DNR the authority to select, manage, and dispose of state lands, and directs DNR to implement the requisite statutes. The Commissioner has delegated authority for these disposals to the Director of DO&G under DNR department order 003.

Title 38 of the Alaska Lands Act states the people of the state "have an interest in the development of the state's oil and gas resources to maximize the economic and physical recovery of the resources" (AS 38.05.180(a)(1)(A)). Further, the legislature found that it is in the state's best interests to "minimize the adverse impact of exploration, development, production and transportation activity," and "to offer acreage for oil and gas leases or for gas only leases." (AS 38.05.180(a)(2)(A)(ii); AS 38.05.180(a)(2)(B)).

AS 38.05.180(a)(2) further provides it is in the state's best interest to encourage an assessment of its oil and gas resources; allow the maximum flexibility in the methods of issuing leases to

recognize the many varied geographical regions of the state and the different costs of exploring for oil and gas in these regions and minimize the adverse impact of exploration, development, production, and transportation activity; and to offer acreage for oil and gas leases.AS 38.05.134(g) states that the prospective licensee has 30 days after issuance of the exploration license to accept or reject the issuance of the exploration license, as limited, changed, or conditioned by the terms contained within the finding. A discussion of the license's term and work commitment is detailed in Section D-3 of this chapter.

B. Written Findings

Alaska statutes govern the disposal of state-owned mineral interests. Under AS 38.05.035(e), the Director may, with the consent of the commissioner, dispose of state land, resources, property, or interests after determining in a written finding that such action will serve the best interests of the state. The written finding is known as a "best interest finding" and describes the proposed License Area, considers and discusses the potential effects of the license, describes measures to mitigate those effects, and constitutes the Director's determination whether the interests of the state will be best served by the disposal. DO&G issues a final written finding, providing opportunity for public comment after the solicitation for public comments and competing proposals. The final written finding includes a discussion of material issues raised during the public comment period, as well as a summary of the comments received (See Appendix A).

1. Applicable Law and Facts

The best interest finding requirements outlined in AS 38.05.035 provide the Department of Natural Resources (DNR) with procedures to ensure Alaska's resources are developed for the maximum benefit of the state as mandated by article VIII, § 2 of the Alaska Constitution. The authorities applicable to this written finding include the requirements and procedures set out in AS 38.05.035(e)–(m), and Alaska case law applicable to the disposal phase.

Under AS 38.05.035(e), the Director may not dispose of state land, resources, or property, or interests therein, unless the Director first determines in a written finding that such action will serve the best interests of the state. The provisions in AS 38.05.035(e) set out the scope of review and process for the written finding.

The statute also expressly empowers DNR to review projects in phases, allowing the analysis of proposed leasing to focus on the issues pertaining to the disposal phase and the reasonably foreseeable significant effects of leasing. (AS 38.05.035(e)(1)(C)). Further explanation of the statutory direction is provided in the sections below. The regulatory authorities governing exploration, development, production, and transportation of oil and gas development are discussed further in Chapter Seven.

2. Scope of Review

As required by AS 38.05.035(e)(1)(A)–(C), the director, in the written finding:

- shall establish the scope of the administrative review on which the Director's determination is based, the scope of the written finding supporting that determination, and the scope of the administrative review and finding may only address reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal;
- may limit the scope of an administrative review and finding for a proposed disposal to a review of: (1) applicable statutes and regulations; (2) facts pertaining to the land, resources or property, or interest in them that are material to the determination and known to the director or knowledge of which is made available to the director during the administrative review; and (3) issues that, based on the applicable statutes, regulations, facts, and the nature of the uses sought to be authorized by the disposal the director finds are material to the determination of whether the proposed disposal will serve the best interests of the state; and
- may, if the project for which the proposed disposal is sought is a multi-phased development, limit the scope of an administrative review and finding for the proposed disposal to the applicable statutes, and regulations, facts and issues that pertain solely to the disposal phase of a project when the conditions of AS 38.05.035(e)(1)(C)(i)–(iv) are met.

a. Reasonably Foreseeable Effects

The scope of this administrative review and written finding addresses only the reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(e)(1)(A)).

A detailed discussion of the possible effects of unknown future exploration, development, and production activities is not within the scope of this best interest finding. Therefore, the Director has limited the scope of this written finding to the applicable statutes and regulations, facts, and issues pertaining solely to the License Area, and the reasonably foreseeable significant effects of the license disposal. However, this finding does discuss the potential cumulative effects, in general terms, that may occur with oil and gas activities related to exploration, development, production, and transportation within the License Area and any mitigation measures as required by AS 38.05.035(g)(1) and (2).

b. Matters Considered and Discussed

Pursuant to AS 38.05.134(f), a written finding issued in support of an exploration license, must consider and discuss facts related to topics set out under AS 38.05.035(g)(1)(B)(i)–(x) that are known at the time the finding is being prepared. The Director must also consider public comments during the public comment period and within the scope of review set out in Sections A and B.1–2 of this Chapter.

This document is organized for ease of reading and reviewing, and does not necessarily follow the order as found in AS 38.05.035(g)(1)(B) (Table 2.1).

Table 2.1. Topics required by AS 38.05.035(g)(1)(B).

AS 38.05.035(g)(1)(B) subsection number	Description	Location in this document
i	Property descriptions and locations	Chapter Three, Four, and Five
ii	Petroleum potential in general terms	Chapter Six
iii	Fish and wildlife species and their habitats in the area	Chapters Four and Five
iv	Current and projected uses in the area; including uses and value of fish and wildlife	Chapter Five
v	Governmental powers to regulate the exploration, development, production, and the transportation of oil and gas or of gas only	Chapter Seven
vi	Reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas or for gas only 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 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, disadvantages, and relative risks of each	Chapter Six
ix	Reasonably foreseeable fiscal effects of the license disposal and the subsequent activity on the state and affected municipalities and communities	Chapter Eight
x	Reasonably foreseeable effects of exploration, development, production, and transportation involving oil and gas or gas only on municipalities and communities within or adjacent to the License Area	Chapter Eight

The facts and issues under consideration in the supplemental information to the finding may address only reasonably foreseeable, significant effects of the uses proposed to be authorized by any future disposals in the license area (AS 38.05.035(g); AS 38.05.035(e)(1)(A)). The Director does not speculate about possible future effects that are subject to AS 38.05.035(h).

C. Review by Phase

The Director may limit the scope of an administrative review and finding for a proposed disposal when the Director has sufficient information and data available upon which to make a reasoned decision. A discussion of phases of oil and gas activities is contained in Chapter Eight.

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

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

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

(iii) the Department's approval is required before the next phase may proceed; and

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

Phased review is appropriate for exploration licensing. Although the licensee may propose specific exploration activities in an application, the issuance of a license does not authorize any oil or gas activities in the license area without further permits from DNR and potentially other agencies.

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 the successful licensee, 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 the licensee requests the license be converted to a lease, the licensee (lessee at conversion) will have the exclusive right to drill for, extract, remove, clean, process, and dispose of any oil, gas, or associated substances they may find on those lands converted to a lease. The license itself does not, however, give the licensee authority to proceed with any of those activities. The licensee must first obtain additional authorizations and 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 on December 17, 2007, and requested comments on April 14, 2008 (AS 38.05.133(d)). The public comment period was extended on June 13, 2008. An additional round of public comments was requested and published on January 19, 2016 to refresh the public participation on this proposal.

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

Condition (iv) is met by the findings in Chapter One discussing the speculative nature of current information on what future development projects and methods may be proposed that would require post-disposal authorizations; and what permit conditions and mitigation requirements will be appropriate for authorizations at later phases.

The exploration license satisfies the statutory requirements for phased review.

D. Licensing Process

1. Licensing Proposal

Prior to reviewing applications for exploration licensing DO&G must first make a preliminary determination of lands subject to exploration licensing. That preliminary determination must be given public notice and following the comment period and evaluation of the comments received a written determination must be published. On February 2, 2016 under AS 38.05.131(c), the Director made a preliminary written determination of state land for Southcentral Alaska. On May 9, 2016, DO&G issued the Final Director's Determination of State Lands Subject to Oil and Gas Exploration Licensing for the Southcentral Region of Alaska which includes the Houston Willow License Area. The Final Determination states that all state-owned acreage in the Southcentral determination area will be available for oil and gas exploration licensing subject to the provisions of AS 38.05.132.

The state's exploration licensing program[1] supplements the state's conventional oil and gas leasing program by targeting areas outside known oil and gas reserves.[2] 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 a bidder may have to pay to win the right to lease. Exploration licensing gives the licensee the exclusive right to explore for oil and gas without this initial expense. Through exploration licensing, the state will receive subsurface geologic information about these regions; if development occurs after exploration, the state will also receive additional revenue through royalties and taxes.

The licensing process begins in one of two ways:

1. Annually in April, applicants may submit to the commissioner a proposal for exploratory activity within an area they have specified; or
2. The commissioner can request proposals anytime to explore areas determined to be subject to the provisions of AS 38.05.132.

Any proposal received by the Commissioner must designate how much money the applicant will spend on exploration (the work commitment), the amount and location of acreage desired for licensing, and the term (duration) of the license (AS 38.05.133(b)). An exploration license area may range from 10,000 to 500,000 acres and must be reasonably compact and contiguous (AS 38.05.132(c)(2)). The exploration license term may not exceed 10 years (AS 38.05.132(b)(1)). The proposal need not describe the type of exploration activity, although direct exploration expenditures must meet the requirements of AS 38.05.132(f)(1). However, before any exploration license may be granted or any exploration activity may occur, the proposed activity must first go through the authorization processes required by statute.

2. License Proposal Notice and Comments

The Houston Willow Exploration License was initiated on April 30, 2007 when DO&G received a timely Exploration License Application from Mr. Samuel H. Cade, Mr. Daniel K. Donkel, and LAPP Resources, Inc. Agency review and public comments were requested and reviewed as part of the review process for this exploration license proposal. Summaries of the comments received and responses to those comments are included in Appendix A. Chapter 1 contains a more thorough review of the timeline and process for reviewing the license proposal and requesting public comments.

[1] AS 38.05.131 provides that the 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.

[2] Known oil and gas reserves include the North Slope, Beaufort Sea, upper Cook Inlet, and Alaska Peninsula.

3. Term and Work Commitment

In accordance with 11 AAC 82.906 the Director set a five-year term for the exploration license. The initial application included a proposal of the maximum possible term for an exploration license – 10 years. Recent exploration licenses have been shortened to terms of 4-5 years in order to encourage timely exploration and to expedite the gathering and return of data regarding the state's resources. The location of the Houston Willow exploration license is also favorable to a shorter term because it is on the road system and close to infrastructure and support services. There are fewer technical barriers to exploration that would necessitate the maximum term available, as proposed by the licensees.

The work commitment amount was adjusted to reflect the current economic climate and likely costs to conduct a field program sufficient to realize usable data. Costs of the proposed activities described in the proposal were considered, including remote sensing; geological, geochemical, and geophysical studies; and exploration drilling. The Director determined that a $750,000 work commitment is compatible with the proposal. Additionally, the license proposal was amended in October 2015 to include exploration for both oil and gas where it had previously been limited to gas, however the applicants did not propose a corresponding increased work commitment. The expanded scope of the license was also a factor in the decision to increase the work commitment to $750,000.

4. Appeal

After the Commissioner issues the written finding, an eligible individual or organization may request reconsideration 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 if one was held (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 has already requested reconsideration by the agency, and may only appeal those points raised in his or her request for reconsideration (AS 38.05.035(l)). By requiring a party to exhaust the administrative review and reconsideration process before appealing to the Superior Court, the Department has full opportunity to review, analyze, and respond to the appealed concerns before litigation. For the purposes of review, the eligible person appealing bears the burden of establishing the invalidity of the written finding (AS 38.05.035(m)).

5. Exploration License Issuance and Conversion to Lease

After a license is issued, the licensee must pay a one-time $1.00 per acre license fee (AS 38.05.132(c)(6)). The licensee 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)(4)). 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.

An annual report for the license is due on or before the anniversary date of the effective date of the license. The annual report satisfies statutory, regulatory, and exploration requirements for:

- Reporting direct expenditures as requested under 11 AAC 82.960 and defined by AS 38.05.132(f);
- Calculating annual bond as required by the license Schedule 2;
- Annual bonding as required by AS 38.05.132(c)(4)(A) and 11 AAC 82.945(c); and
- Submitting geologic or geophysical data as required by 11 AAC 82.981.

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 (AS 38.05.132(d)(1)). 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)(2)).

Once the work commitment has been met and if the licensee requests, the Commissioner will convert all or a portion of the license area to a standard oil and gas lease (AS 38.05.134). If the exploration license issued was for exploration for and recovery of oil and gas, then the lease issued shall be limited to exploration for and recovery of oil and gas (AS 38.05.180(d)(2)(E)). For these reasons, this written finding contemplates that the exploration license may be converted to a lease.

Chapter Three: Description and Location of the License Area

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Chapter Three: Description and Location of the License Area

AS 38.05.035(g)(1)(B)(i) requires that the Director consider and discuss the property descriptions and locations of the License Area. The following overview includes the property descriptions and locations of the License Area and other information material to the Director's written finding that the exploration license will best serve the state's interest (AS 38.05.035(e)(1)(B)(iii)).

A. Property Location and General Description

The License Area consists of approximately 18,698 acres and is located entirely within the Matanuska-Susitna Borough. The License Area is located in the Susitna River Basin within the Matanuska-Susitna Valley. The valley is bounded by the Alaska Range to the northeast, the Talkeetna Mountains to the northwest, and the Chugach Mountains to the south and east. The License Area is generally located north of the community of Houston, south of Willow, and east of the George Parks Highway (Parks Highway) (Figure 3.1).

Specifically, the License Area consists of state-owned, unencumbered gas estates within Township18–19 N., Range 3–4 W., Seward Meridian. The License Area contains subsurface ownership of state-owned lands and waters, privately-owned lands, Alaska Mental Health Trust lands, University of Alaska lands, and School Trust lands (Figure 3.2). Only free and unencumbered state-owned subsurface mineral estates are included in the exploration license.

One method of access to the License Area may be by vehicle from roughly Milepost 58 to Milepost 64 via the Parks Highway. Portions of the License Area may be accessed by various public secondary roads from the Parks Highway. Alternatively, certain portions of the northeast and northwest areas of the License Area may be accessed by helicopter or by floatplane via small lakes. There are three privately-owned airports within the License Area (ADCRA 2016).

B. Land and Mineral Ownership

The Alaska Statehood Act granted to the State of Alaska the right to select from the federal public domain 102.5 million acres of land to serve as an economic base for the new state. The Statehood Act also granted to Alaska the right to all minerals underlying these selections and specifically required the state to retain this mineral interest when conveying its interests in the land (AS 38.05.125). Therefore, when state land is conveyed to an individual citizen, local government, or other entity, state law requires that the deed reserve the mineral rights for the state. Furthermore, state law reserves to the state the right to reasonable access to the surface for purposes of exploring for, developing and producing the reserved mineral. Surface owners are entitled to damages under AS 38.05.130, but may not deny reasonable access. Mineral closing orders, which are commonly associated with surface land disposals, do not apply to oil and gas leasing.

The Alaska Native Claims Settlement Act (ANCSA), passed by Congress in 1971, also granted newly created regional Native corporations the right to select and obtain from the federal domain,

the land and mineral estates within the regional Native corporation boundaries. It also allowed Native village corporations and individual Alaskan Natives to receive land estate interests. However, overlapping selections created conflicts and delays in conveying the land from the federal government, and some selected lands have yet to be conveyed.

For the most part, the state, as the owner of the retained mineral estate, may lease or license these lands for oil and gas development, however there are some parcels of land within the License Area that are owned by Cook Inlet Regional Incorporated, Knikatnu Incorporated, the University of Alaska, and the Alaska Mental Health Trust Land Office.

Figure 3.1. Houston Willow Area Map

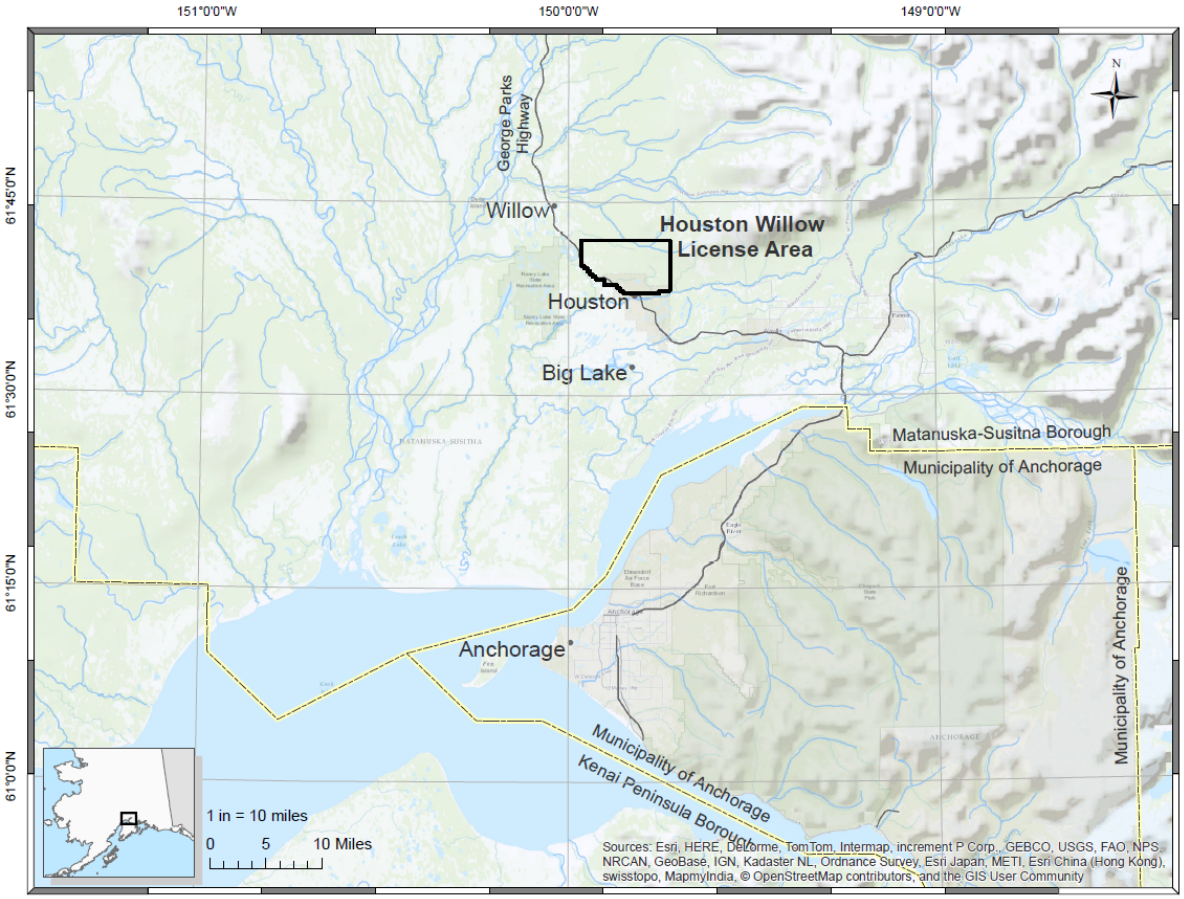
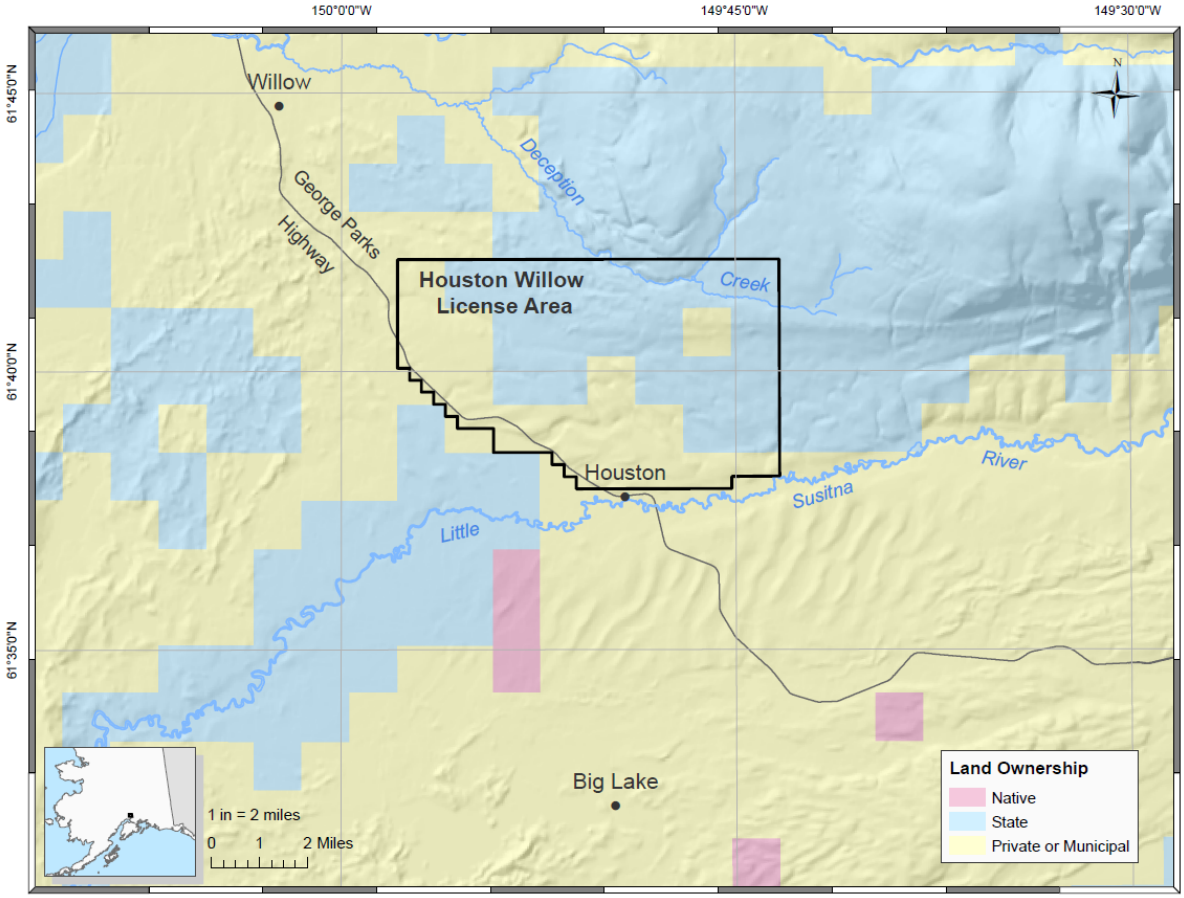


Figure 3.2. Houston Willow Land Status Map



C. History and Cultural Resources

Historic and cultural resources can include a range of sites, deposits, structures, ruins, buildings, graves, artifacts, fossils, and objects of antiquity which provide information pertaining to the historical or prehistoric culture of people in the state, as well as to the natural history of the state.

The Alaska Heritage Resources Survey database indicates that there are approximately six reported cultural resource sites within the License Area. Only a small portion of the state has been surveyed for cultural resources and previously unidentified resources may be located within the License Area. Specific historical accounts for the License Area are unknown, therefore, historical context for the Upper Cook Inlet area, in general, is provided (AHRS 2017).

There is a lack of identified and excavated archeological sites documenting the prehistory of southcentral Alaska. A handful of archeological sites in the Matanuska-Susitna region date to over 8,000 years old, and most of those are found in the mountainous alpine regions. However, two cultural sites in the Susitna River area, the Trapper Creek Overlook and the Susitna Overlook, are dated from 5,000 to 10,000 years old. Excavations of these sites have led archaeologists to conclude that the sites were used for hunting in a period spanning from 7,000 to 12,000 years ago, with the potential for earlier occupations (Wygal and Goebel 2012).

Archaeologists theorize that the Kachemak tradition occupied the Cook Inlet region from 3,400 to 5,000 years ago (Workman and Workman 2010). More recently, the Dena'ina tradition in the Cook Inlet region can be traced archeologically to between 3,000 and 3,500 years ago. The Upper Inlet regional band of the Dena'ina cultural tradition occupied the License Area and much of the Matanuska and Susitna valleys (Metiva and Hanson 2008).

The Upper Inlet regional band of the Dena'ina occupied the Matanuska-Susitna valley area when Russian sailors first sighted Alaska in 1741 and, subsequently, established Russian fur trading outposts in the Alaska region. However, Russian influence was primarily focused along the coast; most Upper Inlet Dena'ina communities remained outside of direct Russian control until the 1840s (Kari and Fall 2003). As such, early Alaska Native village sites exist along the Matanuska and Susitna rivers and their tributaries (Metiva and Hanson 2008).

After the purchase of Alaska by the United States in 1867, the scope of original Dena'ina territory decreased due to gold exploration and American settlement in the Upper Cook Inlet region. Several trails throughout the License Area saw prehistoric and historic use by Alaska Natives, European and American explorers, gold miners, trappers, and the United States government. The Dena'ina people have lived and used the area in and around the License Area for centuries living in semi-permanent villages (Boraas and Leggett 2013).

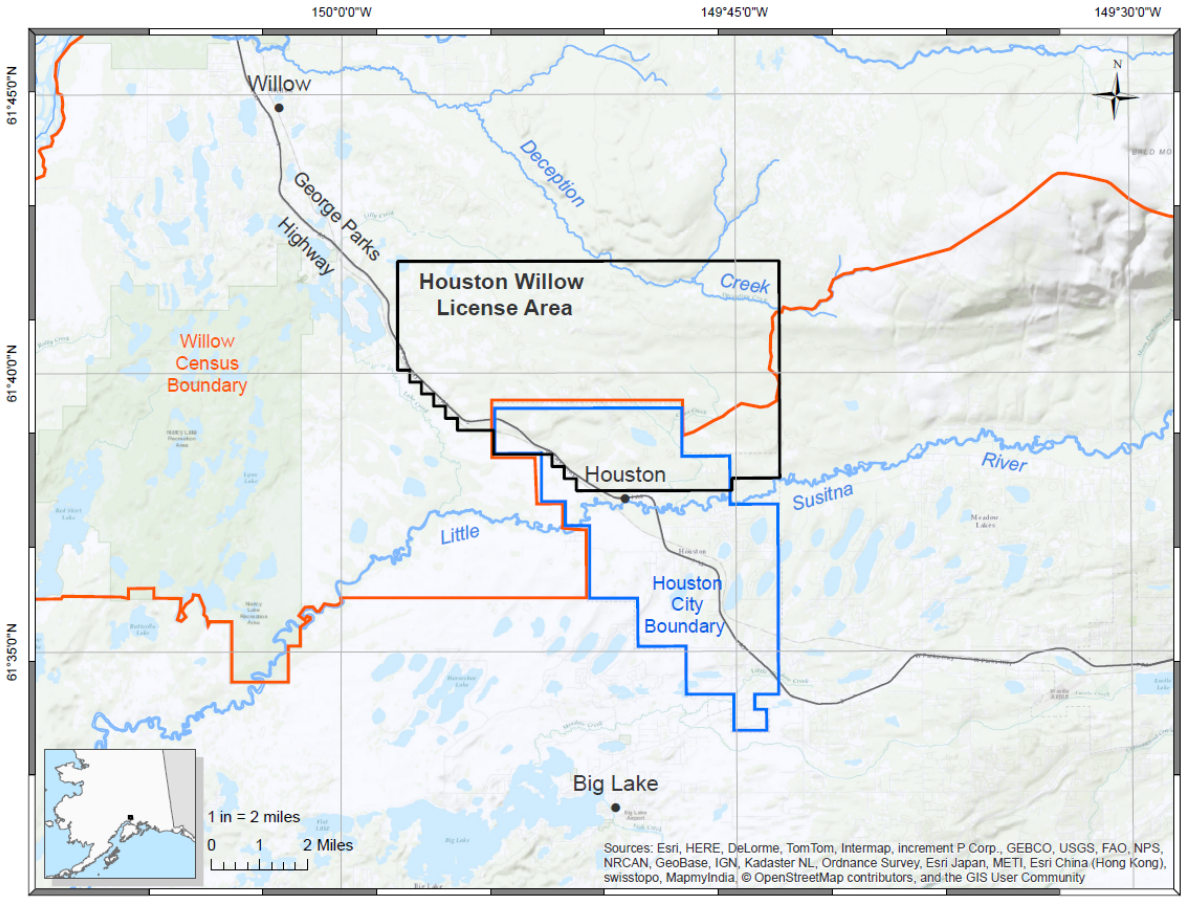
The community of Willow was developed just before 1900 when gold was discovered in the Willow Creek drainage. The prospectors created a series of trails that are now being used as the Alaska Railroad line and a winter trail known as the Double Ender Sled Trail to move materials into the area. The construction of the Alaska Railroad brought more people to the area and a station house was constructed in 1920. An airfield and radar station were constructed by the military during World War II in the area and by the mid-1950s Willow was the largest gold mining district in Alaska and selected to become the capital of Alaska. Due to a lack of funding, plans to move the capital were halted (DCCED 2018a).

Houston Siding, now known as Houston, was first noted on an Alaska Railroad map in 1917 and was named for Tennessee Congressman Sam Houston. The area was the location of the Janios and Athens Coal Mine among other smaller operations and the coal was used to fuel Navy ships in Prince William Sound. In the mid-1950s when power lines and gravel roads were extended north from Wasilla, the area became more populated (DCCED 2018b).

D. Local Communities

The License Area lies entirely within the Matanuska-Susitna Borough. It lies partially within the boundary of the Census Designated Place (CDP) of Willow and partially within the boundary of the town of Houston (Figure 3.3). The community of Big Lake is adjacent to the License Area.

Figure 3.3. Communities Within Houston Willow License Area Map



1. Matanuska-Susitna Borough

a. Population

The Matanuska-Susitna Borough is a second-class borough, with an estimated population of 100,178 people in 2015. The population increased 58 percent between 2000 and 2012 (Fried 2013). In 2010, the population was 84.9 percent Caucasian, 6.5 percent multiracial, 5.5 percent Alaska Native or American Indian, 1.2 percent Asian, 1 percent Black or African American, and 0.2 percent Pacific Islander (ADCRA 2016).

b. Current Economy, Facilities, and Transportation

Between 2009 and 2013, the estimated per capita income of the Matanuska-Susitna Borough (Borough) was $29,534, estimated median household income was $71,037, and estimated median family income was $81,821. In 2010, about 10 percent of the population was below the poverty level (ADCRA 2016). The largest employers in the Borough are the Matanuska-Susitna School District, State of Alaska, Mat-Su Regional Medical Center, Wal-Mart, and Fred Meyer. In 2014, about 17 percent of the workforce worked in state or local government and 15 percent worked in education and health care (DOLWD 2016).

In 2015, there were 45 primary and secondary schools in the Borough with a student population of 18,037 (ADCRA 2016). The Matanuska-Susitna College is located in the Borough and serves over 2,000 students per semester (MSC 2016). The Borough has an on call paid responder system for emergency medical and fire services. The Borough operates a central landfill and a landfill in Skwentna. There are 13 transfer stations located throughout the borough (MSB 2016a).

The Alaska Railroad system and two state highways, the George Parks Highway and Glenn Highway, pass through the Borough. Municipal or state-owned airports are located in Palmer, Wasilla, Talkeetna, and Willow, in addition to numerous smaller federal, state, or private airstrips throughout the Borough (ADCRA 2016). Port Mackenzie is located in the borough and supports a barge dock, a deep-draft dock, and terminal building (MSB 2016b).

2. Big Lake

a. Population

Big Lake is a CDP within the Borough, with an estimated population of 3,629 in 2015. Between 2000 and 2010, the population increased 27 percent. In 2010, Big Lake's population, alone or in combination with other races, was 86.10 percent Caucasian, 10.08 percent Alaska Native or American Indian, 0.20 percent Black or African American, 1.24 percent Asian, 0.79 percent Pacific Islander, and 1.27 percent other (ADCRA 2016).

b. Current Economy, Facilities, and Transportation

Between 2009 and 2013, the estimated per capita income of Big Lake was $27,916, median household income was $63,512, and median family income was $70,903. During the same time period, an estimated 11.4 percent of the population was below the poverty level (ADCRA 2016). In 2014, 23.4 percent of the workforce worked in trade, transportation and utilities, 14.5 percent worked in state and local government, 13.4 percent worked in construction, 11.6 percent worked in educational and health services, and 9.8 percent worked in professional and business services (DOLWD 2016).

In 2015, 478 students attended the Big Lake Elementary School. The CDP contains one public library, a volunteer fire department and state trooper post, and is served by the Palmer landfill (ADCRA 2016).

Big Lake can be accessed by the George Parks Highway and various secondary roads off the George Parks Highway. There are 21 private and state airports within the CDP (ADCRA 2016).

3. Houston

a. Population

Houston is a second-class city within the Borough, with an estimated population of 2,096 in 2015. Between 2000 and 2010, the population increased 59 percent. In 2010, Houston's population, alone or in combination with other races, was 83.27 percent Caucasian, 12.72 percent Alaska Native or

American Indian, 0.33 percent Black or African American, 1.15 percent Asian, 0.24 percent Pacific Islander, and 1.43 percent other (ADCRA 2016).

b. Current Economy, Facilities, and Transportation

Between 2009 and 2013, the estimated per capita income of Houston was $26,442, median household income was $51,974, and median family income was $76,875. During the same time period, an estimated 16.8 percent of the population was below the poverty level (ADCRA 2016). In 2014, 22.0 percent of the workforce worked in trade, transportation and utilities, 14.6 percent worked in state and local government, 14.5 percent worked in educational and health services, 13.8 percent worked in construction, and 9.4 percent worked in leisure and hospitality (DOLWD 2016).

In 2015, 708 students attended the Houston Middle and High Schools. There is no public library in Houston. The Houston Fire Department provides emergency medical and structural firefighting services. The city is served by the unstaffed Houston Police Department, the Alaska State Troopers, and the Palmer landfill (ADCRA 2016).

Houston can be accessed by the George Parks Highway and various secondary roads off the George Parks Highway. There are 6 private airports within the city limits (ADCRA 2016).

4. Willow

a. Population

Willow is a CDP within the Borough, with an estimated population of 2,000 in 2015. Between 2000 and 2010, the population increased 27 percent. In 2010, Willow's population, alone or in combination with other races, was 90.63 percent Caucasian, 7.29 percent Alaska Native or American Indian, 0.00 percent Black or African American, 1.20 percent Asian, 0.18 percent Pacific Islander, and 0.51 percent other (ADCRA 2016).

b. Current Economy, Facilities, and Transportation

Between 2009 and 2013, the estimated per capita income of Willow was $29,978, median household income was $56,612, and median family income was $75,583. During the same time period, an estimated 10.9 percent of the population was below the poverty level (ADCRA 2016). In 2014, 22.6 percent of the workforce worked in trade, transportation and utilities, 17.4 percent worked in state and local government, 14.7 percent worked in educational and health services, 10.9 percent worked in construction, and 10.9 percent worked in professional and business services (DOLWD 2016). Fifteen residents held commercial fishing permits in 2015 (ADCRA 2016).

In 2015, 174 students attended Willow Elementary School and the Beryozova School in the CDP. There is one public library in Willow. The CDP contains one health care facility and is served by a volunteer fire department and the Palmer landfill (ADCRA 2016).

Willow can be accessed by road via the George Parks Highway. The Alaska Railroad system passes through Willow. There are 19 private or state-owned airports within the CDP (ADCRA 2016).

E. Climate

Specific data for the License Area is not readily available, therefore, weather data for Houston, Alaska generally are used to represent weather patterns that are likely to occur in the License Area. Houston is located in the transitional climate zone between the maritime climate of Cook Inlet and the interior weather patterns observed to the north of the License Area. Winters are long and cold with average low temperatures around 10 degrees and the average daily high temperature is below 32 degrees. Summers are comfortable and mostly cloudy with the average daily high temperature above 59 degrees. The wetter season lasts from the beginning of June through the end of October, with August being the rainiest month, and March being the driest month (Weatherspark 2018).

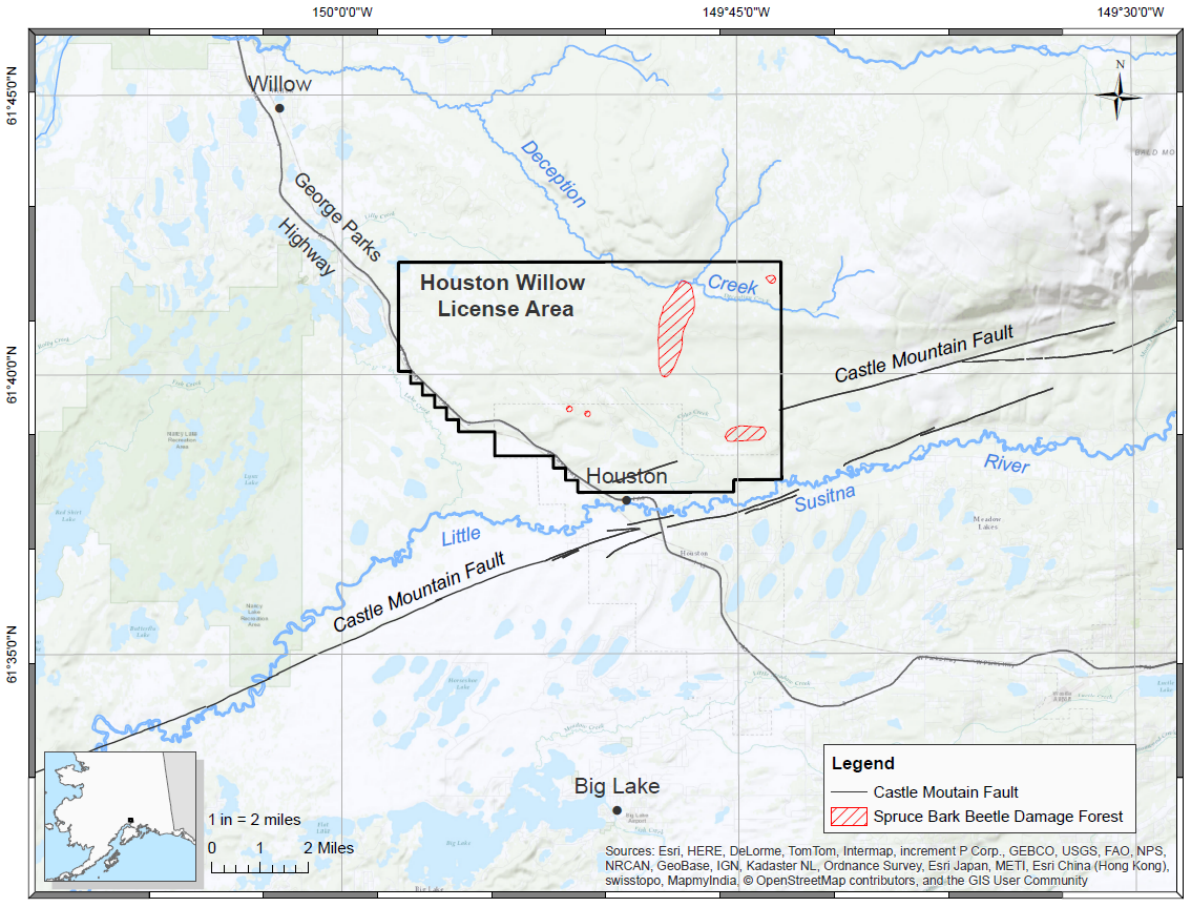
Temperature and precipitation records from 1949 to 2014 show annual and seasonal mean temperature increases throughout Alaska. The average temperature increase in Alaska from 1949 to 2014 was 3.0 °F, although the temperature changes varied greatly across the state. Most of the change occurred in winter and spring months and the least amount in fall (ACRC 2017). According to an ongoing temperature analysis conducted by scientists at NASA's Goddard Institute for Space Studies, the average global temperature on Earth has increased by about 0.8 °C (1.4 °F) since 1880. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15–0.20 °C per decade (NASA 2017).

At northern latitudes, potential effects of climate change may include rising temperatures, and melting glaciers. Northern latitudes including Alaska are sensitive and susceptible to the effects of climate change because much of the social and economic activity is connected to the presence and persistence of permafrost, snow, and ice. Changes in climate can alter natural processes and could increase the magnitude and frequency of certain types of geologic hazards including avalanches, floods, erosion, slope instability, thawing permafrost, and glacial lake outburst floods. If these hazards are not properly addressed, they could have a damaging effect on Alaska's communities and infrastructure, as well as on the livelihoods and lifestyles of Alaskans (DGGS 2017).

F. Natural Hazards

Natural hazards include geological, meteorological, and other naturally occurring phenomena that may have a negative effect on people or the environment. Natural hazards may impose constraints on oil and gas exploration, development, production, and transportation activities. There are five major categories of natural hazards within the area, including earthquakes, erosion, floods, permafrost, and wildfire (Figure 3.4).

Figure 3.4. Natural Hazards Within or Near Houston Willow Area Map



1. Earthquakes

Earthquakes are a common natural hazard that occur in or near the License Area. Ground shaking and surface faulting that accompanies an earthquake can trigger secondary effects such as rockslides, snow avalanches, landslides, and other ground disturbances. The shaking and other results from an earthquake may cause damage or destruction to infrastructure, industry, and human lives (Bolt et al. 2013). Approximately 40 earthquakes of a 2.5 magnitude or greater have occurred within and near the License Area since 1983 (USGS 2016).

The Castle Mountain fault is a contractional feature near the License Area (Haeussler et al. 2002). This fault extends along the southern Talkeetna Mountains and into the Susitna Lowland (Koehler et al. 2011), running nearly parallel to the southern edge of the License Area (Figure 3.4). Paleoseisimic studies have indicated that four significant earthquakes have occurred on the Castle Mountain Fault throughout approximately the past 2700 years, with an average recurrence interval of about 700 years between significant earthquakes. As such, a significant Castle Mountain Fault earthquake may be likely in the near future because it has been approximately 600–700 years since the last significant earthquake (Haeussler et al. 2002).

2. Erosion

Erosion may occur within or near the License Area. Erosion is the gradual destruction or diminution of land where land and water or wind interface. Water erosion may occur through flooding or natural stream channel migration. Impacts from erosion may include loss of infrastructure, structures, and property (ASFPM 2010).

Soils in the Matanuska-Susitna valley range from well to poorly drained. Riverbanks in the Susitna drainage range from gradual beaches to vertical cut banks and most of the shoreland soils are easily eroded. River channels migrate seasonally and erode different reaches of riverbank at different times (USACOE 2007).

Various communities throughout the Matanuska-Susitna valley, including Palmer, Skwentna, Susitna, Talkeetna, Wasilla, and Willow, have reported minimal erosion control issues, where impacts of erosion are not serious and are not affecting community viability (USACOE 2009).

3. Floods

Flooding may occur in or near certain portions of the License Area. Impacts of flooding include damage to property and infrastructure, loss of human life, and spread of disease due to water contaminated by raw sewage, toxins, or other hazardous materials (OSHA 2016).

Excessive rainfall may cause overbank flooding when substantial amounts of rain cause stream water levels to rise to the point of overflowing their banks. Ice jams in rivers or streams may also cause overbank flooding. Ice jams are common during the spring in Alaska, caused by ice moving downstream catching on an obstruction or freezing together. An ice jam can create flooding upstream due to water backing up behind the ice dam, as well as flash flooding downstream when the ice floats, moves, or melts and the blockage breaks. Additionally, river ice breakup and snowmelt commonly occurs around the same time, which may lead to excess water in the channels and increased chance of flooding (NWS 2016a, b).

The Little Susitna River is an example of a river close to the License Area that has a history of flooding. The Little Susitna River runs parallel to the southern edge of the License Area (Figure 3.4) and has flooded at least eight times since 1943 due to both heavy rains and ice jams. These floods have resulted in massive road washouts near Houston, undermined the railroad bed near there which caused a derailment of 13 cars (MSB 2011), and destroyed dwellings located beside the river (AP 2006; MSB 2011).

4. Fires

Wildfires have a high likelihood of occurring within or near the License Area. Burning trash, clearing land, slash burning, and burning debris are the most common causes. Impacts from wildfires may include damage to or loss of structures, infrastructure, or human life (MSB 2008).

April, May, and June are the most active months for wildfires in the Matanuska-Susitna borough. Most of the large wildfires in the Borough have been in dense black spruce forests and associated with windy conditions. Fire risk has also increased in recent years because of forest damage from

spruce bark beetle infestations, which have affected an estimated 309,746 acres of forest in the borough (MSB 2008), including acreage in the License Area (Figure 3.4).

Two major fires that occurred near the License Area include the Miller's Reach Fire and the Sockeye Fire. The Miller's Reach Fire burned 37,000 acres around Big Lake and Houston in 1996, destroying or damaging nearly 450 structures and extensively damaging public infrastructure (FEMA 2016). In 2015, the Sockeye Fire near Willow destroyed 55 homes and caused major damage to outbuildings on 44 properties (Sullivan 2015).

5. Permafrost

Permafrost is rock or soil that has remained at or below 0 °C for two years or more (Ferrians Jr 1994). Permafrost may become a natural hazard if it begins to thaw. Permafrost thawing may be triggered by climate warming, increases in snow accumulation, changes in surface hydrology, or natural or human-caused ground disturbances, such as forest fire or construction (Richter-Menge et al. 2006). Impacts from permafrost thawing may include changes in surface hydrology, changes in ecological systems, changes in the carbon cycle, and thaw settlement (Romanovsky 2004; Pastick et al. 2015).

The License Area lies within an area of the state that is considered to have isolated distribution of permafrost. Although no permafrost has been documented within the License Area, isolated patches of permafrost have been documented in Upper Cook Inlet (Jorgenson et al. 2008; Pastick et al. 2015; Kanevskiy et al. 2013).

6. Volcanoes

No volcanoes are present in the License Area, however, active volcanos along the west side of Cook Inlet may present an ash hazard to the License Area if an eruption should occur. The amount of volcanic ash fallout, if any, in the License Area may vary depending on the strength and length of the eruption and the distance of the erupting volcano from the License Area. Large amounts of volcanic ash may cause lost economic opportunities and may pose a risk to operation of industrial equipment and facilities (NOAA 2010).

In recorded history, frequency of confirmed eruptions and suspected but not confirmed eruptions from the Cook Inlet volcanoes average about 1.7 eruptions per year (AVO 2016). Ash columns may rise tens of thousands of feet into the air from an eruption and prevailing winds tend to blow from the Cook Inlet volcanoes towards the east and northeast (Waythomas and Nye 2002). In 2009, volcanic ash advisories from Mount Redoubt eruptions were issued for southcentral Alaska several times (NOAA 2016) and volcanic ash fell in Houston and Willow in the Susitna Valley (KelJenkins 2016; Associated Press 2009).

7. Mitigation Measures

Several geologic hazards exist in the License Area that could pose potential risks to oil and gas installations and are discussed above.

Detailed site-specific studies may be necessary to identify any specific earthquake hazards for any specific site within the area. The risks from earthquake damage can be mitigated 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 for Alaska. Firebreaks around facilities are recommended to reduce the potential for wildfires to damage infrastructure. Additionally, mitigation measures requiring the siting of facilities away from waterbodies and fish bearing rivers are included in this license to reduce the potential for flood damage to facilities and the resulting effects on the environment.

Although natural hazards could damage oil and gas infrastructure, measures in this best interest finding, regulations, in addition to design and construction standards, are expected to mitigate those hazards. Mitigation measures in this finding address siting of facilities and design and construction of pipelines. A complete listing of mitigation measures is found in Chapter Nine.

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Chapter Four: Habitats, Fish, and Wildlife

Contents

Chapter Four: Habitats, Fish, and Wildlife

This chapter considers and discusses the License 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 habitats and fish and wildlife species that have subsistence, recreational, or commercial value and that are material to the finding of whether the exploration license will best serve the interests of the state (AS 38.05.035(e)(1)(B)).

A. Major Habitats of the Area

The Alaska Department of Fish and Wildlife (ADF&G) manages wildlife resources through game management units (GMUs). The Houston Willow License Area lies within ADF&G's GMU 14A. GMU 14A consists of drainages in GMU 14 bounded on the west by the east bank of the Susitna River, on the north by the north bank of Willow Creek and Peters Creek to its headwaters, then east along the hydrologic divide separating the Susitna River and Knik Arm drainages to the outlet creek at lake 4408, on the east by the eastern boundary of GMU 14, and on the south by Cook Inlet, Knik Arm, the south bank of the Knik River from its mouth to its junction with Knik Glacier, across the face of Knik Glacier and along the north side of Knik Glacier (ADF&G 2016c).

The landforms, vegetation types, and streams and wetlands of the License Area provide habitat for fish, birds, and wildlife. Some of the fish and wildlife of particular importance are salmon, moose, black and brown bears, and several furbearer species. The License Area lies within the Cook Inlet Basin ecological region. The forests of this ecoregion are dominated by hemlock and spruce with open wetlands (Nowacki et al. 2001; Gallant et al. 1995).

Freshwater habitats around the License Area include the outlets of several streams and rivers originating in the Talkeetna Mountains, and ice fields including the Susitna Glacier and Mint Glacier. The rivers and streams within the License Area include Deception Creek, Lilly Creek, tributaries of the Little Susitna River, Zero Lake, Windy Lake, Frying Pan Lake, and several unnamed lakes. The rivers and streams near the License Area include the Little Susitna River, Nancy Lake, L-Shape Lake, and several unnamed lakes (ADF&G 2017a).

1. Terrestrial Habitats

a. Forest

Forest ecosystems support a rich food web because of the numerous habitat niches that correspond with each level of vegetation above ground. Climate, solar radiation, surface water, slope, aspect, soil characteristics, and disturbances together affect vegetation patterns across the upland landscape. Cottonwoods and black spruce predominate in the upper Susitna River valley. The forest creates its own habitats and niches, and the relative mix of species determines specific habitat types, which in turn is influenced by soil type, drainage, elevation, and latitude (ADF&G 2006).

The upland forests, featuring birch, aspen, and white spruce, may have different stages of succession, each harboring different types of wildlife. Early stages of succession provide food for insects, birds, and mammals, where black and brown bears, porcupines, and snowshoe hares eat leaves of the young birch, aspens, and willows (USDA 1998).

b. High Brush

High brush habitats are found throughout the Cook Inlet area, including along streams, above timberline, in avalanche paths, on floodplains, in old forest burns, between beaches and forests, and between tree line and alpine tundra. Trees such as quaking aspen, Alaska paper birch, and white spruce may be scattered thinly throughout the habitat. Shrubs composing this habitat include alder, devil's club, willow, currant, blueberry, raspberry, lingonberry, salmonberry, and dogwood. Other plant species include grasses, lupine, horsetail, fireweed, and several species of fern. Three subsystems of high brush habitats have been identified: coastal alder thickets, floodplain thickets, and birch-alder-willow thickets (ADF&G 2006).

c. Wetlands

Wetlands are transitional zones between aquatic and terrestrial habitats that are characterized by poor soil drainage, and are primarily of four types in Alaska: bogs, grass wetlands, sedge wetlands, and marshes (ADF&G 2006).

The water contained in bogs comes primarily from rainfall rather than from runoff, streams, or groundwater. Bogs are characterized by nearly complete plant cover, including up to 100 percent moss. Grass wetlands are found throughout the Cook Inlet area. Over 50 percent of the plant species are water-tolerant grasses. This habitat is important for recharging ground water, and for maintaining base flows for aquatic resources downstream by storing storm and floodwaters. Sedge wetlands are found in many areas of Southcentral, such as very wet areas of floodplains, slow-flowing margins of ponds, lakes, streams, and sloughs, and in depressions of upland areas (ADF&G 2006).

Marshes, bogs, and tundra that are seasonally flooded and always wet are the most commonly encountered wetland types in the Susitna River valley. Saturated broadleaf shrub-scrub is the second most common. In the area of the confluence of the Indian and Susitna rivers, there are 243 species, 130 genera and 55 families of vegetation whose primary types are low mixed shrub, woodland, and open black spruce, sedge-grass tundra, mat-and-cushion tundra, and birch shrub (AEA 2013).

2. Freshwater Habitats

Alaska's waterways, riparian zones, ponds, and lakes sustain fish and wildlife populations. Water provides migratory routes, spawning and rearing habitats, and overwintering habitats for aquatic species. Terrestrial wildlife uses the water and areas surrounding them for nesting and breeding areas and for seasonal or transportation corridors. Species of birds that overwinter elsewhere in the country or in other habitats within Alaska spend their summers in ponds and lakes for the summer mating, nesting, and rearing season (ADF&G 2006).

The Susitna and Little Susitna Rivers are glacial rivers near the License Area. Glacial rivers are characterized by pronounced daily and seasonal stream-flow fluctuations near the glacier and large year-to-year fluctuations in stream flow. These rivers are low and clear flowing in winter when ground water provides the base flow. Generally, glacial rivers are turbid and have multiple braided channels with erosion and deposition causing frequent channel adjustments (ADF&G 2006).

Additionally, there are clear-water rivers within the License Area that have relatively narrower channel widths, stable beds and banks, relatively low sediment loads, and increased habitat complexity. Clear-water rivers can have 10 times less volume than do glacial rivers and their turbidity is less because groundwater and precipitation provide sources of water (ADF&G 2006).

Riparian zones are the interface between terrestrial and aquatic habitats. Among their several functions is to provide leaf litter, filter sediments and pollution, reduce wind, and regulate water temperature through shading and heat retention. Their root systems provide stream bank and floodplain integrity and stability (ADF&G 2006).

Lakes and ponds with stands of young birch, aspen, and willow are good habitat for muskrat and beaver. Predators in this habitat are coyote, ermine, weasel, red fox, lynx, and sometimes wolverine and wolf (USDA 1998).

Riparian forests and shrublands provide a variety of food types and cover to birds and to the predators and prey of large and small mammals. In the Yentna River drainage, which is part of the Susitna River basin, cottonwood forests and riparian shrublands are common among the riparian plant communities. Cottonwood supports the same fauna as other deciduous forests. Forbs, grasses and berries are present, which attract black and brown bears, hares, voles, lemmings, muskrat, and porcupine. The smaller mammals attract predators such as fox, weasels, mink, river otter, coyote, lynx, and raptors. Seed and insect eating birds are common. Moose, beaver, hare, and their predators frequent areas where shrubs and young cottonwood dominate. Open forests in the riparian zone with forb and grass groundcover support large numbers of rodents and furbearers and the raptors that feed on them. Riparian willows and alders are prime moose habitat for grazing, especially in winter (USDA 1998).

3. State Designated Areas Near the License Area

a. Willow Mountain Critical Habitat Area

North of the License Area, in the Talkeetna Mountain Range east of the Parks Highway between Willow Creek and the Kashwitna River, the Willow Mountain Critical Habitat Area supports some of the largest concentrations of moose found in the state. Located along the western slopes of Willow Mountain, the area encompasses both the upper extent of mixed forest and the lower alpine zone (ADF&G 2017s).

b. Nancy Lake State Recreation Area

Nancy Lake State Recreation Area is adjacent to the west of the License Area and contains approximately 22,000 acres of rolling hills with mature spruce and birch forests, numerous lakes and ponds, and extensive wetland habitats (DNR 2013). Nancy Lake State Recreation Area's

combination of lakes, wetlands, and forests create an ideal habitat for many mammals and birds, including moose, black bears, brown bears, beavers, waterfowl, common loons, and Pacific loons (DNR 2017).

c. Little Susitna State Recreation River

The Little Susitna Recreation River includes approximately 67 river miles of the Little Susitna River and 5.5 miles of Nancy Lake Creek. From the headwaters to the mouth, the Little Susitna River changes from a clear, rushing mountain stream to a slowly meandering muddy river draining marshy lowlands. The terrain within the Little Susitna Recreation River ranges from steep hillsides on the upper river to flat and rolling lowlands on the lower river. Contiguous wetlands are the prevalent land feature in middle sections, particularly in the Nancy Lake Creek area (DNR 1991).

B. Fish and Wildlife Populations

The entire License Area lies within Game Management Unit (GMU) 14A. The diversity of the landforms and vegetation types and the abundance of streams and wetlands in the License Area provide habitat for a wide variety of Alaska's fish and wildlife. The scope of review for the fish and wildlife includes species that are important to subsistence and sport, commercial other fishing; hunting; trapping; and species of concern.

1. Fish

Anadromous fish water bodies within and near the License Area include the Susitna River, Little Susitna River, Deception Creek, Lilly Creek, Nancy Lake, and their tributaries. These waterbodies provide habitat for resident fish, including rainbow trout, Dolly Varden, lake trout, Arctic grayling, northern pike, burbot, and whitefish. In addition, these water bodies provide spawning, rearing, and overwintering sites for a number of anadromous fish species, including Chinook (king), sockeye (red), chum (dog), humpback (pink), and coho (silver) salmon (ADF&G 2016d).

a. Freshwater Species

Within and near the License Area, freshwater lakes and streams provide habitats habitat for several fish species including Arctic grayling, northern pike, burbot, Dolly Varden, whitefish, rainbow trout, and various other species.

i. Arctic Grayling

Arctic grayling are freshwater fish with the largest natural range of any sport fish and are found across nearly the entire state. Arctic grayling of all ages can be found throughout a stream. Adults tend to live in the cooler upper sections of the river and stream systems, sub-adults occupy the middle, while juveniles prefer the warmer lower reaches. Some grayling migrate to spawn, feed, and overwinter while others remain in a short section of a stream for their entire lives. Migratory Arctic grayling move upstream in the spring to spawn and then migrate to summer feeding areas immediately afterward. Arctic grayling seek the deep reaches on lower clear rivers and can tolerate low oxygen regimes in winter months. Their main food source is insects, but they will also eat smaller fish, voles, and shrews (ADF&G 2017b).

Arctic grayling range includes the License Area. Most stocks throughout Alaska are healthy and isolated from potential negative effects such as over-fishing, mining, agriculture, and development (ADF&G 2017b).

ii. Northern Pike

Northern pike spawn in the spring of each year, soon after the ice goes out. Eggs are deposited in the grassy margins of a lake shore, slow-moving stream, or slough. They overwinter in the deep, slow waters of large rivers. Their spawning and overwintering areas tend to be short distances apart. Juvenile northern pike feed on small crustaceans, insects, and smaller fish when they reach 50 millimeters in length. Adults feed on other fish (whitefish, burbot, smaller northern pike, and juvenile salmon), voles, shrews, and small waterfowl (ADF&G 2017n).

Northern pike are common in many smaller lakes and in sloughs and tributaries of the Susitna River and in the Little Susitna River. However, northern pike are not native to the Susitna basin and can cause damage to salmon and rainbow trout populations. For these reasons, northern pike are considered an invasive species in Southcentral Alaska, including within and near the License Area, and programs are underway to eradicate them (ADF&G 2017n, l).

iii. Burbot

Burbot spawn under the ice from February through March. 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. They grow slowly, but have a long lifespan, up to 24 years. Young burbot feed on invertebrates and insects. By age five or six, their diet is primarily fish (ADF&G 2017e).

Burbot occupy most large clear and glacial rivers and many lakes throughout most of Alaska, including waterbodies near the License Area. Burbot populations dramatically declined in the early 1980s due to unsustainable rates of sport fishing. Bag limits have been decreased and certain burbot fisheries have been closed until further notice in an attempt to recover the population (ADF&G 2017e).

iv. Dolly Varden

The southern form of Dolly Varden are present in the License Area. The southern form of Dolly Varden may be freshwater resident or sea-run Dolly Varden. Freshwater Dolly Varden tend to be a much smaller fish, measuring 3 to 6 inches, and are found in small headwater streams, or in land-locked lakes and ponds (ADF&G 2017i).

The sea-run Dolly Varden reaches sexual maturity in five to six years, grows to a length of 12 to 16 inches, and lives less than eight years (ADF&G 2008a). Sea-run fish return to spawn annually in late August to November and will spawn more than once in their lives, but rarely more than three times (ADF&G 2017i). Alevins remain in the gravel, absorbing their yolk sacs, for 60 to 70 days before emerging in April and May. The young fish feed on insects and, as they grow larger, annelids, fish eggs, and other small fish. After two to four years in freshwater, the fish begin to migrate to saltwater in May or June, where they will spend the summer feeding before returning to

freshwater to spawn and spend the winter (ADF&G 2008a). In general, Dolly Varden are abundant and populations are stable (ADF&G 2017i).

v. Whitefish

The License Area is within the range of the humpback whitefish. Some populations of humpback whitefish are anadromous which means it spends part of its life in the ocean and part of its life in fresh water. Humpback whitefish are known to rear in channel ponds, sloughs, estuaries, and the marine environment until maturity, when they migrate upstream to spawn. Age at first maturity for adult humpback whitefish seems to increase with latitude and occurs as young as four years old (in the Kuskokwim River) to as late as 11 years old (near the Arctic Ocean) (ADF&G 2017k).

Depending on her size, a female humpback whitefish may release up to 50,000 eggs. Whitefish eggs are negatively buoyant and non-adhesive. The female broadcasts her eggs over loosely compacted gravel beds in turbid and swiftly flowing water. The eggs presumably hatch in the spring and the young descend downstream to feed and rear (ADF&G 2017k).

vi. Rainbow Trout

Rainbow trout mostly reside in streams and spend short amounts of time in estuarine water. They seek shallow gravel riffles in clear-water streams to spawn in late winter or early spring. Spawning begins in late March and lasts through early July. Eggs hatch a few weeks to four months after spawning, depending on water temperature. By mid-summer, fry emerge from the gravel to feed on crustaceans, plant material, and aquatic insects and their larvae. Resident rainbow trout move into lakes and streams after two or three years and eat fish, salmon carcasses, eggs, and small mammals. Rainbow trout mature in two or three years (ADF&G 2017q).

b. Salmon

Generally, Chinook, coho, and sockeye salmon comprise the majority of personal use, subsistence, sport, and commercial fishing interest. However, all five species of Pacific salmon return to the waters of the Matanuska-Susitna Basin to spawn, including rivers and lakes in and near the License Area (ADF&G 2013b).

i. Chinook (king) Salmon

Chinook salmon are present in Deception Creek and the Little Susitna River and their tributaries in all life stages (ADF&G 2016d).

The Susitna River run of Chinook salmon is the fourth largest in the state. Between 100,000 to 200,000 Chinook salmon return annually to the dozens of clear-water streams that feed the primary tributaries of the Yentna, Skwentna, Chulitna, and Talkeetna rivers. Willow Creek is the only stream in the region that has been stocked with Chinook salmon smolt by ADF&G, a program that began in 1985. Those fish return early to mid-June (ADF&G 2008c).

Chinook salmon are the largest of the Pacific salmon species at maturity and can exceed 30 pounds. Fresh water streams and estuaries are important habitat for spawning Chinook salmon and are nursery grounds for developing eggs, fry, and juveniles. Chinook salmon hatch in fresh water and rear in rivers for one year, feeding on plankton and insects. The following spring the smolt migrate

to an estuary before migrating to the open ocean, where they spend from one to five years feeding on herring, pilchard, sand lance, squid, and crustaceans. They return to their natal streams to spawn in fresh water (ADF&G 2017f).

ii. Sockeye (red) Salmon

Sockeye salmon are present in Nancy Lake and the lower reaches of the Little Susitna River to its confluence with Lake Creek (ADF&G 2016d). Sockeye salmon are widely dispersed in the Matanuska-Susitna region. Juvenile sockeye salmon rear in river sloughs and in Byers, Hewitt, Lockwood, Red Shirt, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey lakes, among other smaller lakes. The majority of sockeye salmon rear in Larson, Chelatna, Shell, and Judd lakes (Fair et al. 2009).

Sockeye salmon spend one to three years in the ocean before returning to their natal streams to spawn. Rivers, streams, and upwelling areas along lake beaches are important sockeye salmon spawning habitat. Eggs hatch during the winter and the alevins remain in the gravel until spring, when they emerge as fry and move to rearing areas. Juveniles spend one to three years in fresh water and feed on zooplankton and small crustaceans before migrating to sea. While at sea, sockeye feed on zooplankton, larval and small adult fishes, and squid. Adult sockeye salmon measure 18 to 31 inches long and weigh 4 to 15 pounds (ADF&G 2017p).

iii. Chum (dog) Salmon

Chum salmon spawn in the Little Susitna River (ADF&G 2016d). Chum salmon stocks are not a management concern in the Susitna River (Sheilds and Dupuis 2016). Chum salmon spawn throughout the Susitna River basin below Devil's Canyon and appear to prefer mainstem spawning sites, but the greatest numbers migrate up the Yentna River and its tributaries (Cleary et al. 2016).

Chum salmon spawn in September and October. They prefer to spawn in small to medium, slow-flowing side channels, though they also will spawn in large, muddy rivers, in cold and clear headwaters, and in the mouths of rivers below the high tide line. Eggs hatch after three to four months and the alevin remain in the gravel for an additional 60 to 90 days, after which they begin their migration to the sea within days or weeks. While migrating within rivers, they feed on insect larvae. When they reach the sea, they stay in the estuary and feed on crustaceans, insects, and young herring before forming schools and moving to salt water, when they feed on zooplankton. Adult chum salmon average 24 to 28 inches long and weigh 10 to 13 pounds (ADF&G 2017g).

iv. Coho (silver) Salmon

Coho salmon are present in Deception Creek and the Little Susitna River and their tributaries in all life stages, rear in Nancy Lake and Windy Lake, and spawn and rear in Lilly Creek (ADF&G 2016d). Coho salmon spawn from July to November. The eggs develop over the winter and hatch in early spring. The alevins stay in the gravel until they emerge in May or June. In the autumn, juveniles move out of the main channel to pass the winter, which protects them from the effects of flooding. Some coho salmon leave fresh water in the spring to rear in brackish, estuarine ponds, and return to fresh water in the autumn. They spend one to three winters in streams and may spend up to five winters in lakes before migrating to sea. Most coho salmon stay at sea 18 months,

feeding on small fishes, before returning to fresh water to spawn. Adult coho salmon typically weigh 8 to 12 pounds, are 24 to 30 inches long (ADF&G 2017h).

v. Pink Salmon

Pink salmon are present in and around the License Area and spawn in the Little Susitna River (ADF&G 2016d). Pink salmon mature and complete their life cycle in two years. As soon as they emerge from their gravel spawning grounds, they migrate to the ocean where they begin to feed on plankton, larval fishes, and aquatic insects. They return to spawn 18 months later between late June and mid-October. Adult pink salmon weigh between 3 and 5 pounds and average 20 to 25 inches long (ADF&G 2017o).

2. Birds

In the neighboring Willow Mountain Critical Habitat Area, frequently seen birds include spruce grouse, ptarmigan, ravens, magpies, gray jays, rosy finches, boreal and black-capped chickadees, redpolls, white-crowned sparrows, golden-crowned sparrows, Wilson's warblers, Swainson's thrushes and downy woodpeckers. Dippers can be found along the creeks. The abundance of both birds and small mammals attracts raptors such as goshawks, sharp-shinned hawks, merlin, red-tailed hawks, and gyrfalcon (ADF&G 2017s). Olive-sided flycatchers and blackpoll warblers are two sensitive species that are present in or near the License Area (ADF&G 2006). Some other species of special interest are discussed below.

a. Waterfowl

i. Trumpeter Swans

Trumpeter swans usually find a mate at age two and mate for life. They breed between their third and fifth years. Trumpeter swans nest in clear, quiet, ponded waterbodies with relatively little seasonal fluctuation. They prefer shallow margins that allow for digging and foraging of submerged parts of aquatic plants. They begin nesting as soon as spring thaw allows, incubation lasts 31 to 35 days, and the chicks fledge 11 to 15 weeks later. A young swan eats a high protein diet of aquatic invertebrates and will weigh 21 to 30 pounds as an adult. Trumpeter swans feed on foliage, seeds, and tubers of marsh plants such as horsetail, sedge, bulrush, widgeongrass, and pond lily. Trumpeter swans migrate south for the winter in October or November (ADF&G 2017r).

Trumpeter swans may be found in and around the License Area. A 1990 census indicated that more than 80 percent of the world’s population of trumpeter swans comes to Alaska. Statewide, trumpeter swan populations increased 7 percent between surveys in 2005 and 2010 as they began to occupy previously unoccupied breeding grounds (Conant et al. 2007; USFWS 2012). The most recent surveys estimate that there are approximately 13,000 trumpeter swans in Alaska (USFWS 2017).

ii. Loons

Common loons are found on lakes throughout the Cook Inlet and Susitna Basin area during the summer, and they winter along the coast from the Aleutians to Baja California. The Pacific loon is distributed widely throughout the Cook Inlet area, and is the most common wintering loon on the

coasts of Southcentral Alaska. Red-throated loons are also common throughout the License Area. Loons migrate to coastal areas in September or early October, and return to their freshwater nesting habitat in May. Loons mate for life and return each year to the same area to breed. Breeding success may be related to the presence of gulls, jaegers, and foxes. Loons are excellent divers and feed on small fish, aquatic vegetation, insects, mollusks, and frogs (ADF&G 1994). The US Fish and Wildlife Service (USFWS) conducts loon surveys in Southcentral Alaska to determine the distribution, abundance, productivity, and population trends (USFWS 2010).

b. Shorebirds

The Cook Inlet and Susitna Basin area is important for many species of shorebirds as a stopover site during migrations and a wintering area. 28 species have been identified in the area. Migrating shorebirds appear suddenly in the Cook Inlet area in early May, their numbers increase rapidly, and then they depart abruptly by late May. More than 150,000 birds have been counted in surveys during that time period. The Cook Inlet area supports 11–21 percent of the Pacific flyway population of dunlin, and perhaps the entire population of rock sandpiper (Gill and Tibbitts 1999).

c. Landbirds

i. Bald Eagles

Bald eagles are widely distributed along inland waterways and may be present throughout the License Area. Bald and golden eagles are protected by the federal Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. 668–668c) which makes take or possession of an eagle, either alive or dead, illegal. Bald eagles are usually found near shorelines and river areas, which is related to food supply, as well as near prominences which are used for perches and nests. Fish are the main diet of bald eagles, including salmon, herring, 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 2017c).

Bald eagles nest in trees that are close to water, with a clear view of the surrounding area, often in old cottonwoods. 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 the young leave the nest after about 75 days. Bald eagles reach sexual maturity at about four or five years of age. Bald eagles begin building nests in March and April (ADF&G 2017c).

ii. Golden Eagles

Golden eagles are typically found south of the Brooks Range and may be present in the License Area. They are often confused with juvenile bald eagles because of the similarity in the plumage of the two birds. Golden eagles prefer open prairie-like barren areas and select rugged cliffs or bluffs for nesting sites. Golden eagles usually have a clutch of two eggs laid between late April and May followed by a 35–45-day incubation period. Typically, only one of the young survives. They feed mainly on ground squirrels, hares, and other birds but are capable of killing the young of large game animals (ADF&G 2017j).

iii. Other Landbirds

Several other bird species commonly found in the mixed-conifer forests of the License Area, include Smith's longspurs, gray jays, boreal chickadees, northern flickers, red-tailed hawks, and boreal owls, many of which are protected by the Migratory Bird Treaty Act (ADF&G 2006).

3. Mammals

Numerous terrestrial mammals inhabit the License Area. Several species of particular importance, due to their subsistence and recreational uses, include black and brown bears, moose, wolves, and several furbearer species (ADF&G 2006).

a. Black and Brown Bear

Black bears may be found within and near the License Area. An estimated 530–1,050 black bears are present in GMU 14 (ADF&G 2014). Black bears are found along rivers and lakes during the spring and summer and in upland areas during the fall. They take advantage of the varied vegetation types and abundant prey especially in riparian and wetlands areas (ADF&G 2006). 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 usually in January or February. Black bears breed every two to three years and commonly give birth to two cubs at a time. Black bears have a varied diet comprised of green vegetation, small mammals, newborn moose and caribou, salmon, berries, ants, grubs, and insects. Other bears, usually brown, are the predators of black bears (ADF&G 2016a).

Brown bears (classified as the same species as grizzlies) are present in the License Area. Approximately 30–60 brown bears are present in GMU 14A (ADF&G 2013a). Brown bears are very adaptable and eat a large variety of foods. Common foods include salmon, berries, sedges, cow parsnip, ground squirrels, carrion, and roots. Brown bears may also hunt caribou and moose, especially newborns (ADF&G 2008b).

Most brown bears reach sexual maturity at 5 years of age, but females do not usually produce a litter until later. Brown bears mate from May to July. In the fall, pregnant females usually enter dens first, and leave them, with their newborn cubs, last in the spring. Cubs are born in the den during January and February and twins are common. Adult males do the opposite, entering dens later in the fall and emerging sooner in the spring. Most denning sites are found on hillsides or mountain slopes, usually below 1,800-foot elevation. In areas with mild winters, some male bears may stay active all winter (ADF&G 2016b).

b. Moose

Moose are present throughout the License Area. The moose population in GMU 14A was once considered scarce, but has increased with the increase in human population in the area. Land clearing associated with development have contributed to an increase in moose browse. Recent surveys using the geospatial population estimator showed an increase in population from 6,613 moose in the 2008 study to 7,993 in 2011 (Peltier 2014).

Vegetation type, quality, and production are important to moose habitat. Snow depth in winter, fire, and flood histories influence the availability of vegetation. High quality forage near wetlands of forbs; the leaves of birch, willow, aspen; and vegetation in shallow ponds are a primary food sources. Riverbanks, gravel bars, and areas adjacent to rivers also provide good moose habitat because of the scouring effect of floods, which produce regenerating willows and other plants accessible to moose (Woodford 2006).

Female moose typically breed at 28 months and gestation lasts about 230 days. Calves are born in the spring and weaned by fall in time for mating season in late September and early October. Moose move around seasonally to calving, rutting, and wintering areas. Moose travel a few miles to as many as 60 miles during the transitions. Moose calve from mid-May through early June. (ADF&G 2017m).

c. Furbearers

The License Area supports populations of beaver, muskrat, river otter, coyote, lynx, wolverine, red fox, marten, and mink. Most furbearer species are challenging to study because of their secretive behaviors. Population trends and estimates usually come from harvest data and trapper questionnaires. All the species were common during the 2009–2012 reporting years except marten and wolverine in GMU 14A and 14B (Peltier 2013).

Beaver are present in the License Area. The beaver is the largest member of the rodent family in North America. They can live up to 12 years in the wild and continue growing throughout their lifecycle reaching lengths up to four feet and up to 70 pounds. Mating takes place in the winter and females produce an average of two to four kits per litter born in the late spring. Beavers are considered common throughout their range (ADF&G 2017d).

American marten, mink, and wolverine, are present in the License Area and are members of the family Mustelidae. They are carnivorous and opportunistic feeders. Mating for marten occur in July and August and mating for wolverine ranges from May to August both with 2–3 young in a litter. (ADF&G 2008a).

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Chapter Five: Current and Projected Uses

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Chapter Five: Current and Projected Uses

This chapter considers and discusses the current and projected uses in the License Area, including uses and value of fish and wildlife as required by AS 38.05.035(g)(iv). The land and waters included in and near the License Area provide habitat for a variety of fish and wildlife as described in Chapter Four. The License Area also provides a variety of uses such as subsistence, sport, and commercial harvest activities. In addition, the area has been used for forestry, and mineral and oil and gas exploration. These and other current and projected uses are considered and discussed below. The following information is not intended to be all inclusive, but to provide an overview of the current and projected uses.

A. Current and Projected Uses in the License Area

1. State Game Refuges, Wildlife Refuges, Critical Habitat, and other Designated Areas

The Department of Natural Resources (DNR) manages several recreation areas in the Matanuska-Susitna region and has three area land use plans in effect. The area plans are the Southeast Susitna, the Susitna, and the Susitna-Matanuska area plans. The License Area is located within the Susitna Area Plan boundary. Guidelines and direction for managing state lands that are established by the area plan do not apply to oil and gas related activities. Oil and gas lease sales and gas only lease sales are subject to the planning process established under AS 38.05.180 (AS 38.04.065(i)).

The Alaska Department of Fish and Game (ADF&G) manages the Willow Mountain Critical Habitat Area (WMCHA) approximately 5 miles north of the License Area. The state legislature established critical habitat areas to protect and preserve areas crucial to the perpetuation of fish and wildlife and to restrict all other uses not compatible with that purpose (AS 16.20.500). The WMCHA supports some of the largest concentrations of moose in the state. It is located on the western slopes of Willow Mountain, in the Talkeetna Mountain Range. The WMCHA is open to most public uses if the activity does not damage refuge resources, disturb wildlife, or disrupt existing public uses. Allowed activities generally include hunting, trapping, fishing, wildlife watching, hiking, boating, snow machining, and camping. A general permit for off-road vehicle use is required from ADF&G's Division of Habitat. In addition, ADF&G requires permits for any oil and gas related activity in critical habitat areas (AS 16.20 and 5 AAC 95). ADF&G also issues special area permits.

In addition, DNR and ADF&G jointly manage the Matanuska Valley Moose Range with a western boundary approximately 4 miles to the east of the License Area. The Matanuska Valley Moose Range is a 130,000-acre range set aside by the state legislature in 1984 to maintain, improve, and enhance moose populations and habitat of the area, and for multiple public uses of the area (ADNR and ADF&G 1986).

Other designated areas in vicinity of the License Area include the Hatcher Pass Management Area; the Susitna Basin Recreation River, the Nancy Lake State Recreation Area; the Nelchina Public Use

Area; Summit Lake State Recreation Site; and the Knik River, Matanuska Lakes, Finger Lake, and Willow Creek State Recreation Areas. Additionally, Palmer Hay Flats and Susitna Flats State Game Refuges, and Independence Mine State Historical Park are in the region.

B. Uses and Value of Wildlife, Fish, and Plants

ADF&G manages wildlife resources through game management units (GMUs). ADF&G compiles and analyzes harvest and biological information, enabling the establishment of ecologically sound population-based fishing, hunting, and trapping regulations. This information may also be used to promote conservation strategies and recovery actions (ADF&G 2016d). The License Area is located within the boundaries of GMU 14A.

1. Subsistence and Personal Use

The state, through the Boards of Fisheries and Game, manages subsistence resources on all state-owned lands and waters in Alaska. Residents from the Houston, Willow, Wasilla, and surrounding areas use the License Area and surrounding regions for subsistence fish, wildlife, and plant harvests. Alaska law defines subsistence as "noncommercial, customary and traditional uses" of fish or game for a variety of purposes. AS 16.05.258 requires that subsistence uses be consistent with sustained yield.

The U.S. Fish and Wildlife Service established migratory bird subsistence harvest regulations in Alaska that allow for the continuation of customary and traditional subsistence uses of migratory birds in Alaska and prescribe regional information on when and where the harvesting of birds may occur. Eligibility to harvest is limited to permanent residents, regardless of race, however areas with road access and higher population densities like the areas surrounding the License Area are excluded from eligible subsistence harvest.

Under 5 AAC 77, Alaska residents are allowed the "taking, fishing for, or possession of finfish, shellfish, or other fishery resources" for personal use and not for sale or barter. Personal use is allowed when that taking does not jeopardize the sustained yield of a resource. Residents must also have a valid resident sport fishing license to participate in personal use fisheries (ADF&G 2017b).

a. Subsistence

ADF&G manages and monitors subsistence fishing in the state. The License Area is located within the designated Anchorage Non-Subsistence Use Area. The closest subsistence fishery to the License Area is the Yentna River fish wheel fishery targeting sockeye salmon. The fishery began in 1996 as a personal use fishery but was reclassified as a subsistence fishery in 1998. It takes place in the main stem of the Yentna River, from its confluence with Martin Creek upstream to its confluence with the Skwentna River. The fishery is open July 15 to July 30, three days a week. In 2012, Skwentna residents harvested about 57 percent of the catch and held nine of 21 permits issued. The rest of the permits were held by residents of Cook Inlet area communities. In 2012, a total of 343 salmon were harvested, 81 percent of which were sockeye salmon. The harvest numbers are less than the historical average of 592 salmon (Fall et al. 2014).

South of the License Area on the western shore of Cook Inlet there is a subsistence fishery near the Village of Tyonek. The subsistence fishery in the Tyonek subdistrict was established in 1980. In 1981, the Board of Fisheries adopted permanent regulations, and the fishery is open to all Alaskan residents. In 2016, there were 70 permits issued by ADF&G and 60 of those permits were returned. The total number of salmon harvested was 1,196. Of those, there were 813 chinook, 164 sockeye, and 206 coho (ADF&G 2017f).

b. Personal Use

ADF&G manages and monitors personal use fisheries. The closest personal use fishery to the License Area is in Fish Creek and is a dipnet fishery for sockeye salmon. Fish Creek drains Big Lake and empties into the Knik Arm of Cook Inlet. The fishery is opened by emergency order only and only if ADF&G projects more than the 35,000 fish escapement goal. When the fishery is open, the typical peak run is between July 15 and July 25 (ADF&G 2017b). During the 2016 season, the Fish Creek dip net personal use fishery was not opened, as only approximately 46,000 sockeye salmon escaped to Big Lake in 2016 (ADF&G 2017f).

2. Sport Fishing

Populations of salmon and other fish species are important to sport fisheries in the License Area. State sport fishing licenses are generally required. In addition to a fishing license, anglers fishing for Chinook salmon must also purchase a Chinook salmon stamp at an additional cost (ADF&G 2017d). Sport fishing opportunities are available year-round in and around the License Area. The area contains a wide variety of fishing opportunities including grayling, trout, and salmon fisheries (ADF&G 2017e).

Table 5.1 shows the peak sport fish run timing for certain species in the Anchorage, Matanuska, and Susitna drainages. The main sport fishing window is from June to September, but the main opportunities extend from May through November (ADF&G 2017e). Table 5.2 shows the number of sea-run salmon harvested in the waters surrounding the License Area from 2000 to 2010.

Table 5.1. Peak sport fish run timing in the Anchorage, Matanuska, and Susitna region

Species	May	June	July	August	September	October	November
Chinook Salmon		X	X				
Coho Salmon				X			
Chum Salmon			X	X			
Dolly Varden				X	X	X	
Northern Pike	X	X			X	X	
Arctic Grayling	X	X		X	X	X	
Whitefish	X	X	X	X	X	X	X

Source: ADF&G 2017d

Table 5.2. Knik Arm, Anchorage, and Susitna River Drainage sport sea-run salmon harvest estimates in number of fish, 2000-2010

Year	Knik Arm	Anchorage	Susitna River Drainage	Southcentral Alaska Total
2000	45,099	36,942	70,792	1,031,773
2001	38,248	47,292	53,727	976,642
2002	54,413	30,651	48,454	1,032,804
2003	34,927	19,909	35,318	1,031,264
2004	45,669	18,471	77,606	1,135,246
2005	35,169	20,854	70,781	1,125,268
2006	49,866	25,706	78,914	922,362
2007	39,740	17,345	59,691	1,073,768
2008	46,458	23,181	63,693	965,710
2009	46,631	18,836	56,783	967,790
2010	34,522	8,702	48,332	901,182

Source: Jennings et al. 2011

Current economic estimates for sport fishing specific to the License Area are unavailable. However, in 2011, through the multiplier or ripple effect, statewide fishing in Alaska generated approximately $359 million in salaries and wages, 9,992 jobs, and over $1 billion into the statewide economy as a result of sport fishing in Alaska (USFWS 2012; Southwick 2013). All categories increased since 2006 (Table 5.3). It should be noted that these estimates, which use data from the USFWS's National Survey of Fishing, Hunting and Wildlife-Associated Recreation, may underestimate the total economic impact of sport fishing in Alaska. The data does not include expenditures made outside Alaska, for example, fishing equipment purchased in another state and used for fishing in Alaska (Southwick et al. 2008).

Table 5.3. Economic impact of sport fishing in Alaska, 2006 and 2011.

Year	Retail Sales	Multiplier Effect	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 2008, 2013

Recreational fishers harvest five species of Pacific salmon in this region as well as eulachon. There are also wild stocks of rainbow trout, Dolly Varden, Arctic grayling, and northern pike. More than 90 area lakes are stocked with rainbow trout, grayling, Arctic char, coho salmon, and Chinook salmon (Metiva and Hanson 2008).

In Southcentral Alaska in 2014, sport fishing totaled 95,003 angler days. Most of the effort was focused on coho salmon and 84,396 angler days were reported by nonresidents (ADF&G 2016c). Until 2008, the Matanuska-Susitna basin annually averaged about 300,000 angler days and Alaska residents accounted for approximately 60 percent of those days. Between 2001 and 2009, the number of anglers decreased. In 2009, the estimated number of non-resident anglers dropped further (Jennings et al. 2011).

Salmon fishing tends to be most heavily concentrated on a few streams in the Susitna basin. The three most popular streams in the drainage east of the Susitna River are Clear, Sheep, and Willow creeks. The three most popular streams on the west side of the Susitna drainage are Kroto Creek, Lake Creek in the Yentna River drainage, and the Yentna River (Jennings et al. 2011). The Little Susitna River which is adjacent to the License Area is a popular sport fishing location for anglers that are targeting the five Pacific salmon species. Over 40,000 angler-days have been logged annually on the Little Susitna River and the area has a boat launch facility accessed from Point MacKenzie Road and also non-motorized access from the Parks Highway north of Houston, AK (ADF&G 2016e).

3. Hunting

Hunting is an important part of the culture and economy of the License Area. Revenue from sales of licenses, tags, and permits funds ADF&G's research and management of wildlife (ADF&G 2017c). Hunting guide services are available in and around the License Area, and contribute to the local economy. In 2017, 21 large game hunting guides were licensed within GMU 14 (DCCED 2017). Waterfowl, moose, black bears, and some furbearer species are the most commonly hunted in and around the License Area (DMLW 2008).

The lands around the License Area are popular for waterfowl hunting because of high concentrations of waterfowl, and its proximity to the large population centers of the state. In GMU 14, migratory birds that are available for hunting are ducks, geese, brant, common snipes, and sandhill cranes. Hunting season for these birds is open from September 1 through December 16 (ADF&G 2016b).

Although data specific to the License Area is not available for migratory bird or waterfowl hunting in Alaska, there were approximately 5,500 active waterfowl hunters in 2014 and approximately 3,100 active waterfowl hunters in 2015. The most popular target species was the mallard duck followed by the American wigeon and Canada goose. The green-winged teal, northern pintail, and goldeneye ducks were also popularly harvested birds. Approximately 53,200 ducks were harvested in 2014 and 27,600 ducks were harvested in 2015. Approximately 7,365 Canada geese were harvested in 2014 and 5,258 were harvested in 2015 (USFWS 2016).

Moose harvest numbers have ranged from 417 to 788 moose in the years between 2003 and 2012 with an average of 579 moose taken from GMU 14A. One of ADF&G's management objectives for GMU 14A is to achieve an annual harvest between 360 and 750 moose while maintaining a population of over 6,000 moose in the unit. In 2017–18, the fall general open season for hunting moose was from August 25 through September 25 and the bag limit was one bull (Peltier 2014; ADF&G 2017a).

Table 5.4 shows the moose hunter residency and success for regulatory years 2008–12.

Table 5.4. GMU 14A moose hunter residency and success, 2008-2012

Regulatory Year	Successful General Hunt - Unit 14 Residents	Successful General Hunt- Alaskans living outside of Unit 14	Successful nonresident hunters	Successful hunters of unknown origin	Total
2008	355	22	15	1	393
2009	430	27	18	2	477
2010	473	15	13	4	505
2011	469	25	21	3	518
2012	288	15	9	2	314

Source: Peltier 2014

Black bear hunting is open year-round in GMU 14, and in 2011 the bag limit for black bears was raised from one bear to three. Most black bear harvest takes place in the end of May and throughout June, though recently, hunter participation has increased in September in association with the fall moose hunting season (ADF&G 2014).

In GMU 14A, increasing human population has altered the management objectives to reduce the amount of bear-human interaction and conflicts. Brown bear hunting season in GMU 14A is open from September 1 through May 31 and the bag limit is one bear for every four regulatory years. Between 2008 and 2012, an average of 26.3 brown bears were harvested from GMU 14A and the data shows an increasing number of successful hunts. The majority of brown bear hunters are local residents and 26 percent of the successful hunters were non-residents in the period between 2002 and 2011 (ADF&G 2013).

Trappers operate in GMU 14. Although more than half of the state's population lives within the boundaries of GMU 14, trapping in this unit is low volume, limited to trail and road access, and takes place mostly in subunits 14A and 14B. The most recent trapper report divides the state into five regions and the exploration license is within Region IV. Only 11.6 percent of registered trappers in Region IV responded to the ADF&G survey and of those approximately 54 percent reported that they participated in trapping in 2015. The trappers ranked marten, red fox, and wolverine respectively as the three most important species; however, within GMU 14A muskrat, red squirrel, and ermine were the three most commonly harvested species. In 2015, 184 muskrat, 57 red squirrel, and 21 ermine were harvested from GMU 14A (ADF&G 2016a). Table 5.5 shows the species harvested from Region IV that ADF&G requires to be sealed. Table 5.6 shows the average fur prices for 2011 through 2015.

Table 5.5. Furbearer species reported harvested in Region IV, 2010 - 2015

Regulatory Year	Beaver	Fisher	Lynx	Marten	River Otter	Wolf	Wolverine
2010	1,105	0	1,767	656	255	305	180
2011	724	0	1,127	1,105	231	378	160
2012	683	0	631	704	253	157	170
2013	634	0	191	556	208	205	158
2014	574	0	128	310	203	112	99
2015	409	0	113	657	182	149	150

Note: The species list is limited to sealing records
Source: ADF&G 2016a

Table 5.6. Average and top price paid for raw furs 2011–15 (in U.S. dollars)

Species	2011	2012	2013	2014	2015	Top Price 2015
Beaver	$ 32.56	$ 32.56	$ 18.71	$ 13.30	$ 10.04	$ 63.00
Coyote	$ 65.99	$ 76.27	$ 56.49	$ 51.75	$ 39.87	$ 340.00
Fox	$ 52.82	$ 59.97	$ 40.18	$ 23.84	$ 16.53	$ 115.00
Lynx	$ 179.78	$ 205.11	$ 144.49	$ 87.37	$ 61.88	$ 220.00
Marten	$ 108.78	$ 143.81	$ 76.94	$ 54.12	$ 46.51	$ 190.00
Mink	$ 22.83	$ 27.90	$ 17.51	$ 9.83	$ 9.10	$ 24.00
Muskrat	$ 9.97	$ 12.53	$ 10.36	$ 3.94	$ 2.87	$ 8.90
River Otter	$ 86.76	$ 100.75	$ 53.95	$ 38.65	$ 20.00	$ 56.00
Squirrel	$ 0.97	$ 0.74	$ 0.94	$ —	$ 0.38	$ 1.00
Wolf	$ 245.29	$ 215.84	$ 170.17	$ 127.75	$ 157.88	$ 600.00
Wolverine	$ 269.95	$ 271.35	$ 224.90	$ 217.41	$ 208.90	$ 390.00

Source: ADF&G 2016a

4. Commercial Fishing

The License Area is located within the Central Region of the state, as determined by ADF&G, which is part of the Upper Cook Inlet commercial fishing regulatory area. No commercial fishing activities occur within the License Area; however, commercial fishing is an important part of the culture and economy in nearby Cook Inlet. People that live in the communities surrounding the License Area work in the commercial fishing industry or in supporting industries.

5. Recreation and Tourism

The License Area offers year-round outdoor recreational activities and opportunities valuable to residents and visitors to the area. Three agencies manage the recreational resources in and around the License Area: the Alaska Division of Parks and Recreation; the Alaska Department of Transportation and Public Facilities (DOTPF); and the Bureau of Land Management (BLM). Abundant rivers, streams, lakes, and trails are used for hiking, wildlife viewing, fishing, hunting, sightseeing, cross-country skiing, snowmobiling, rafting, boating, camping, and other private and commercial recreational activities. Numerous historic trails are some of the most important recreational resources in and around the License Area (DMLW 2008).

The Alaska Visitor Statistics Program is a statewide visitor study that examines visitor volume and surveys. The most recent study was performed in 2015 and analyzed data from the summer season of 2015. The License Area was not specifically addressed in the study, rather the Southcentral region of Alaska was examined. Wildlife viewing, train, and hiking or nature walks were more popular among Southcentral visitors than the total visitor market. Approximately 259,000 sport

fishing licenses were sold to non-residents in 2015 which was an increase of 7 percent from the same period in 2014 (McDowell 2016).

An estimated 800,000 tourists visit the Matanuska-Susitna Borough (Borough) annually for the wildlife, scenery, and to hike, camp, and fish. They contribute an estimated $282 million annually in economic activity. Winter recreation such as skiing, snow machining, and dogsledding are increasingly popular. Tourism in the Susitna Valley has been developing as new lodges open. In 1997, Mt. McKinley Princess Lodge opened, followed in 1999 by Cook Inlet Region Incorporated's Talkeetna Lodge. The two hotels are now among the top 50 employers in the Borough. Since 2000, accommodation employment has more than doubled (Metiva and Hanson 2008).

An extensive public trail system contributes to all season tourism. More than 2,020 miles of trails have been dedicated in the Borough. Some of these include the Hatcher Pass trails, the Crevasse-Moraine trail, and trails around Sutton and Lazy Mountain. The Iditarod National Historic Trail also runs through this region (Metiva and Hanson 2008). Other recreational sites include the Independence Mine State Historical Park, Summit Lake State Recreation Site, the Nancy Lake State Recreation Area, and Hatcher Pass East Management Area.

6. Agriculture

There are more than 50 farms in the Matanuska-Susitna region listed with the Alaska Division of Agriculture (ADNR 2017). In 2007, crops and livestock together generated $11.8 million in revenue annually (Metiva and Hanson 2008). The most recent estimate of agricultural output is $15.7 million. Locally produced and organically grown vegetables are available at 14 weekly farmers' markets in the borough (Matanuska-Susitna 2014). The Susitna-Matanuska Area Plan shows 17 potential agricultural project areas on both sides of the Susitna River from Petersville south to the lower Yentna River (DMLW 2008). DNR is offering agricultural land in the Willer-Kash Agriculture Project about 5 miles northwest of Willow (ADNR 2016).

7. Forestry

Alaska has three forest regions as defined by the Alaska Forest Resources and Practices Act. The Mat-Su Forest Region (Region II) encompasses the License Area and consists of spruce/hardwood trees. There is an Interagency Land Management Agreement between DNR and the Division of Forestry for an experimental forest within the License Area. The Lilly Timber Sale and East Spur Timber Sale are also within the License Area (Curran 2015). The License Area is within the Southeast Susitna area plan area which has the potential to be one of Southcentral Alaska's major timber supply resources (DMLW 2008).

There are several areas designated for timber sales near the License Area and laid out in the Division of Forestry's Five Year Schedule of Timber Sales. About 683,000 acres, mostly in the central parts of the Susitna Valley, are classified for forestry. The forest resources are a mix of white spruce and paper birch in the uplands and cottonwood and balsam poplar in the lowlands. White spruce is valued for saw logs, biomass, and fiber; birch has some value for processing at a mill. The cottonwood and balsam poplar have little commercial value (ADNR 2011). Timber use

has declined over the years; the typical mill operator is a small sawmill producing rough, green lumber or house logs for the local market (Metiva and Hanson 2008). DNR has recommended the creation of a state forest within the Susitna Valley in its Susitna Matanuska Area Plan (ADNR 2011).

8. Oil, Gas, and Mining

There is no commercial lode mining in this area, but there is some exploration for gold at the historic Lucky Shot mine east of Willow in the Willow Creek mining district (Miranda 2017). Coal was mined in the early decades of the 20th century and high-quality coal deposits exist but they are not being mined (Metiva and Hanson 2008). In 2012, the Department of Environmental Conservation approved an air quality permit for a coal mining operation about eight miles northeast of Palmer at Wishbone Hill. In October 2014, DNR renewed surface coal mining permits (ADNR 2014).

There are no producing oil or gas wells in this subregion. An exploration well southwest of Trapper Creek on an existing exploration license was planned for the winter of 2014 or 2015 (Petroleum News 2014). However, this work was not completed. For a complete description of the history of oil and gas exploration and potential for the License Area, see Chapter 6.

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Chapter Six: Petroleum Potential and the Likely Methods of Oil and Gas Transportation in the License Area

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Chapter Six: Petroleum Potential, Operations, and Transportation Methods in the License Area

A. Geology

1. Geologic background and regional setting

The proposed License Area is situated near the southeast corner of the Susitna sedimentary basin. Like the rest of south-central Alaska, it is within a geologically active zone of convergence between two tectonic plates: the oceanic Pacific plate and the continental North American plate. The denser oceanic plate is subducted, driven beneath the continental plate and down toward the earth's hot mantle, where it contributes fluids and molten rock to regions of partial melting in the overlying plate. Magma generated in this way ascends though the overlying continental plate, with some being emplaced at depth, where it solidifies into large complexes of intrusive granitic rock (plutons). Other magmas ascend all the way to the earth's surface, where they erupt to form chains of volcanoes. Collectively, the belt of volcanic and plutonic rocks formed above the subducting slab along the active margin of the continental plate is known as a magmatic arc. On convergent continental margins, rock units become highly deformed by compressional faulting and folding, thickening the continental crust to form mountain ranges. The heat and pressure associated with plate convergence also promote regional metamorphism, the physical and chemical alteration of pre-existing igneous or sedimentary rocks. A wide variety of metamorphic rock types may form at convergent plate boundaries depending on the degree of thermal alteration and physical deformation.

Igneous and lightly metamorphosed rocks make up much of the Alaska Range and Talkeetna Mountains that bound the Susitna lowlands where sedimentary strata have accumulated intermittently over tens of millions of years or much of Cenozoic time. It is in thick sedimentary basins that oil and gas are formed and trapped to form useable energy resources. The Cook Inlet sedimentary basin, immediately south of the Susitna basin, is unequivocally the most important petroleum habitat in southcentral Alaska. It hosts dozens of commercial oil and/or gas reservoirs in Cenozoic formations that together constitute a prospective basin-fill succession approaching 25,000 feet thick. In contrast, the Susitna basin is estimated to contain a maximum of 13,000 to 16,000 feet of Cenozoic strata, and despite many similarities to the Cook Inlet, it remains unknown whether it contains commercially viable hydrocarbon resources.

The present-day Susitna basin lowland encompasses approximately 5,000 square miles. It is bordered on the southwest by Mesozoic plutonic, metavolcanic, and sedimentary rocks of Mount Susitna and Beluga Mountain; on the northwest by mostly fine-grained and deformed Jurassic-Cretaceous Kahiltna flysch outcrops in the foothills of the Alaska Range; on the east by igneous and metamorphic rocks in the Talkeetna Mountains; and is separated from the Cook Inlet basin to the south by the Lake Clark–Castle Mountain fault (Trop and Ridgway, 2007; Wilson et al., 2012; Gillis et al., 2013; Saltus et al., 2016). The Susitna basin's first order structural features include two

areas of thick Tertiary sedimentary deposition, the Susitna sub-basin to the southeast, and the Yentna sub-basin to the northwest, separated by probable Cretaceous metasedimentary basement rocks of the northeast-trending Yenlo Hills uplift (Gillis et al., 2013; Wilson et al., 2012). The Susitna sub-basin is bounded on the southwest by a linear bedrock escarpment, the inferred trace of the Beluga Mountain fault, which exposes an extensive outcrop belt of Cretaceous intermediate volcanics and sedimentary rocks to the west (Wilson et al., 2012). Modeling of the steep gravity gradient coincident with the linear topographic escarpment indicates this northwest striking basin-controlling structure is a compressional, up-to-the-southwest high-angle reverse fault (Hackett, 1977) or thrust fault (Stanley et al., 2017).

Published data regarding the Susitna basin subsurface are sparse, but recent collaborative investigations by US Geological Survey (USGS) and the Alaska Department of Natural Resources (DNR) have brought to light significant new information, particularly on the age and lithology of earliest deposition of the basin-fill succession (Stanley, et al., 2013; Gillis et al., 2013). Geologic mapping around the basin margins suggests that basement rock type beneath the basin varies laterally. Basement likely consists of Cretaceous volcanic rocks in the southwest near the Beluga Mountain fault, Jurassic-Cretaceous Kahiltna flysch and undivided Mesozoic sedimentary, metasedimentary, and volcanic rocks in the north near the Alaska Range and the Yenlo Hills uplift, and mixed Mesozoic-Cenozoic intrusive and volcanic rocks in the east near the Talkeetna Mountains and Matanuska Valley. Both the Red Shirt Lake 1 and Fish Creek 1 wells near the Castle Mountain Fault on the south edge of the basin bottom in granitic rock, possibly closely related to the Cretaceous-Tertiary granite, granodiorite, and diorite exposed at Mount Susitna and in the Talkeetna Mountains.

Some 22 exploratory wells, stratigraphic tests, and core hole wells have been drilled in the Susitna basin (north of the Castle Mountain fault) to date, 15 of which are clustered near Houston and Willow at the southeastern margin of the basin near the Lake Clark–Castle Mountain fault. Most were drilled to evaluate shallow gas and coal-bed methane (CBM) potential. Four additional wells (Sheep Creek 1, Kashwitna Lake 1, Red Shirt Lake 1, and Fish Creek 1) are widely spaced along the basin's southern and eastern margins, reaching depths between 1,371 and 2,074 feet. By themselves, these basin-margin wells shed little light on the age of initial subsidence, basement lithology, or petroleum potential in the deeper parts of the basin.

The basin's deepest wells, Trail Ridge Unit 1 (13,708 feet measured depth) and Pure Kahiltna Unit 1 (7,265 feet measured depth), were drilled in the Susitna sub-basin, south of the probable Cretaceous rocks exposed in the Yenlo Hills uplift. Both wells are now known to have bottomed in interbedded non-marine sedimentary and volcanic rocks of Late Paleocene to Early Eocene age equivalent to the Arkose Ridge Formation, as dated by palynologic (pollen-based) and radiometric techniques (Stanley, et al., 2013). Previous estimates of the age of initial basin fill ranged from probable Paleocene (Trop and Ridgway, 2007) to Miocene (Wahrhaftig et al., 1994; Meyer and Boggess, 2003; Meyer, 2005), so these firm constraints on the type and timing of initial deposition provide important insights into the basin's history and petroleum potential.

Late Paleocene and younger sedimentary deposits in the Susitna basin include fluvial and lacustrine conglomerate, sandstone, mudstone, and coal (Trop and Ridgway, 2007), similar to the Kenai Group and suggestive of a possible genetic link to Cenozoic deposition in the Cook Inlet basin. Coals are widespread and common throughout the sedimentary stratigraphic section, as documented

in outcrop, shallow borings, and wells, with reported thicknesses of up to nearly 50 feet on individual coal seams (Wahrhaftig, 1994). Their role as potential sources of biogenic gas or coal-bed methane reservoirs is discussed in the subsequent section on petroleum potential. Stanley et al. (2013) were the first to document that some of the coal-bearing strata penetrated in the Trail Ridge Unit 1 and Pure Kahiltna Unit 1 wells are of Eocene age, approximately equivalent to the West Foreland Formation in Cook Inlet. Oligocene strata equivalent to the Hemlock Conglomerate have not been recognized in outcrop anywhere in the Susitna basin, although the Bell Island sandstone unit, considered a local member of the lowermost Tyonek Formation, has been speculatively correlated with the Hemlock. Coal-bearing strata in the northern Susitna basin have been mapped as Miocene Tyonek(?) Formation and Pliocene Sterling(?) Formation (Reed and Nelson, 1980). However, the depositional systems linkage between Tertiary Susitna basin units and age-equivalent formations in Cook Inlet remains poorly understood.

Trop and Ridgway (2007) reported that Quaternary fluvial and glacial surficial deposits in the basin attain a thickness of up to nearly 600 feet. More recently, Stanley et al. (2013) interpreted lithologic and palynologic data at the Trail Ridge Unit 1 well to conclude that Quaternary boulder gravel, coarse sand, and subordinate claystone are as much as 1,200 feet thick in the Susitna sub-basin. Karlstrom (1964) recognized five glacial stages during the 1.8 million years of Pleistocene time during which glaciers advanced southward from the Alaska Range, modifying the landscape even up to the rounded summit of Mount Susitna, more than 4,265 feet above present sea level.

2. Local Geology of the License Area

As noted above, 15 of the 22 wells and core holes drilled to date north of the Castle Mountain fault in the Susitna basin are in the Houston-Willow vicinity (Table 1). Most of them are clustered near the Parks Highway within two miles north of the surface trace of the Castle Mountain fault. Many of these wells are shallow and have only rudimentary logs, and provide limited insight into the area's full stratigraphic and structural configuration. Nonetheless, USGS-led collaborations with DNR have progressed subsurface investigations in the area in preparation for an assessment of undiscovered, technically recoverable resources in Susitna basin. Initial findings (Stanley et al., 2017) suggest the Rosetta 4, 4A, and Houston Pit 1 wells were drilled near the crest of the Castle Mountain fault anticline recognized by Haeussler et al. (2000) and Haeussler and Saltus (2011). Tyonek Formation lies near the surface below a mantle of unconsolidated surficial deposits, and is underlain by Arkose Ridge Formation at depths below approximately -1,000 feet subsea. The anticline is apparently bounded to the south by a contractional strand or splay of the Castle Mountain fault zone; the Rosetta 3 well penetrates the fault -2,165 feet subsea, where it places Arkose Ridge Formation above Tyonek Formation. South of this fault but still north of the main trace of the Castle Mountain fault, the Houston 1, 2, and 3 wells penetrated coal-bearing Tyonek Formation with modest gas shows. Perforations in five coal beds in the Houston 3 well yielded minor gas, flowing at rates of up to 3,620 cubic feet per day and 476 barrels of water per day on pumping during early production testing. The well has since been plugged and abandoned and determined to be uneconomic. Figure 6.1 displays the locations of oil and gas wells in and around the License Area.

Figure 6.1. Houston Willow Area Oil and Gas Well Locations.

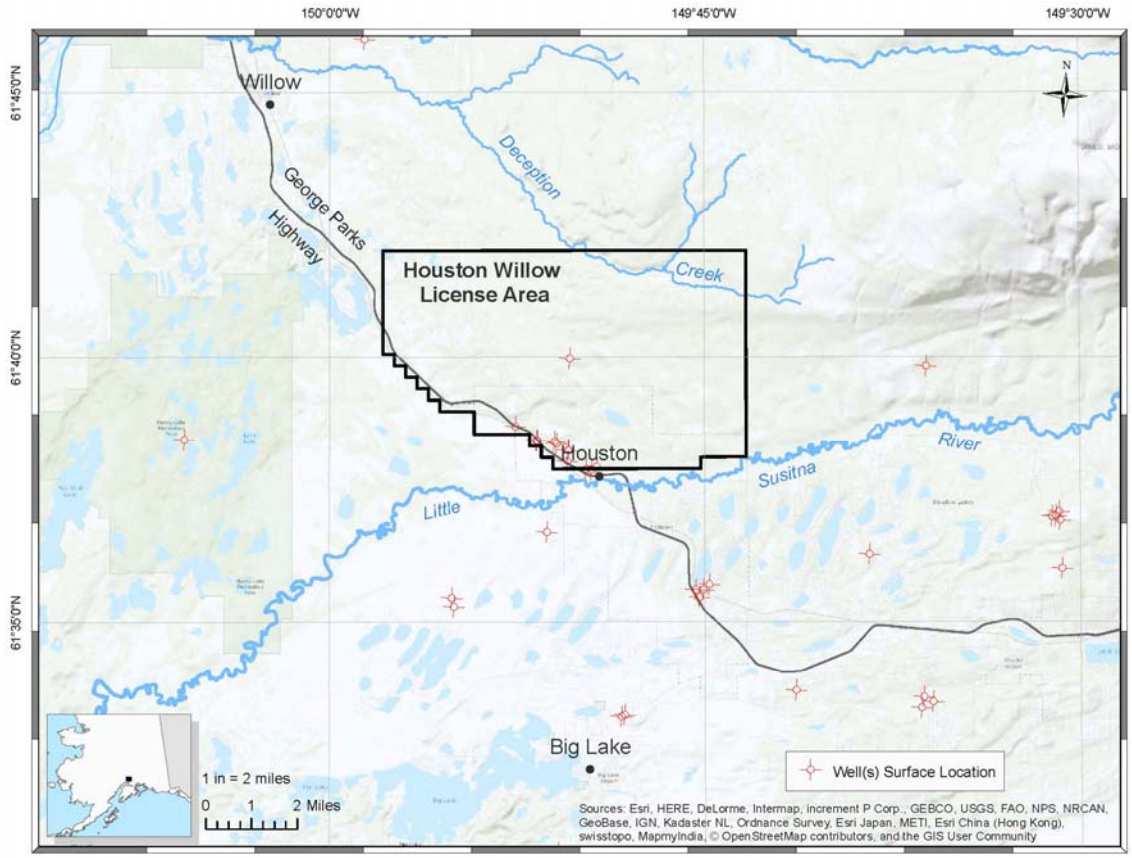

Table 6.1. List of wells and core holes in the Houston-Willow vicinity.

Well or Core Hole	API Number	Operator	Completion Date	Total Depth, ft.
HOUSTON CORE HOLE 1	50-009-10022-00-00	U.S. Bureau of Mines	11/10/1951	482
HOUSTON CORE HOLE 2	50-009-10023-00-00	U.S. Bureau of Mines	8/5/1952	1,142
HOUSTON CORE HOLE 3	50-009-10024-00-00	U.S. Bureau of Mines	8/18/1952	386
HOUSTON CORE HOLE 3A	50-009-10024-01-00	Anchorage Oil and Gas Co.	10/1/1955	2,135
ROSETTA 1	50-009-10014-00-00	Anchorage Gas and Oil Dev.	6/30/1959	4,260
ROSETTA 2	50-009-10015-00-00	Anchorage Gas and Oil Dev.	5/21/1956	1,100
ROSETTA 3	50-009-10016-00-00	Anchorage Gas and Oil Dev.	8/1/1959	6,109
ROSETTA 4	50-009-10017-00-00	Anchorage Gas and Oil Dev.	10/7/1961	1,627
ROSETTA 4-A	50-009-10018-00-00	Hackathorn Drilling Co.	9/24/1962	2,407
HOUSTON 1	50-009-20009-00-00	Growth Resource International	8/27/2004	1,730
HOUSTON 3	50-009-20011-00-00	Growth Resource International	5/5/1998	2,030
HOUSTON 2	50-009-20010-00-00	Growth Resource International	8/27/2004	2,105
HOUSTON 4	50-009-20012-00-00	Growth Resource International	4/6/1998	478
HOUSTON 22	50-009-20018-00-00	Growth Resource International	8/26/2004	513
HOUSTON PIT No. 1	50-009-20028-00-00	Evergreen Resources (Alaska)	3/19/2004	1,604

B. Exploration History

The Houston-Willow area has been explored for energy resources since 1917, when excavations for the Alaska Railroad exposed subbituminous coal in the Miocene Tyonek Formation. The coal was

mined intermittently over the years, eventually supplying military bases until at least 1955 (Stanley et al., 2017). The U.S. Bureau of Mines drilled three Houston core holes in 1951–52 (Table 6.1), encountering Tyonek sandstones that reportedly flowed methane and brackish water at measured depths less than about 1,140 feet (May and Warfield, 1957). The Alaska Oil and Gas Conservation Commission (AOGCC) records indicate that Anchorage Oil and Gas completed a fourth Houston core hole to a measured depth of 2,135 feet in 1955, but no information is available regarding what the well encountered. From 1956 to 1962, Anchorage Gas and Oil Development and Hackathorn Drilling completed five Rosetta oil and gas exploration wells to measured depths of 1,100–6,109 feet (AOGCC, 2017). Between 1998 and 2004, after a long lull in exploration, Growth Resource International and Evergreen Resources completed a series of six coal bed methane (CBM) exploratory wells in the Houston area. To date, drilling in the area has encountered no oil shows, and only noncommercial quantities of gas.

Recent USGS-led studies (for example, Stanley et al., 2013; Saltus et al., 2016; Stanley et al., 2017) mark the first publicly available syntheses of available well, core hole, seismic, and potential fields geophysical data in the Susitna basin and the Houston area. They have significantly advanced the regional and local geologic understanding. Perhaps, the most significant information derived from the 15 wells and geophysical data near the proposed License Area are subsurface constraints for structural models of the Castle Mountain fault anticline. Further exploration using modern seismic, drilling, and logging techniques would likely help to resolve details of the anticline's geometry and to clarify its conventional gas and CBM resource potential.

C. Petroleum Potential

The petroleum potential of underexplored regions such as the Susitna basin is best analyzed using a petroleum systems approach. The critical elements of a natural petroleum system are effective source rocks, effective reservoir, and a trap that includes an effective seal. All three basic components must be physically connected when hydrocarbons are being generated and expelled from the source rocks. Clearly, the starting point of any petroleum systems analysis is characterizing the source rock.

Neither outcrop nor well data provide any indication of an oil-prone source rock in the Susitna basin. As described above, the wells in the deeper parts of the basin bottom in early Tertiary strata, penetrating only coaly, non-marine clastic strata above the oldest basin fill consisting of mixed volcanic and volcaniclastic rocks. The known Mesozoic units below the Tertiary basin are plutonic, metavolcanic, and metasedimentary rock types, with no capacity to source either oil or gas of any type. The coal-bearing basin fill strata are potential sources of either biogenic or thermogenic gas, depending on their level of thermal maturity. Biogenic gas forms at low temperatures, at ranks of peat to subbituminous, corresponding to vitrinite reflectance measurements of less than about 0.5 percent. Thermogenic conversion of gas-prone coaly kerogen to natural gas occurs at higher temperatures, in coals of subbituminous A to high-volatile bituminous C and higher rank, corresponding to vitrinite reflectance greater than about 0.6–0.7 percent (Michael et al., 1993; Rice, 1993; Tang, 1991). Merritt and Hawley (1986) identify the surface and near-surface Susitna coal field as primarily subbituminous in rank. It is possible but uncertain whether they reach higher thermal maturity levels consistent with thermogenic gas generation at depth in the basin. In short, while thermogenic gas from coal may or may not be present in Tertiary reservoirs in the Susitna

basin, biogenic gas charge like the hydrocarbon system in Cook Inlet appears plausible, at least in certain areas.

Based on currently available geological, geophysical, and engineering information, and considering the exploration history and proximity to known hydrocarbon accumulations, Division of Oil and Gas Resource Evaluation staff currently evaluate the Houston-Willow area of the Susitna basin as having minimal oil potential and moderate to low potential for commercial gas production. The area's conventional gas and CBM potential has been evaluated in some 15 wells and core holes in the Houston and Willow area, without commercial success. Challenges in the production of the area's CBM and conventional gas resource include produced water disposal, marginal methane content in the coals, marginal coal seam thickness, and structural complexity. Nonetheless, recent advances in understanding the Castle Mountain fault anticline suggest that modern seismic acquisition focused on this structure may help identify and de-risk future exploration objectives in the License Area.

D. Likely Methods to Transport Oil and Gas from the License Area

Transporting and distributing petroleum products and natural gas from oil and gas fields to refining and processing plants requires a comprehensive transportation system. Any oil or gas ultimately produced from future leases will have to be transported to market. The Director is required under AS 38.05.035(g)(1)(B)(viii) to consider and discuss the method or methods most likely to be used to transport oil or gas from the License Area, and the advantages, disadvantages and relative risks of each.

Strategies used to transport potential petroleum resources depend on many factors, most of which are unique to an individual discovery. The location and nature of oil or gas deposits determines the type and extent of facilities necessary to develop and transport the resource. DNR and other federal, state, and local agencies will review the specific transportation system when it is actually proposed. The following discussion is a general overview of the methods most likely to be used to transport oil or gas from the License Area.

Modern oil and gas transportation systems may consist of pipelines, marine terminals with offshore loading platforms, trucks, and tanker vessels. Since there are no waterbodies suitable for tankers or offshore loading platforms with marine terminals in or around the License Area, those methods would not be a likely method of transportation.

1. Pipelines or Pipeline Facility

A pipeline or pipeline facility means all the facilities of a total system of pipe. A pipe system is owned or operated under a contract, agreement, or lease. A pipeline is used by a carrier for transportation of crude oil, natural gas, or products for delivery, for storage, or for further transportation. A pipeline is a general term that includes all the components of a total system of pipe to transport crude oil or natural gas or hydrocarbon products 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 for both

the upstream part of the and all other facilities used or necessary for an integral line of pipe transportation (AS 38.35.230).

Onshore pipelines most likely would be buried as further described below. Buried pipelines 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 regarding inspection, repair, and maintenance. 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 or gas from either system.

a. Oil Transportation

Feeder pipelines, or gathering pipelines, may be connected to larger systems for oil transport. These are either elevated or buried depending on several factors such as the substance being transported, the local soil and ice conditions and other considerations such as movement of wildlife. An individual pipeline may alternate between buried and elevated. The advantages and disadvantages of the two options are set forth below. The mode of transport from a discovery is an important factor in determining whether or not the discovery can be economically produced. The more expensive a given transportation option, the larger a discovery will have to be for economic viability.

Buried pipelines may be feasible in the License Area. However, there are some important considerations regarding long sections of buried pipe. First is cost, which depends on length, topography, soils, and distance from the gravel mine site to the pipeline. Second, buried pipe is more difficult to monitor and maintain than elevated pipelines, although significant technological advances in leak detection systems have been made that increase the ease with which buried pipelines can be monitored. These systems are described under the oil spill prevention subsection in this chapter. Third, buried pipelines may contribute to increased loss of wetlands because of gravel fill. Finally, buried pipelines are sometimes not feasible from an engineering standpoint because of the thermal stability of fill and underlying substrate (Wen et al. 2010; DeGeer and Nessim 2008).

b. Natural Gas Transportation

Unlike oil, gas is difficult to store due to its physical nature. Gas needs high pressures and low temperatures to increase the bulk density and needs to be transported immediately to its destination after production from a reservoir (Mokhatab et al. 2006 citing Thomas and Dawe 2003). Moving natural gas from producing regions to markets requires a transportation system. The gas may have to travel a great distance to reach its point of use. Pipelines may follow elevated or buried routes, depending upon the engineering requirements needed and the soils found in the field. Natural gas may require treatment to remove impurities and to prepare it for transport. Treatment may include depressurization and dehydration. To keep the gas flowing along the pipeline route, the gas may also undergo pressurization by compressors and liquid separation treatment.

During transport, the gas is monitored. Pigging facilities and metering stations are constructed along the pipeline to monitor and manage the gas. Central control stations manage information along the pipeline to allow for quick prevention and necessary reaction to problems (Mokhatab et al. 2006).

Burial of natural gas pipelines can be desirable for both safety and operational reasons. High-pressure gas lines pose a risk of rupture and explosion. Burial and offset from an oil pipeline mitigate the potential impacts if a gas explosion were to occur. High-pressure gas lines operate more efficiently when chilled. In designing buried pipelines for use in Alaska, it is important to consider large deformations that could occur from frost heave, thaw settlement, and slope movement (ASME 2008).

i. Advantages of Pipelines for Transporting Oil and Gas

Pipeline monitoring is now done mainly by using remote instrumentation, and in some cases using smart pigs and maintenance pigs. Numerous monitoring and safety systems are installed to provide redundancy in these electrical and mechanical safety systems. Additionally, mechanical shutoff valves are being replaced by vertical expansion loops to provide a more fail-safe method of controlling pipeline pressures and leaks.

The incidence of accidents from transportation of natural gas via gathering lines is historically very low. Data provided by the Pipeline and Hazardous Materials Safety Administration within the U.S. Department of Transportation (PHMSA) shows what types of pipelines systems are most susceptible to accidents. Over the course of the period from 1992 to 2011, PHMSA data shows far fewer incidents from gathering lines than transmission and distribution lines. The data further shows the incidents of rail and trucking far exceed the incident rates of natural gas pipelines (Furchtgott-Roth 2013). Additional advantages of transporting natural gas through pipelines is the reduced cost, expanding the development of lower emission fuel, and a faster, more dependable delivery to markets.

ii. Disadvantages of Pipelines for Transporting Oil and Gas

The most distinct disadvantage of pipelines is their high up-front investment for construction costs. Additional considerations for pipeline operators are the challenges of preserving the quality of crude oil along with maintenance of the pipe. The larger the pipeline, the more the cold weather challenges are manifested, and the more operational costs are shifted to address these issues. This is exacerbated by fluctuations in throughput.

When transporting oil by pipeline, many chemicals are added to the oil to improve the rate and efficiency of throughput and to protect the pipeline. After extraction, oil cools from reservoir temperature and heavy fractions such as wax form crystals. Several deposits of wax may plug both pipelines and production facilities. To remove deposits of wax from the pipeline a vessel known as a pig is used in combination with a wax inhibitor. Other chemicals are added to the oils stream such as corrosion inhibitors to prevent corrosion damage to the pipe. Other cold-weather risks such as ice formation, reduced pigging velocities, water dropout, and reduced accuracy in leak detection can negatively impact the operation of oil pipelines and be considered a disadvantage to transporting oil by pipeline. (SPCS 2014)

The potential problems and risks associated with transportation of natural gas through pipelines are typically addressed in mitigation measures. A major risk of transporting gas through a pipeline is a leak or explosion. The measures and methods employed to prevent leaks or explosion, including line integrity protection, pipeline monitoring, and in-line inspections, are detailed in the Spill and

Leak Prevention section below. Other disadvantages related to waterbody crossings are addressed through mitigation measures listed in Chapter Nine.

2. Trucking

Transporting oil and gas by trucks is associated with greater risks than transporting by pipeline when measured by incidents, injuries, and fatalities (Furchtgott-Roth 2013). Between 2011 and 2012 trucks moving oil to refineries within the United States and Canada increased by 38 percent (IER 2013). Truck transportation is commonly used to move smaller amounts of oil and gas shorter distances which may be applicable in the License Area.

The federal government is the major source for transportation funding in Alaska. DOTPF is responsible for prioritizing, arranging, and administering the majority of transportation related capital projects. The State of Alaska pays for maintenance and operations for State roadways, but may not dedicate revenue to transportation purposes. The Alaska legislature maintains a large degree of control over State transportation programs and priorities. DOTPF projects and programs must compete each year with other social and infrastructure needs for money from the General Fund (DOT&PF 2018).

a. Advantages of Trucks for Transporting Oil and Gas

Transporting oil and gas by trucks has an advantage in that trucks can go anywhere roads are in place to service the production facilities and transport to a refinery facility, or other end user. Additionally, immediate environmental impacts tend to be smaller because trucks carry smaller quantities than the other transportation alternatives, thus any spill would be limited in size (Factoring 2018).

b. Disadvantages of Trucks for Transporting Oil and Gas

Moving oil and gas by truck is more expensive on a per barrel basis than using a pipeline. Studies show that the average cost to move a barrel of oil by truck is quadruple the cost to move it by pipeline. It is difficult to make these comparisons because trucks are typically used to move the product much shorter distances, and they are more feasible for a smaller scale project where developing new infrastructure can be prohibitive (Strata 2017).

E. Spills and Releases: Risk, Prevention, and Response

The risk of a spill exists any time crude oil or petroleum products are handled. AS 38.05.035(g)(1)(B)(vii) requires the Director to consider and discuss lease stipulations and mitigation measures, including any measures to prevent and mitigate releases of oil and hazardous substances, to be included in the license, and a discussion of the protections offered by these measures. The mitigation measures related to release of oil and hazardous substances were developed after the director considered the risk of oil spills, methods for preventing spills, and techniques for responding to spills.

1. Oil Spill History and Risk

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

a. Exploration and Production

As noted above, risk factors and spill incidents within the overall oil and gas industry vary among activities. Exploration and production facilities may include onshore gravel pads, drill rigs, pipelines, and facilities for gathering, processing, storing, fuel transfer, and moving oil and gas. Mitigation measures are developed to prevent and contain spills from fuel and hazardous material transfer, equipment storage, vehicle fueling, and maintenance activities. When spills occur at these facilities, they are usually related to everyday operations, such as fuel transfers. The ADEC – Spill Prevention and Response Team must be contacted to report a spill and begin an investigation into the cause of the spill. Reporting to the U.S. Coast Guard (USCG), US Environmental Protection Agency (EPA), and local government contact is also required. Large spills are rare at the exploration and production stages because spill sizes are limited by production rates and by the amount of crude oil stored at the exploration or production facility.

The most dramatic form of spill can occur during a well blowout. A well blowout can take place when high pressure is encountered in the well and sufficient precautions, such as increasing the weight of the drilling mud, are not effective. The result is that oil, gas, or mud is suddenly and violently expelled from the well bore, followed by uncontrolled flow from the well. Blowout preventers, which immediately close off the open well to prevent or minimize any discharges, are required for all drilling and work-over rigs and are routinely inspected by the AOGCC to prevent such occurrences.

Blowouts are extremely rare in Alaska and their numbers decline as technology, experience, and regulations influence drilling practices. The AOGCC regulations set forth a comprehensive well permitting process and rigorous well operations inspection program. It also has a program to ensure well failures or blowouts do not occur. Drilling plans and procedures are scrutinized to assess potential problems within rock formation and the drilling fluids used to control downhole pressure. Well construction is evaluated and rigs are inspected before permission to drill is granted. (AOGCC 2009).

b. Pipelines

An analysis of oil spills in Alaska between 1995 and 2011 found that the highest frequency of spills came from facility oil piping, process piping, and wells. The largest spills by volume generally

came from flowlines. The two largest spills during the period came from storage tanks and oil transmission pipelines. The analysis found that the most frequent cause of failure leading to a spill was a valve or seal failure, and the most frequent cause of large spills (1,000 gallons or greater) was corrosion (Robertson et al. 2013). ADEC commonly cites the primary causes of spills as line failure, equipment failure, human error, containment overflow, and tank failure (ADEC 2016, 2015, 2014, 2013).

Both state and federal agencies have oversight of pipelines in Alaska. State agencies include the ADEC and the Division of Oil and Gas, which includes the State Pipeline Coordinator's Section, and the federal and state Joint Pipeline Office. Federal agencies include PHMSA and the Bureau of Safety and Environmental Enforcement within the U.S. Department of the Interior.

2. Spill and Leak Prevention

Prevention and response activities begin long before any spill or leak. Information gleaned from past spills has led to increased emphasis on prevention rather than response alone. State and federal laws require that industries that produce, store, or transport oil develop contingency plans that specify measures to prevent and respond to oil spills. Contingency planning, thorough training, exercise and practice programs, improved safety standards, well-maintained equipment and routine surveillance are important components of oil spill prevention. Advancements in engineering design and equipment, redundancy in critical components, and changes in operating procedures and practices have contributed to improvements in well control (AOGCC 2009).

If oil or gas is found in commercial quantities and production is proposed, plans for transportation will be made by the licensee and be evaluated though the local, state, and federal application and permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards and will involve public participation.

a. Blowout Prevention

Oil, gas, and other hazardous substances may be released in a well blowout. A well blowout can take place when high pressure gas is encountered in the well and sufficient precautions, such as increasing the weight of the drilling mud, are not effective. The result is that gas or mud is suddenly and violently expelled from the well bore, followed by uncontrolled flow from the well. Blowout preventers (BOP), which immediately close off the open well to prevent or minimize any discharges, are required for all drilling and workover rigs and are routinely inspected by the AOGCC (AS 46.04.030). BOP greatly reduce the risk of a gas release. If a release occurs; however, the released gas will dissipate unless it is ignited by a spark (Florence et al. 2011).

Each well has a blowout prevention program that is developed before the well is drilled. Operators review bottom-hole pressure data from existing wells in the area and seismic data to learn what pressures might be expected in the well. Engineers use this information to design a drilling mud program with sufficient hydrostatic head to overbalance the formation pressures from surface to the total depth of the well. Engineers also design the casing strings to prevent various formation conditions from affecting well control performance. BOP equipment is installed on the wellhead after the surface casing is set and before actual drilling begins. BOP stacks are routinely tested in

accordance with government requirements. Under 20 AAC 25.035, the AOGCC regulates compliance with blowout prevention requirements.

b. Leak Detection

Leak detection systems and effective emergency shut-down equipment and procedures are essential in preventing discharges of oil and gas from any pipeline. Once a leak is detected, valves at both ends of the pipeline, as well as intermediate block valves, can be manually or remotely closed to limit the amount of discharge. The number and spacing of the block valves along the pipeline will depend on the size of the pipeline and the expected throughput rate.

The technology for monitoring pipelines is continually improving. Leak detection methods may be categorized as hardware-based (optical fibers or acoustic, chemical, or electric sensors) or software-based (to detect discrepancies in flow rate, mass, and pressure). Leak detection methods include acoustic monitoring, pressure point analysis, ultrasound, radiographic testing, magnetic flux leakage, the use of coupons, regular ground and aerial inspections, and combinations of some or all of the different methods. The approximate location of a leak can be determined from the sensors along the pipeline. A computer network is used to monitor the sensors and signal any abnormal responses. Modern pipeline systems are operated from control centers with computer connectivity and satellite and telecommunication links to strive for rapid response and constant monitoring of pipeline conditions (NRC 2003).

Design and use of "smart pigs," data collection devices that are run through the pipeline while it is in operation, have greatly enhanced the ability of a pipeline operator to detect internal and external corrosion and differential pipe settlement in pipelines. Pigs can be sent through the pipeline on a regular schedule to detect changes over time and give advance warning of any potential problems. (NRC 2003).

3. Oil Spill Response

Cleanup response includes initial response, remediation, and restoration. During initial response, the responsible party: gains control of the source of the spilling oil; contains the spilled oil; protects the natural and cultural resources; removes, stores, and disposes of collected oil; and assesses the condition of the impacted areas. During remediation, the responsible party performs site and risk assessments, develops a remediation plan, and removes, stores, and disposes of more collected oil. Restoration attempts to reestablish the ecological conditions that precede the spill, and usually includes a monitoring program to assess the results of the restoration activities (Jorgenson and Carter 1996).

Spill preparedness and response practices are driven by the Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases (Unified Plan). The Unified Plan represent a coordinated and cooperative effort by government agencies and were written jointly by the USCG, EPA, and ADEC (ADEC 2010, 2012).

Spill response follows the Incident Command System (ICS) outlined in the Unified Plan. The ICS allows for all components of a response including federal, state, and local agencies; other personnel; equipment and facilities; and procedures and permitting to be managed with a common

organizational structure on operating period. This coordination increases the efficiency of a response and decreases duplication of efforts. The ICS is designed to be scalable to each incident, and roles and responsibilities within the ICS are adjusted accordingly.

The ICS is led by the Unified Command, which directs all aspects of incident response (including oversight, monitoring, clean up, etc.); it also includes an Incident Commander (IC), who is in command of the control, containment, removal, and disposal of the spill.

The Unified Command is implemented in situations where more than one agency has jurisdiction. Under federal and state law, the Responsible Party (RP) for an oil or hazardous substance incident is required to report the incident and mount a response effort to contain and clean up the release. When the RP is identified, the RP On Scene Coordinator, usually a senior representative of the RP, is the Incident Commander. When there is no RP or the RP is unable to satisfactorily respond to a spill, the spill response will be directed by an Incident Commander designated by the agency with jurisdictional authority (federal, state, or local) and will follow the response protocols and guidance outlined in the Unified Plan (ADEC 2010, 2012).

a. Prevention

i. Authorities

The local Area Plan outlines how a spill response will be organized within the Unified Command. Participants in spill response activities may be part of a federal, state, or local agency, local community, private or volunteer organization.

Federal On-Scene Coordinator: The USCG is the lead agency for coastal oil and hazardous materials spill responses and serves as the Federal On-Scene Coordinator (FOSC) in the Unified Command. For oil spills on inland waters, more than 3000 feet inland from the tideline, the EPA will be the FOSC. The role of the USCG or EPA in the Unified Command will vary according to spill type and size.

State On-Scene Coordinator: The ADEC is the lead agency for the State of Alaska in oil and hazardous materials spill response. The ADEC serves as the State On-Scene Coordinator (SOSC) in the Unified Command. The ADEC and other response personnel use the Alaska Incident Management System (AIMS) for Oil & Hazardous Substance Response which contains detailed guidance necessary to properly respond to a major spill incident.

Local On-Scene Coordinator: In the event of an oil spill or hazardous substance release in the License Area, a senior member of the local community with jurisdiction, unless otherwise specified by local plans, will serve as the LOSC in the Unified Command.

Responsible Party: Under federal and state law, the Responsible Party (RP) must contain, control, and clean up any oil or hazardous substance spilled. The RP must notify the federal, state, and local authorities of the spill incident and initiate an effective response. The RP is expected to respond to an incident using its own resources and securing additional contractual expertise and equipment when necessary. The FOSC and SOSC have the authority to oversee the RP's activities, and both are authorized to take over or supplement the RP's response activities if they determine those activities to be inadequate. During an RP-driven response, if the vessel or facility has a contingency

plan, it will serve as the primary guidance document for the spill response and the RP will designate the Incident Commander. If there is no RP, or if the RP does not have a government-approved contingency plan, the Unified Plan will become the guiding document during the spill response.

Alaska Regional Response Team: The Alaska Regional Response Team (ARRT) is a standing body established under the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) (40 CFR 300.115). The ARRT is comprised of state and federal agencies with the USCG and EPA serving as co-chairs and ADEC is the state's primary representative. The ARRT provides a regional mechanism for the development and coordination of preparedness activities before a pollution response (ADEC 2010, 2012). The ARRT developed and published the *Alaska Incident Management System Guide (AIMS) for Oil and Hazardous Substance Response* that provides guidance regarding wildlife, in-situ burning, the use of dispersants, and the protection of cultural resources including archaeological and historic sites (AIMS Work Group 2002).

During a significant spill response, the ARRT members or their representatives will participate in the FOSC's ICS as appropriate. The ARRT can coordinate assistance and advice to the FOSC by providing additional federal and state resources and expediting approvals for federal and state permits. Appropriate ARRT members are convened as necessary to make decisions on in-situ burning, use of chemical countermeasures, and nationwide permits. These federal and state emergency response activities are mandates in the National Contingency Plan and are coordinated with the National Incident Management System and the National Response Framework (ADEC 2012, 2010; AIMS Work Group 2002).

ii. Training

Training and spill response exercises are a key component of enhancing preparedness and response capability for the entire Alaska response community including federal, state, and local agency partners and regulated operators. Training and spill response exercises may be conducted by federal, state, local agencies, and industry. Each organization and participant have specific goals for response exercises. Regulated industries must be aware and conduct response exercises to meet the required federal National Preparedness for Response Exercise Program guidelines, state plan commitments, and other regulatory programs such as the Occupational Health and Safety Administration’s Hazardous Waste Operations and Emergency Response under 29 CFR 1910.120 and 8 AAC 61 (ADEC 2010, 2012).

The ADEC’s Interagency Coordination Unit provides coordination and facilitation for the Statewide Hazmat Response Team and Work Group. The Statewide Hazmat Response Work Group has over 25 participating entities including local, state, federal, military, private and industry hazmat response partners. The work group meets three times per year to discuss and update the following: statewide response capabilities, standardizing operating procedures, lessons learned from recent responses, training, exercises, funding, and other topics of interest. In 2016, the Statewide Hazmat Response Teams responded to three separate scenarios simulating releases of hazardous substances (ADEC 2016).

b. Response and Remediation

i. Spill Response

Response actions vary greatly with the nature, location, and size of the spill. A spill response progresses through a series of steps where the number of personnel and amount of equipment are increased or decreased as necessary to meet the demands of the situation. This increase of resources to address response needs is called a ramp up. The USCG and EPA will rely on their respective agency's Incident Management Handbooks and State of Alaska personnel will employ the AIMS Guide and well as the Spill Tactics for Alaska Responders to direct their staffing of emergency response teams (ADEC 2012; AIMS Work Group 2002).

The ramp up begins when the spill is first reported and progresses with the sequential and prioritized activation of the response resources of the RP and the local, state, and federal responders. Each spill response will differ according to spill size and severity, location, season, and personnel needs will vary accordingly. Response teams consider all factors that may affect the situation and revise, modify, or expand these priorities as the situation dictates. The strategies listed in the Unified Plan should be used as a guide in developing an effective response (ADEC 2010, 2012).

ii. Fate and Behavior of Spilled Oil

Spills in Alaska require careful preplanning to overcome the effects imposed by the cold-weather environment. Machinery and people face significant challenges when operating in cold weather. Quick response and recovery greatly affect the efficacy of any spill cleanup. After a spill, the physical and chemical properties of the individual constituents in the oil begin to be altered by the physical, chemical, and biological characteristics of the environment. These are called weathering, evaporation, oxidation, dispersion, dissolution, biodegradation, and emulsification (ADEC 2012).

The various types of petroleum products respond quite differently when released into the environment. Spills of refined product that enter the water generally will disperse and experience significant evaporation, making recovery difficult. Crude oil will be affected by the same natural degradation factors but to a much lesser degree. Crude oil spills are "persistent" in nature and require aggressive actions and innovative techniques to be successful. The passage of time before the start of recovery allows oil to spread, expanding the affected area and thus requiring more response resources (ADEC 2012).

Upland spills follow topography; oil flows downhill. Wintertime spills may be constrained or facilitated by snow and ice. Ice and snow can act effectively as natural barriers by impeding the spread of oil, and can be used effectively to create berms for spill containment (NRC 2003).

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

iii. Cleanup Techniques and Remediation

Cleanup plans, regardless of the location and nature of the spill, must balance the objectives of maximizing recovery and minimizing ecological damage. All oils are not the same, and knowledge of the chemistry, fate, and toxicity of the spilled oil can help identify cleanup techniques that can reduce the ecological impacts of an oil spill. Hundreds of laboratory and field experiments have investigated the fate, uptake, toxicity, behavioral responses, and population and community responses to crude oil.

Cold weather, in particular, can challenge both personnel and machinery. Conversely, ice and snow can act as natural barriers and facilitate clean up. However, spills that occur during the summer risk impacting the diverse species that use habitats in the License Area. Cleanup plans address specific steps to accommodate these conditions (NRC 2003; Nuka Research and Planning Group LLC 2007).

The best cleanup techniques are those that quickly remove volatile aromatic hydrocarbons. To limit the most serious effects, it is desirable to remove the maximum amount of oil as soon as possible after a spill. The objective is to promote ecological recovery and not allow the ecological effects of cleanup to exceed those caused by the spill itself (Jorgenson and Carter 1996).

State regulations require operators to be able to mechanically entrain and recover, within 72 hours, a response planning standard (RPS) volume of oil (18 AAC 75.434). For exploration facilities, the RPS is a minimum of 16,500 barrels plus 5,500 barrels for each of 12 days beyond 72 hours. For production facilities, the RPS is, at a minimum, three times the annual average daily production for the maximum producing well at the facility. If well data demonstrate a lower RPS is appropriate, it may be adjusted accordingly (Nuka Research and Planning Group LLC 2007).

4. Hazardous Substances

Hazardous substances are identified as a large range of elements, compounds, and substances regulated by the US EPA, USCG, ADEC, and other government agencies. In addition to petroleum products, waste products, toxic water pollutants, hazardous air pollutants, hazardous chemical substances, and other products presenting an imminent danger to public health or welfare are identified for prevention from release and response in cases of spills. AS 46.03.826(5). In order to minimize releases or spills during oil and gas operations, mitigation measures have been developed and can be found in Chapter Nine.

Any release of a hazardous substance must be reported by a RP as soon as the person has knowledge of the discharge. The release must be reported to the National Response Center and the ADEC and response protocols are initiated. There are a number of safeguards in place to react quickly to hazardous releases. Coordination, trained personnel, and technological advances can be employed quickly to address the occasions when releases occur (ADEC 2012).

It is essential for those in command control to recognize and identify the substance release for safe containment. An initial characterization of the hazard during the evaluation phase of containment requires an assessment of potential threat to public health and environment, need for protective actions, and protection of response personnel. A more comprehensive characterization will follow if

necessary. In certain cases, local or state entities have the authority to order evacuations beginning with those living or working in downwind or in low-lying areas. Response personnel will secure sites, establish control points, and establish work zones. The LOSC is in command and control until he or she determines an imminent threat to public safety no longer exists. While the largest volume of transport hazard substances are natural gas and crude oil, agency coordination between federal, state, and local entities are equipped to contain and manage releases of all hazardous substances present in the License Area (ADEC 2012).

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Chapter Seven: Governmental Powers to Regulate Oil and Gas

Contents

Chapter Seven: Governmental Powers to Regulate Oil and Gas

AS 38.05.035(g)(1)(B)(v) requires the Director to consider and discuss the governmental powers to regulate the exploration, development, production, and transportation of oil and gas or gas only. Oil and gas activities are subject to numerous federal, state and local laws, regulations, policies, and ordinances. Each licensee is obligated to comply with all federal, state, and local laws. Regulatory agencies may have different roles in the oversight and regulation of oil and gas activities, and some agencies may have overlapping authorities with other agencies.

Most oil and gas activities require individual authorizations regardless of which phase (exploration, development, production, or transportation) of oil and gas development they are associated with. Phases of oil and gas development are addressed in greater detail in Chapter Eight. Common oil and gas activities associated with exploration requiring prior authorization include seismic surveys, development of drill pads, and drilling exploration wells. In the development phase, common activities requiring prior authorization include construction of pads, roads, support facilities, and drilling development wells. In the production phase, common oil and gas activities requiring prior authorization include constructing and operating processing facilities, construction of transmission pipelines, flow lines, and above-ground storage tanks. The transportation phase is focused on moving oil and gas, and regulatory authorities tend to shift toward monitoring activities and facilities in the field to ensure post-disposal oil and gas activities are conducted as approved. These phases are not always sequential and associated oil and gas activities may occur at any point throughout the project. The completion of one phase does not automatically trigger the beginning of a new phase.

This chapter is not intended to provide a comprehensive description of the broad spectrum of government agencies authorized to prohibit, regulate, and condition oil and gas activities which may ultimately occur as a result of the issuance of the Houston Willow Exploration License. Actual processes, terms, conditions, and required authorizations will vary with time-certain, site-specific operations, and the activities discussed in the previous paragraph are not all inclusive. Licensees are responsible for knowing and complying with all applicable federal, state, and local laws, regulations, policies, ordinances, and the provisions of the License. Some, but not all, of the major permits and approvals required by each agency are discussed below.

A. State of Alaska

The State of Alaska has several agencies that approve, oversee, or coordinate activities related to oil and gas.

1. Department of Natural Resources (DNR)

a. Division of Oil and Gas (DO&G)

i. Plan of Operations Approval

Operations undertaken on or in the License Area are regulated by 11 AAC 83.158, 11 AAC 83.346, and the license or lease. They require the licensee to prepare plans of operations that must be approved by the DO&G before they begin activities on the license or lease. 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 license terms. Each plan of operations is site-specific and is tailored to the proposed activity requiring the permit. DO&G may make field inspections to monitor and assess compliance.

When it considers a plan of operations, DO&G may require stipulations in addition to the mitigation measures developed through the written finding (11 AAC 83.158(e), 11 AAC 83.346(e)). These additional stipulations may address site-specific concerns directly associated with the proposed operations. The stipulations and the terms and conditions of the license and lease are attached to the plan of operations approval and are binding on the licensee. The license also requires the licensee keep the License Area open for inspection by authorized state officials. DNR, Alaska Department of Environmental Conservation (DEC), Alaska Department of Fish and Game (ADF&G), and Alaska Oil and Gas Conservation Commission (AOGCC) may monitor field activities for compliance with each agency's terms. In addition, each licensee must post a statewide bond before beginning operations (11 AAC 83.160).

ii. Pipeline Rights-of-way

The State Pipeline Coordinator's Office was established within DNR by Administrative Order in 1987, and is now the State Pipeline Coordinator's Section of the DO&G. Administrative Orders established the State Pipeline Coordinator as the lead agency for the State in processing pipeline right-of-way leases under Alaska Statute 38.35.010 - 230, the Right-of-Way Leasing Act (Administrative Order 134 and 187). The State Pipeline Coordinator also coordinates the State's oversight of preconstruction, construction, operation, and termination of jurisdictional pipelines (SPCS 2017).

b. Division of Mining, Land, and Water (DMLW)

i. Temporary Water Use Authorization

Exploration activities 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 (DMLW 2016). 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 is subject to conditions, and may be suspended or terminated if such action is considered necessary to protect the water rights of other persons or the public interest. Information on lake bathymetry, fish presence, and fish species may be required when winter water withdrawal is proposed to calculate the appropriate withdrawal limits.

ii. Permit and Certificate to Appropriate Water

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 remits the fee required under 11 AAC 05.010 and:

(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 certificated, and

(2) has substantially complied with all permit conditions.

iii. Land Use Permits

DO&G issues land use permits, also known as a geophysical permit or a miscellaneous land use permit (MLUP), under 11 AAC 96.010. Geophysical exploration permits are required for all geophysical and exploration activity in the Houston Willow Exploration License Area. Submission of seismic exploration and stratigraphic test data to the state is required as a condition of the issuance of a land use permit to conduct seismic exploration field operations or to drill a stratigraphic test well under 11 AAC 96.210.

DMLW issues land use permits to manage surface uses and activities on state public domain land and to minimize adverse effects on the land and its resources under 11 AAC 96. Land use permits may be required for some oil and gas activities, unless the activities are otherwise approved under any department-administered lease, oil and gas exploration license, plan of operations, contract, or permit (11 AAC 96.007). Land use permits may be issued for a period of up to five years depending on the activity, and may be revoked at will or for cause in accordance with 11 AAC 96.040. Generally allowed uses on state land are subject to the conditions set out in 11 AAC 96.025.

iv. Material Sale Contract

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 minimum, a description of the License Area, the materials to be extracted, the volume of material to be extracted, 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 (11 AAC 71.200).

A contract may be extended if the DMLW 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 (11 AAC 71.20).

The DMLW Director may require the purchaser to provide a performance bond guaranteeing performance of the terms of the contract. If required, the bond amount is based on the total value of the sale and must remain in effect for the duration of the contract unless released in writing by the DMLW director (11 AAC 71.095).

c. Office of History and Archaeology (OHA)

The OHA performs the work of the State Historic Preservation Office (SHPO) (OHA 2015b). OHA follows the state's Historic Preservation Plan in maintaining the Alaska Heritage Resources Survey (AHRS). The Historic Preservation Plan was last updated in 2011 and is current through 2017. A revised plan that will guide preservation activities in the state from 2018 through 2023 was approved by the National Park Service in December 2017.

AHRS is 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 the sites are over 50 years old. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction (OHA 2015a). 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 distributed to others.

AS 41.35.010 declares it is the policy of the state to preserve and protect the historic, prehistoric, and archeological resources of Alaska from loss, desecration, and destruction so that the scientific, historic, and cultural heritage embodied in these resources may pass undiminished to future generations. Further, the historic, prehistoric, and archeological resources of the state are properly the subject of concerted and coordinated efforts exercised on behalf of the general welfare of the public in order that these resources may be located, preserved, studied, exhibited, and evaluated.

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)).

2. Department of Environmental Conservation (ADEC)

The ADEC 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. The ADEC implements and coordinates several federal regulatory programs in addition to state laws (ADEC 2016d).

a. Interference with Salmon Spawning Permits

The ADEC 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 with the intent 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.

b. Air Quality Permits

The ADEC administers the U. S. Environmental Protection Agency's Clean Air Act (42 USC 85 §§ 7401–7671 et seq.) and the state's air quality program under a federally-approved State Implementation Plan (AS 46.14; 18 AAC 50). Through this plan, federal requirements of the Clean Air Act are met including 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 set limits on 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 with an aerodynamic diameter less than or equal to ten microns (PM10), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns (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 (EPA 2016c). NSPS are intended to promote 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 (EPA 2016b). NESHAPs are set for air pollutants that are not covered by NAAQS, but that may be harmful (EPA 2017). The standards are categorized by type of source, and require the maximum degree of reduction in emissions that is achievable, as determined by the US Environmental Protection Agency (EPA).

The two primary types of permits issued to meet these requirements are Title I Construction Permits and Title V Operation Permits (ADEC 2016a). Permits specify what activities are allowed, what emission limits must be met, and may specify how the facility must be operated. Permits may contain monitoring, recordkeeping, and reporting requirements to ensure that the applicant meets the permit requirements (ADEC 2016a).

i. Title I (NSR) Construction Permits

Title I permits deal specifically with air construction permits for PSD and minor source specific permits (MSS) as well as other requirements of the Clean Air Act. The Title I permit must be obtained before onsite construction can begin. Existing and new facilities that propose to construct or modify a stationary source would likely need to apply for a PSD or MSS permit. PSD 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"; an air quality analysis; an additional impacts analysis; and public involvement. MSS permits usually require an air quality analysis (EPA 2016d).

The process for a Title I permit can take up to three years, depending on the amount of meteorological or pollutant data collection required. Once a complete Title I permit application is submitted, ADEC strives to issue Title I minor permits within 130 days. Title I PSD permits can take up to 18 months to issue once a complete permit application is received. Article 5 of 18 AAC 50 contains the regulations covering Title I minor permits. Article 3 of 18 AAC 50 contains the regulations covering the Title I PSD permits. With a few exceptions, ADEC has adopted the federal PSD permit program under 40 CFR 52.21 by reference.

ii. Title V Operations Permits

The federal Clean Air Act gives the EPA authority to limit emissions from air pollution sources after the source has begun to operate. 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 is responsible for issuing Title V permits and making compliance inspections (AS 46.14; 18 AAC 50). The permit establishes limits on the type and amount of emissions allowed, requirements for pollution control devices and prevention activities, and monitoring and record keeping requirements (ADEC 2016a).

If a Title V permit is required, permittees have up to one year after beginning operations to submit their completed Title V permit application. Operations can continue while ADEC processes the application if the application is both timely and complete. However, significant revisions to an existing permitted facility cannot be made until ADEC approves the permit revision. Processing time for permit revisions can take up to six months. Title V permits and revisions can be processed concurrently with Title I permits. Article 3 of 18 AAC 50 contains the regulations covering Title V permits. With a few exceptions, ADEC has adopted the federal operating permit program under 40 CFR Part 71 by reference.

iii. Other Requirements

The ADEC also operates ambient air quality monitoring networks under the provisions of the Clean Air Act 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 (ADEC 2016c).

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 the AOGCC any flaring event lasting over an hour. The AOGCC investigates these incidents to determine if there was unnecessary waste of the natural gas resource (AOGCC 2004).

c. Solid Waste Disposal Permit

The ADEC 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 Underground Injection Control (UIC) Class I injection wells. A different state agency, AOGCC, regulates UIC Class II oil and gas waste management wells.

The ADEC 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).

All produced waters must be reinjected down well or treated to meet Alaska Water Quality Standards before discharge. 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). Hazardous substances to be disposed of have a separate permitting and review process by both DEC under 18 AAC 62 and 63 and the EPA.

d. 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.

e. APDES Discharge Permits and Certification

The ADEC administers the Alaska Pollution Discharge Elimination System (APDES) program (ADEC 2016b). 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" (18 AAC 83.990).

There are two basic types of APDES permits: general permits and individual permits. General permits cover multiple facilities that have similar wastewater characteristics in a defined area. Individual permits are issued to a single facility and the terms, limits, and conditions are specifically tailored for that facility and circumstances. APDES permits are effective for a period not exceeding five years, and the facility must reapply for the permit before it expires.

f. Industry Oil Discharge Prevention and Contingency Plans

The ADEC regulates spill prevention and response under AS 46.04.030. Contingency plans (C-plans) must be filed with DEC before beginning operations. 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 and approved for each facility before activity commences.

Discharges of oil or hazardous substances must be reported to ADEC 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 ADEC's satisfaction. ADEC will modify proposed cleanup techniques or require additional cleanup techniques for the site as ADEC determines to be necessary to protect human health, safety, welfare, and the environment (18 AAC 75.335(d)).

C-plans must describe existing and proposed means of oil discharge detection, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation (AS 46.04.030; 18 AAC 75.425(e)(2)(E)). 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).

3. Alaska Department of Fish and Game (ADF&G)

a. Fish Habitat Permit

Under AS 16.05.841–871, the ADF&G has the statutory responsibility for protecting freshwater anadromous fish habitat and providing free passage for anadromous and resident fish in freshwater bodies and any activity or project that is conducted below the ordinary high water mark of an anadromous stream. These activities include, but are not limited to, construction and maintenance for bridges and culverts, stream diversion, stream crossing, and using explosives in the bed of a specified river, lake, or stream. The ADF&G may attach additional stipulations to any permit authorization to mitigate potentially negative impacts of the proposed activity.

b. Special Area Permit

Under AS 16.20, authorization for land and water use activities that may impact fish, wildlife, habitats, or existing public use in any of the refuges, sanctuaries, or critical habitat areas designated by the Alaska State Legislature, may require a special area permit. Examples of activities requiring a special area permit include, but are not limited to, construction or placement of structures, damaging or clearing vegetation, detonation of explosives, natural resource development, or energy exploration, and any activity that is likely to have a significant effect on vegetation, drainage, water quality, soil stability, fish, wildlife, or their habitat, or which disturbs fish or wildlife (5 AAC 95.420). The ADF&G may require a mitigation plan pursuant to 5 AAC 95 when deemed necessary.

4. Alaska Oil and Gas Conservation Commission (AOGCC)

The AOGCC is an independent, quasi-judicial agency of the State of Alaska. Established under the Alaska Oil and Gas Conservation Act, AS 31.05.005, the AOGCC has statutory mandates consistent with the protection of health, safety, and the environment. The AOGCC's regulatory authority is outlined in 20 AAC 25.

The AOGCC acts to prevent waste, protect correlative rights, improve ultimate recovery, and protect underground freshwater. It issues permits, orders, and administers the Underground Injection Control (UIC) program for enhanced oil recovery and underground disposal of oil field waste. The AOGCC serves as an adjudicatory forum for resolving certain oil and gas disputes between mineral owners, including the state (AOGCC 2015).

a. Permit to Drill

Under AS 31.05.090, the AOGCC is authorized to issue permits to drill. Anyone wishing to drill a well for oil, gas, or geothermal resources first must obtain a permit to drill from the AOGCC. This requirement applies to exploratory, stratigraphic test and development wells, and injection and other service wells related to oil, gas, and geothermal activities. Typically, operating companies have obtained approval from all other concerned agencies by the time an operator, as defined by 20 AAC 25.990(46), applies to the AOGCC for a permit to drill. The application must be accompanied by the items set out in 20 AAC 25.005(c).

Under 20 AAC 25.015, once a permit to drill has been approved, the operations detailed in the permit to drill application must not be changed without additional approval from the AOGCC. After issuance of a permit to drill, information on the surface and proposed bottom-hole locations and the identity of the lease, pool, and field for each well is published as part of the AOGCC's weekly drilling report (AOGCC 2015).

b. Underground Injection Control Program (UIC)

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 UIC program requires the AOGCC to verify the mechanical integrity of injection wells, determine if appropriate injection zones and overlying confining strata are present, determine the presence or absence of freshwater aquifers and ensure their protection, and prepare quarterly reports of both in-house and field monitoring for the EPA. Through a Memorandum of Understanding with the EPA, the AOGCC has primacy for Class II wells in Alaska, including oilfield waste disposal wells, enhanced oil recovery wells, and hydrocarbon storage wells.

The AOGCC reviews and takes appropriate action on proposals for the underground disposal of Class II oil field wastes (20 AAC 25.252). Before receiving 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 in a manner that 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 of the well and is not a disposal operation subject to regulation as a Class II well (AOGCC 2015).

c. 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 cuttings incidental to the drilling of a well. The 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 (AOGCC 2015).

d. Disposal Injection Orders

Under 20 AAC 25.252, operators may apply for disposal injection orders to dispose of waste in individual wells. After the public review process and AOGCC analysis, an order may be issued that approves the proposed disposal project (AOGCC 2015).

e. Area Injection Orders

Injection orders may be issued on an area basis rather than for individual wells in areas where greater activity is anticipated (20 AAC 25.402). The area injection orders describe, evaluate, and approve subsurface injection on an area wide basis for enhanced oil recovery and disposal purposes (AOGCC 2015).

f. Flaring Oversight

The goal of the flaring oversight program is the elimination of unnecessary flaring whenever possible in accordance with 20 AAC 25.235. Operators are required to report all flaring events lasting longer than one hour to the AOGCC. Flaring events over one hour are analyzed and investigated if necessary. The operator may be penalized if it is determined that waste has occurred (AOGCC 2015).

5. Department of Labor and Workforce Development (DOLWD)

In response to studies of the state's workforce by the DOLWD that identified the need to increase the supply of skilled construction workers available in the state, Governor Walker signed Administrative Order No. 278 (AO 278). AO 278 states that increasing opportunities for on-the-job training through monitoring the use of apprentice workers on state-financed construction projects will work to improve the future pool of skilled construction workers available. AO 278 requires the commissioners of the Department of Transportation and Public Facilities and the Department of Administration to strive to require that not less than 15 percent labor hours on a qualified project are performed by federally-registered apprentices in certain job classifications, and directed the DOLWD to collect information related to compliance with AO 278 and submit the requisite reports to the governor. Additionally, DNR was directed to, in the development of Best Interest Findings for disposal of mineral and oil and gas leases, seek input from other agencies and include a discussion of the potential benefits of the lessee's hiring and employment of apprentices to perform at least 15 percent of total work hours. As to existing leases, DNR was directed to consider ways to encourage lessees developing minerals, including oil and gas, on state-owned land to employ apprentices for work performed on the leased area. This is addressed in further detail in Chapters Eight and Nine.

The DOLWD also administers some delegated authorities of the Occupational Safety and Health Administration (OSHA), PL-91-596, 1970. Section 18 of the law allows states to obtain approval to assume responsibility for development and enforcement of federal occupational safety and health standards. The DOLWD has obtained approval from OSHA for administration of some of the federal OSHA standards (DOLWD 2016; OSHA 2016).

B. Federal

1. 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 air, land, and water.

a. Air Quality Permits

The ADEC administers the federal Clean Air Act and the air quality program for the State of Alaska under a federally-approved State Implementation Plan (EPA 2016a). More information is available in Section 2(b) above.

b. Hazardous Waste (RCRA) Permits

The Federal RCRA regulates the management of solid waste, hazardous waste, and underground storage tanks holding petroleum products or certain chemicals (40 CFR 264.175(b)–(c)). Regulations set the parameters for transporting, storing, and disposing of hazardous wastes and for designing and operating treatment, storage, and disposal facilities safely (40 CFR 264.193(b). Regulations are enforced through inspections, monitoring of waste handlers, taking legal action for noncompliance, and providing compliance incentives and assistance (EPA 2016e).

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

c. National Pollutant Discharge Elimination System (NPDES) Discharge Permit

The ADEC administers the NPDES EPA program, now titled the Alaska Pollutant Discharge Elimination System (APDES). 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.

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

The EPA regulates injection wells used to dispose of fluid pumped into the well. Authorized as part of the federal Safe Drinking Water Act of 1974, the EPA's UIC program protects underground sources of drinking water from being contaminated 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. The

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

2. U.S. Army Corps of Engineers (USACE)

a. Section 10 and Section 404 Permits

The USACE has regulatory authority over construction, excavation, or deposition of materials in, over, or under navigable waters of the United States, or any work which would affect the course, location, condition, or capacity of those waters (Rivers and Harbors Acts of 1890) (superseded) and 1899 (33 U.S.C. 401, et seq.; 33 U.S.C. 403) (USACE 2014). 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 USACE, which is authorized to issue Section 404 permits for discharging dredge and fill materials.

Permits issued for specific projects are the basic type of permit issued. General permits (including programmatic, nationwide, and regional general permits) authorize activities that are minor and will result in minimal individual and cumulative adverse effects. General permits carry a standard set of stipulations and mitigation measures. Letters of permission, another type of project authorization, are used when the proposed project will not have significant individual or cumulative environmental impact, and appreciable opposition is not expected (USACE 2017).

In making a final decision on whether to issue a permit, USACE 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 (USACE 2017).

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 (USACE 2017).

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

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

3. Pipeline and Hazardous Materials Safety Administration (PHMSA)

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 movement of hazardous materials by pipeline (PHMSA 2016). Federal PHMSA inspectors review technical issues on hazardous liquid pipelines in Alaska. The 2006, PIPES Act requires hazardous liquid pipeline operators to develop integrity management programs for transmission pipelines (PHMSA 2006).

4. Fish and Wildlife Service (USFWS)

The USFWS is a technical bureau within the Department of the Interior dedicated to conservation, protection, and management of fish, wildlife, and natural habitats. USFWS has management authority for migratory birds, threatened and endangered species, the national wildlife refuge system, aquatic resources, and landscape conservation (USFWS 2015). USFWS issues incidental take permits under the ESA for a limited set of marine mammals such as polar bears, walrus, and sea otters, as well as freshwater and terrestrial endangered species. Incidental take permits are required when non-Federal activities will result in take of threatened or endangered species (USFWS 2013).

C. Other Federal and State Regulatory Considerations

1. Regulations 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 processes for participation by federal, state and local governmental agencies to participate in response to pollution incidents (ARRT 2014). The Unified Plan is the area contingency plan for Alaska. Since Alaska is so large and geographically diverse, the federal agencies have found it necessary to prepare subarea contingency plans (ADEC 2010).

2. Alaska National Interest Lands Conservation Act (ANILCA)

The Alaska National Interest Lands Conservation Act (ANILCA) provides for "the national interest in the scenic, natural, cultural and environmental values on the public lands in Alaska". The Act provides opportunities for rural residents engaged in a subsistence way of life to continue in that subsistence way of life on public land.

The office of Project Management and Permitting is the lead coordinating agency for state participation in implementation of ANILCA which directs federal agencies to consult and coordinate with the State of Alaska. Following the passage of ANILCA in 1980, the Governor's office and state agencies responsible for natural resources, transportation, and tourism assigned representatives to a team to track and influence federal actions that implement ANILCA. The main objectives of ANILCA is to protect access for traditional activities, promote access along waterways, protect access and development opportunities located on inholdings and adjacent non-federal lands, and encourage tourism to benefit local economies.

3. 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.

D. Local Governmental Powers

1. Matanuska-Susitna Borough (MSB)

Under the authority of Title 29 of the Alaska Statutes, the MSB is responsible for planning and zoning through the implementation of Title 15 of the Matanuska-Susitna Borough Code. The land management principles and procedures contained in Title 15 ordinance evolved from the information used to develop the Matanuska-Susitna Borough Comprehensive Development Plan (MSB 2005).

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Chapter Eight: Reasonably Foreseeable Effects of Licensing and Subsequent Activity

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Chapter Eight: Reasonably Foreseeable Effects of Licensing and Subsequent Activity

This chapter considers and discusses reasonably foreseeable effects that an exploration license and subsequent activities could have on habitats, fish and wildlife populations, and their uses, and potential effects on historic and cultural resources, fiscal effects, and effects on local communities. This discussion of the reasonably foreseeable effects is required under AS 38.05.035(g)(1)(B)(vi)(ix), and (x). Although there is a large body of research concerning oil spills, there is little research available specific to the License Area. Therefore, this chapter includes research that is applicable to the License Area and similar environments and that the director finds relevant to consider and discuss for this written finding.

Alaska statutes specify that speculation about possible future effects is not required (AS 38.05.035(h)). However, many studies, much of which are applicable to the License Area, are available on the effects of oil and gas development for northern habitats, fish, and wildlife. Although the License Area may differ from these areas in some respects, it shares much in common with these environments, thus much of this body of knowledge is applicable to the License Area. As a result, these effects are considered and discussed below as required by AS 38.05.035(g).

Activities associated with exploration and development could, over time, cumulatively affect local terrestrial and freshwater habitats, fish, wildlife, and birds. Some potential effects of these activities include physical disturbances that could alter the landscape, lakes, rivers, and wetlands; alter habitat; or change behavior of fish, wildlife, and birds. Contamination of terrestrial or freshwater habitats by discharges from well drilling and production discharges, gas blowouts, or oil spills, is also possible. Development would likely require a pipeline or vehicular transportation of the resource. In this section, these and other effects of oil and gas production are considered and discussed.

A. Phases of Oil and Gas Development

There are several different phases of oil and gas activities: 1) exploration, 2) development, 3) production, and 4) transportation. While not all post-disposal oil and gas activities are routine, there are some oil and gas activities that are reasonably foreseeable because they are commonly undertaken during exploration, development, production, and transportation, regardless of the project. Post-disposal activities, such as seismic surveys, drilling, and construction, have associated or potential effects.

Oil and gas activities include those direct and indirect activities that have occurred in the past, are presently occurring, or are likely to occur in the future. Petroleum-related activities include such activities as conducting seismic operations, constructing roads and snow trails for transporting equipment and supplies for winter drilling of exploration wells, drilling exploration and delineation wells, constructing gravel pads and roads, drilling production and service wells, installing pipelines, and constructing oil and gas processing facilities.

Oil and gas exploration, development, production, and transportation activities may cause potentially negative changes in the License Area. From the initial exploration and seismic phase of the

extraction and field operations to the transportation of the product, oil and gas activities involve construction of dedicated infrastructure that can change the quality of the surrounding environment and modify habitat for terrestrial and marine wildlife.

Common industrial facilities associated with the oil and gas industry include: drill sites, well pads, production pads and injection pads, wells (such as exploratory, development, production and waste disposal), processing facilities, above ground oil storage tanks, building modules, facility oil piping, crude oil transmission pipelines, drilling mud plant, flow lines and pipelines, maintenance complex, emergency response center, warehouse facilities and seismic vibrators (thumper truck), transportation, gravel roads, airports, bridges, power plants, refineries, residential centers, and solid waste disposal units (Trammell et al. 2015).

1. Disposal

An exploration license serves as the disposal of state lands, and as the license can be converted to leases, is the first required step in developing the state's oil and gas resources. The exploration license program supplements the state's oil and gas leasing program by targeting areas outside of known oil and gas provinces. The intent of exploration licensing is to encourage exploration in areas far from existing oil and gas infrastructure, with relatively low or unknown hydrocarbon potential, and where there is a higher investment risk to the operator. Exploration licensing gives an interested party the exclusive right to conduct oil and gas exploration without the initial expense of bonus bids or the other costs and restrictions of a competitive oil and gas lease sale. Through exploration licensing the state receives valuable subsurface geologic information on these undeveloped regions and, if the license is converted to leases and development occurs, additional revenue through royalties and taxes could be realized.

2. Exploration

The purpose of the exploration phase is to search for reservoirs of oil and gas. Oil and gas resource exploration begins with gathering information about the petroleum potential of an area by examining the surface and subsurface 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, and normally precede exploratory drilling. Although geophysical exploration and exploration drilling are activities that could result in potential effects to the License Area, exploration predominately occurs in the winter to mitigate effects on the landscape and wildlife.

Common activities undertaken during the exploration phase includes aerial and geophysical surveys used to define prospects, geological studies, core testing, and exploratory drilling. Exploration wells may be used to drill in unproven areas, for field extension step outs or delineation wells used in unproven areas to increased proven limits of a field, or to conduct deep tests within a producing area to unproven deeper zones.

3. Development

The purpose of the development phase is to gather, examine, and analyze geologic and other data pertaining to newly-discovered reservoirs gained in exploration to plan how to maximize recovery of hydrocarbons from a reservoir. Common activities include drilling development and disposal wells, construction of roads and pads, and installation of pipelines and production facilities. Development wells are drilled in proven areas of a field to prepare for production operations. Some production operations overlap with development operations. Drilling occurs after initial discovery of hydrocarbons in a reservoir and several wells may be required.

4. Production

The production phase is the process of bringing well fluids to the surface and preparing them for transport to the processing plant or refinery. The fluids undergo operations to be purified, measured, tested, and transported. Pumping, storage, handling, and processing are typical production processes. The final project parameters will depend on the surface location, size, depth, and geology of a specific commercial discovery. Production also refers to the amount of oil or gas produced in a given period (Chaudhuri 2016).

A central processing facility usually serves as the operational center for long-term production activities in an oil or gas field. The central processing facility typically is located on the largest and most central, or initial, development pad. Equipment at the central processing facility is used to separate the three-phase fluids that are produced from the wells on the pad. The central processing facility may also be used to process produced oil and gas from smaller, outlying satellite pads. Produced oil is filtered to remove sand and processed to remove water and gas before being piped through a sales meter. In the case of a commercial, non-associated gas operation, gas is processed and sent through a compressor then directly into a gas pipeline to market. Water can be processed, chemically-treated, and reinjected into the reservoir for pressure maintenance (BLM 2013).

5. Transportation

The transportation phase encompasses the movement of oil or gas from one place or another by some means, such as pipeline or truck. A network of gathering and common carrier pipelines moves sales quality oil from producing pads. Another network of pipelines moves liquids and gases throughout a producing field for processing, reinjecting, and transportation to market.

B. Post-Disposal Oil and Gas Activities

Oil and gas activities associated with the post-disposal phases include geotechnical and geophysical surveys; exploratory and development drilling operations; construction of pads, facilities, and other infrastructure; and production and transportation have the potential to affect resources in various ways. Acoustic environments, soils, vegetation, hydrology, water resources, and air quality may be impacted by post-disposal oil and gas activities. Direct and indirect effects of oil and gas activities can disturb or displace wildlife and impact habitats through alteration, fragmentation, or loss.

Disturbance resulting from post-disposal oil and gas activities will depend on the type, location, and intensity of the activity. Habitat disturbance and alteration in the License Area could result from seismic activities, drilling wells, constructing gravel pads, roads, airstrips, support and processing facilities, and pipelines. Noise in the environment occurs at differing levels, frequencies, and durations and from many sources, some of which are natural. Noise arising from oil and gas activities can contribute disturbance above background levels. Noise may be generated in all phases of exploration, development, production, and transportation (AMAP 2013). The facilities required to support oil and gas development may have some effects. As infrastructure expands from a development, it may begin to fragment the surrounding habitats. Fragmentation has the potential to disrupt migrations, displace breeding grounds, and alter the relationships between predators and prey. Governmental authorities regulate oil and gas activities to minimize effects on the environment and mitigation measures are part of the license agreement which reduce or eliminate future effects of oil and gas exploration and development.

1. Seismic

Seismic survey work is an integral part of exploration for oil and gas fields. Seismic data is collected from surface-induced seismic pulse to image subsurface formations with sensors collecting the data as seismic shock waves bounce off formations. The shock waves are created by vibrator trucks or small explosives along predetermined lines. Seismic surveys are typically conducted in two dimension (2D) or three dimension (3D) surveys. Both survey types are useful for evaluating a prospect. The 2D seismic survey is collected over grid lines along easy access points. A 3D seismic survey is similar to 2D acquisition with more sensors collecting more data (Rigzone 2018).

Seismic may be used during all phases of oil and gas development, including pre-disposal, to locate and produce oil and gas from new and existing developments. Companies may elect to license existing data and reprocess the data without conducting a seismic survey. Other companies may acquire data through commissioning their own program. Geophysical exploration by means of seismic surveys informs the analysis of a play, where a company will conduct exploratory drilling, further mapping of a producing field, and evaluating new intervals throughout the development process.

Reflection seismic data are used to image the layering and geometries of the subsurface and detect changes of lithology and fluid properties. These images when combined with current well information can be used to better image and define the limits of the discovered hydrocarbon pool and to help design efficient development drilling and enhance the ability to successfully identify high-grade drilling targets.

Several advanced seismic techniques can be used to image producing fields. Lands already in production are sometimes subjected to additional 3D seismic to monitor changing reservoir properties resulting from production. This seismic technique is sometimes called 4D seismic because, though it would be conducted like 3D, repetition adds the dimension of time. This technique can also use permanent static geophones to ensure repeatability and coupling. Additional geophysical techniques can be used to gather information specifically about very near surface geology, usually to identify drilling hazards. They include high-resolution shallow seismic, side-scan sonar, fathometer recordings and shallow coring programs. High-resolution shallow seismic surveys

are specifically designed to image the bottom of a water body and very shallow geology. They employ a lower energy seismic source and a shorter cable than surveys targeting deeper oil and gas potential (U. S. Senate 2011).

When a licensee or contractor seeks a permit to perform a seismic survey of any variety in the License Area, a miscellaneous land use permit (MLUP) is required through DNR. Seismic surveys can be performed at any phase of oil and gas development. Through the MLUP review, DNR will evaluate the project plan and consider other agencies' input and authorities to assess potential impacts of the project. Potential project impacts are mitigated through mitigation measures.

2. Drilling

An exploration license gives a licensee the right to use the License Area for exploration activities and prior to development, production, and transportation activities, they must convert the license to leases. Before initiating any drilling, a plan of operation application must be submitted to DNR for review and approval. The application is reviewed for legal compliance by DNR and other state, federal, and local government entities. DNR evaluates foreseeable effects of the proposed application operations, assesses mitigation measures, and determine the need for stipulations to protect resources and the best interest of the state. An application may require conditions for approval before final approval of a plan of operations. All exploratory, delineation, and development well drilling is subject to plan of operation approval.

a. Exploratory Drilling

Exploration drilling, which proceeds only after obtaining the appropriate permits, is the only way to determine whether a prospect contains commercial quantities of oil or gas, and aids in determining whether to proceed to the development phase. Drilling operations collect well logs, core samples, cuttings, and a variety of other data. A well log is a record of one or more physical measurements as a function of depth in a borehole and is achieved by lowering measuring instruments into the well bore. Well logs can also be recorded while drilling. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled (Chaudhuri 2016).

The drill site is selected to provide access to the prospect and, if possible, is located to minimize the surface area that may have to be cleared. Sometimes temporary roads must be built to the area. Construction of support facilities such as production pads, roads, and pipelines may be required. A typical drill pad is made of sand and gravel placed over a liner. The pad supports the drill rig, which is brought in and assembled at the site, along with a fuel storage area if necessary, and a camp for workers. (Chaudhuri 2016).

To define the limits of reservoirs after a discovery is made, several delineation wells may be drilled before making a commitment to full project development. Additional delineation wells surrounding the discovery well would likely be planned for the following winter seasons and might require new pads. Delineation-well drilling would be coordinated with any existing 3D seismic surveys (Duplantis 2016). Upon making a discovery and sufficiently delineating a reservoir, production of the resource and development of the field will take place.

b. Production drilling

Production, or development, drilling will be conducted from gravel pads with several wells typically drilled from that pad depending on development plans for the field. The production drilling process is similar to exploration drilling in that drilling fluid is used to balance pressure to prevent blow-outs, remove rock fragment, and cool the drill bit. During the process of drilling the well, well casing is placed in the hole for stabilization and to prevent caving. Once drilling is completed, testing is conducted to determine where to perforate zones and begin stimulation of those zone to enhance flow rates. Production tubing is installed in the well to carry liquids and gas to the surface and a "Christmas tree" is installed at the surface to control flow from the well (EPA 2018). This process occurs for each production well drilled on the pad and other pads in the field.

Directional drilling is used to extend the length of the reservoir that is penetrated by the well (U. S. Senate 2011). Exploration wells within the License Area may be directionally drilled because of a lack of suitable surface locations directly overlying exploration targets. The drilling technique is controlled to direct the bore hole to reach a particular part of the reservoir. Directional drilling technology enables the driller to steer the drill stem and bit to a desired bottom hole location, sometimes miles away from the surface location of the rig. Directional wells initially are drilled straight down to a predetermined depth and then gradually curved at one or more different points to penetrate one or more given target reservoirs (Duplantis 2016). Directional drilling allows multiple production and injection wells to be drilled from a single surface location such as a gravel pad thus minimizing cost and the surface impact of oil and gas drilling, production, and transportation facilities. It can also be used to reach a target located beneath an environmentally-sensitive area and may offer the most economical way to develop oil fields. Extended reach drilling is used to access reservoirs that are remote, up to six miles, from the drilling location. These techniques allow for drilling into reservoirs where it is not possible to place the drilling rig over the reservoir (U. S. Senate 2011).

In addition to production wells, other wells are drilled to inject water or gas into the field to maximize oil recovery. These wells generally are referred to as service, or injection, wells. Numerous injection wells are required for waterflood programs, which are used routinely throughout the production cycle to maintain reservoir pressure. Application of horizontal well technology can reduce the number of production wells required to drain a pool and reduce the number of drilling pads and their sizes. (U. S. Senate 2011).

c. Drilling and Production Discharges

Industrial, specialty, and potentially hazardous chemical products are used at all stages of oil and gas production. The main categories are drilling fluids, production chemicals, and injection chemicals.

i. Drilling Fluids, Drilling Mud and Rock Cuttings

Drilling fluids are necessary for most new well drilling operations. They provide a barrier for well control, help to remove cuttings from the well bore as they are produced, maintain pressure on the formation, and maintain formation stability among other functions (IPIECA 2009). The Alaska Oil and Gas Conservation Commission (AOGCC) requires drilling fluid systems to meet its requirements unless it determines otherwise (20 AAC 25.033).

Once a rig is in place and drilling has begun, waste discharges could include drill cuttings, spent drilling fluids, cuttings from water-based well intervals, domestic wastewater, excess cement, brine water from desalination units, non-contact cooling water, and blowout preventer fluid (UNEPIE 2007). Generally, all wastewater, spent fluids, and chemicals would be disposed of in injection wells approved by the EPA, the AOGCC, or Alaska Department of Environmental Conservation (ADEC), depending upon waste characterization.

ii. Produced Water

Produced water is water that comes from an oil and gas reservoir to the surface through a production well with hydrocarbons. It is the largest waste stream from the production phase of conventional oil and gas wells. The produced water volume increases over the economic lifetime of a producing field and may be up to 95 percent of the total volume produced by the end of the field's production history. Produced water contains formation water, injection water, and other chemical additives such as hydrate inhibitors, emulsion breakers, flocculants, coagulants, defoaming agents, scale and corrosion inhibitors bactericides and other substances (AMAP 2013citing to Lee et al. 2005, Tibbets et al. 1992, and Roe Utvik 1999)

Produced water is often reinjected into reservoirs for waterflooding and pressure maintenance or injected through waste water injection wells to shallow reservoirs. As a field matures, measures are taken to treat produced water before reinjection into the reservoir to eliminate bacteria and chemical additives. The ADEC and AOGCC authorize disposal of produced water. More information can be found in Chapter Seven outlining government authorities to regulate waste water disposal and produced water injection.

3. Road and Facility Construction

a. Facilities

After a commercial discovery of oil or gas has been confirmed by delineation wells and seismic surveys, several construction activities are required to develop a permanent production operation. A production operation complex would, at a minimum, contain a production pad that could potentially support dozens of wells and contain a large central processing facility for an oil field or a combined central processing and gas compressor facility. The production operation also would include feeder lines, regional pipelines, a booster pump for oil or additional compression stations for gas, a high-pressure gas trunk line, a gas conditioning facility, and an oil-sale pipeline to transport the resource to market. (NRC 2003).

b. Roads

Development and operation of oil and gas facilities in the License Area may require access. Such access could be necessary to respond to spills or other emergencies; conduct training to respond to potential spills; conduct pipeline inspection, maintenance, and repair; or facilitate additional construction (NRC 2003).

Snow-packed trails are also constructed and approved for use by low-ground-pressure vehicles and can be used for moving equipment, supplies, personnel accommodations, and drill rigs capable of

disassembly to components small enough for transport on such vehicles. Construction of gravel pads may be used for well sites, production and support facilities, roads, and an airstrip. Gravel is the preferred material for development pad construction. The development area must be level, stable, and elevated above ground surface (NRC 2003).

For the most part, authorizations relating to road construction for temporary use are issued through land use permits by DNR's Division of Mining Land and Water (DMLW). The only exception is temporary use roads for seismic surveying will be authorized through a MLUP issued by the DNR's DO&G. The DO&G will authorize permanent roads on future leases in the License Area through a plan of operations. The authorizations evaluate potential impacts and seek agency review to address and mitigate potential impacts from construction.

4. Transportation by Pipeline

The actual locations of new pipelines in the License Area would depend on the location and sequence of commercial-sized discoveries. At present, there is no accurate way of predicting where or when commercial fields would be discovered and developed.

The diameters and lengths of new pipelines in the License Area would depend on the characteristics of new fields. Generally, infield oil pipelines, such as flowlines or gathering lines carry oil, gas, and water from wellhead manifolds to central processing facilities. Return lines containing gas or water would carry these substances back to injection wells on production pads. Infield flowlines would be relatively small, between four and ten inches in diameter.

Within DNR, the DO&G and State Pipeline Coordinator (SPC) each have authority to approve operation and construction of pipelines in the License Area. The DO&G will approve gathering lines through a plan of operations approval and SPC will issue leases of state land through a right-of-way process. SPC also coordinates the oversight of all construction and operation phase for sales pipelines or pipelines transporting products after metering has occurred. Chapter Six provides methods most likely to be used to transport oil or gas from the License Area in addition to the merits and relative risks for each method.

5. Oil Spills and Gas Releases

Oil spills and natural gas releases can occur on pads within the License Area when exploration drilling or development and production is occurring. Spills and releases can also occur during the course of transportation on pads, or between facilities. Chapter Six and Seven provide information on regulatory authorities for prevention and response, process for spill or release containment, cleanup, and response training. Chapter Nine includes mitigation measures for spill and release prevention.

a. Spills on Land

Historically, at oil and gas facilities, most oil spills occur on land, and in areas of containment – on pads or in facilities designed to contain a spill. However, there is a risk of spills onto the native ground. Because much of the exploration phase is being done in the winter, containment and remediation would be more effective.

However, with the onset of development and production, operations are continually conducted which carries a risk of spills onto the ground. Oil spills on the ground surface behave more predictably and are easier to control than spills into water because, generally, spills on land occur in a more stable environment and move more slowly to affect a smaller area. If the spill moves, it will collect in depressions or water courses. But if the volume is large and the duration of the spill is long enough, it can move down the water course to the nearest water bodies (Owens 2000).

The grade of oil spilled will affect how it weathers. Light crudes may infiltrate soil or sediments but may also evaporate rapidly. The porosity and permeability of surface materials will determine how other oil types penetrate the surface (Owens 2000). Spills may flow directly into freshwater or may migrate to freshwater. Once a spill arrives at a water body, the primary processes influencing the behavior of the spilled oil are spreading and drift, emulsion and dispersion, evaporation, dissolution, sorption, sedimentation, sinking, and photo and biodegradation.

b. Spills into Water

The effects of a spill in freshwater can be both direct and indirect and the magnitude of either depends most importantly on the type of product spilled, the flow dynamics in the particular environment, what species are present, the climate, and the spill response. Immediate effects on aquatic organisms are from being coated or entrapped. Acute toxicity can result from dissolution of the spilled substance, which can lead to membrane damage and systemic toxicity, though post-spill field observations suggest that toxic effects tend to be less extensive than physical ones. In general, the chance of an organism being affected by a spill depends on whether it directly encounters the spill before the spill has had a chance to weather or dissipate (API 1999).

c. Gas Releases

Natural gas is primarily composed of methane (CH_4) and ethane (C_2H_6), which make up 85 to 90 percent of the volume of the mixture. Methane is a colorless, odorless, and tasteless gas. The EPA identified methane as a greenhouse gas in new source performance standards adopted on August 2, 2016, but it has since proposed to stay portions of that rule (EPA 2016a). Methane is not toxic in the atmosphere, but it is classified as a simple asphyxiate, possessing an inhalation hazard (AMAP 2013).

There are three general types of potential gas releases: loss of well control at production areas, ruptured gas pipelines, and gas processing facilities. A release from a well is estimated to last one day and release 10 million cubic feet of natural gas. A release from a ruptured transmission pipeline or gas processing facility is estimated to release 20 million cubic feet over a few hours. These releases would be localized to the area adjacent to the release site. Thermal effects are estimated to be within 500 meters of the ignition source (AMAP 2013).

Natural gas releases pose a primarily acute hazard. Hazards associated with natural gas are predominantly flammable in nature. If an ignition source exists, a release of gas can result in an immediate fire or explosion near the point of the release. This hazard is reduced over a relatively short period after the release ends as the gas disperses. If the vapors accumulate in a processing facility or compressor station, then the hazard may remain longer.

C. Reasonably Foreseeable Cumulative Effects to Air and Water

1. Reasonably Foreseeable Cumulative Effects on Air Quality

The types and relative amounts of air pollutants generated by oil and gas operations vary according to the phase of activity (i.e., exploration, development, or production). During the exploration phase, air pollutant emissions are mainly made up of nitrogen oxides, carbon monoxide, particulate matter, and sulfur dioxide. During the development phase, emissions are similar to those used in the exploration, but with less carbon monoxide, particulate matter, and sulfur dioxide. During the production phase, emissions mainly contain nitrogen oxides, carbon monoxide, and particulate matter. In addition to these pollutants, hazardous air pollutants may also be released. Benzene, toluene, ethylbenzene, and xylenes are common hazardous air pollutants associated with volatilization of oil and gas resources. Depending on specific atmospheric environments, hydrogen sulfide may also be found in oil (BLM 2012).

The main air pollutants of concern in Alaska are fine and coarse particulate matter categories (PM 2.5 and PM 10), followed by carbon monoxide, lead, ozone, sulfur dioxide, and nitrogen dioxide (ADEC 2012). Combustion sources are the primary sources of fine particulates. The EPA requires an annual emissions inventory report for sources with potential emissions at or above 2,500 tons per year of sulfur oxide, nitrogen oxide, or carbon monoxide, and for annual emission of 250 tons for volatile organic compounds and for large and small particulate matter (ADEC 2011). Nitrogen oxides comprise roughly 90 percent of the total air pollution components, followed by carbon monoxide at about four percent and PM 10 at 1 percent (ADEC 2014).

Methane is a potent greenhouse gas and the main component of natural gas. In 2012, nearly 29 percent of all methane emissions in the United States were produced by the oil and gas industry, the largest source, according to the EPA. Other estimates have suggested higher levels (Rassenfoss 2015). Two major sources of methane emissions were liquid unloading, which account for 14 percent of methane emissions, and pneumatic controller equipment, which produces 29 percent, and is one of the larger sources of methane emissions in the natural gas supply chain. Pneumatic controllers use gas pressure to control the opening and closing of valves and emit gas as they operate. Liquid unloading is a method to clear wells of excess liquids to increase production. Liquid unloading is more common in older wells (Allen et al. 2013).

2. Mitigation Measures and Other Regulatory Protections

Fuel-burning equipment at oil exploration and production facilities and from vehicles could impact air quality. Dust emissions from roads and construction activities may also occur, but are limited to summer months, when the ground is not covered by snow.

Potential effects from future oil and gas activities would be distributed throughout the License Area where projects occur. Emissions associated with routine program activities would increase, although all applicable standards would continue to be applied. Maximum concentrations of air pollutants occur close to facilities, and disperse farther from the facilities (BLM 2012).

Federal and state air quality regulations, particularly the Clean Air Act (42 U.S.C. §§ 7401-7671), AS 46.03, AS 46.14, and 18 AAC 50 are expected to avoid, minimize, and mitigate potentially negative effects. Additional information regarding air quality permits and regulations can be found in Chapter Seven.

3. Reasonably Foreseeable Cumulative Effects on Water Resources and Water Quality

Oil and gas activities that may affect the water resources and water quality in the License Area include seismic exploration and overland transport, gravel road and pad construction, gravel mining, and water withdrawals to support the construction, drilling, and operations phases and construction of roads and pads. Effects on hydrology and water resources include changes in drainage patterns, impoundments, increases in turbidity from dust along roads, creation of erosion and sedimentation conditions at stream crossings, filling of wetlands, lowered lake levels, and spills.

Potential cumulative effects on water quality are related to discharges of drilling muds, cuttings and produced waters, increased turbidity from construction of gravel structures, roads and pipelines, and oil spills. Water use from lakes, ponds or groundwater wells may be required for the construction and maintenance of roads and pads, and for blending drilling muds in drilling activities, and for potable and domestic water uses.

Turbidity, which is related to suspended particles in the water column, could increase if pipeline construction or repairs, or gravel structure construction were performed improperly. Water quality characteristics that could potentially be affected by oil and gas activities include pH, total suspended solids, organic matter, calcium, magnesium, sodium, iron, nitrates, chlorine, and fluoride. Potential activities that might affect surface water quality parameters include accidental spills of fuel, lubricants or chemicals, increases in erosion or sedimentation causing elevated turbidity and suspended solids concentrations, and oil spills.

Produced water, as noted above, is water that is trapped in underground formations and brought to the surface along with oil and gas. It is the largest volume of aqueous waste and may be 98% of the total volume of waste from exploration and development. The volume of produced water from oil and gas wells is not constant over time. As a well ages, the percentage of water increases and the percentage of oil or gas declines. Produced water is typically composed of inorganic salts, heavy metals, solids, production chemicals, hydrocarbons, benzene, polycyclic aromatic hydrocarbons, and occasionally naturally occurring radiation. (UNEPIE 2007).

Containment ponds for produced water, if used, can contain contaminated water and oil and could be a source of waterfowl mortality (NDG&F 2011). But produced water from drilling typically is injected underground; little treatment is required and underground injection is the least costly option. Underground injection is subject to the federal Safe Drinking Water Act's Underground Injection Control program, which is designed to prevent contamination of public water supply aquifers (EPA 2016b).

Gravel roads are often constructed to provide access year-round to sites. These could be located in wetlands where drainages are easily altered by road construction and temporary or permanent impoundments are created which divert, impede, or block flow in stream channels, lakes, or shallow-

water tracks. Hydrologic effects include changes to drainage patterns associated with road construction, alteration of floodplains from gravel mining, and water extraction from lakes and rivers. Impounded water can produce high flows through culverts, which is likely to produce streambank erosion, channel scour and downstream deposition of sediment if culverts are improperly placed or sized.

4. Mitigation Measures and Other Regulatory Protections

Post-disposal oil and gas activities such as exploration, development, production, and transportation could result in adverse effects to the water resources of the License Area. Many adverse effects could be lessened by mitigation, but would not be completely eliminated. Most of the effects to water resources and water quality would result from oil and gas development activities, with construction of roads, permanent pads, stream-crossing structures, and water use from lakes being the major contributors. Potential effects include change in surface drainage due to construction of roads and pads, loss of wetlands and associated functions largely from construction of roads and pads and gravel mine development, loss or fragmentation of wildlife habitat, and increased risk of spills.

Permits may contain stipulations on water use and quantity drawn in order to meet standards related to protection of recreation activities, navigation, water rights, or any other substantial public interests. Water use permits may also be subject to conditions, including suspension and termination of exploration activities, to protect fish and wildlife habitat, public health, or the water rights of other persons.

Effluents discharged by the oil and gas industry are regulated through ADEC's Alaska Pollution Discharge Elimination System (APDES) program (ADEC 2016). Because of permitting requirements for proper disposal, fish and other aquatic organisms are not expected to be impacted by drilling muds, cuttings, produced waters, and other effluents associated with oil and gas exploration, development, and production. Permanent roads and large-scale fill of wetlands will require a Clean Water Act Section 404 permit, and will be discussed in mitigation.

Mitigation measures included in this best interest finding address water quality and include protection of wetland, riparian, and aquatic habitat, water quality monitoring, stream buffers, and water conservation. A complete listing of mitigation measures can be found in Chapter Nine.

D. Reasonably Foreseeable Cumulative Effects on Fish Habitats and Populations

Most oil and gas development projects would result in some cumulative effects to fish and fish habitat to the extent that they increase the footprint of gravel pads and roads. Oil and gas activities which introduce infrastructure across fish-bearing streams or are perpendicular to hydrologic flow would have a greater cumulative effect on fish and fish habitat. Most potentially negative effects would be limited to the localized area of development (ADF&G 2006).

The potential effects on fish because of oil and gas development include injury at water-use intakes, altered water quality, physical habitat changes, point and non-point source pollution, increased turbidity and sedimentation, and barriers to fish movements. Collectively, these could contribute to

reduced success at different life stages, behavioral changes, diminished condition, susceptibility to pollutants or disease, shifts in fish species distribution, and mortality (ADF&G 2013).

Some aspects of oil and gas development and production have caused impacts on fish that have accumulated, while impacts on fish from other aspects have not persisted. Impacts from gravel pads and roads as well as causeways have accumulated by impeding fish movements and significantly altering fish habitat by changing physical and chemical conditions. Year-round freshwater use for domestic facilities, seawater use for waterflooding, and oil spills have all affected fish in ephemeral ways that have not likely accumulated (BLM 2012).

The elements of oil and gas development and production most likely to contribute to future effects on fish that could accumulate include permanent infrastructure such as roads, pads, pipelines and causeways, and gravel mining necessary to build the infrastructure. The gravel infrastructure and associated gravel mining associated with oil and gas development and production have caused effects to fish that have accumulated by impeding fish movements and significantly altering the physical and chemical conditions of fish habitat (Ott et al. 2014).

1. Development and Habitat Alteration

Potential effects in degradation of stream banks and erosion, reduction of or damage to overwintering areas, habitat loss due to gravel removal, high impact facility sighting, effects due to water removal, siltation, impediments to fish passage and migration, and mortality due to oil spills or other 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 (Ott et al. 2014; IPIECA 2012).

Road development and water withdrawal for oil and gas exploration can affect fish and aquatic habitats. Erosion is a potential impact of all phases of exploration and development. Major construction, especially of roads, can increase erosion and runoff leading to increased stream turbidity and sedimentation. Increased turbidity and sedimentation could have negative impacts on egg and juvenile survival, as well as potentially reducing or altering stream flow, affecting overwintering habitat availability and the ability of fish to migrate upstream (Brown 2008).

Road development at stream crossings could disrupt migratory pathways and alter access between key summering and wintering habitats. Due to the use of small drainages, including ephemeral streams, any development that would impede fish passage within these small drainages, could have negative impacts on fish populations within the License Area (Morris and Winters 2008).

2. Seismic

Many species of fish are sensitive to seismic noise and pressures. Studies have shown a variety of effects caused by seismic pulses, among them fish moving out of the area and becoming more difficult to catch (Wardle et al. 2001).

The effects of seismic noise have been studied on wild and caged freshwater fish as well, with differing results. One experiment showed that northern pike and chub showed no difference between

the ear tissues of fish exposed to an air gun blast and those from ear tissues of a control group not exposed to an air gun blast (Song 2008). Conversely, another study showed that air gun blasts caused substantial damage to red snapper ears, which are similar to a salmon's ear structure (McCauley 1998).

Differences between the two studies may have affected the results. The two studies differed in the sizes and numbers of air guns used, the pressures, sound exposures, and recovery times of the fish (24 hours in the Song study versus 58 days in the McCauley study). In the McCauley study, the subjects were caged in shallow water, and bathymetry is one variable that can affect how sound behaves in the ocean. Seismic pulses in shallow water will be higher-frequency than those in deep water (Song 2008). Blasting criteria have been developed by ADF&G and are available upon request. The location of known fish bearing waters and information on blasting criteria can be obtained from ADF&G's Division of Habitat.

3. Accidental Discharges and Spills

Accidental discharges and spills from oil and gas activities may contaminate aquatic habitats. Some contaminants that have a long half-life and travel in the upper atmosphere have both local and distant anthropogenic sources, alternatively, spilled petroleum products would be directly related to oil and gas activities. Spilled petroleum products may result from activities such as drilling and transportation of personnel and materials. Petroleum products may persist in aquatic environments for years after a spill or leak. Petroleum products in the water column can affect the ability of fish to take up oxygen or through ingestion. Oil contaminations can also severely impact egg, larvae, and juvenile survival because they may not have the ability to escape from the contaminated waterbody (Trammell et al. 2015).

The effects of oil spills on fish and their habitat are based on the timing and location of the spill. Summer spills when the water is not frozen are more likely to affect fish than a spill onto ice. A spill into a lake is likely to have longer lasting effects than a spill into a stream or river which could lead to effects on a larger area due to its mobility. Spills occurring farther upstream in a watershed also place more freshwater habitat at risk than those that occur in lower reaches or along the coast where the contaminants are more readily diluted with the higher volumes of water. (EPPR 1998).

4. Mitigation Measures and Other Regulatory Protections

Post-disposal oil and gas activities could potentially have effects on fish populations, although the direct, indirect, and cumulative impacts to fish and fish habitats are expected to be localized and minor. Measures in this best interest finding, along with regulations imposed by other state, federal and local agencies are expected to avoid, minimize, and mitigate those potential effects. AS 16.05 requires protection of documented anadromous streams from disturbances associated with development. Any water intake structures in fish bearing or non-fish bearing waters will be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. All water withdrawal equipment must be equipped and must utilize fish screening devices approved by the Alaska Department of Fish and & Game. Use of continuous fill causeways is prohibited. Disposal of wastewater into water bodies is prohibited unless authorized by an APDES permit. A complete

listing of mitigation measures can be found in Chapter Nine. Chapter Seven also provides information on solid waste and wastewater disposal.

E. Reasonably Foreseeable Cumulative Effects on Bird Habitats and Populations

Post-disposal oil and gas activities have the potential to affect birds through habitat loss, alteration, and disturbance resulting from vehicle noise, dust deposition, or disturbance from increased aircraft noise or visual stimuli. Activities such as seismic surveys, road and other construction activities, and ongoing vehicle and human traffic may alter landscapes and habitat. Overall impacts to birds are expected to be minor, localized, and negligible on a population basis.

Some bird species, during periods of nesting, molting, and staging, are sensitive to activities associated with development. Generally, responses to industrial activities depend on the species exposed, the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and possibly other factors (MMS 1996). Potential impacts are more likely to occur after the exploration phase, as few resident species are present during winter when exploration occurs. Potential impacts include habitat loss, barrier to movement, disturbance during nesting and brooding, change in food abundance and availability, and oil spills.

1. Disturbance

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

2. Seismic

No bird species are known to have been significantly affected by the high-energy impulses produced by seismic air guns. A 2001 Beaufort Sea study of molting male, long-tailed ducks before, during, and after seismic testing found no effect of the activity on either movements or diving behavior. Nor did it affect site fidelity. The authors noted that logistical and ecological factors limited their ability to detect more subtle disturbance effects (Lacroix et al. 2003).

3. Displacement and Habitat Loss

Siting of facilities, such as drill pads, roads, airfields, pipelines, housing, oil storage facilities, and other infrastructure, could eliminate or alter some preferred bird habitats such as wetlands. Onshore pipeline corridors may include a road and associated impacts from traffic noise and dust may deter nesting in the immediate vicinity (MMS 1996).

After facilities are built, the direct alteration of habitat displaces individuals that can no longer nest in the area covered by the facility. Additional birds may avoid the area adjacent to the facility due to disturbance effects. The effects of such direct displacement of individuals on the overall population dynamics of a given species is not known because it is poorly understood how much nesting habitat availability may be a limiting factor for overall populations (NRC 2003).

4. Construction

Construction activities may result in a permanent loss of some bird habitat. Gravel mining and placement for the construction of oil field infrastructure causes loss of habitat for ground nesting birds. Disturbances caused by construction of gravel roads, pads, and associated human activity have been observed in Pacific loons located in or near oil fields. Gravel mining and placement for the construction of oil and gas infrastructure can lead to loss of habitat for nesting birds. (Ott et al. 2014).

Overall direct mortality impacts due to collisions with vehicles, aircraft, buildings, pipelines, powerlines, and communications towers were estimated to occur only at very low levels during present and future developments. (NRC 2003).

5. Oil Spills

Direct contact with spilled oil by birds is usually fatal, causing death from hypothermia, shock, or drowning. Oil ingestion from preening oily feathers or consumption of oil-contaminated foods may reduce reproductive ability, and could lead to chronic toxicity through the accumulation of hydrocarbon residues. Oil contamination of eggs by oiled feathers of parent birds significantly reduces egg hatching success through toxic effects on chick embryo or abandonment of the nest by parent birds (MMS 2003; NRC 2003). The presence of humans, aircraft, boat and vehicular traffic involved in cleanup activities would be expected to cause displacement of nesting, molting, and feeding birds in the oiled areas and contribute to reduced reproductive success of the birds (MMS 2003). The number of birds impacted by a spill would depend on the time of year and the density of local bird populations. Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe (BLM 2005).

6. Mitigation Measures and Other Regulatory Protections

Post-disposal oil and gas activities could potentially have effects on birds. Most of these potential effects would likely occur as secondary effects attributed to habitat disturbance. Direct and indirect impacts from disturbance, of many different types, are difficult to measure, but are likely accumulating as the number of developments and the amount of developed area increase. New oil and gas developments have reduced their footprint size and the corresponding direct impacts have been reduced; however, these new developments often rely on aircraft support for transportation of personnel and equipment potentially increasing disturbance to feeding, nesting, staging and molting birds.

Measures in this best interest finding, along with regulations imposed by other state, federal, and local agencies, as well as future lease provisions, are expected to avoid or mitigate those effects. If

development occurs, some alteration of bird habitat can be expected, particularly with regard to aircraft-related impacts. However, with state and federal oversight, post-disposal oil and gas activities within the License Area should not prevent overall bird population levels from remaining at or near current levels. A complete list of mitigation measures for the License Area can be found in Chapter Nine.

F. Reasonably Foreseeable Cumulative Effects on Terrestrial Habitats

The process of finding and producing oil and gas in the License Area requires various activities that could impact vegetation and habitats. These activities include the development of considerable infrastructure, including well sites, miles of pipelines and roads, airstrips, and numerous oil production facilities and living facilities. Habitat fragmentation, especially for large mammals, is an established consequence of such extensive development.

1. Effects of Seismic Surveys

Oil and gas production activities in the License Area could require off road travel in winter for seismic exploration activity, road construction for exploratory drilling, and routine maintenance of infrastructure such as pipelines. Modern exploration techniques and equipment have mitigated the most severe impacts on vegetation (ADNR 2015).

Winter seismic surveys can affect vegetation based on snow depth, vehicle type, traffic pattern, and vegetation type. Soil-water content and freeze-thaw 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 freezing (Richter-Menge et al. 2016).

Effects from seismic surveys during any season could be substantial if operations are conducted improperly. Vehicles may leave visible tracks, but these 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, increasing the likelihood of recovery. Damage has been observed to shrubs, forbs, and tussocks in oil fields, with more significant impacts observed on higher, drier sites, with little to no evidence of damage observed in wetlands (NRC 2003).

The evolution of seismic technology in the field is in the intensity of data acquisition, the sensitivity of the instrumentation and precision that the equipment can be located using global positioning satellite system. Advancements in the digital processing of the acquired data and the resultant resolution of the subsurface stratigraphy has led to better seismic interpretation resulting in higher success rates for exploration wells. It is anticipated these advancements will create greater efficiency in exploration with fewer effects on the environment (U. S. Senate 2011).

2. Habitat Fragmentation

Habitat fragmentation occurs when isolated areas of habitat are created due to a disturbance, like a pipeline or road. Pipelines or roads reduce or prevent animals from moving between patches of

habitat and can result in a barrier effect. Habitat loss and more isolated habitat patches are the primary elements of habitat fragmentation. All of these can result in altered ecosystem processes and lower biological diversity (Dunne 2009).

Effects of constructing production pads, roads, and pipelines include direct loss of habitat acreage due to gravel infilling and loss of 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 secondary effect of construction activities is dust deposition, which may reduce photosynthesis and plant growth (Truett and Johnson 2000).

The effects on the ecosystems impacted by roads include potential chemical input from roads to waterbodies and the airshed and bioaccumulation in soils. Roads can impact sediment transport and floodplain ecology. When roads alter habitats, invasive plant species can be introduced and some plant species may be changed or removed. Additionally, new roads can change the density, composition, and populations of wildlife species. The effects of roads can also include physical disturbance, habitat loss or fragmentation, and threatening or extinction of populations and species near the roads' edge, mortality of wildlife on roads, the use of road edges as habitat, and dispersal of wildlife along road networks (NRC 2005).

3. Accidental Discharge and Spills

Chemicals used in the exploration, drilling, development, and transportation of oil and gas can be released to the land, water, or air either by accident or as a by-product of routine operations. The addition of pipeline and associated facilities and roadways, increase the amount of stored and transferred oil and other petroleum and gas-related fluids, which in turn increase the potential for spills (AMAP 2013). Spills confined to roads and pads can typically be cleaned up without substantial damage to water or vegetative resources.

During exploration well drilling, muds and cuttings are stored on-site, in holding tanks, or in a temporary reserve pit, and then moved 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 (AMAP 2013). The down-hole injection of drilling muds and cuttings is unimportant if muds are not placed into a subsurface drinking water aquifer. 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).

4. Oil Spills

The release of hydrocarbons can have toxic effects on vegetation, soils, wildlife, birds, and fish. Effects of spilled oil on the landscape would depend on the time of year, vegetation, and terrain. 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. Natural recovery in wet habitats may occur in 10 years or less if aided by cleanup activities and the addition of fertilizer (Jorgenson and Carter 1996)

Oil spills could damage soils by altering vegetation patterns and by surface disturbance associated with clean-up activities. In some cases, spill cleanup would be more likely to damage soils than allowing some residual oil to remain in place. Oil weathers over time, and organisms may be able to tolerate the presence of oil while it is naturally degrading (Jorgenson and Carter 1996). The long-term effects of oil may persist in sediments for many years. Shifting of population structure, species abundance, diversity and distribution can be long-term effects, especially in areas that are sheltered from weathering processes (NRC 2003).

Oil-spill cleanup would mitigate impacts on soils only if cleanup methods and operations were very carefully controlled and minimized surface disturbance. The area affected would be limited to the area immediately adjacent to and covered by the spill (NRC 2003).

5. Mitigation Measures and Other Regulatory Protections

Terrestrial mammals can move away from sources of disturbance and contamination, or find new habitat. Many studies have examined the responses of different species to roads, construction, pipelines, ground and aerial traffic, and gravel pads, but it is difficult to assess the long-term effects on the health and population of those species. There is little available data to compare the usability and value of damaged or disrupted habitats with the undisturbed habitats that is still available. There are also many influences that contribute to the behavior and habitat selection of the different species like weather, predation, and changes in population that are not dependent on the construction of oil and gas infrastructure, roads, or pipelines.

Post-disposal oil and gas activities could potentially have cumulative effects on terrestrial habitat. Mitigation measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. For example, impacts to important wetlands must be minimized, exploration facilities, including exploration roads and pads, must be temporary. The preferred method for disposal of muds and cutting from oil and gas activities is by underground injection, a method that is expected to continue. A listing of administrative authorities can be found in Chapter Nine.

G. Effects on Subsistence

Subsistence users of the License Area depend on the fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on fish, wildlife, and habitats could also affect subsistence uses. Potential cumulative effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on subsistence uses are discussed below.

Oil and gas exploration, development, and transportation may have potential effects on subsistence fishing and hunting. Potential post-license activities that could have potential effects on subsistence uses of the License Area include seismic surveys, discharges from well drilling and production, construction of roads and support facilities, and ongoing disturbances from production activities such

as pipeline activities, vehicle, boat, and aircraft traffic. Potential effects on subsistence uses may also include: increased or decreased access to hunting and fishing areas; concerns about safety of subsistence foods; and increased competition for nearby subsistence resources (EVOSTC 2017). If access to areas is restricted, subsistence users may have to travel greater distances and spend more time away from home in order to harvest resources.

H. Effects on Recreation and Tourism

Tourism may be characterized as business tourism, pleasure and vacation tourism, and visiting friends and relatives. Of these, business and vacation tourism are the types most affected by oil and gas development. An analysis of the 2010 BP Macondo oil spill in the Gulf of Mexico, which included 11 case studies of other oil spills, concluded that the average range of oil spill impacts to tourism was 12 to 28 months (USTA 2010). An analysis of the effects of the 1989 *Exxon-Valdez* oil spill showed that 60% of the tourism providers had cancellations and that visitor inquiries fell 55% one year after the spill (EVOSTC 2017).

I. Effects on Cultural Resources

If development occurs, impacts and disturbances to the historic and cultural resources could be associated with 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 (DOI 1987; BLM 2007).

Spills can have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon C-14 dating methods (DOI 1987). The effects of cleanup activity on these resources are minor because the work plan for cleanup is constantly reviewed, and cleanup techniques are changed as needed to protect archaeological and cultural resources (Bittner 1996).

J. Fiscal Effects on the State, Municipalities, and Communities

This section considers and discusses the fiscal effects, both statewide and local, of licensing activities. Licensing and subsequent activity may generate income for state government, with additional benefits that include increased revenue sharing, creation of new jobs, and indirect income multiplier effects. Fiscal effects may be statewide and local.

1. Fiscal Effects on the State

a. Revenue

Alaska's economy and state government operations depend heavily on revenues derived from oil and gas activity. Oil and gas licensing, possible conversion to leases, and lease sales generate income to state government through royalties, bonuses, rents, interest, production taxes, petroleum corporate income taxes, and petroleum property taxes. Between Statehood in 1959 and FY2016, oil related revenues totaled $177.7 billion (real 2016 dollars). The oil and gas industry paid over $2 billion in taxes and royalties, with $1.6 billion paid to state government and $447 million paid to local governments in FY 2016. From the $1.6 billion paid to state government, $1.1 billion of that being allocated into the Unrestricted General Fund (UGF). Total oil revenue for FY2016 was down from almost $2.4 billion in FY2015 (McDowell Group 2017).

In October 2017, the Alaska Department of Revenue (ADOR) released their preliminary 10-year revenue forecast for revenue deposited into the UGF based on the forecast of Alaska North Slope oil prices and oil production forecasts. UGF is forecast to be $1.8 billion, for FY2018, $2.0 billion in FY2019, and $2.8 billion by the end of the forecast period in FY2027. This is based on a forecast of Alaska North Slope oil prices averaging $54.00 per barrel for FY2018, climbing to $75.00 per barrel by FY2027 (ADOR 2017). These projections are adjusted biannually through ADOR revenue forecasts.

Issuing an exploration license would provide a onetime increase in state income from the licensing fee. The licensee is also required to post a bond in the amount of the work commitment. However, the state would not receive any money from this unless the licensee did not fulfill its work commitment. Additional revenue from rentals, royalties, and taxes would be collected should exploration result in production, but the amount of additional revenue is unknown.

Exploration licensing may provide other long term contributions to the state, such as additional geologic information even if exploration does not lead to production. Because the upfront capital for obtaining an exploration license is generally less than for obtaining leases, new and smaller companies may be encouraged to begin operating in Alaska. Relatively small successes could spur additional activity and investment in exploring and developing Alaska's oil and gas resources.

b. Alaska Permanent Fund

Revenues from oil and gas activities go into the state's General Fund, but 25 percent of the royalty revenue is set aside for the state Permanent Fund, whose value in 2017 approached $60 billion (APFC 2018). Each year eligible state residents receive a permanent fund dividend (PFD) check that is based on a five-year average of the fund's earnings (ADOR 2016).

c. Oil and Gas Industry Jobs

The oil and gas industry employs fewer than 5 percent of all Alaska workers but affects the state's economy more than those numbers suggest because of the high wages, which are 2.8 times higher than average annual wages of all industries combined. Statewide, 17,049 workers were employed in the oil industry in 2011, with wages totaling $1.7 billion. The number of workers decreased by 0.2%, and wages increased by 4.3% from 2010 to 2011 (DOLWD 2016). A 2011 study estimated that there

are nine jobs generated in Alaska's economy for each job directly related to the oil and gas industry because of a multiplier effect that includes employment with oil support services, other businesses that provide goods and services to the industry, and other support sector firms in the state. Consequently, the oil and gas industry was estimated to generate 44,800 jobs and about $2.65 billion in annual payroll in 2010 (AOGA 2014).

d. Apprenticeships

In November 2015, Alaska Governor Bill Walker signed Administrative Order 278 (AO 278), which requires DNR to consider ways to encourage licensees or lessees to employ apprentices for work performed in the area. The goal of AO 278 is to require apprentice level employees to perform at least 15 percent of the total work hours. Licensees and lessees are encouraged to employ apprentice level workers to the extent they are qualified and available.

Apprentice hiring has many benefits to oil and gas companies employing workers in Alaska. A company's workforce is strengthened through reduced turnover of employees which reduces expenditures for retraining and onboarding, increases productivity and knowledge transfer, and improves safety records. It is also important to note oil and gas companies may create or sponsor suit-to-fit apprenticeship programs for the company's desired trade or service.

Apprenticeship programs are part of the Alaska Apprenticeship Training Coordinators Association. Alaska provides world-class resource potential and a well-trained workforce familiar with the oil and gas industry. Licensees and lessees are often familiar with the resource potential, but greater utilization of apprenticeship as a workforce development tool would benefit any company hoping to succeed in Alaska. DNR will convey information to new and existing lessees about apprenticeship options in Alaska.

In consultation with the DOLWD, DNR has increased its understanding of the apprenticeship programs in Alaska and the benefits of hiring apprentices. DNR has included a mitigation measure encouraging apprentice hiring on projects on state oil and gas licenses. It is also required that a plan of operations application include proposals detailing how the licensee will attempt to employ and use apprentices to perform at least 15 percent of total work hours in the License Area including from both contractors and subcontractors.

2. Fiscal Effects on Municipalities and Communities

As exploration takes place, employment opportunities would be added to the state and regional economy. These jobs would not be limited to the oil and gas industry, but would spread throughout the trade, transportation, service, and construction industries. The number of jobs produced would depend on the commercial quantities of oil and gas discovered, and whether projects to develop those discoveries lead to the development of the resource.

Industry investment in environmental and wildlife studies, planning and design activities, materials acquisition, facility construction, seismic surveys, drilling, transportation, and logistics contributes to state and local economies. Some of the money from the state's General Fund is passed through to borough and municipal governments in the form of property taxes. The legislature appropriates funding for state agencies, including the University of Alaska, from the General Fund. The

legislature has also used the General Fund to assist local communities through the Community Revenue Sharing program housed in the Department of Commerce, Community, and Economic Development.

The exploration license is located partially within the Houston City Boundary and the City of Houston may benefit from property taxes associated with oil and gas infrastructure. Additionally, the area is incorporated within the Matanuska-Susitna Borough, which could levy a property tax on oil and gas infrastructure. Those revenues could fund education, health and public safety programs, transportation system improvements, and other public services (ADOR 2016). Alaska collected $125.2 million in oil-related property taxes in FY 2015 (APFC 2016a).

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Chapter Nine: Mitigation Measures

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Chapter Nine: Mitigation Measures

Under AS 38.05.035(e), the Director of the Division of Oil and Gas (DO&G) is authorized to impose conditions or limitations, in addition to those imposed by statute, to ensure that a resource disposal is in the state's best interest. AS 38.05.134(f)(1) also requires that this written finding describe the limitations, stipulations, conditions, or changes from the initiating proposal that are required to make the issuance of the exploration license conform to the best interests of the state. To mitigate the potential adverse social and environmental effects of specific post-disposal related activities, DO&G has developed mitigation measures which are conditions and limitations to the exploration license and any subsequent leases, are binding on the licensee, and will condition future plans of operation, plans of development, and other permits.

The mitigation measures presented in this Houston Willow Exploration License Best Interest Finding were developed to mitigate potential effects of License and lease-related activities, after considering all information made known to the Director at this time. Additional project-specific mitigation measures may be imposed if and when the licensee submits plans of operation or development.

The mitigation measures discussed in this Chapter will apply to oil and gas activities in, on, or accessing all licensed land and waterbodies as a condition of issuing the License, regardless of the ownership status of the land. The Director may consult with local government organizations and other agencies in implementing the mitigation measures below. The licensee is subject to 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 the licensee that compliance with the mitigation measure is not practicable and that the licensee 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 application as specified by the application instructions, and decisions of whether to grant exceptions will be made during the plan of operations review.

A. Mitigation Measures

1. Facilities and Operations

a. Oil and gas facilities, including pipelines, shall be designed using industry-accepted engineering codes and standards. Technical submittals to the DO&G that reflect the "practice of engineering," as defined by AS 08.48.341, must be sealed by a professional engineer registered in the State of Alaska.

b. A plan of operations shall be submitted to and approved by DO&G before conducting exploration, development, or production activities in accordance with 11 AAC 83.

c. Facilities shall be designed and operated to minimize sight and sound impacts in areas of high residential, recreational, and subsistence use and important wildlife habitat.

d. The siting of facilities, including roads, airstrips, and pipelines, is prohibited within one-half mile from the mean high water mark and 500 feet of all fish-bearing waterbodies.

e. Zero Lake Road is currently the only access road into the area and it must be undamaged or restored after use. The licensee consult with Forestry on road locations, design, construction, financing, improvements, maintenance, signage and safety.

f. The siting of facilities is prohibited within one-half mile of the banks as measured from the ordinary high water mark of the Little Susitna River and Deception Creek. Facilities may be sited, on a case-by-case basis, within the one-half mile buffer if the licensee demonstrates that siting of such facilities outside this buffer zone is not feasible or prudent, or that a location within the buffer is environmentally preferable. Consultation with the Alaska Department of Fish and Game (ADF&G) is required for siting within the one-half mile buffer. Setbacks are measured from the bank of the river at the time of application.

g. Impacts to important wetlands shall be minimized to the satisfaction of the Director, in consultation with ADF&G and Alaska Department of Environmental Conservation (ADEC). The Director will consider whether facilities are sited in the least sensitive areas.

h. Road and pipeline crossings shall be aligned perpendicular or near perpendicular to watercourses.

i. Pipelines

    i. Shall use existing transportation corridors and be buried where soil and geophysical conditions permit.

    ii. In areas with above ground placement, pipelines shall be designed, sited, and constructed to allow for the free movement of wildlife and to avoid significant alteration of large ungulate movement and migration patterns.

    iii. At a minimum, above ground pipelines shall be elevated seven feet, as measured from the ground to the bottom of the pipeline, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage. A licensee shall consider snow depth in relation to pipe elevation to ensure adequate clearance for wildlife.

    iv. Pipelines and gravel pads shall facilitate the containment and cleanup of spilled fluids.

j. Exploration roads, pads, and airstrips must be temporary. Use of gravel roads, pads, and airstrips may be permitted on a case-by-case basis by the Director, in consultation with the Division of Mining, Land, and Water (DMLW) and ADF&G. Approval for use of existing facilities will depend on the extent and method of restoration needed to return these structures to a usable condition.

k. Artificial gravel islands and bottom founded structures shall not be located in active stream channels, except as provided for in (k).

l. Each proposed structure will be reviewed on a case-by-case basis. Causeways, docks, artificial gravel islands, and bottom-founded structures may be permitted if the Director, in consultation with ADF&G and ADEC, determines that the structures are necessary for field development and that no practicable alternatives exist. A monitoring program may be

required to address the objectives of water quality and free passage of fish, and mitigation shall be required where significant deviation from objectives occurs.

m. 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, ADEC, the Matanuska-Susitna Borough (MSB), and any non-state surface owner, determines that such removal and rehabilitation is not in the state's interest.

n. Material sites required for oil and gas activities shall be:

   i. restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage;

   ii. where practicable, material sites must be designed and constructed to function as water reservoirs for future use; and

   iii. located outside active floodplains of a watercourse unless the Director, after consultation with DMLW and ADF&G, determines that there is no practicable alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.

o. The Director may include plan stipulations if necessary to reduce or eliminate adverse impacts to fish and wildlife or to protect the environment.

2. Fish Wildlife and Habitat

a. Any water intake structures in fish bearing or non-fish bearing waters shall be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. All water withdrawal equipment must be equipped and must use fish screening devices approved by ADF&G.

b. Removal of snow from fish-bearing rivers, streams, and natural lakes shall be subject to prior written approval by ADF&G. Compaction of snow cover overlying fish-bearing waterbodies is prohibited except for approved crossings.

c. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of large ungulate calving and wintering areas during the plan of operations approval stage.

d. Bears

   i. A licensee must consult with ADF&G before commencing any activities to identify the locations of known bear den sites that are occupied in the season of proposed activities.

   ii. Exploration and production activities shall not be conducted within one-half mile of occupied bear dens unless alternative mitigation measures are approved by ADF&G.

e. A licensee who encounters an occupied bear den not previously identified by ADF&G shall report it to the Division of Wildlife Conservation, ADF&G, within 24 hours. The licensee will avoid conducting mobile activities one-half mile from discovered occupied dens unless

alternative mitigation measures are approved by the Director, with concurrence from ADF&G. Non-mobile facilities will not be required to relocate.

3. Subsistence, Commercial, and Sport Harvest Activities

a. License-related use will be restricted if necessary to prevent unreasonable conflicts with subsistence or sport fish and wildlife harvest activities. 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. Licensees will consult the MSB, nearby communities, and Native organizations for assistance in identifying and contacting local subsistence users.

b. Before submitting a plan of operations that has the potential to disrupt subsistence activities, the licensee will consult with the potentially affected subsistence communities and the MSB (collectively “parties”) to discuss the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. The parties will also discuss the reasonably foreseeable effect on subsistence activities of any other operations in the area that they know will occur during the licensee’s proposed operations. Through this consultation, the licensee will make reasonable efforts to ensure that activities are compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests.

4. Fuel and Hazardous Substances

a. The licensee will ensure that secondary containment is provided for the storage of fuel or hazardous substances and sized as appropriate to container type and according to governing regulatory requirements in 18 AAC 75 and 40 CFR 112. Containers with an aggregate storage capacity of greater than 55 gallons that contain fuel or hazardous substances will not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

b. During equipment storage or maintenance, the site must 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.

c. 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.

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

e. All independent fuel and hazardous substance containers must be marked with the contents and the licensee’s or contractor’s name using paint or a permanent label.

f. A freshwater aquifer monitoring well and quarterly water quality monitoring are required down gradient of a permanent storage facility, unless alternative acceptable technology is approved by ADEC.

g. Waste from operations must be reduced, reused, or recycled to the maximum extent practicable. Garbage and domestic combustibles must be incinerated whenever possible or disposed of at an approved site in accordance with 18 AAC 60.

h. Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The licensee must use the most appropriate and efficient method to achieve this goal. The primary method of garbage and putrescible waste is prompt, on-site incineration in compliance with State of Alaska air quality regulations. The secondary method of disposal is on-site storage in animal-proof containers with backhaul to an approved waste disposal facility.

i. New solid waste disposal sites, other than for drilling waste, will not be approved or located on state property for exploration.

j. The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Drilling mud and cuttings will not be discharged into lakes, streams, rivers, or wetlands. On-pad temporary cuttings storage may be allowed as necessary to facilitate annular injection and backhaul operations. Injection of non-hazardous oilfield wastes is regulated by Alaska Oil and Gas Conservation Commission through its Underground Injection Control Program for oil and gas wells.

5. Access

a. Except for approved off-road travel, exploration activities must be supported only by temporary roads, winter trails, existing road systems, or air service. Wintertime off-road travel across tundra and wetlands may be approved in areas where snow and frost depths are sufficient to protect the ground surface. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Exceptions may be granted by the Director of the DMLW, and the Director if it is determined after consulting with ADF&G that travel can be accomplished without damaging vegetation or the ground surface. Exceptions, including the use of gravel, may also be granted on a site-specific basis if it is determined after consulting with ADF&G and DMLW that no practicable alternatives exist for constructing an exploration road or pad.

b. 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 structures. Areas of restricted access must be identified in the plan of operations.

6. Prehistoric, Historic, and Archaeological Sites

a. Before the construction or placement of any structure, road, or facility supporting exploration, development, or production activities, the licensee must conduct an inventory of prehistoric, historic, and archaeological sites within the area, including a detailed analysis of the effects that might result from that construction or placement.

b. The inventory of prehistoric, historic, and archaeological sites must be submitted to the Director and the Office of History and Archaeology (OHA), who will coordinate with the MSB for review and comment. If a prehistoric, historic, or archeological site or area could be adversely affected by a license activity, then the Director, after consultation with OHA and the MSB, will direct the licensee 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 license operations, the licensee shall report the discovery to the Director as soon as possible. The licensee shall make all reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the Director, after consultation with the State Historic Preservation Office and the MSB, has directed the licensee on the course of action to take for its preservation.

7. Hiring Practices

a. The licensee is encouraged to employ local and Alaska residents and contractors, to the extent they are available and qualified, for work performed in the License Area. Licensees shall submit, as part of the plan of operations, a hiring plan that shall include a description of the operator's plans for partnering with local communities to recruit, hire, and train local and Alaska residents and contractors. As a part of this plan, the licensee is encouraged to coordinate with employment and training services offered by the State of Alaska and local communities to train and recruit employees from local communities.

b. In accordance with Administrative Order 278, the licensee is encouraged to employ apprentice labor to perform at least 15 percent of total work hours, to the extent they are available and qualified, for work performed in the License Area. Licensees shall submit, as part of the plan of operations, a hiring plan detailing the means by which the licensee might incorporate apprentice labor.

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

d. A plan of operations application must include a training program

   i. for all personnel including contractors and subcontractors;

   ii. designed to inform each person working on the project of environmental, social, and cultural concerns that relate to that person's job;

   iii. using methods to ensure personnel understand and use techniques necessary to preserve geological, archaeological, and biological resources; and

   iv. designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating.

B. Definitions

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

Hazardous substance - As defined under 42 USC 9601 – 9675 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980).

Important wetlands - Those wetlands that are of high value to fish, waterfowl, and shorebirds because of their unique characteristics or scarcity in the region or that have been determined to function at a high level using the hydrogeomorphic approach.

Minimize - To reduce adverse impacts to the smallest amount, extent, duration, size, or degree reasonable considering the environmental, social, or economic costs of further reduction.

Plan of operation - A plan of operations under 11 AAC 83.158 and a unit plan of operations under 11 AAC 83.346.

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

Secondary containment - An impermeable diked area or portable impermeable containment structure capable of containing the volume of the largest independent container. Minimum secondary requirements are identified in 18 AAC 75.075.

Temporary - No more than 12 months.

Appendix A: Summary of Comments and Responses

Contents

Appendix A: Summary of Comments and Responses

A. Comments Received

AS 38.05.035(e)(7)(B) requires that final written findings include a summary of agency and public comments, if any, and the Department's responses to those comments. This appendix summarizes comments received in response to the April 14, 2008 and January 19, 2016 requests for public comments, and agency information, and the department's responses.

1. Alaska Department of Fish and Game (ADF&G) Division of Habitat

Palmer, AK, July 14, 2008, Mike Bethe, ADF&G Area Manager/Mat-Su

Comment summary: ADF&G provides an overview of the fish and wildlife resources in the area, discusses important watersheds, trails, habitat and anadromous streams in the area, and recommends mitigation measures in the proposed area. They state that the mitigation measures are necessary to protect fish and wildlife resources, their habitat and public uses of those resources.

DNR response: Information provided by ADF&G was reviewed and considered. Relevant information was incorporated into Chapter Four, Habitat, Fish and Wildlife; Chapter Five, Current and Projected Uses; Chapter Seven, Governmental Powers; Chapter Eight, Foreseeable Effects; and Chapter Nine, Mitigation Measures.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires 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 leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

Palmer, AK, February 26, 2016, Ron Benkert, ADF&G Habitat Biologist IV

Comment summary: ADF&G provides update to the 2008 ADF&G comment. As of 2013, new blasting standards were developed and are now applied to projects. Moose population has risen to an estimated 8,500. Bear hunting has increased in the area during the spring. Potential encounters of beaver activity should be addressed by a mitigation strategy.

DNR response: Information provided by ADF&G was reviewed and considered. Relevant information was incorporated into Chapter Four, Habitat, Fish and Wildlife; Chapter Five, Current

and Projected Uses; Chapter Seven, Governmental Powers; Chapter Eight, Foreseeable Effects; and Chapter Nine, Mitigation Measures.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires 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 leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

2. Alaska Department of Natural Resources (ADNR) Division of Forestry

Palmer, AK, June 24, 2008, Ken Bullman

Comment summary: ADNR Division of Forestry (DOF) stated that much of the proposed area is designated Forestry use and is a harvest block for a small timber harvest. Zero Lake Road is the only access road into the area and it must be undamaged or restored after use. Request that licensee consult with Forestry on road locations, design, construction, financing, improvements, maintenance, signage and safety. The object is for roads to have dual purposes and for less roads to be built. Licensees must consult with DOF if wood is used in exploration operations. DOF has been working with mushers regarding use of timber roads. Since Zero Lake Road is one of the few public roads into state lands, it is heavily used by the public for many purposes and safety of the public must be provided for.

DNR response: Information provided by ADNR Division of Forestry was reviewed and considered. Relevant information was incorporated into Chapter Four, Habitat, Fish and Wildlife; Chapter Five, Current and Projected Uses; Chapter Seven, Governmental Powers; Chapter Eight, Foreseeable Effects; and Chapter Nine, Mitigation Measures. A mitigation measure was included in Chapter 9 to address the Division of Forestry's concern about the Zero Lake Road use and restoration.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires 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 leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

Palmer, AK, February 18, 2016, Rick Jandreau, Mat-Su Area Forester

Comment summary: Provides addition to the 2008 DOF comment. A large portion of the area is designated Forestry, and there is an active timber sale program in the area (provides timber for local

businesses and firewood to the valley and Anchorage). DOF also has a road system in the area that accommodates multiple users. Access and use of the lands should be maintained for all users. Exploration company should maintain roads it uses. DOF should have the option to keep open any new roads constructed. Timber cleared should be decked for DOF. All roads should provide access for firefighters during the fire season.

DNR response: Information provided by ADNR Division of Forestry was reviewed and considered. Relevant information was incorporated into Chapter Four, Habitat, Fish and Wildlife; Chapter Five, Current and Projected Uses; Chapter Seven, Governmental Powers; Chapter Eight, Foreseeable Effects; and Chapter Nine, Mitigation Measures.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires 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 leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

3. Chickaloon Native Village Traditional Council

Chickaloon, AK, September 15, 2008, Doug Wade, Tribal Chairman

Comment summary: The Chickaloon Native Village Traditional Council stated that the proposed area does not lie within the Chickaloon Village service area. The Knik Tribal Council and Montana Creek Native Association are the organizations from the area that should be contacted as affected parties. Tribal governments should be included in the definition of local governments.

DNR response: The Knik Tribal Council and Montana Creek Native association were included in the January 19, 2016 request for comments when the Houston Willow Exploration License comment period was reopened. A description of lands for the exploration license is included in Chapter Three. Additionally, the legal description of the License Area is included as an attachment to the exploration license contained in Appendix B. Native allotments and the Alaska National Interest Lands Conservation Act and its implications are discussed in Chapter Seven, Governmental Powers.

Chickaloon, AK, February 26, 2016, Jessica Winnestaffer, Department Director and Gary Hay Executive Director

Comment summary: The Chickaloon Native Village Traditional Council stated that a project in this area has direct impact on the traditional and customary use of the area and requests a special notice for consultation. The commenter is concerned about the impact to salmon streams in the area. They are concerned about impacts on private lands with home and small businesses and potential impacts on residents' mental health and well-being. They are concerned about the project being adjacent to and covering the Parks highway, and related interference with the viewshed and impacts on tourism. They are opposed to oil and gas exploration in this area, and reassert that DNR

should consult with tribal governments before public comment is initiated on such proposed projects.

DNR response: As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize those potential impacts especially on setbacks from streams and rivers and impacts to important fish rearing habitat. Spill response techniques and technology have improved and other agencies including ADEC are responsible for review of spill prevention and response plans for any proposed activity associated with this exploration license. Those responsibilities are discussed in Chapter 7, Governmental Powers to Regulate Oil and Gas, of this best interest finding.

Consultation with tribal governments, including the Chickaloon Native Vilage Traditional Council, was conducted as part of the outreach for public comments on this proposal.

4. Joan and Bruno Bryner

Willow, AK, July 11, 2008

Comment summary: The commenter stated that the proposal area contains anadromous waters, lands in private ownership, is close to residential areas, and contains an important trail system (Haessler-Norris) used by dog teams and snowmachiners. They stated exploration should not occur where it will infringe on recreational access, habitat, or residential areas. The commenter stated specific sections of the area within Willow should be excluded from exploration entirely.

DNR response: Fish and wildlife and their habitats are considered and discussed in Chapter Four of the Houston Willow Oil and Gas Exploration License Best Interest Finding. Communities are discussed in Chapter Three of the best interest finding. Uses of the area, including those on the Haessler-Norris trail system, are discussed in Chapter Five. Effects of oil and gas exploration on fish and wildlife, communities, and uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts especially on setbacks from streams and rivers and impacts to important fish rearing habitat. Additionally, mitigation measures address access restrictions to the License Area.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to

the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

5. Paul and Erin McLarnon

Willow, AK, July 11, 2008

Comment summary: The commenters stated that the proposal area contains lands in private ownership, is close to residential areas, and contains an important trail system (Haessler-Norris) used by dog teams and snowmachiners. The commenters stated that exploration should not occur where it will infringe on recreational access or residential areas. The commenter stated that specific sections of the area (MTRS provided) within Willow should be excluded from exploration entirely. The commenters stated exploration of gas should not be used as a loophole to avoid the Mat-Su Borough Coalbed Methane Permit. The commenter requested exclusions of the following parcels of land from the exploration license:

T 19N, R.4W. Seward Meridian, sections 35 and 36,

T 19N, R.3W Seward Meridian, sections 31–35

T 18N R.4W. Seward Meridian, section 12

DNR response: Fish and wildlife and their habitats are considered and discussed in Chapter Four of the Houston Willow best interest finding. Communities are discussed in Chapter Three of the best interest finding. Uses of the area, including those on the Haessler-Norris trail system, are discussed in Chapter Five. Effects of oil and gas exploration on fish and wildlife, communities, and uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts especially on setbacks from streams and rivers and impacts to important fish rearing habitat. Additionally, mitigation measures address access restrictions to the License Area.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

6. Nicholas Van Wyck

Willow, AK, July 11, 2008

Comment summary: The commenter stated that this license should be granted because it is in the state's best interest because more gas reserves must be found to help supply industrial and residential needs.

DNR response: Support for the exploration license program is noted.

7. Willow Area Community Organization

Willow, AK, June 17, 2008, Linda Oxley, Chairperson

Comment summary: The commenter stated that the proposed area lies within the boundary of Willow community. They stated the area's proximity to residential areas is not acceptable. They stated the area contains anadromous waters. The commenter expressed their concern for heavy equipment in pristine upland environments. They also stated that recreational access to area trail systems must be maintained. They stated that the Willow community comprehensive plan is being drafted.

DNR response: Communities, income and population statistics, and land ownership are discussed in Chapter Three of the best interest finding. Fish and wildlife and their habitats are considered and discussed in Chapter Four of the Houston Willow best interest finding. Uses of the area are discussed in Chapter Five. Effects of oil and gas exploration on fish and wildlife, communities, and uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts especially on setbacks from streams and rivers and impacts to important fish rearing habitat, as well as impacts to residential, recreation, and sensitive habitat areas. Additionally, mitigation measures address access restrictions to the License Area.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state’s standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

8. Friends of Mat-Su (now Envision Mat-Su)

Palmer, AK, May 22, 2008, Mimi Peabody, Projects Coordinator

Comment summary: The commenter stated that recreational access to area trail systems must be maintained. The commenter stated public property should not be gated. The commenter stated exploration of gas should not be used as a loophole to avoid the Mat-Su Borough Coalbed Methane Permit. The commenter requested DO&G to evaluate whether gas development poses a potential threat to fresh water supplies.

DNR response: Uses of the area, including those of trail systems and recreation areas, are discussed in Chapter Five. Effects of oil and gas exploration on uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts of the Houston Willow exploration license and the exploration activities.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

9. Michael Quick

Address Not Provided, July 11, 2008

Comment summary: The commenter stated that beauty, wildlife habitat, and personal use should be maintained. The commenter stated that they support traditional oil and gas exploration, but does not support CBM extraction. Proposes a 5-mile setback from Nancy Lake State Recreation area boundary.

DNR response: Fish and wildlife and their habitats are considered and discussed in Chapter Four of the Houston Willow best interest finding. Communities are discussed in Chapter Three of the best interest finding. Uses of the area are discussed in Chapter Five. Effects of oil and gas exploration on fish and wildlife, communities, and uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts especially on setbacks from streams and rivers and impacts to important fish rearing habitat, as well as impacts to residential, recreation, and sensitive habitat areas.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

10. Matanuska Susitna Borough (MSB)

Palmer, AK, June 16, 2008, John Duffy, Borough Manager

Comment summary: The commenter stated that exploration work would require the following permits/conditions, if applicable: conditional use permits for work performed within the city of Houston and for coal bed methane; floodplain development permit; land use permit for work on borough land; maintain integrity of existing trails; structures must comply with borough setback regulations.

DNR response: As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws,

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

Palmer, AK, February 24, 2016, Susan Lee, Planner II

Comment summary: The Matanuska Susitna Borough provided additional comments to the 2008 comment. The commenter stated that a permit is required for access through MSB land. The commenter requested clarification on land ownership in the area, as a cursory review of borough ownership revealed borough land throughout the area. The commenter stated that the Zero Lake Trailhead, the Haessler-Norris Trail System (easements are being obtained for this trail system), the Historic Willow Sled Trail, and the Historic Question Creek are within the License Area. The commenter stated that if these trails are used, there should be weight limits imposed or mitigation of impacts should be required. The commenter stated that if additional access is developed, proposed trail intersections should be analyzed to minimize conflicts with existing trails and users. The commenter stated that Deception, Lily, and Nancy Creeks are within the License Area and are anadromous. The commenter stated that some properties are located within a special flood hazard area and so a floor hazard development permit would be required.

DNR response: Fish and wildlife and their habitats are considered and discussed in Chapter Four of the Houston Willow best interest finding. Communities are discussed in Chapter Three of the best interest finding. Uses of the area are discussed in Chapter Five. Effects of oil and gas exploration on fish and wildlife, communities, and uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts especially on setbacks from streams and rivers and impacts to important fish rearing habitat, as well as impacts to residential, recreation, and sensitive habitat areas.

As stated in Chapter Three, Description and Location of the License Area, only free and unencumbered state-owned subsurface mineral estates are included in the exploration license.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

11. National Marine Fisheries Service

Address Not Provided, June 9, 2008, Jonathan Taylor, LTJG/NOAA

Comment summary: The proposed action will not result in adverse effects to Essential Fish Habitat or other resources of concern to NMFS and NMFS has no objection to the project.

DNR response: Comment noted.

12. ADNR Office of History and Archaeology (OHA)

Anchorage, AK, July 2, 2008, Judith E. Bittner, State Historic Preservation Officer

Comment summary: The commenter stated that there are many reported archaeological sites within the project solicitation area. The stated that it is likely that there are many unreported archaeological sites within the area because the entire proposed area has not undergone a comprehensive cultural resources survey. The commenter requested that prior to DO&G releasing a permit for exploration, the licensee should send OHA a letter containing the following information about archaeologic sites in the area: literature research, map, field verification of sites, and sites where exploration should be avoided. The commenter stated that after OHA receives the letter, OHA's comments and concerns should be placed as stipulations within the permit/license.

DNR response: The history of the region and cultural resources of the area are considered and discussed in Chapter Three of the Best Interest Finding. Effects of oil and gas exploration on cultural resources, and uses of the area are discussed in Chapter Eight. DNR has included mitigation measures in Chapter Nine of this best interest finding to reduce and minimize potential impacts of oil and gas exploration on prehistoric, historic, and archaeological sites.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state’s standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

13. Brad Tischer

Address Not Provided, May 14, 2008

Comment summary: The commenter stated that they live in the area and indicates support for exploration in the area and by smaller companies. The commenter proposed paying Exxon $800 million with the condition they do not do business in Alaska.

DNR response: Support for the exploration license program is noted.

14. University of Alaska

Anchorage, AK, February 15, 2016, Jerry Kilanowski, Forester

Comment summary: The University of Alaska supports the exploration and development of the State's oil and gas resources. UA owns several parcels consisting of surface, subsurface, or both surface and subsurface rights within the area.

DNR response: A complete title report was performed as part of the best interest finding process and a complete legal description of lands is included as an appendix to the best interest finding.

As stated in Chapter Three, Description and Location of the License Area, only free and unencumbered state-owned subsurface mineral estates are included in the exploration license.

As stated in Chapter Seven, Governmental Powers, licensees and lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances. In addition to existing laws and regulations applicable to oil and gas activities, the state’s standard oil and gas lease contract requires that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Licenses and leases are subject to all future laws and regulations in effect after the effective date of the license or leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

Appendix B: Exploration License

Oil and Gas Exploration License
Form #DOG 2013-09 EL

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

Houston Willow Exploration License
ADL 391282

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

Daniel K. Donkel and Samuel H. Cade

("the licensee") whether one or more, whose address for purposes of notification is set out in Paragraph 18.

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 **$500,000.00**. 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 licensee 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. Upon submission of a plan of operations, the licensee shall furnish a bond in accordance with 11 AAC 83.160.

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. (a) 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.

(b) The state may require such financial assurances as the commissioner determines necessary to ensure the licensee's ability to meet its obligation under this paragraph. If at any time the commissioner determines that existing financial assurances are insufficient to satisfactorily guarantee the performance of all the licensee's obligations under this paragraph, the commissioner may require the delivery of such substitute or supplemental financial assurances as the commissioner determines necessary.

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 18 below. When activities under a plan of operations are underway, the licensee shall also designate, by notice under Paragraph 18 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:

Samuel H. Cade
3410 Amberwood Lane
Prosper, TX 75078

Daniel K. Donkel
7237 Woodville Crescent
Orlando, FL, 32819

(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: _____

Chantal Walsh, Director, Division of Oil and Gas

STATE OF ALASKA)
) ss.
Third Judicial District)

On , before me appeared Chantal Walsh, Director 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: _____

LICENSEE: _____

Signature: _____

Printed Name/Title: _____

INSERT NOTARY ACKNOWLEDGMENT OF LICENSEE'S SIGNATURE HERE

Schedule 1

Legal Description
Houston-Willow Exploration License
ADL 391282

Legal Description: Tract: 1

T. 018 N., R. 003 W., Seward Meridian, Alaska

Section 1, Surveyed, Lots 1 - 4, S1/2N1/2, S1/2, 641.04 acres;
Section 2, Surveyed, Lots 1 - 4, S1/2N1/2, S1/2, 641.68 acres;
Section 11, Surveyed, All, 640.00 acres;
Section 13, Surveyed, All, 640.00 acres;
Section 14, Surveyed, All, 640.00 acres;
Section 23, Surveyed, E1/2NE1/4, SW1/4NE1/4, W1/2NW1/4, SE1/4NW1/4, N1/2S1/2, 400.00 acres;
Section 24, Surveyed, N1/2, 320.00 acres;

This Tract (1) contains 3,922.72 acres, more or less.

According to the survey plat approved by the United States Survey General's Office in Juneau, AK on December 4, 1915 and the survey plat accepted by the United States, Department of the Interior, Government Land Office in Washington, DC on June 25, 1917.

****

Legal Description: Tract: 2

T. 018 N., R. 003 W., Seward Meridian, Alaska

Section 3, Surveyed, Lots 1 - 4, S1/2N1/2, S1/2, 640.96 acres;
Section 4, Surveyed, Lots 1 - 4, S2N2, S2, 640.96 acres;
Section 9, Surveyed, All, 640.00 acres;
Section 10, Surveyed, All, 640.00 acres;
Section 15, Surveyed, N1/2, SE1/4SW1/4, SE1/4, 520.00 acres;
Section 16, Surveyed, All, 640.00 acres;
Section 21, Surveyed, SE1/4NE1/4, W1/2NE1/4NW1/4NW1/4, NW1/4NW1/4NW1/4, SW1/4NW1/4, N1/2S1/2 excluding USS 9028 Lot 7, 250.44 acres;
Section 22, Surveyed, NE1/4, E1/2SE1/4SE1/4NW1/4, N1/2S1/2, 325.00 acres;

This Tract (2) contains 4,297.36 acres, more or less.

According to the survey plat approved by the United States Survey General's Office in Juneau, AK on December 4, 1915, the survey plat accepted by the United States, Department of the Interior, Government Land Office in Washington, DC on June 25, 1917, and the U. S. Survey officially filed by the United States Department of Interior, Bureau of Land Management in Anchorage, AK on September 26, 1988.

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Legal Description: Tract: 3

T. 018 N., R. 003 W., Seward Meridian, Alaska

Section 5, Surveyed, Lots 1 - 4, S1/2N1/2, N1/2S1/2, S1/2SW1/4, 560.80 acres;
Section 6, Surveyed, Lots 1 - 7, S1/2NE1/4, SE1/4NW1/4, E1/2SW1/4, SE1/4, 616.19 acres;
Section 7, Surveyed, Lot 1, N1/2NE1/4, NE1/4NW1/4, 154.24 acres;
Section 8, Surveyed, S1/2NE1/4, W1/2, SE1/4, 560.00 acres;
Section 17, Surveyed, N1/2, N1/2S1/2, S1/2SE1/4, 560.00 acres;
Section 18, Surveyed, Lots 1 - 4, NE1/4, E1/2NW1/4, NE1/4SW1/4, W1/2SE1/4, N1/2NE1/4SE1/4, SW1/4NE1/4SE1/4, N1/2SE1/4NE1/4SE1/4, N1/2S1/2SE1/4NE1/4SE1/4, W1/2SE1/4SE1/4, SE1/4SE1/4SE1/4, S1/2NE1/4SE1/4SE1/4, S1/2N1/2NE1/4SE1/4SE1/4, 574.04 acres;
Section 20, Surveyed, SW1/4NE1/4, NE1/4SE1/4, 80.00 acres;

This Tract (3) contains 3,105.27 acres, more or less.

According to the survey plat approved by the United States Survey General's Office in Juneau, AK on December 4, 1915 and the survey plat accepted by the United States, Department of the Interior, Government Land Office in Washington, DC on June 25, 1917.

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Legal Description: Tract: 4

T. 018 N., R. 004 W., Seward Meridian, Alaska

Section 1, Surveyed, Lots 1 - 4, S1/2N1/2, S1/2, 640.00 acres;
Section 2, Surveyed, Lots 1 - 4, S1/2N1/2, S1/2, 640.00 acres;
Section 11, Surveyed, NE1/4, N1/2NW1/4, SE1/4NW1/4, N1/2SE1/4, SE1/4SE1/4, 400.00 acres;
Section 12, Surveyed, All, 640.00 acres;
Section 13, Surveyed, NE1/4, N1/2NW1/4, N1/2N1/2NE1/4SE1/4NW1/4, S1/2S1/2NE1/4SE1/4NW1/4, NW1/4SE1/4NW1/4, S1/2SE1/4NW1/4, 275.00 acres;

This Tract (4) contains 2,595.00 acres, more or less.

According to the survey plat accepted by the United States, Department of the Interior General Land office in Washington, DC on August 12, 1931 and the survey plat accepted by the United States, Department of the Interior, Bureau of Land Management in Washington, DC on June 10, 1963.

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Legal Description: Tract: 5

T. 019 N., R. 003 W., Tract A, Seward Meridian, Alaska

Section 31, Unsurveyed, All, 618.00 acres;
Section 32, Unsurveyed, All, 640.00 acres;
Section 33, Unsurveyed, All, 640.00 acres;
Section 34, Unsurveyed, All, 640.00 acres;
Section 35, Unsurveyed, All, 640.00 acres;
Section 36, Unsurveyed, All, 640.00 acres;

This Tract (5) contains 3,818.00 acres, more or less.

According to the survey plat accepted by the United States, Department of the Interior, Bureau of Land Management in Washington, DC on March 21, 1966.

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Legal Description: Tract: 6

T. 019 N., R. 004 W., Seward Meridian, Alaska.

Section 35, Surveyed, Lots 1 and 2, S1/2NW1/4, SW1/4, and the bed of Frying Pan lake, 320.00 acres;
Section 36, Surveyed, Lots 1 - 4, NE1/4, S1/2, and the bed of Windy Lake, 640.00 acres;

This Tract (6) contains 960.00 acres, more or less.

According to the survey plat accepted by the United States, Department of the Interior, Government Land Office in Washington, DC on June 24, 1917.

Aggregating 18,698.35 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	$ _____
	Line 1 Minus		
3.	Line 2	Balance of Remaining Work Commitment	$ _____
4	Enter	# of Years Remaining in Term of License	_____
	Line 3 Divided by		
5	Line 4	Annual Bond Due	$ _____

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

Appendix C: Sample Lease

Oil and Gas Conversion Lease
Form #DOG 201804 CL

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

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 (f) or (g) 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	3700 Airport Way
Anchorage, Alaska	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.

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.

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. (a) 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.

(b) The state may require such financial assurances as the commissioner determines necessary to ensure the lessee's ability to meet its obligation under this paragraph. If at any time the commissioner determines that existing financial assurances are insufficient to satisfactorily guarantee the performance of all the lessee's obligations under this paragraph, the commissioner may require the delivery of such substitute or supplemental financial assurances as the commissioner determines necessary.

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 12.5 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: _____

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.