U.S. Fish and Wildlife Service Mission Statement

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

National Wildlife Refuge Mission Statement

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

—National Wildlife Refuge System Improvement Act of 1997
DRAFT ENVIRONMENTAL ASSESSMENT FOR THE
SHADURA 3D SEISMIC PROJECT
KENAI NATIONAL WILDLIFE REFUGE, AND
KENAI PENINSULA BOUROUGH, ALASKA

November 2012

Prepared by:
U.S. Fish and Wildlife Service
Region 7

Alaska Regional Office
Branch of Realty Operations
1011 East Tutor Road, MS–211
Anchorage, Alaska 99503

Kenai National Wildlife Refuge
2139 Ski Hill Road
P.O. Box 2139
Soldotna, Alaska 99669-2139
November 15, 2012

Re: Release and review of the Draft Environmental Assessment (EA) for the Shadura Natural Gas Development Project

Dear Reader,

In 2012, the U.S. Fish and Wildlife Service (Service) received an application for a special use permit (SUP) for a proposed three-dimensional (3D) seismic acquisition program in the northern portion of the Kenai National Wildlife Refuge (Kenai NWR), Alaska. Although the Service owns the land surface in the project area, Cook Inlet Region, Inc. (CIRI) owns the subsurface oil and gas resources. CIRI has entered into a lease with NordAq to develop these gas resources. NordAq’s application for a right-of-way was made subject to ANILCA Section 1110 (b), Access to Inholdings.

This Environmental Assessment (EA) documents the site-specific analysis of the proposed 3D seismic acquisition program. Two alternatives were evaluated in detail—NordAq’s proposed 3D seismic acquisition program and the No Action alternative.

The public comment period will run for 30 days beginning November 15, 2012, and ending December 15, 2012. During that time, you are welcome to submit written comments to the Service at the address listed below. Following the comment period, the Service will prepare a Final EA. The Service will respond to all substantive comments on the EA. We ask that your comments relate directly to the EA, that you are as specific as possible, and that you cite the location(s) in the document on which you are commenting.

If you have any questions or wish to obtain additional copies of this document, please contact:

Peter Wikoff,
U.S. Fish and Wildlife Service,
1011 East Tudor Rd. MS-231,
Anchorage, AK 99503.

Facsimile: 907-786-3976,
email: fw7_kenai_planning@fws.gov.
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</tr>
</tbody>
</table>
Contents

CHAPTER 1 — PURPOSE AND NEED ................................................................. 1–1
  1.1 Purpose and Need ................................................................................. 1–1
  1.2 Shadura Natural Gas Development Project ........................................ 1–1
  1.3 Planning Context ................................................................................. 1–1
  1.4 Legal and Policy Guidance ................................................................. 1–4
  1.5 Planning Area ..................................................................................... 1–4
     1.5.1 Establishment of Kenai National Wildlife Refuge ...................... 1–4
  1.6 Legal and Regulatory Context ............................................................ 1–5
     1.6.1 NEPA Requirements ................................................................. 1–5
     1.6.2 Title XI of the Alaska National Interest Lands Conservation Act 1–5
  1.7 Public Involvement ............................................................................ 1–6
  1.8 Permits and Authorizations Needed to Implement the Project .......... 1–6

CHAPTER 2 — ALTERNATIVES ..................................................................... 2–1
  2.1 No Action Alternative .......................................................................... 2–1
  2.2 Proposed Action ................................................................................ 2–1
     2.2.1 Proposed Schedule ...................................................................... 2–4
     2.2.2 Detail of the Proposed Survey .................................................. 2–4
     2.2.3 Pre-plot Plan Survey ................................................................. 2–4
     2.2.4 Source and Receiver Deployment and Retrieval ...................... 2–4
     2.2.5 Data Acquisition and Recording ............................................. 2–5
     2.2.6 Survey Completion, Inspection, Monitoring and Restoration ..... 2–5
     2.2.7 Staging Area/Access ................................................................. 2–6
     2.2.8 Fuel Storage and Handling ..................................................... 2–6
     2.2.9 Waste Management .................................................................. 2–6
     2.2.10 Health, Safety, and Environment Training .............................. 2–8

CHAPTER 3 — AFFECTED ENVIRONMENT ................................................. 3–1
  3.1 Physical Environment .......................................................................... 3–1
     3.1.1 Meteorology and Air Quality .................................................. 3–1
     3.1.2 Geology and Soils .................................................................... 3–3
     3.1.3 Hydrology ................................................................................. 3–4
  3.2 Biological Environment ...................................................................... 3–7
     3.2.1 Vegetation and Wetlands .......................................................... 3–7
     3.2.2 Wildlife .................................................................................... 3–10
     3.2.3 Aquatic Life .............................................................................. 3–14
     3.2.4 Special-Concern Species ......................................................... 3–14
  3.3 Human Environment .......................................................................... 3–16
     3.3.1 Land Use .................................................................................. 3–16
     3.3.2 Recreation ............................................................................... 3–17
     3.3.3 Transportation ......................................................................... 3–18
     3.3.4 Visual Resources ...................................................................... 3–19
     3.3.5 Noise ....................................................................................... 3–20
     3.3.6 Cultural Resources ................................................................... 3–20
3.3.7 Socioeconomics ................................................................. 3–21
3.3.8 Subsistence ......................................................................... 3–23
3.3.9 Environmental Justice ....................................................... 3–23
3.3.10 Fire Management .............................................................. 3–24
3.3.11 Hazardous Substances and Wastes ................................. 3–24

CHAPTER 4 — ENVIRONMENTAL CONSEQUENCES ......................... 4–1
4.1 Overview .............................................................................. 4–1
4.1.1 Direct and Indirect Effects ................................................... 4–1
4.1.2 Cumulative Effects ............................................................. 4–1
4.1.3 Significance Criteria (elements leading to a significance threshold) ................................................... 4–6
4.1.4 Mitigation ................................................................. 4–6
4.2 Physical Environment .......................................................... 4–6
4.2.1 Meteorology and Air Quality .............................................. 4–6
4.2.2 Geology and Soils ............................................................. 4–8
4.2.3 Hydrology ................................................................. 4–9
4.3 Biological Environment ....................................................... 4–11
4.3.1 Vegetation and Wetlands .................................................. 4–11
4.3.2 Wildlife ........................................................................... 4–13
4.3.3 Aquatic Life ................................................................. 4–15
4.3.4 Special-Concern Species ................................................... 4–16
4.4 Human Environment .......................................................... 4–17
4.4.1 Land Use ......................................................................... 4–17
4.4.2 Recreation ....................................................................... 4–19
4.4.3 Transportation ................................................................. 4–20
4.4.4 Visual Resources .............................................................. 4–21
4.4.5 Noise ............................................................................. 4–22
4.4.6 Cultural Resources ............................................................ 4–24
4.4.7 Socioeconomics .............................................................. 4–25
4.4.8 Subsistence ................................................................. 4–27
4.4.9 Environmental Justice ...................................................... 4–29
4.4.10 Hazardous Substances and Waste ................................. 4–30
4.4.11 Wildfire Management ..................................................... 4–31

CHAPTER 5 — CONSULTATION AND COORDINATION .................... 5–1
CHAPTER 6 — PREPARERS AND CONTRIBUTORS .......................... 6–1
CHAPTER 7 — REFERENCES CITED ........................................... 7–1
Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1–1</td>
<td>Major Federal, State, and Borough Authorizing Actions</td>
<td>1–7</td>
</tr>
<tr>
<td>Table 3–1</td>
<td>Relative Importance of Functions and Values for Wetlands in the General Project Area</td>
<td>3–10</td>
</tr>
<tr>
<td>Table 3–2</td>
<td>Mammal Species Potentially Occurring in the Project Area</td>
<td>3–11</td>
</tr>
<tr>
<td>Table 3–3</td>
<td>Known Cultural Resources in the Study Area</td>
<td>3–21</td>
</tr>
<tr>
<td>Table 3–4</td>
<td>Population</td>
<td>3–21</td>
</tr>
<tr>
<td>Table 3–5</td>
<td>Personal and Median Household Income</td>
<td>3–22</td>
</tr>
<tr>
<td>Table 3–6</td>
<td>Occupied and Vacant Housing</td>
<td>3–22</td>
</tr>
<tr>
<td>Table 3–7</td>
<td>Population Living Below the Poverty Line, 2006–2010</td>
<td>3–24</td>
</tr>
<tr>
<td>Table 4–1</td>
<td>Estimated Daily Emissions from 3D Seismic Drilling Operations</td>
<td>4–7</td>
</tr>
<tr>
<td>Table 4–2</td>
<td>Estimated Total Emissions from 3D Seismic Drilling Operations</td>
<td>4–7</td>
</tr>
<tr>
<td>Table 6–1</td>
<td>U.S. Fish and Wildlife Service</td>
<td>6–1</td>
</tr>
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<td>ARCADIS US</td>
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Figures

<table>
<thead>
<tr>
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<tr>
<td>Figure 1–1</td>
<td>General Location of the Project</td>
<td>1–2</td>
</tr>
<tr>
<td>Figure 1–2</td>
<td>Distribution of Leases and CIRI Mineral Estate</td>
<td>1–3</td>
</tr>
<tr>
<td>Figure 2–1</td>
<td>Project Vicinity Map</td>
<td>2–2</td>
</tr>
<tr>
<td>Figure 2–2</td>
<td>Project Vicinity Map Detail</td>
<td>2–3</td>
</tr>
<tr>
<td>Figure 2–3</td>
<td>Rediske Air Property</td>
<td>2–7</td>
</tr>
<tr>
<td>Figure 3–1</td>
<td>Surface Water Resources</td>
<td>3–5</td>
</tr>
<tr>
<td>Figure 3–2</td>
<td>Wolf and Lynx Presence</td>
<td>3–13</td>
</tr>
<tr>
<td>Figure 3–3</td>
<td>ADF&amp;G Anadromous Streams</td>
<td>3–15</td>
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Appendices

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<tr>
<td>Appendix A</td>
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CHAPTER 1—PURPOSE AND NEED

The U.S. Fish and Wildlife Service (Service) is evaluating an application for a special use permit (SUP) for a proposed three-dimensional (3D) seismic acquisition program in the northern portion of the Kenai National Wildlife Refuge (Kenai NWR), Alaska (Figure 1–1). This evaluation will analyze the project as directed by the National Environmental Policy Act (NEPA). This Environmental Assessment (EA) has been prepared in accordance with the requirements of NEPA (42 United States Code [USC] 4371, et seq.), as implemented by the Council on Environmental Quality (CEQ) regulations in 40 Code of Federal Regulations (CFR) 1500–1508.

This chapter discusses the purpose of and need for this EA, the proposed project, legal and regulatory context, public participation, and the federal and state permits and approvals necessary for the proposed project to proceed.

The purpose of an EA is to determine the extent of impacts to the project area from the proposed action. If the Responsible Official (Service) determines that no significant impacts will occur, a finding of no significant impact (FONSI) will be prepared. If a FONSI is not appropriate, the EA will be used to facilitate the preparation of an environmental impact statement (43CFR46.3 and CEQ Regulations §1508.13).

1.1 PURPOSE AND NEED

The purpose of this EA is to gather information and analyze the probable impacts of the alternatives presented herein, to enable the Service to comply with NEPA guidelines, and to make an informed decision regarding the NordAq Energy, Inc. application for a SUP. The need for this EA arises from the application for a SUP from NordAq Energy, Inc. (NordAq) to access natural gas leases of portions of the Cook Inlet Region, Inc. owned subsurface beneath the Refuge to conduct the 3D seismic program. The Service must decide on the best alternative to conduct the 3D seismic program and what stipulations, if any, will be required. The Alaska National Interests Land Conservation Act (ANILCA) Section 1110 (b) requires that the Service provide for reasonable access to the subsurface estate.

1.2 SHADURA NATURAL GAS DEVELOPMENT PROJECT

Cook Inlet Region, Inc. (CIRI) owns the subsurface estate of oil, gas, and coal on a portion of the Kenai NWR (Figure 1–2). NordAq has leased a portion of this oil and gas estate, in the northwest portion of the Kenai NWR, from CIRI. The Shadura Seismic Project (Project) will include drilling and setting seismic sources to generate seismic waves and distributing receivers to record reflected seismic waves. Chapter 2 provides details of the Project.

1.3 PLANNING CONTEXT

The Kenai NWR is part of a national system of more than 545 refuges. The Service places an emphasis on managing individual refuges in a manner that reflects the National Wildlife Refuge System mission.

The Service is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefits of the American people.

The mission of the U.S. Fish and Wildlife Service is:

*Working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.*
FIGURE: 1-2

DISTRIBUTION OF LEASES & CIRI MINERAL ESTATE

SAW ED MER SI C E PROJECT EA
The National Wildlife Refuge System comprises more than 96 million acres of Federal lands, encompassing national wildlife refuges, wetlands, and special management areas. The System has units in each of the 50 states and in the territories of the United States.

The mission of the National Wildlife Refuge System is:

“To administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Administration Act, as amended).”

1.4 LEGAL AND POLICY GUIDANCE

The National Wildlife Refuge System Administration Act, as amended, states that each refuge shall be managed to fulfill both the mission of the Refuge System and the purposes for which the individual refuge was established. Refuges throughout the System are influenced by a wide array of laws, treaties, and executive orders. Among the most important are the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, the Refuge Recreation Act, the Endangered Species Act, and the Wilderness Act. For national wildlife refuges in Alaska, the Alaska National Interest Lands Conservation Act of 1980, as amended, provides key management direction. ANILCA sets forth purposes of the refuge, defines provisions for planning and management, and authorizes studies and programs related to wildlife and wildland resources, subsistence opportunities, and recreation and economic uses. NEPA as amended, guides planning efforts on refuges.

1.5 PLANNING AREA

The Kenai Refuge encompasses 1.98-million acres in southcentral Alaska. The Refuge is located on the 5-million acre Kenai Peninsula and is bordered on the north by Chickaloon Bay; on the east by the Chugach National Forest and Kenai Fjords National Park; on the south by Kachemak Bay; and on the west by Cook Inlet. The Refuge is bordered by a number of communities, including Hope to the northeast; Cooper Landing to the east; Seward to the southeast, Homer to the southwest; Ninilchik, Soldotna, and Kenai to the east; and Sterling in the center.

1.5.1 Establishment of Kenai National Wildlife Refuge

Franklin D. Roosevelt established the Kenai National Moose Range (Moose Range) on December 16, 1941, for the purpose of “…protecting the natural breeding and feeding range of the giant Kenai moose on the Kenai Peninsula, Alaska, which in this area presents a unique wildlife feature and an unusual opportunity for the study, in its natural environment, of the practical management of a big-game species that has considerable local economic value…” (Executive Order 8979).

ANILCA substantially affected the Moose Range by altering its boundaries and broadening its purposes from moose conservation to protection and conservation of a broad array of fish, wildlife, habitats, other resources, and educational and recreational opportunities. ANILCA also redesignated the Moose Range as the Kenai National Wildlife Refuge, added nearly a quarter of a million acres of land, and established the 1.32-million acre (534,349 hectare) Kenai Wilderness.

The Refuge is considered by many to be “Alaska in Miniature.” It consists of the western slopes of the Kenai Mountains and forested lowlands bordering Cook Inlet. Treeless alpine and subalpine habitats are home to mountain goats, Dall sheep, caribou, wolverine, marmots, and ptarmigan. Most of the lower elevations on the Refuge are covered by boreal forests composed of spruce and birch forests intermingled
with hundreds of lakes. These boreal forests are home to moose, wolves, black and brown bears, lynx, snowshoe hares, and numerous species of neotropical birds such as olive-sided flycatchers, myrtle warblers, and ruby-crowned kinglets. At sea level, the Refuge encompasses the largest estuary on the Peninsula—the Chickaloon River Flats. The Flats provides a major migratory staging area for thousands of shorebirds and waterfowl, and provides a haul-out area for harbor seals and feeding areas for beluga whales.

1.6 LEGAL AND REGULATORY CONTEXT

The Service was the lead agency for preparing this EA with the role of technical analysis and decision-making under NEPA and its implementing regulations (40 CFR 1500–1508). The Service will develop a Decision Notice (DN) and may determine that a FONSI is justified for this EA.

The Project is subject to the regulations and requirements of various surface property owners. Some project components would be located on Alaska State lands. Other project components would be located within the boundaries of the Kenai NWR, a Conservation System Unit established by ANILCA, Public Law (PL) 96–487 and managed by the Service.

In addition, the Project is subject to various other federal, state, and borough regulations and requirements. For example, the Project must meet the requirements of the federal Clean Water Act (CWA), Clean Air Act (CAA), National Historic Preservation Act (NHPA), and Endangered Species Act of 1973 (ESA). It also must meet the requirements of the Alaska Historic Preservation Act, other various statues in the Alaska Administrative Code (AAC), and Kenai Peninsula Borough (KPB) local ordinances.

As mentioned in Section 1.2, CIRI owns oil, gas, and coal resources in the Project area and has leased a portion of its oil and gas estate to NordAq. CIRI is an Alaska Native Regional Corporation established under the Alaska Native Claims Settlement Act (ANCSA). Private surface and subsurface property rights (including the oil and gas estate leased to NordAq) were conveyed to CIRI pursuant to ANCSA in the settlement of Alaska Native Corporation land claims in the Cook Inlet region.

1.6.1 NEPA Requirements

NEPA is the United States’ basic national charter for protection of the environment. It establishes procedures for how federal agencies make decisions. NEPA procedures insure that environmental information is available to the public and officials before decisions are made and before actions are taken. The information must be of the highest quality practical. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA. Most importantly, NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail.

The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences and take actions that protect, restore, and enhance the environment (40 CFR 1500.1). In addition, the EA addresses the Service’s 2009 Revised Comprehensive Conservation Plan (CCP) and EIS.

1.6.2 Title XI of the Alaska National Interest Lands Conservation Act

As noted above, the Project is partially located within the Kenai NWR, a Conservation System Unit established by ANILCA. Section 1110(b) of Title XI of ANILCA, Transportation and Utility Systems In and Across, and Access Into, Conservation System Units in Alaska, addresses access to inholdings and applies to issuance of a right-of-way (ROW) permit.
Regulations at 43 CFR 36.10 require that adequate and feasible access be granted to the owners of valid inholdings, in this case CIRI and NordAq, for economic and other purposes. This access is subject to reasonable regulation to protect the natural and other values of the Kenai NWR. These regulations define “adequate and feasible access” as that which is reasonably necessary and economically practicable, but not necessarily the least costly, for achieving the use and development on the applicant’s non-federal land or occupancy interest. Under these federal regulations, the Service must specify in the permit the route(s) and method(s) of access across the area(s) desired by the applicant, unless it is determined that:

- The route or method of access would cause significant adverse impacts on natural or other values of the area and adequate and feasible access otherwise exists; or
- The route or method of access would jeopardize public health and safety and adequate and feasible access otherwise exists; or
- The route or method is inconsistent with the management plan(s) for the area or purposes for which the area was established and adequate and feasible access otherwise exists; or
- The method is unnecessary to accomplish the applicant’s land use objective.

If the Service makes one of the findings above, it must specify in the permit another alternate route(s) and/or method(s) of access that will provide the applicant adequate and feasible access after consultation with the applicant.

In addition, the Service must add terms and conditions to a Title XI ANILCA Right-of-Way under 43 CFR 36.9 that would:

- To the maximum extent feasible, be compatible with the purposes for which the Kenai NWR was established.
- Include requirements for restoration, revegetation, and curtailment of erosion of the surface of the land.
- Ensure compliance with applicable air and water quality standards and related facility siting standards established pursuant to law.
- Require the minimum necessary width designed to control or prevent damage to the environment, including fish and wildlife habitat.
- Prevent damage to public health and safety.
- Protect the interests of individuals living in the general area of the ROW who rely on fish, wildlife, and other biotic resources for subsistence purposes.
- Employ measures to avoid or minimize adverse environmental, social, or economic impacts.

### 1.7 PUBLIC INVOLVEMENT

Public involvement is an important aspect of the NEPA process. As part of this process, the Service invited public participation through advertisements, open meetings, and comment periods.

### 1.8 PERMITS AND AUTHORIZATIONS NEEDED TO IMPLEMENT THE PROJECT

A variety of federal and state permitting actions would be required to implement the proposed Project. Table 1–1 lists the major federal and state permits, approvals, and consultations likely to be required for the Project. This list, however, is not necessarily complete. In addition, various borough and local permitting and approval actions may be required for the alternative selected by the decision makers.
### Table 1–1 Major Federal, State, and Borough Authorizing Actions

<table>
<thead>
<tr>
<th>Agency and Permit or Approval</th>
<th>Nature of Action</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Federal Permits, Approvals, and Authorizing Actions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U.S. Fish and Wildlife Service</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Use Permit</td>
<td>Permits to cover 3D seismic surveying activities.</td>
<td>National Wildlife Refuge System Administration Act, 16 USC 668dd-ee; Refuge Recreation Act, 16 USC 460k-460k-4</td>
</tr>
<tr>
<td>Consultation process, endangered or threatened species</td>
<td>Reviews impacts on federally listed and candidate threatened and endangered fish, wildlife, and plant species.</td>
<td>Section 7 of the Endangered Species Act of 1973, as amended (16 USC 1344), 33 CFR 323, 325</td>
</tr>
<tr>
<td><strong>U.S. Army Corps of Engineers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationwide 6 Survey Activities</td>
<td>Authorizes seismic surveys in waters of the United States or adjacent wetlands.</td>
<td>Section 404, Clean Water Act, 40 CFR 122-123; 33 CFR 323 and 325</td>
</tr>
<tr>
<td><strong>U.S. Environmental Protection Agency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Pollutant Discharge Elimination System General Permit for Discharge of Stormwater from Construction Activities</td>
<td>Permit to regulate stormwater that is contaminated by pollutants derived from on-site operations and for construction activities associated with road and pad development.</td>
<td>Clean Water Act, 33 USC 1342(1)(2).</td>
</tr>
<tr>
<td><strong>Advisory Council on Historic Preservation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultation on cultural and historic resources, if necessary</td>
<td>Protects cultural and historic resources. Coordinated with the Alaska State Historic Preservation Officer.</td>
<td>National Historic Preservation Act Section 106 and 36 CFR 800</td>
</tr>
<tr>
<td><strong>State Permits, Approvals, and Authorizing Actions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alaska State Historic Preservation Office</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archaeological consultation</td>
<td>Archaeological Clearance. Programmatic agreement or consultation for cultural inventory, evaluation, and mitigation.</td>
<td>Alaska Historic Preservation Act, Alaska Statute 41.35</td>
</tr>
<tr>
<td><strong>Alaska Department of Natural Resources Division of Oil and Gas</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Land Use Permit for Geophysical Exploration</td>
<td>Permit for all seismic work on state lands.</td>
<td>11 Alaska Administrative Code 96</td>
</tr>
<tr>
<td><strong>Kenai Peninsula Borough Approval</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Use Approval</td>
<td>Approval to access KPB land</td>
<td>KPB Local Ordinance Title 21</td>
</tr>
</tbody>
</table>
CHAPTER 2— ALTERNATIVES

This chapter describes the alternatives that the Service considered in this analysis. Two alternatives were evaluated in detail—NordAq’s proposed 3D seismic program and the No Action Alternative.

2.1 NO ACTION ALTERNATIVE

Under the No Action Alternative, a SUP would not be issued to NordAq. Seismic exploration activities would not be conducted on mineral rights within the Refuge and NordAq would not achieve the goal of imaging the Shadura geologic prospect. The Service’s authority to implement a “No Action” alternative that precludes development by denying the process is limited. CIRI owns the subsurface estate of oil, gas, and coal on a portion of the Refuge and NordAq has leased a portion of this oil and gas estate from CIRI. ANILCA Section 1110(b) requires that the Service provide for reasonable access to the subsurface estate. Consequently, the Service cannot deny NordAq reasonable access to explore for and develop the oil and gas deposits in the leased estate. The Service, however, has the authority and responsibility to protect the environment on the Refuge through the NEPA process.

2.2 PROPOSED ACTION

NordAq proposes to conduct a 48-square-mile, 3D seismic acquisition program on the Kenai Peninsula in the northern portion of the Kenai NWR, Alaska during the winter of 2012–13. The proposed survey area is located west of the Swanson River Oil and Gas Unit and east of the Cook Inlet coastline (Figure 2–1). A small portion of the survey would be conducted off the Refuge (Figure 2–2).

A seismic survey consists of sending energy (source) waves into the earth and recording (receivers) the speed and intensity of the return signal as it bounces off rocks of different densities. A seismic source, in this case dynamite charges placed in 25-foot-deep holes, is used to generate the seismic waves. A 3D program consists of a grid pattern of sources and receivers placed over the geologic target. The source charges are placed in holes in lines that run at 45- or 90-degree angles to the equally spaced receivers. Source energy signals bounce back to the surface where they are recorded by receivers on the surface. Following retrieval of the survey equipment, data are compiled and processed by computers. The result is a three dimensional image of the rock stratigraphy and structure.

The purpose of the survey is to image the sub-surface rock strata of the Shadura geologic discovery to help in planning for exploration and development. Seismic data are used to assist in mapping gas-charged sandstone intervals, faults, and potential hydrocarbon traps. Seismic data are needed to optimize well planning and design and reduce drilling uncertainty and project costs. Three-dimensional surveys increase the accuracy of reservoir depletion planning and assist in optimizing the location and design of wells. Acquiring 3D seismic data over the Shadura discovery is necessary to reduce and minimize the risk of drilling an unsuccessful well (dry hole).

This seismic survey would employ heliportable drilling units and autonomous (cable-free) receivers in contrast to historic methods in Alaska that use tracked vehicles, tethered receivers, and extensive line clearing. Heliportable seismic survey methods are used commonly in remote, roadless areas with difficult terrain. The method provides for minimal intrusion on the surveyed landscape. Survey data would be acquired by sequentially deploying sources and crews via helicopter, detonating charges one at a time across the survey area, recording return signals, and then retrieving autonomous (cable free) receivers.
This alternative would be conducted in the winter months and temporarily disturb approximately 0.01 acre of land (from shot hole drilling). No land would be disturbed permanently. Tree clearing would be done to the minimum extent practicable to ensure survey data quality is not compromised. NordAq would allow natural recovery of affected areas, or as directed by the Service, and would monitor the status of any identified problem locations following the survey and restore as necessary under the direction of the landowner or manager.

2.2.1 Proposed Schedule

The proposed schedule for executing and completing the Proposed Action is as follows:

<table>
<thead>
<tr>
<th>Generalized Activity</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning and Permitting</td>
<td>August-September 2012</td>
<td>November 2012</td>
</tr>
<tr>
<td>Drilling and Data Acquisition</td>
<td>December 2012</td>
<td>April 2013</td>
</tr>
<tr>
<td>Post-Survey Inspection &amp; Restoration</td>
<td>Late March 2013</td>
<td>No later than October 2013</td>
</tr>
</tbody>
</table>

2.2.2 Detail of the Proposed Survey

The 3D seismic survey would be conducted in four basic segments. They are (a) pre-plot planning, surveying, and permitting; (b) source and receiver deployment and retrieval; (c) data acquisition and recording; and (d) survey completion, inspection, monitoring, and restoration. Each is described below.

Approximately 70 to 80 people would be employed on the survey (as many are expected to be local hires as possible). Twenty of these would be dedicated to drilling operations. Two teams would lay out equipment and two teams would retrieve. A single day crew shift would conduct the survey alleviating the need for nighttime operations. The survey is anticipated to take 60 to 90 days to complete.

2.2.3 Pre-plot Plan Survey

Prior to snowfall, all baseline environmental fieldwork would be completed. All hazards and no-surface entry restrictions would be identified and marked, and buffers would be created using Global Positioning System equipment. No-entry buffers would be plotted into the navigation system to protect and avoid any identified historic and cultural resources, fish habitats, riparian zones, occupied bear dens, and surface structures, including utility lines.

2.2.4 Source and Receiver Deployment and Retrieval

NordAq is planning to use a cable-free recording system (Autoseis Nodal cable-free recording boxes and Sercel SG-10 geophones with snow plates). This system would eliminate the need for cables and battery packs. The receivers are hand placed into position and held by a small spike or snow plate. The autonomous nodes can record data continuously and river crossings needed to deploy tethered recorders would be eliminated. Each unit has its own charging station located in a specially built trailer for downloading and charging. The trailer would not be towed through the Refuge. A small (10 kV) portable generator would provide electric power for the recording shack. This unit would consume about 5 gallons of gasoline per day. Approximately 8,205 autonomous receiver nodes would be hand placed throughout the survey area.

Prior to drilling the source charge holes in locations of dense trees, crews would hand clear vegetation to create a “sky hole” to aid the helicopter pilot in lowering, positioning, and hoisting the drilling units.
Chapter 2 — Proposed Action and Alternatives

Approximately 10 to 20 percent of the source holes would require sky holes. There would be no clearing in sparsely treed or treeless areas. Operations would avoid dense areas of trees and reposition source points where practicable.

Portable drills and crews would be deployed by helicopter to operate the drills, and deploy and retrieve the receiver nodes. Everything required to drill a shot hole is moved onto the location by the helicopter in two picks. Operations would avoid dense areas of trees and reposition source points where practicable. The drills would be left in the field overnight to reduce total fuel consumption, helicopter flight time, labor costs, emissions, noise, and risk of accidents. No overland vehicles would be employed, except possibly after the Service opens the Refuge to snow machine travel.

Source energy shot holes would be drilled to a depth of 25 feet and loaded with a 2.2-pound (1-kilogram) explosive charge (source charges). Prior to drilling, a barrier would be placed on the ground to aid in returning all cuttings to the hole. The shot holes would be backfilled with the cuttings generated during drilling and tamped before detonation to prevent the energy escaping to the surface. The source charges are placed in a straight line. Source lines would be run in a North-South direction and spaced 1,485 feet apart. The interval between source charges would be 370 feet. With these parameters, no more than 4,928 four-inch diameter source holes would be drilled resulting in a drilling disturbance of 0.01 acre. Although the ground around the holes would be frozen, some trampling of vegetation would occur around the source holes.

Sources would not be placed in water or in buffer zones. Receivers would not be placed on rivers or streams, but may be placed on frozen lakes where land-fast ice is thick enough to support crews. Each hole takes approximately one hour to drill, set the charge, and backfill. If four drilling units are employed simultaneously, approximately 60 holes could be drilled in one day. The project would likely use 4 to 6 drilling units with one spare on standby.

2.2.5 Data Acquisition and Recording

The seismic survey would be conducted over a continuous period up to three months. Survey crews would be deployed to the survey area via helicopter and existing roads or trails. Receiver node batteries would be charged and stationed in portable charging trailers located at the off-Refuge staging location. The recording nodes would be hand loaded into sling bags and heliported to awaiting survey crews. The receiver nodes would be placed on the surface by crews on foot and assisted by the helicopters. Helicopters would lower and hoist receiver and source equipment. Following drilling and installation of source charges and placement of receiver nodes, source charges would be detonated one at a time. The reflective energy waves would be recorded by the nodes and stored for later upload at the recording shack. Following a period of data acquisition over a portion of the survey area, crews would retrieve the receivers and redeploy them over the next portion of the survey area. As necessary, the recording shack would be moved by helicopter through the central portion of the survey area, which would likely involve about three locations.

2.2.6 Survey Completion, Inspection, Monitoring and Restoration

Following acquisition of the data and retrieval of the equipment, the entire survey area would be inspected by helicopter for wooden survey lathe, lost gear, and garbage. Operations would only occur during daylight hours. Crews also would identify any damaged land or property in need of restoration efforts. Restoration of damaged surface locations or property would be reported to Kenai NWR. Restoration requirements would then be determined by Kenai NWR and carried out by the permittee. NordAq or their contractor would oversee the restoration of damaged surface locations within the survey area.
area. Cleared locations would be allowed to re-vegetate naturally with no active revegetation effort to reduce the opportunity for invasive plants to become established at the sites.

A small percentage of source charges may not detonate. These source locations would be mapped, and a crew would plug the holes during the survey inspection and cleanup. In addition, a small percentage of holes may blow material to the surface. These locations would be mapped, revisited, and repaired during the post-survey inspection and cleanup.

2.2.7 Staging Area/Access

Source charge material (explosives), drills, helicopters, road vehicles, and fuel would all be stored on a parcel of private land located outside the Refuge, near the survey area. Equipment and operations also would be staged from here. The intended parcel is in Section 18, Township 8 North, Range 10 West, Seward Meridian. This location meets the Bureau of Alcohol, Tobacco and Firearms’ required setback distances for stored explosives (27 CFR 555.218). The area would be fenced and have 24-hour security. Alternate staging locations are under consideration and all would meet the storage requirements for fuel and explosives. The Rediske Air property located at a nearby Nikiski airstrip is being considered as an alternate staging location (Figure 2–3).

The plan for access into the Refuge does not involve the use of tracked vehicles. The crews would access the survey area via existing roads, trails, and helicopters. If crews experience heavy or deep snow and if snow machine use is authorized by the Service, the crew would use up to 12 snow machines while deploying receivers and acquiring data. Snow machines would be used to pack down the snow so foot crews would be able to access the survey area.

2.2.8 Fuel Storage and Handling

Fuel (aviation gas and diesel) would be stored in areas with secondary containment that meets the requirements of 40 CFR 112 criteria for fuel storage. The staging area or an equivalent facility would also be used to store fuel for land vehicles. Fuel to support all other operations and vehicles would be stored on private land at existing commercial vendors’ shops in the Nikiski area or an equivalent staging facility. Alternative fuel storage locations also may be identified to save costs, reduce air emissions, and reduce the logistical complexity of the survey. The drilling units have 10-gallon tanks and the associated compressors have 20-gallon tanks. The drill and compressor units are completely self-contained with all fuel, magazines, and drill rods on board.

There would be a trailer/truck located at the staging area at all times. There would be a 300-gallon heliportable fuel container (fly tank) to carry fuel to the rigs when they cannot be refueled outside the Refuge. The drilling units and associated compressors would be refueled daily at the drill staging area or in the field, when necessary. Standard Operating Procedures (SOPs) for refueling would be strictly observed. During fuel transfers, secondary containment or a surface liner would be placed under all inlet and outlet points, hose connections, and hose ends on containers or vehicle fuel tanks. Appropriate spill response equipment, sufficient to respond to a spill of up to five gallons, would be on hand during any transfer or handling of fuel as required by 40 CFR. Trained personnel would closely monitor transfer operations at all times. SOPs for safe operations would be referenced in the plan of operations.

2.2.9 Waste Management

All necessary steps would be taken to maintain clean work areas, particularly with regard to food and food associated waste. Because the survey would not require a field camp, the potential for attracting animals to the job site is reduced. Waste from operations would be reduced, reused, or recycled to the
Figure: REDISKE AIR PROPERTY - DRAFT
maximum extent practicable. Garbage and domestic combustibles would be disposed of at an approved site in accordance with 18 AAC 60 (Alaska solid waste management regulations). Any hazardous waste would be handled and disposed of according to Alaska regulation (18 AAC 62).

### 2.2.10 Health, Safety, and Environment Training

All equipment maintenance and fueling would be conducted off the Refuge. During equipment storage or maintenance, the ground would be protected from leaking or dripping fuel. Drip pans or other surface liners designed to catch and hold fluids would be placed under the equipment. Alternatively, an area may be created for storage or maintenance by using an impermeable liner or other suitable containment mechanism.

A health, safety, and environmental plan would be developed and implemented for all aspects of the proposed project. All personnel would attend a safety meeting every morning before leaving for the survey area. At this meeting, field personnel would be briefed on safety issues, logistics, current weather, and road conditions.

In accordance with the Archeological Resources Protection Act (16 USC 470aa), the disturbance of archeological or historical sites and the removal of artifacts is prohibited. The excavation, disturbance, collection, or purchase of historical, recent, ethnological, or archeological specimens or artifacts are prohibited. If historic properties were encountered during project activities, work would stop and the Refuge Manager and the State Historic Preservation Officer (SHPO) would be contacted.

Before commencement of any activities, NordAq would prepare a Bear Interaction Plan to minimize potential conflict and interaction with black and brown bears. Crews will receive bear/wildlife awareness training (include all large wildlife). NordAq would employ professional bear guards for the protection of all. NordAq would also consult with the Service and Alaska Department of Fish and Game (ADF&G) to identify the locations of known bear den sites that are occupied in the season of proposed activities. If a crew encounters an occupied den not previously identified by the Service or ADF&G, NordAq would report it to the Division of Wildlife Conservation, ADF&G, within 24 hours of its discovery.
CHAPTER 3—AFFECTED ENVIRONMENT

The National Wildlife Refuge System Administration Act, as amended, states that each refuge shall be managed to fulfill both the mission of the Refuge System and the purposes for which the individual refuge was established. Under this Act, the mission of the Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

On December 16, 1941, Executive Order 8979 established the Kenai National Moose Range for the purpose of “…protecting the natural breeding and feeding range of the giant Kenai moose on the Kenai Peninsula, Alaska, which in this area presents a unique wildlife feature and an unusual opportunity for the study, in its natural environment, of the practical management of a big-game species that has considerable local economic value…” On December 2, 1980, ANILCA modified the Moose Range’s boundaries and its purposes and re-designated the Moose Range as the Kenai NWR. It also established the 1.32-million acre Kenai Wilderness within the Kenai NWR.

ANILCA broadened the purposes from moose conservation to protection and conservation of a broad array of fish, wildlife, habitats, other resources and education, research, and recreational opportunities. Specifically, the ANILCA-defined purposes for Kenai Refuge are:

(i) to conserve fish and wildlife populations and habitats in their natural diversity, including but not limited to moose, bears, mountain goats, Dall sheep, wolves and other furbearers, salmonoids and other fish, waterfowl and other migratory and nonmigratory birds;

(ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;

(iii) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the Refuge;

(iv) to provide in a manner consistent with subparagraphs (i) and (ii), opportunities for scientific research, interpretation, environmental education, and land management training; and

(v) to provide, in a manner compatible with these purposes, opportunities for fish and wildlife-oriented recreation.

The Wilderness Act of 1964 also provides additional purposes for the Kenai Wilderness Area.

Management of the Kenai NWR is dictated, in large part, by the legislation that created it and its purposes and goals. The Refuge’s purposes are identified above. Specific long-term goals and objectives for management of resources are presented and discussed in the 2009 Revised Comprehensive Conservation Plan for the Kenai NWR.

3.1 PHYSICAL ENVIRONMENT

3.1.1 Meteorology and Air Quality

3.1.1.1 Meteorology and Climate

The climate of south central Alaska is in the subarctic zone (Service 2009b). The climate of the Cook Inlet Basin is in the transitional climate zone (KPB 2008) between the maritime and continental zones. Occasionally during the winter months, this area will experience short periods of extreme cold, high
winds, or both (KPB 2008). The average annual temperature at the Kenai Municipal Airport (approximately 16 straight-line miles southwest of the proposed project area) is 34.2 degrees Fahrenheit, with an average maximum temperature of 42.4 degrees Fahrenheit and an average minimum temperature of 25.9 degrees Fahrenheit (Western Regional Climate Center [WRCC] 2012). Average maximum temperatures range from 20.9 degrees Fahrenheit in January to 62.1 degrees Fahrenheit in July. Average minimum temperatures range from 4.0 degrees Fahrenheit in January to 47.6 degrees Fahrenheit in June.

The Cook Inlet basin lies in the rain shadow of the Kenai Mountains and receives 15 to 30 inches of precipitation annually (KPB 2008). Sterling receives about 17 inches of total precipitation per year and the Kenai Municipal Airport receives about 19 inches (Service 2009b). The average total snowfall at the Kenai Municipal Airport is 61.2 inches and the average snow depth is four inches (WRCC 2012).

Monthly average wind speeds at the Kenai Municipal Airport range from a low of 7.1 mph to a high of 8.9 mph, with an annual average of 7.9 mph (WRCC 2012). Prevailing winds come from the north-northeast September through March and from the north during April. In mid-spring wind direction switches, coming from the south-southwest May through July and from the south during August before transitioning once again to coming from the north-northeast in early fall (WRCC 2012).

3.1.1.2 Air Quality

On June 23, 2011 the U.S. Department of Agriculture (U.S. Forest Service), the U.S. Department of the Interior (Bureau of Land Management, the Service, and the National Park Service), and the Environmental Protection Agency (EPA) entered into a Memorandum of Understanding (MOU) pertaining to the how to address air quality issues and oil and gas development on federal lands. The MOU establishes a framework set of procedures that the agencies will use to analyze and mitigate potential impacts associated with oil and gas development on Federal lands to the air quality and visibility, as well as other air quality related values (AQRVs). The MOU framework is to be used during the NEPA process when making Federal oil and gas decisions and applies at the planning, leasing, and field development stages.

The CAA, last amended in 1990, requires EPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The NAAQS describe thresholds for monitored air chemistry concentrations of six “criteria pollutants”: nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), lead (Pb), ozone (O₃), and particulate matter (PM₁₀ and PM₂.₅). Threshold concentrations for these pollutants, designed to protect human health, are designated “primary standards”.

The CAA also established the Prevention of Significant Deterioration of Air Quality (PSD) program to protect the air in areas where air quality is better than national standards. The primary purpose of the PSD program is to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value (42 U.S.C. 7401 et seq.). PSD increments establish maximum allowable increases in concentration for individual pollutants as measured from a baseline concentration.

There are three classifications within the PSD program, with Class I areas having the most stringent emission levels, Class II areas having slightly less stringent requirements, and Class III areas designated as those areas that meet NAAQS. Class I areas include international parks, national wilderness areas, and national memorial parks in excess of 5,000 acres and national parks in excess of 6,000 acres that were in existence as of August 7, 1977. The project area is primarily located within the Kenai NWR but also includes areas within the KPB. The Kenai NWR and most of the land in the KPB are classified as Class II areas. Class II air sheds are generally pollution free and allow some industrial development (KPB 2008).
The closest Class I area to the project area is the Tuxedni Wilderness Area, which is to the west across Cook Inlet.

Existing industrial sources of air pollution in the project area include four petrochemical facilities in Nikiski, the Chugach Beluga power plant, the Conoco-Phillips Kenai natural gas facility, and the Agrium Urea nitrogenous fertilizer plant (KPB 2005). Typical air pollutants from these types of sources include PM, CO, NO₂, SO₂, ammonia, and hydrocarbons. Impacts from these emissions tend to be localized and prevailing winds transport pollutants from the project area toward the Lower Cook Inlet and the open sea (KPB 2008).

Except for the industrial point sources of air pollution, the most widely noticed air pollution in the KPB results from natural phenomena, including volcanic emissions of ash and sulfuric gases and smoke from forest fires (KPB 2005). Areas of the country where air pollution levels persistently exceed the NAAQS can be designated as nonattainment areas. The Kenai Peninsula is designated as an attainment area (KPB 2005, EPA 2012); air quality in the KPB is generally good and all areas in the KPB meet the NAAQS (KPB 2008). Although the KPB currently has no ordinances that regulate air quality (KPB 2008), Alaska Department of Environmental Conservation (ADEC) has been conducting air quality monitoring at a site in Soldotna since October of 2011 in response to staff observations of dust events and summer wildland fires on the Kenai Peninsula (ADEC 2012).

Temperature inversions are not common in the area. When they do occur, however, air pollution has been visible in the Kenai NWR (Johnston 2001a as cited in MWH Americas Inc. 2002), and a brown haze has been observed over the Cook Inlet and the northern lowlands of the Kenai NWR (Service 2009b). In addition, low visibility due to fog is sometimes an issue (KPB 2008).

### 3.1.2 Geology and Soils

#### 3.1.2.1 Physiography and Geology

The project area is located within the Kenai Lowlands, a subset of the Cook Inlet-Susitna Lowlands physiographic province. This province extends from the town of Homer in the south to the Susitna River floodplain in the north. The Kenai Lowlands comprise most of the western Kenai Peninsula and are bordered by the Kenai Mountains to the east and Cook Inlet to the west. Glacial features, such as ground moraines, kettles, drumlin fields, eskers, and outwash plains, characterize the area (Wahrhaftig 1965). Elevations in the project area range from approximately 25 to 50 feet above mean sea level.

Glacial activity has produced thick deposits of glacial and associated sediments across the Kenai Lowlands. Underlying bedrock consists of Tertiary Period sedimentary deposits of the Kenai Group (65.5 to 2.6 million years ago) which is primarily comprised of siltstone, fine sandstone, and shale. It ranges from more than 20,000 feet thick in the Cook Inlet trough and to approximately 5,000 feet thick beneath the project area. No bedrock exposures are present within or near the project area. Coastal erosion processes have also influenced topography in the northern portion of the project area near Dunlin and Crane Lakes (Reger et al. 2007).

Surficial geology of the project area is dominated by ground moraine deposits derived from the Kenai Mountains and deposited approximately 27,000 to 32,000 years ago. Later phases of glaciations were less extensive and the project area was, at various times, covered by large glacial lakes and outwash plains. The extremely active glacial and depositional history of the area (Van Patten 2005) has produced a complex assortment of till deposits (unconsolidated, poorly sorted silt, sand, gravel, and boulders) and lacustrine (lake) sediments in the area. Loess (windblown silt) is also commonly interbedded with till, lake, and morainal deposits. Glacial outwash and fluvial deposits are likely present along the Swanson River.
3.1.2.2 Soils

Two soil types dominate the project area—Typic Cryorthods and Sphagnic Borofibrists (Rieger et al. 1979), and permafrost is not present (Jorgenson et al. 2008).

Typic Cryorthods are well-drained soils found on moraines, terraces, low hills, and outwash plains. They have typically formed in thick ash-influenced deposits of loess that overlie gravelly to very gravelly glacial till, gravelly loam, or very gravelly sand. Within the Typic Cryorthods are the Naptowne and Cohoe soil series, described as well-drained silt loams found on moraines where loess overlies very gravelly sand. These soils have thin (0 to 3 inches) surface organic horizons and are susceptible to erosion when the organic material is removed. The National Resources Conservation Service rates both soils as having a moderate hazard of erosion by water and a severe hazard of erosion by wind (Van Patten 2005).

The Sphagnic Borofibrists are very poorly drained, fibrous organic soils that have formed in depressions among moraines (including fens and kettles) and on low parts of terraces and floodplains. These soils consist of a peat mat approximately five to ten feet thick that may overlie a mineral substrate composed of marl. The water table in the area of the Sphagnic Borofibrists is typically near the surface and free water may be present between peat horizons.

Within the Sphagnic Borofibrists are Starichkof and Doroshin soil series with 0 to 4 percent slopes (Van Patten 2005, map unit 676). Wind and water erosion hazards for these soils are slight because of flat slopes, organic binding, and high water table. Topographic depressions within the project area also contain the Nikolai soil series. Nikolai soils are mineral soils that have formed on loamy till and have a thicker muck horizon and a thinner peat horizon than the Starichkof and Doroshin soils (Van Patten 2005).

3.1.2.3 Geologic Hazards

The Kenai Peninsula is extremely active seismically. Major faults in the region paralleling Cook Inlet include the Sterling, Border Ranges, and Eagle River faults on the Kenai Peninsula and the Bruin Bay and Lake Clark faults on the mainland east of Cook Inlet. Small earthquakes (magnitude 4.0 or less) occur frequently in the region, but are not typically associated with damage (KPB 2011). The U.S. Geological Survey (USGS) identifies the probability of a magnitude 8.0 or greater earthquake occurring within 62 miles of the project area over the 30-year operational life of the project as approximately 70 percent (USGS 2012a).

Seismically induced ground shaking is the most substantial direct geologic hazard present within the project area. Peak ground accelerations in the project area for earthquakes with return intervals of 475 and 2,475 years are 30 to 40 %g and 60%g, respectively (Wesson et al. 1999). Other geologic hazards in the project area include the deposition of volcanic ash from volcanoes within the Cook Inlet area. This ash can decrease water infiltration and increase surface water runoff. In addition, large volumes of ash can adversely affect water and soil quality.

3.1.3 Hydrology

3.1.3.1 Surface Water

The project area is located within the Upper Kenai Peninsula Watershed (Hydrologic Unit Code 19020302). Lakes, ponds, kettles, and fens are predominant features in the landscape and the Swanson River bisects the project area, flowing from the southeast to the northwest and emptying to Cook Inlet (Figure 3–1). Historical discharge data from Bishop Creek, southwest of the project area, indicate that
Kenai National Wildlife Refuge
Captain Cook State Recreation Area
ADNR Active Lease
KPB Lands
ADNR Active Oil & Gas Unit

Seismic Activity Project Area

SCALE:

0 0.5 1 2 Mi

0 0.5 1 2 Km

Projection: State Plane Alaska Zone 4 (feet), NAD83
Seward Meridian

SHADURA 3D SEISMIC PROJECT EA

PROJECT AREA
SURFACE WATER

FIGURE: 3-1
streamflow in non-glacial drainages is greatest during April and May because of snowmelt (USGS 2012b). However, streamflow may be influenced by timing of ice melt, spring seepage, and storm events.

Most lakes in the project area are frozen from November to May, whereas the Swanson River and other local streams freeze later and thaw earlier (Service 2009b). As precipitation or snowmelt cause water levels to rise, many of the ponds and depressions become connected through surface water flow (Anderson and Jones 1972). Flood hazards are possible within the project area, but Federal Emergency Management Agency (FEMA) has not analyzed them (FEMA 1999).

With the exception of near surface layers, the saturated hydraulic conductivity of peat is low, producing perched water conditions. Under typical conditions, surface flows contribute the majority of discharge from peatlands. However, a substantial proportion of discharge also comes from subsurface flow through macropores, also referred to as “pipes”, which have diameters ranging from fractions of an inch to one foot (Anderson and Jones 1972, Smart et al. 2012). Pipes form branching networks and may be several hundred yards long. The depth of pipes, and of individual pipes, can vary greatly as pipes form at the boundary of soil horizons, at the peat-mineral interface, and elsewhere within the soil profile. Over the course of a year, pipes may contribute approximately 14 to 49 percent of total streamflow from a peatland-dominated catchment and the proportion increases during low-flow periods (Holden et al. 2002, Smart et al. 2012). Functionally, pipe networks serve to connect peatlands to stream networks, thereby altering stream water chemistry and temperature. Soil pipe networks are difficult to locate and define because pipes are often only visible at stream banks or where the pipe roof has collapsed (Holden 2004).

Soil pipe densities are poorly understood, but based on work conducted in northern England, a range of 25 to 75 pipes per linear kilometer of (or 40 to 120 per linear mile) may be expected within the project area peatlands (Holden 2005). Although soil pipe networks have not been identified within the project area, collapsed pipe roofs have been observed within the peatlands in the Anchor Stream headwaters catchment (Gracz 2012). The similar geomorphic configuration of peatlands within the project area along with the nature and orientation of the kettle ponds suggest that pipe networks are likely present.

There is no documentation of water bodies within the project area that fail to meet Alaska Water Quality Standards and none are listed as impaired water bodies in Alaska’s Final 2010 Integrated Water Quality Monitoring and Assessment Report (ADEC 2010). Although non-glacial streams of the Kenai Lowlands generally have good water quality, they may have naturally occurring high concentrations of iron (Anderson and Jones 1972).

3.1.3.1 Ground Water

Ground water is the main source of water for domestic wells along the Cook Inlet Spur as well as the main source of water used by oil and gas operations in the Swanson River Unit. Three principal aquifers are present in the Kenai Lowlands: the unconfined aquifer, upper confined aquifer, and deep confined aquifer. These aquifers are well defined near Kenai, Soldotna, and Nikiski, but not within or near the project area. The unconfined aquifer is the main source of water for domestic wells in the Kenai Lowlands. The upper confined aquifer supplies much of the industrial water in the Nikiski area. The confining layer separating the unconfined and upper confined aquifer occurs approximately 70 to 100 feet below ground surface near Nikiski, but is poorly defined elsewhere (ENSR Consulting and Engineering [ENSR] 1990). Additionally, the confining layer leaks and allows for recharge from the unconfined to upper confined aquifer (Nelson 1981). The top of the deep confined aquifer occurs at approximately 340 feet below ground surface near Nikiski (ENSR 1990). Semi-confined to confined aquifer conditions likely occur beneath the project area and have the potential to be artesian (Anderson and Jones 1972).

Ground water in the Cook Inlet Basin has naturally occurring high concentrations of radon, arsenic, manganese, iron, and dissolved solids that occasionally exceed drinking water standards or EPA
Secondary Maximum Concentration Levels (SMCLs). These concentrations are directly related to the geologic materials that comprise the aquifers and chemical conditions within the aquifers. Kenai Peninsula water wells generally have higher proportions of sodium, chloride, and silica than wells from elsewhere in the Cook Inlet Basin (Glass 2001).

3.2 BIOLOGICAL ENVIRONMENT

The diverse habitat in the Kenai NWR supports a variety of mammals, birds, and aquatic life. This section discusses the vegetation and wetland communities in the project area and wildlife that are likely to use these communities during the winter months when the activities are proposed to occur.

3.2.1 Vegetation and Wetlands

3.2.1.1 Vegetation

This section describes the vegetation communities found in the project area. A formal on-site vegetation survey was not conducted in the proposed project area; however a wetlands survey was conducted in the summer of 2011 and 2012 that provides information on vegetation communities in the project area (Holden 2005, ARCADIS US 2011).

The overall topography of the project area consists of flat to gently sloping hills dominated by spruce (Picea spp.) forests, paper birch (Betula papyrifera) forests, and wetland communities (ARCADIS 2011). The major community types found within the vegetation analysis area are discussed below. The analysis area includes an area large enough to discuss direct and indirect impacts to vegetation and to facilitate discussion of habitats in the wildlife section. Wetland communities are present within the analysis area and are described in detail in Section 3.2.1.3

3.2.1.1.1 Conifer Communities

Black spruce (Picea mariana) forests are generally present along with organic soils and the density of black spruce forests increases as drainage improves. Poorly drained spruce forests usually have a thick moss mat (Hylocomium splendens, Pleurozium schreberi, Sphagnum spp.). Common understory shrubs include prickly rose (Rosa acicularis), willows (Salix spp.), bog Labrador tea (Ledum groenlandicum), bog blueberry (Vaccinium uliginosum), lingonberry (V. vitis-idaea), and twinflower (Linnaea borealis). Where an herbaceous layer is present, common herbs include Reedgrass (Calamagrostis spp.), wood horsetail (Equisetum sylvaticum), and hare’s-tail cottongrass (Eriophorum vaginatum). Lichens including Peltigera aphthosa and P. canina are typically found in black spruce forests (Viereck et al. 1992).

3.2.1.1.2 Deciduous Communities

Paper birch forests occur on upland slopes of south-central Alaska. These forests usually support a shrub layer of green alder (Alnus crispa), prickly rose, and high-bush cranberry (Viburnum edule). The herb layer is typically dominated by bluejoint (Calamagrostis canadensis) and horsetails (Equisetum spp.; Viereck et al. 1992).

Black cottonwood/balsam poplar (Populus trichocarpa, P. balsamifera) forests occur on moist, well-drained areas of flood plains in south-central Alaska. Older stands have a more developed understory, which typically consists of prickly rose, high-bush cranberry, devil’s club (Oplopanax horridus), bluejoint, and horsetails (Viereck et al. 1992).

Mixed deciduous forests occur in taiga regions and are usually composed of paper birch, aspen, balsam poplar. Typically, understory vegetation includes alder, prickly rose, high-bush cranberry, and horsetail.
3.2.1.1.3 Shrub Communities

The shrub communities consist of two primary types. Willow-dominated communities range from thickets to open scrub. Alder scrub/shrub communities occur on steep slopes and flood plains.

3.2.1.1.4 Wetland and Aquatic Communities

Wetland communities are present within the analysis area and are described in detail in Section 3.2.1.3. In general, these communities are composed of shrubs and herbaceous species. Dominant shrub species include dwarf black spruce, dwarf birch (Betula nana), and Labrador tea (Ledum groenlandicum). Graminoids dominate the herbaceous community and common species include common cottongrass (Eriophorum angustifolium) and horsetail (Viereck et al. 1992).

3.2.1.2 Invasive Plants

Exotic plant species have already colonized the Swanson River and Swanson oil and gas pads, but are not documented in the project area (Morton 2012). The most noxious species of concern are reed canarygrass (Phalaris arundinacea), sweet clover (Melilotus spp.), and hawkweed (Hieracium caespitosum and H. umbellatum). All four species spread aggressively and compete with native vegetation. Once established, all species are difficult to eradicate; however, sweet clover and reed canarygrass may be managed mechanically and both hawkweeds may be managed with herbicides. Soil disturbance and the use of potentially infested equipment and materials from off-site increase the risk of invasive species introduction (Kenai Peninsula Cooperative Weed Management Area 2010a, b, c, University of Alaska Alaska Natural Heritage Program 2011a, b, c).

3.2.1.3 Wetlands

The U.S. Army Corps of Engineers (USACE) regulates activities that affect jurisdictional waters of the U.S., including wetlands, under Section 404 of the Clean Water Act (CWA) and navigable waters under Section 10 of the Rivers and Harbor Act. Wetlands were identified in the general project area through interpretation of the Service’s National Wetland Inventory data, KPB land classification data, high-quality aerial photography, field knowledge, and collection of field data during the summer of 2012. Wetlands in the project area are assumed to be under the jurisdiction of the USACE because of the apparent connection to a traditionally navigable waterway, the Swanson River. Wetlands and other waters of the U.S. in the analysis area are described below using observations from the 2012 ARCADIS wetland survey and Cowardin et al. (1979).

3.2.1.3.1 Freshwater Forested Wetlands

Black spruce dominates the vegetation throughout the palustrine forested wetlands with the shrub stratum dominated by Labrador tea (Ledum sp.). Paper birch dominated forested wetlands are present in the project area and are typically located near streams. The hydric soils within these wetlands generally have an organic layer greater than five inches, which saturated soils and with a high water table present (Holden 2005).

3.2.1.3.2 Scrub-Shrub Wetlands

Scrub-shrub wetlands are abundant in the project area and are dominated by shrubs including willow (Salix sp.), Labrador tea, crowberry (Empetrum nigrum), leatherleaf (Chamaedaphne calyculata), and bog rosemary (Andromeda polifolia). Dwarf birch (Betula nana) and/or dwarf black spruce trees (Picea mariana) frequently occur as well. Graminoids such as bluejoint grass and sedges (Carex sp.) are also
present. Bryophytes are also common in this wetland type as well. Soils are saturated with a thick layer of peat (between 2 and 18 inches; Holden 2005).

3.2.1.3.3 Scrub-Shrub Emergent Wetlands

Scrub-shrub emergent wetlands are similar to scrub-shrub wetlands, but with an increased presence of herbaceous hydrophytes such as bluejoint grass, horsetails (Equisetum sp.), cottongrass (Eriophorum sp.), and bryophytes. Shrub presence may be reduced; however, the species composition is very similar to scrub-shrub wetland. On average, the peat layer in the soil is similar to, but not as thick as, the scrub shrub wetland ranging, from 1.5 to 12 inches (Holden 2005).

3.2.1.3.4 Freshwater Emergent Wetlands

Freshwater emergent wetlands are semi-permanently flooded to saturated areas (Cowardin et al. 1979, Holden 2005). Freshwater emergent wetlands are dominated by bluejoint grass. Some small shrubs and saplings may be present, however they are not as abundant as those in the saturated scrub-shrub persistent emergent wetland habitats (Holden 2005). Most saplings and shrubs are small or stunted because of saturated environmental conditions. Freshwater emergent wetlands are typically hummocky and have an organic layer of 2 inches or less (Holden 2005).

3.2.1.3.5 Lakes

Lakes and ponds are characterized by permanently flooded areas with unconsolidated bottoms. Lake unconsolidated bottoms consist of at least 25 percent small stones and less than 30 percent vegetation. Additional information is provided in Section 3.2.3, Aquatic Life.

3.2.1.3.6 Riverine

Riverine habitat within the project area consists of perennial streams with water flowing throughout the year with a low to high gradient and a slow to fast flow velocity (Holden 2005).

3.2.1.3.7 Wetland Function and Values

Wetland functions are self-sustaining properties of a wetlands ecosystem that exist in the absence of society. Functions result from both biotic and abiotic components of specific wetlands and include all processes necessary for the self-maintenance of the wetlands ecosystem, such as primary production and nutrient cycling. Functions relate to the ecological significance of wetland properties without regard to subjective human values. Wetland values are benefits to society that derive from one or more wetland functions. The value of a particular wetlands function is based on human use or human judgment of the worth, merit, quality, or importance attributed to those functions (USACE 1999).

Wetlands located within the project area are primarily in pristine condition and are subject to minimal human disturbances. Wetland functions and values were assessed for each wetland type found within the project area during the wetlands survey conducted during summer 2012. The relative importance of each function and value within each wetland type were ranked as low, medium, or high and are summarized in Table 3–1 (Holden 2005).
Table 3–1  Relative Importance of Functions and Values for Wetlands in the General Project Area

<table>
<thead>
<tr>
<th>Functions and Values</th>
<th>Relative Importance by Type of Wetland</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forested</td>
</tr>
<tr>
<td>Flood Flow Alteration</td>
<td>Low</td>
</tr>
<tr>
<td>Sediment Removal</td>
<td>Low(^1)</td>
</tr>
<tr>
<td>Nutrient &amp; Toxicant Removal</td>
<td>Low(^1)</td>
</tr>
<tr>
<td>Erosion Control and Shoreline Stabilization</td>
<td>Low</td>
</tr>
<tr>
<td>Production of Organic Matter &amp; Export</td>
<td>Low</td>
</tr>
<tr>
<td>General Habitat Suitability</td>
<td>High</td>
</tr>
<tr>
<td>Anadromous Fish Habitat</td>
<td>Low</td>
</tr>
<tr>
<td>General Heterogeneity</td>
<td>High</td>
</tr>
<tr>
<td>Moose Habitat</td>
<td>High</td>
</tr>
</tbody>
</table>

Note:
1. Rated low because of a lack of an up-gradient source; pristine environment
Source: ARCADIS US 2012

3.2.2 Wildlife

3.2.2.1 Mammals

Several studies have been conducted by ADF&G and the Service in the project area that evaluate specific mammal distribution and population dynamics. These studies were used to develop a list of species of mammals that may use the habitat within the general project area (Table 3–2).

Brown bears are typically dormant during the winter months, but this dormancy is not the same as a true hibernation, meaning that the bear can be aroused and awaken. Denning times can vary depending on location, snow levels, and temperature. A telemetry study between 1995 and 2003 had no confirmed brown bear dens within the project area. The study also modeled relative probability of brown bear den sites based on favorable den locations, high elevation, steep slopes, and areas away from potential human contact. The modeling indicated the project area has mostly a zero to 20 percent probability that the area is used for brown bear denning with a small section on the south east section of the project area having a 20 to 40 percent probability (Goldstein et al. 2010). The Kenai NWR also does not have any record of a brown bear dens in the area from 1996 to 2002 (Service 2012a).
Research suggests black bears in the north-central Kenai Peninsula tend to den in excavated dens from 189 to 233 days of the year. Fall entrance and spring emergence from the den are related to weather and the availability of food (Schwartz et al. 1986). Based on harvest data from ADF&G, the population of black bears within the Kenai NWR has remained stable or increased since 1985 (Service 2009b).

Moose like to browse on early successional species of plants that can be found in deciduous forests and shrub habitats (Service 1996) as well as wetland and aquatic areas (Reid 2006). Species of preference include the paper birch, quaking aspen (*Populus tremuloides*), and several species of willow (Reid 2006).

Although the population of moose in the Kenai NWR has generally increased since 1985, the population within the project area (game management unit [GMU] 15A) has been in decline (Service 2009b). In 2001, the population in GMU 15A was estimated at 2,068 moose (Rausch et al. 2008). The decline in
population could be attributed to a continually maturing forest since the last major fire in 1969 because aged forests have a more limited supply of food resources for moose than early successional habitats (Service 2009b). Multiple observations of moose presence were observed during the 2012 wetland survey within the project area (ARCADIS US 2012).

By 1915, humans had extirpated gray wolves from the Kenai Peninsula with recolonization occurring in the late 1960s. Through monitoring of the population and territories of wolf packs, the Kenai NWR estimates that there are 80 to 90 wolves in five to seven wolf packs in GMU 15A. The Swanson River pack and Elephant Lake pack ranges overlap the entire project area (Figure 3–2;Service 2009b, 2012a). Wolves prefer to use coniferous and deciduous forests with an abundance of moose or caribou (*Rangifer tarandus*) prey and minimal human presence (Thurber et al. 1994, Reid 2006). Research suggests that wolves may travel along secondary roads, but avoid main roads and highways (Thurber et al. 1994). Wolf dens are typically excavated and in well-drained soil areas. Wolves breed in February and March (Stephenson and Boertje 2008).

The abundance of lynx is cyclically linked to the abundance of its main prey, snowshoe hares. When densities of snowshoe hares are low, lynx must revert to consuming squirrels, grouse, and voles. When populations of snowshoe hare are high, however, reproductive success of lynx increases (Stephenson 2008, Service 2009b). Coniferous and deciduous forests in successional communities provide the main habitat for the lynx (Reid 2006, Stephenson 2008). The abundance of lynx is high within the project area (Figure 3–2; MWH Americas Inc. 2002). Multiple snowshoe hare kill sites were observed during the 2012 wetland survey within the project area (ARCADIS US 2012).

Burrowing mammals do exist within the project area, rarely coming to the surface during winter months. Shrews, voles, and lemmings burrow in the snow during the winter to reach grass seed heads (Osborne 1994a, b).

### 3.2.2.2 Birds

The Kenai NWR provides habitats for birds during the winter months. The Service has conducted avian surveys on the Kenai NWR; however, minimal studies have been conducted in the project area. Most bird species migrate south for the winter. Species that potentially remain in the project area year-round include the Dark-eyed Junco (*Junco hyemalis*), Pine Siskin (*Carduelis pinus*), Boreal Chickadee (*Poecile hudsonica*), Common Loon (*Gavia immer*), and Hairy Woodpecker (*Picoides grisegena*). Rock Ptarmigan (*Lagopus muta*), Ruffed Grouse (*Bonasa umbellus*), Spruce Grouse (*Dendragapus canadensis*), White-tailed Ptarmigan (*Lagopus leucura*), Wild Turkey (*Meleagris gallopavo*), and Willow Ptarmigan (*Dendroica coronate*; Service 2008, Cornell 2011a, Service 2012a).

There are also nine species of raptors that could occur in the project area year-round including, the Bald Eagle, Boreal Owl (*Aegolius funereus*), Common Raven (*Corvus corax*), Great Gray Owl (*Strix nebulosa*), Great Horned Owl (*Bubo virginianus*), Northern Goshawk (*Accipiter gentilis*), Gyrfalcon (*Falco rusticolus*), Peregrine Falcon (*Falco peregrines*) and Northern Hawk Owl (*Curnia ulua*) (Sibley 2003). Only two species of raptor, however, commonly occur on the Kenai NWR—the Bald Eagle and Northern Harrier (*Circus cyaneus*; Service 2008). In 2011, two Bald Eagle nests and one Osprey nest were detected near the project area (Service 2012a). Bald Eagles are further discussed in detail in Section 3.2.4.2.2. The Northern Harrier is present during the summer months, nests on the ground and is primarily observed in marshy wetlands and herbaceous vegetation communities (Sibley 2003).
3.2.3 Aquatic Life

Lakes and small streams mark the landscape throughout the project and surrounding areas (Figure 3–1). Lakes and ponds in the area are relatively small and mostly unnamed. Named lakes and rivers include Gull Lake, Dunlin Lake, Salmo Lake, Crane Lake, Snipe Lake, Goseneck Lake, Plover Lake, Killdeer Lake, Shadura Lake, Ooha Lake, Flat Lake, Terr Lake, Akula Lake, Bishop Creek and Swanson River (Figure 3–3). These lakes and streams are typically frozen between November and May (Service 1995).

3.2.3.1 Fish

A review of the ADF&G Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes indicates that the Swanson River, Bishop Creek, and an unnamed creek near Tern Lake, located within the project area, are anadromous and provides spawning and rearing habitat for coho salmon (*Oncorhynchus kisutch*), pink salmon (*Oncorhynchus gorbuscha*), sockeye salmon (*Oncorhynchus nerka*), and Dolly Varden (*Salvelinus morma Walbaum*; ADF&G 2008).

Other species recorded in the Swanson River include rainbow trout (*Oncorhynchus mykiss*), threespine stickleback, ninespine stickleback (*Pungitius pungitius*), slimy sculpin (*Cottus cognatus*), and Arctic lamprey (*Lampetra japonica*; Jones et al. 1996, ADF&G 2008). The Swanson River has historically been a collection location for broodstock for a rainbow trout stocking program at the Fort Richardson hatchery and the recently closed Elmendorf State Fish Hatchery (replaced by the William Jack Hernandez Sport Fish Hatchery). Lakes in south-central and interior Alaska have been stocked with the offspring of these broodstock rainbow trout (Service 2009b, ADF&G 2012).

ADF&G has sampled the major lakes within the vicinity of the project area, including Salmo and Snipe Lakes as well as two unnamed lakes in the Crane Lake Watershed (Figure 3–3). Results of the sampling indicate coho salmon, rainbow trout, Dolly Varden, longnose sucker, and threespine stickleback are present in these lakes (Jones et al. 1996, ADF&G 2008, Palmer 2012). ADF&G plans to survey lakes and streams in the greater project area during the summer of 2012 to verify fish presence (or absence) and habitat (Litchfield 2012).

3.2.3.2 Essential Fish Habitat

Essential Fish Habitat (EFH), as established by the 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act, mandates identification and conservation of EFH for commercially harvested species. EFH is defined as, “those waters and substrate necessary for fish for spawning, breeding, feeding, or growth to maturity.” The five species of salmon that occur in Alaska have designated EFH. As discussed above, water bodies within the project area provide habitat for three of the five salmon species including coho, pink, and sockeye salmon. EFH for these salmon species is described below as stated in the final 2005 EFH Environmental Impact Statement of National Marine Fisheries Service (NMFS 2005).

3.2.4 Special-Concern Species

3.2.4.1 Threatened or Endangered Species

Federally listed threatened and endangered (T&E) species are those species formally listed by the Service or National Marine Fisheries Service under authority of the ESA. No known federally endangered T&E species occur on the Kenai NWR (Service 2009b).
3.2.4.2 *Other Special-Concern Species*

The ADF&G Comprehensive Wildlife Conservation Strategy for the State of Alaska derived a list of State Species of Concern from various conservation plans, lists, and organizations including the Service, NatureServe (a network of natural heritage programs and The Nature Conservancy that ranks special concern species within the state), Audubon Alaska, Alaska Shorebird Conservation Plan, and Boreal Partners in Flight, a partnership for the conservation of bird populations (ADF&G 2006c). The mammal, fish, amphibian, and common avian Species of Concern are included in Appendix A along with their ranking and habitat information. Several organizations have updated their lists of special-concern species since the publication of the Comprehensive Wildlife Conservation Strategy and those changes have been included in Appendix A.

3.2.4.2.1 *Amphibians*

The wood frog (*Rana sylvatica*) is distributed throughout south-central and southeast Alaska, including the Kenai NWR. Wood frogs inhabit diverse habitats, including mixed forests (coniferous and deciduous), open meadows (herbaceous), and muskeg ponds (wetlands and aquatic). Wood frogs rely on aquatic habitats for breeding and early development, but are considered terrestrial otherwise. They have the ability to survive winters by hibernating (by freezing solid) under a layer of snow covered in dead vegetation (Broderson and Tessler 2008, Reeves and Trust 2008, Reeves et al. 2010).

Recent research suggests an increase in the frequency of amphibian abnormalities during developmental life stages in the Kenai NWR because of multiple stressors, such as toxic metals, organic contaminants, and dragonfly predators. Field studies support the theory that contaminants interfere with amphibian development. Deformations may result in increased predation-inflicted injuries (Reeves et al. 2010).

The chytrid fungus (*Batrachochytrium dendrobatidis*) is an increasing threat to the wood frog. It was first detected on Kenai NWR in 2002 in one pond and was detected in 2006 in three different ponds. All four ponds were located along the same gravel access road and the Swan Lake recreational canoe route. These ponds are located south and east of the project area. No other species of amphibians, reptiles, or fish were nearby that could have spread the fungus (Reeves and Green 2006, Reeves 2008).

3.2.4.2.2 *Bald Eagles*

Although no longer federally listed, the Bald Eagle remains protected under both the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Kenai NWR biologists have conducted Bald Eagle/Osprey nest surveys since 1957. In 2011, two Bald Eagle nests were observed near the project area (Service 2012a).

3.3 *HUMAN ENVIRONMENT*

3.3.1 *Land Use*

3.3.1.1 *Land Ownership*

Most land within the Kenai Peninsula is held in the public trust by the federal government. The State of Alaska manages lands for forestry, fish and wildlife protection, and recreation. Private land owners, private corporations, and Native corporations also own lands within the Kenai Peninsula. Surface ownership within the project area includes federal lands within the Kenai NWR, Alaska State lands, and KPB rights-of-way. CIRI owns the subsurface estate of oil, gas, and coal in the northwest portion of the Kenai NWR. NordAq has leased a portion of this oil and gas estate from CIRI. Private surface and
subsurface property rights, (including the oil and gas estate leased to NordAq), were conveyed to CIRI pursuant to ANCSA in the settlement of Alaska Native Corporation land claims in the Cook Inlet region.

### 3.3.1.2 Existing Land Uses

Land uses in the Kenai NWR and project vicinity include recreation, oil and gas related industry, logging, and residential uses. Recreational uses include fishing, hunting, hiking, sightseeing, camping, as well as winter related recreation activities. In winter months, land uses include cross-country skiing, snowshoeing, trapping, ice fishing, and snowmachine travel (Service 2009b). Recreational uses are discussed in Section 3.3.2. Oil and gas development has occurred on the Kenai NWR since the 1950s and there are several established units including the Swanson River Unit, Beaver Creek Unit, Birch Hill Unit, Sunrise, and Wolf Lake Facilities. The Swanson River Unit is adjacent to the east boundary of the project area. Establishment of these units has led to the subsequent construction of well pads, service roads, and buried pipelines. Timber harvesting and logging are also land uses conducted within the Kenai Peninsula although there are no logging facilities or timber sale areas proximate to the Project. There are two small residential areas approximately a mile west of the project area. In addition, there are a number of Service-owned administrative and recreational cabins within Kenai NWR used year-round. There are also several privately owned cabins within the Kenai NWR that are located on Tyonek surface owned lands near the project area.

### 3.3.1.3 Land Use Management

The 2009 Revised CCP developed long-term goals and objectives for management of resources within the Kenai NWR and provides policy guidance. Effective as of the issuance of the Record of Decision for the 2009 Revised CCP, four management categories have been adopted (Service 2009a). The categories progress from most to least protective as follows: Wilderness, Minimal, Moderate, and Intensive. Implementation of these general management categories by the Service is subject to existing valid rights.

The project area is located within Kenai NWR lands in the Minimal Management category (Service 2009a). Lands within this category are to be maintained in pristine conditions and as areas with important fish and wildlife and wilderness values. Even though these lands are not designated Wilderness Area, they have important natural, scenic, and recreational value. They generally would not be subject to planned habitat manipulation and restrictions are placed on motorized access, recreation, and economic uses. Lands in this category represent the Service’s recommendations for future Wilderness designation.

The nearest designated Wilderness Area is more than eight miles southeast of the project area. Even though lands within the project area are not designated as Wilderness, these lands have important natural, scenic, and recreational value.

There are no designated Wild and Scenic Rivers within the Kenai NWR. Current and proposed management direction for the Kenai NWR provides adequate protection for all river-related values (Service 2009b).

Project activities may be located on State of Alaska lands immediately north of the Kenai NWR boundary.

### 3.3.2 Recreation

The Kenai NWR is the most accessible and most visited of the 16 refuges in Alaska. In part, its popularity is derived from its location—it is one of only two Alaskan refuges accessible from the highway system and is located close to Anchorage, which is home to more than half the state’s population (Service 2009b). In 2004, approximately 4.5 million people traveled through the Kenai NWR along the Sterling
Chapter 3 — Affected Environment

Highway (Service 2009b). One of the stated purposes of the Kenai NWR is “to provide, in a manner compatible with these [other] purposes, opportunities for fish and wildlife-oriented recreation” (Service 2009b). During winter months, recreational activities include cross-country skiing, ice fishing, snowmobiling, hunting, snowshoeing, and dog mushing.

Hunting and trapping occur primarily during the fall and winter months, but hunting can occur throughout the year for some wildlife species, such as black bears, snowshoe hares, and red squirrels. More than half of the Kenai NWR (63 percent) is open to snow machining, depending upon adequate snow cover.

Of the Refuge’s 1.9 million acres, there are 13,252 acres of active oil and gas leases (Service 2009b). Access and seismic line roads associated with oil and gas activities have allowed for greater recreational access to previously hard to access or remote areas of the Kenai NWR. As an example, the Swanson River, Swan Lake, and Mystery Creek access roads, originally built to support oil and gas operations, are now open to public vehicles, which has increased recreational opportunities (Service 2009b).

Trapping is another recreational activity that occurs on the Kenai Peninsula. Beavers, coyotes, lynx, marten, mink, muskrats, river otters, short-tailed weasels, and wolverines are furbearing species found on the Kenai Peninsula. Generally, trapping occurs in the winter months and may be done in conjunction with snowmachining. According to the 2010 Furbearer Management Report (Harper 2010), most trappers travel via highway to access traplines, then use snowshoes or snowmachines to travel along traplines. Trapping can vary widely from year to year, based upon snow conditions, fur prices, animal populations, and other factors. During the 2008–2009 season, 48 beavers, 33 lynx, 26 marten, 19 river otters, and no wolverines were reported harvested in GMU 15A. Harvests were monitored through mandatory sealing for beaver, lynx, marten, river otter, and wolverine (McDonough 2010).

Rainbow trout can be caught throughout the year. The best time is late fall or early winter after salmon anglers have left, and the trout may be feeding on salmon carcasses and eggs. The ADF&G estimates that 95 percent of rainbow and steelhead trout caught yearly by anglers are released back to the river.

The Kenai Refuge Canoe Trail System was originally constructed in the 1960s for recreationists seeking a remote wilderness experience (Service 2009b). The Swan Lake and Swanson River Canoe Trails (Canoe Trails), comprising the Kenai Refuge Canoe Trail System, are located in the northern portion of the Kenai NWR and this system is one of two nationally recognized wilderness canoe trails. The routes are identified as National Recreational Trails (Service 2009b). Beyond canoeing, the Canoe Trails are used year-round for a variety of activities including canoeing, camping, fishing (including ice fishing), cross-country skiing, trapping, and wildlife viewing. The lakes thaw out in mid-May and freeze again in early October.

More than half of the Kenai NWR (63 percent) is open to snowmachining December 1 through April 30, depending upon adequate snow cover. The open season for snowmachine use has varied from zero to 150 days from 1976 through 2006. During three winters in that period, there was inadequate snow accumulation the entire season. During the other 27 years, snowmachines were allowed in designated areas for an average of 109 days each winter.

3.3.3 Transportation

There are approximately 650 miles of State-maintained roads in the KPB and more than 100 miles of maintained refuge roads within the Kenai NWR (Service 2009b). The Seward and Sterling highways are the primary highways on the Kenai Peninsula. Other major roads include the Kenai Spur and North Kenai Spur highways and Kalifornski Road (K-Beach Road).
Oil and gas exploration and development have had a substantial influence on road access and use within the Kenai NWR; access roads originally built to support oil and gas operations are now open to the public for hiking, snow machining, horseback riding, and vehicle travel. Over 1,800 miles of historic seismic lines, cleared during exploration for oil and gas, traverse Kenai NWR lands north of the Kenai River. The seismic lines allow access for hikers and snow machines.

### 3.3.4 Visual Resources

Visual resources include land, water, vegetation, animals, and structures that are visible on the land. The intrinsic beauty of the project area is a valued resource. Visual resources are important to both visitors and local residents. The character of the landscape, potential viewing locations, and number of viewers are important factors to consider when describing the visual resources of an area. Visual resources, and their analysis, address the importance of the inherent aesthetics of the landscape, the public value of viewing the natural landscape, and the contrast or change in the landscape resulting from proposed facilities.

Special values, including scenic value, are identified and described in the Service’s 2009 Revised CCP as mandated by Section 304(g) of the ANILCA (Service 2009b). The project area falls within the Lowland Lakes System, which is identified in the Service’s 2009 Revised CCP as an ecosystem or place having special value within the Kenai NWR. There are no designated Scenic Byways, National Wild and Scenic Rivers, scenic trails, or scenic floats near the project. There is a scenic overlook within the Captain Cook State Recreation Area (CCSRA), located approximately two miles west of the project area.

The Kenai Lowlands consists of low ridges, hills, muskeg, and thousands of lakes (Service 2009b). Overall, most of the land is less than 500 feet above mean sea level and locally within this elevation relief ranges from 50 to 250 feet (Service 2009b). The vicinity of the project area is relatively flat and largely undeveloped. The lowlands are generally wet with organic soils supporting wetland communities, such as black spruce and heath species. Uplands in the area generally consist of mixed forest and tall shrub communities. The Swanson River bisects the project area from south to north and lakes of varying size dot the landscape. Larger lakes in the area include Salmo, Dunlin, Snipe, Gooseneck, Plover, Killdeer, Shadura, and Ootka. Multiple streams interconnect some of the lakes.

The existing landscape character reflects influences of human activities. Existing modifications to the landscape character have resulted from development near the project area, including the CCSRA, a public road located immediately northwest of the project area, seismic lines from past exploration activity in the northwestern portion of the project area, and the Swanson River Oil and Gas Unit located immediately southeast and east of the project area.

#### 3.3.4.1 Visual Sensitivity

“Sensitivity of landscape viewshed” is the extent that features are noticeable or apparent in the landscape. Areas that are visible from many locations or at close range are relatively more sensitive to modifications of the landscape. Viewing distance and screening by vegetation or topography are aspects considered in evaluating the sensitivity of the landscape. Visual sensitivity is relative to the number of people who view the area and the degree of public concern for scenic quality. Factors typically considered when measuring public concern include type of users, amount of public use, public interest, and adjacent land uses. Areas identified within the vicinity of the project area that may have visual sensitivity include areas of public use, such as the CCSRA, Swanson River, seismic lines, and areas that the Service’s 2009 Revised CCP identifies as having special value such as the Lowland Lakes System.

The CCSRA provides multiple recreational opportunities; however, the majority of the opportunities do not occur during the winter months. They include canoeing, boating, beach combing, bird watching,
wildlife viewing, berry picking, and fishing in Stormy Lake (Alaska Division of Parks and Outdoor Recreation 2010). There is also a scenic overlook, a campground, two designated tent camping areas, and two picnic areas.

3.3.5 Noise

Noise level (or volume) is generally measured in decibels (dB) using the A-weighted sound pressure level (dBA). The A-weighting scale is an adjustment to the actual sound power levels to be consistent with that of human hearing response. The dB measurement is on a logarithmic scale. To the average human ear, the apparent increase in “loudness” doubles for every 10-dB increase in noise.

The area adjacent to the proposed project area is undeveloped and ambient noise levels are generally low as representative of undeveloped lands. Ambient sound levels were measured at five-kilometer intervals from 257 sites across two million acres of the Kenai NWR during the last three weeks in June of 2004 and 2006 (Service 2009b). The mean sound level was 45.1 dB, with a range of values from 32 to 95 dB (Service 2009b).

Although there are no stationary noise sources within the project area, road noises can be heard within portions of the Kenai NWR. Noise is also generated by, hunting activities during the hunting season and snow machine use during the winter. Some locations are more susceptible to the effects of noise, such as residential areas located in close proximity to localized sources of noise. The nearest community to the project area is Nikiski located approximately ten miles from the south end of the project area. The Gray Cliff subdivision is located northeast of where the North Kenai Spur Highway ends. In addition, there are a number of seasonal-use cabins within the Kenai NWR and several privately owned cabins located on Tyonek surface-owned lands near the project area. Currently the State of Alaska and KPB do not have general regulations limiting noise (KPB 2005).

3.3.6 Cultural Resources

The Kenai Peninsula as a whole is rich in prehistoric and historic sites and buildings (Service 2009b), however, a search of the Alaska Heritage Resource Survey site files (March 2012) revealed no report of cultural resource sites in the project area.

The prehistory of southwest Alaska is grouped into the Paleoarctic (10,000 to 6,000 years ago), the Northern Archaic (6,000 to 3,000 years ago), the Kachemak tradition (3,000 to 1,000 years ago), and the Late Prehistoric (after 1,000 years ago). The Service (2009b) indicates that sites or individual artifacts associated with the Paleoarctic and Northern Archaic are present in the Kenai region, but are poorly represented. Indications of intensive, long-term occupation begin with Kachemak related materials dating as early as 1,000 BC (3,000 years ago). Late Prehistoric occupations are related to the historic Kenai Dena’ina and Eskimo groups that occupied the region at the time of earliest recorded European contact in the late 1700s.

In general, prehistoric sites are more common on the Kenai Peninsula on dry terraces near rivers and lakes that support anadromous fish populations. The project area is dominated by small lakes that support resident (non-anadromous) fish populations and cultural resources are generally small and scarce in this portion of the Peninsula. The few cultural resource surveys that have been completed have been predominantly for roads and developments along the coast west of the project and for oil and gas projects associated with the existing Swanson River Unit east and south of the project. Several past cultural resources surveys along the coast have included areas along the lower Swanson River west of the project.

The existing information does not fully represent the cultural resource sites that are present, but gives an
idea of the types of sites that are present and the types of settings in which they are likely to be found. The results are summarized in Table 3–3.

### Table 3–3 Known Cultural Resources in the Study Area

<table>
<thead>
<tr>
<th>AHRS No.</th>
<th>Site Type</th>
<th>Age or Affiliation</th>
<th>Buildings or Structures?</th>
<th>Cemetery or Burials?</th>
<th>NRHP eligible?</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEN-00054</td>
<td>Historic oil well</td>
<td>1957</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KEN-00096</td>
<td>Prehistoric and historic</td>
<td>Tanaina – 1800s</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>settlement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KEN-00097</td>
<td>Prehistoric settlement</td>
<td>Tanaina</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>KEN-00099</td>
<td>Prehistoric and historic</td>
<td>Tanaina – through 1890</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>settlement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KEN-00112</td>
<td>Prehistoric settlement</td>
<td>Undetermined</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
<tr>
<td>KEN-00113</td>
<td>Prehistoric cache pits</td>
<td>Undetermined</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
<tr>
<td>KEN-00114</td>
<td>Prehistoric habitation</td>
<td>Undetermined</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
<tr>
<td>KEN-00253</td>
<td>Prehistoric habitation</td>
<td>Undetermined</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
<tr>
<td>KEN-00434</td>
<td>Historic cabin, ruins</td>
<td>Dena’ina – early 1900s</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
<tr>
<td>KEN-00547</td>
<td>Prehistoric cache pits</td>
<td>Dena’ina</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
<tr>
<td>KEN-00548</td>
<td>Historic structural debris</td>
<td>Undetermined</td>
<td>no</td>
<td>no</td>
<td>unknown</td>
</tr>
</tbody>
</table>

Note:
1. All AHRS site numbers in Kenai Borough begin with KEN-

#### 3.3.7 Socioeconomics

The project is located on the northwestern portion of the KPB approximately 13 miles northeast of Nikiski, an industrialized community that is home to the region’s oil and gas industry. For the purposes of identifying socioeconomic characteristics that could be affected, the region of influence for the project includes the Nikiski Census Designated Place (CDP), Sterling CDP, the City of Soldotna, and the City of Kenai. The following discussion focuses on population, employment, income, and characteristics of the communities within the region of influence. Demographic information is provided in Section 3.3.9, Environmental Justice.

##### 3.3.7.1 Population

The project is located within and immediately adjacent to the Nikiski CDP. Population information for the communities within the region of influence is presented in Table 3–4. For comparative purposes, Table 3–4 also presents population data for the KPB and the State of Alaska.

### Table 3–4 Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Nikiski CDP</th>
<th>Sterling CDP</th>
<th>City of Kenai</th>
<th>City of Soldotna</th>
<th>Kenai Peninsula Borough</th>
<th>State of Alaska</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2,743</td>
<td>3,802</td>
<td>6,327</td>
<td>3,482</td>
<td>40,802</td>
<td>550,043</td>
</tr>
<tr>
<td>2000</td>
<td>4,327</td>
<td>4,705</td>
<td>6,942</td>
<td>3,759</td>
<td>49,691</td>
<td>626,932</td>
</tr>
<tr>
<td>2010</td>
<td>4,493</td>
<td>5,617</td>
<td>7,100</td>
<td>4,163</td>
<td>55,400</td>
<td>710,231</td>
</tr>
</tbody>
</table>

3.3.7.2 Income

Personal and median household income data for communities in the region of influence is presented in Table 3–5. Comparative data also are provided for the Kenai Peninsula Borough and State of Alaska.

<table>
<thead>
<tr>
<th>Income</th>
<th>Nikiski CDP ($)</th>
<th>Sterling CDP ($)</th>
<th>City of Kenai ($)</th>
<th>City of Soldotna ($)</th>
<th>Kenai Peninsula Borough ($)</th>
<th>State of Alaska ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal</td>
<td>25,271</td>
<td>32,672</td>
<td>27,921</td>
<td>28,559</td>
<td>29,127</td>
<td>30,726</td>
</tr>
<tr>
<td>Median Household</td>
<td>48,958</td>
<td>64,545</td>
<td>52,701</td>
<td>46,548</td>
<td>57,454</td>
<td>66,521</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau 2011b

3.3.7.3 Housing

Housing data for the communities within the region of influence are presented in Table 3–6. Almost 85 percent of the 1,998 housing units in the Nikiski CDP are occupied. Of the 309 vacant units, 129 are seasonal use structures. Only 35 units were identified as being available for rent, and 20 for sale (U.S. Census Bureau 2011b).

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Housing Units</td>
<td>1,998</td>
</tr>
<tr>
<td>Occupied Housing Units</td>
<td>1,689</td>
</tr>
<tr>
<td>Vacant Housing Units</td>
<td>309</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau 2011b

3.3.7.4 Economy

The KPB has a diverse economy, with no single dominant industry. The largest industrial sectors by number of employees include natural resources and mining, trade, transportation, and utilities, local government, educational and health services, and leisure and hospitality.

Nikiski is the center of the Peninsula’s oil and gas industry. It hosts the Tesoro Alaska refinery, the East Forelands complex that supports the offshore production platforms in Cook Inlet, and a number of smaller production- and transportation-related infrastructure industries. This is reflected in employment figures—about 20 percent of all workers are employed in the natural resources and mining sector, which includes oil and gas industry employment.

The economy of Nikiski has suffered a series of setbacks in recent years because of the closing of the Agrium fertilizer plant and the intermittent operation of the LNG facility. Both the closing and intermittent operation are directly attributable to declining natural gas production in Cook Inlet. These closings resulted in the direct loss of more than 300 high-paying jobs, as well as associated contractor and support personnel jobs. Employment in the oil and gas-related sectors has been decreasing over time as oil and gas fields have matured and production has declined; however, oil and gas producers and refiners
still employ 837 individuals directly, and account for approximately 2,311 indirect and 1,552 induced jobs throughout the Peninsula (McDowell Group 2011).

Commercial fishing is an important component of the economy and culture of the KPB as well as of Nikiski. Seven residents of Nikiski currently hold permits for the drift gillnet salmon fishery in Cook Inlet, while 22 hold setnet salmon fishery permits. Commercial fishing and the oil and gas industry have coexisted on the Peninsula for more than six decades; the beaches of Nikiski near the Tesoro refinery are known to be particularly productive (Alaska Commercial Fisheries Entry Commission 2011).

Although tourism is an important component of the Peninsula’s economy, it is less so in Nikiski and the northern portion of the Kenai Peninsula because of the number of industrial facilities in the area and the comparative lack of state and federal recreational areas when compared to other portions of the Peninsula. Tourism-related businesses account for only 11 percent of business licenses in Nikiski. In the Borough as a whole, more than 20 percent of businesses are engaged in tourism-related endeavors (Alaska Department of Commerce Community and Economic Development 2011).

### 3.3.7.5 Unemployment

As of February 2012, the unemployment rate for the KPB stood at 10.2 percent, higher than the statewide average of 8.0 percent. Unemployment is generally seasonal, with winter unemployment rates three to four percent higher than unemployment during the summer months (Alaska Department of Labor and Workforce Development 2012). Month-over-month unemployment rates have generally declined since 2010.

### 3.3.8 Subsistence

Subsistence hunting and fishing regulations in Alaska differ significantly depending upon ownership of the land. Federal regulations allow subsistence hunting by residents of rural communities, while prohibiting subsistence hunting by residents of urban areas. Much of the Kenai Peninsula is considered non-rural under federal subsistence management regulations. Only five communities (Ninilchik, Port Graham, Nanwalek, Seldovia, and Cooper Landing) are identified as rural communities (Federal Subsistence Management Program 2011). As recently as 1985, subsistence activities were reportedly not occurring in the Refuge (Service 2009b). Through various procedural and legal processes, subsistence hunting and fishing have become recognized uses on the Kenai NWR. Residents of the five federally recognized rural communities may participate in federal subsistence hunts for moose or bear on portions of the Kenai NWR, including General Management Unit 15A in which the proposed project is located. The moose hunting season in GMU 15A usually occurs between August 10 and September 20. The black bear subsistence hunt season is year-round; Ninilchik residents can take up to two bears, with residents of the other four communities limited to one bear per person (Federal Subsistence Management Program 2010).

Waters near the project area (the Swanson River and Stormy Lake) are known to support coho, sockeye, and pink salmon at various life stages, as well as to support Dolly Varden and rainbow trout (ADF&G 2008). Federal regulations provide for the subsistence harvest of fish species in selected locations on the Kenai Peninsula but none of the selected subsistence fishing locations are found near the project area or in any of the watersheds crossed by the project.

### 3.3.9 Environmental Justice

Approximately 86 percent of the population of the Nikiski CDP identifies as white, approximately three percent of the population identifies as Hispanic, and nearly eight percent identifies as American Indian or
Alaska Native. The remaining percentages identify themselves as people of other races. The population of the Nikiski CDP is considerably less diverse than the State, where 66.7 percent of the population identifies as white and 14.8 percent identifies as American Indian or Alaska Native (U.S. Census Bureau 2011b).

CIRI is the Alaska Native regional corporation for the Kenai Peninsula. Three village corporations are located near the Project: Kenai Native Association, Inc., Salamatof Native Association, and Point Possession, Inc. There are two federally recognized Indian Reorganization Act tribes located in the area; they are the Kenaitze Indian Tribe with approximately 1,240 tribal members, and the Village of Salamatoff with approximately 140 tribal members.

Data on the low-income population (defined as those individuals living below the poverty line) in the region of influence is shown in Table 3–7. Data for the KPB and State of Alaska are shown for comparative purposes.

<table>
<thead>
<tr>
<th>Table 3–7 Population Living Below the Poverty Line, 2006–2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nikiski CDP</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Sample Size</td>
</tr>
<tr>
<td>Number in Poverty</td>
</tr>
<tr>
<td>Percent in Poverty</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau 2011a

3.3.10 Fire Management

Fire management includes the full range of activities necessary to conserve, protect, and enhance habitat for wildlife and to maintain desired ecological conditions. Fire management activities include preparedness, emergency suppression operations, wild land fire use, fire prevention, education, monitoring, research, prescribed fire, hazardous fuel reduction, and mechanical treatments.

Within the Kenai NWR, fire management is conducted in accordance with the Kenai NWR Fire Management Plan, as well as Service and Department of Interior policies and approved interagency fire management plans (Service 2001). In addition, KPB has prepared an All-Hazard Mitigation Plan that includes measures to address the hazard associated with wildfires (KPB 2011).

The project area is located within an area that allows both prescribed fires and wildland fires (Service 2009b). Prescribed fires are fires ignited to meet specific management objectives. Management-ignited prescribed fire and wildland fires have been the primary tools used to mimic or restore natural fire regimes and are relied on to accomplish management objectives, including the reduction of hazardous fuels, range improvement, wildlife habitat enhancement, and restoration of natural fire regimes.

3.3.11 Hazardous Substances and Wastes

Hazardous substances are defined in Section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and hazardous wastes are defined under the Resource Conservation and Recovery Act (RCRA) of 1976. Petroleum products, including diesel oil and natural gas, are not specifically listed or designated as hazardous substances under CERCLA.
Limited development has occurred proximate to the project area. The Kenai NWR was the first national wildlife refuge in Alaska to complete a Contaminants Assessment Process (CAP) (Service 2009b). The purpose of the CAP is to document existing and potential contamination issues affecting national wildlife refuges by assessing known or suspected contaminant sources, contaminated areas, contaminant-transport pathways, and areas vulnerable to spills and/or contamination. Based on the results from the CAP as summarized in the Kenai NWR Contaminant Assessment (Parson 2001), no contamination has been identified in the immediate project vicinity, however, several potentially contaminated sites were identified within the Kenai NWR. The potentially contaminated sites are primarily associated with oil and gas development in the Swanson River Field and Beaver Creek Field. Spilled materials include antifreeze, methanol, hydraulic fluid, solvents, diesel fuel, triethylene glycol, crude oil, xylene, and produced water (MWH Americas Inc. 2002).
CHAPTER 4—ENVIRONMENTAL CONSEQUENCES

This chapter presents the evaluation of the potential environmental consequences of the No Action and Proposed Action on the physical, biological, and human environments. Where appropriate, the discussion also identifies mitigation. Overall, the chapter is organized by resource area similar to Chapter 3.

4.1 OVERVIEW

An environmental impact or consequence is defined as a modification or change in the existing environment brought about by the action taken. Effects can be direct, indirect, or cumulative and can be temporary (short term) or permanent (long term). The terms “effect” and “impact” are synonymous as used in this EA.

4.1.1 Direct and Indirect Effects

Direct and indirect effects are two of the three types of effects that CEQ specifically addresses. Direct effects are those that are caused by the action taken and occur at the same time and place. Indirect effects are those caused by the action taken and occur later in time or are farther removed in distance from the action.

The analysis of environmental effects discussed in this chapter considers the context, duration, intensity, and type of impact. Context is the setting within which an effect is analyzed, such as an affected locality or region, affected commercial or cultural interests, or society as a whole. In this EA, the intensity of impacts to resources is evaluated within a local context (i.e., project area) or regional context, as appropriate. The contribution of direct and indirect effects to cumulative impacts was evaluated in a regional context.

The duration of an effect considers whether the impact would occur in the short term or the long term. Short-term effects are temporary, transitional, or impacts directly associated with the seismic survey activities. Long-term effects would last a year or more after completion of the seismic survey or would be permanent.

Intensity is a measure of the relative degree of severity of an effect. The intensity of the impact considers whether the effect would be negligible, minor, moderate, or major. Negligible impacts would not be detectable and would have no discernible effect. Minor impacts would be slightly detectable, but would not be expected to have an overall effect. Moderate impacts would be clearly detectable and could have an appreciable effect. Moderate impacts suggest the need for additional care in following standard procedures, employing best management practices (BMPs), or applying precautionary measures to minimize adverse impacts. Major impacts would have a substantial, highly noticeable effect. In general, major impacts are likely to be considered significant in the context of a NEPA analysis.

Finally, effects were evaluated in terms of whether they would be beneficial or adverse. Beneficial impacts would improve resources, conditions, or both. Adverse impacts would deplete or negatively alter resources, conditions, or both.

4.1.2 Cumulative Effects

Cumulative impact is the “cumulative effect on the environment that results from the incremental impact of the action when added to “other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions”. Cumulative impacts can
result from individually minor but collectively significant actions taking place over time. CEQ regulations implementing NEPA require that the cumulative impacts of a proposed action be assessed (40 CFR Parts 1500–1508).

This EA uses a variety of methods, depending on the resource area, to determine cumulative socioeconomic and environmental effects. Methods for gathering and assessing data regarding cumulative impacts include interviews, use of checklists, trends analysis, and forecasting. In general, past, present, and reasonably foreseeable future actions (RFFAs) are assessed by resource area.

Cumulative impacts were assessed for impacts on the environment that would result from the incremental effects of the Shadura 3D Seismic Program added to other past, present, and RFFAs occurring within the analysis area. To be included in the analysis, the effects of these other actions had to overlap the effects of this Project in time, space, or both. RFFAs include other oil and gas projects, subsistence activities, and human activities. Under NEPA, past and present actions become part of the existing affected environment. Therefore, the analysis of cumulative impacts focuses on RFFAs. The RFFAs included in the cumulative impacts analysis were defined as projects or actions that would result in effects that would overlap the direct or indirect effects of the Shadura 3D Seismic Program in time, space, or both.

A variety of RFFAs were considered in the impact analysis. They included projects on and off the Kenai NWR. All are described briefly below.

### 4.1.2.1 Existing Swanson River and Beaver Creek Oil and Gas Units

Swanson River Oil and Gas Unit (SRU), just east of the drilling pad’s location produces natural gas from the Sterling and Beluga formations, and oil from the Hemlock formation. Facilities include 43 miles of roads, 65 well pads, 140 wells, and a large compressor plant. Twenty-eight wells have been shut in for various reasons and 64 wells have been permanently plugged. Two depleted Tyonek formation gas pools are used for natural gas storage. Swanson River Unit Gas Storage is located in the unit area. The operator injects gas usually when temperatures are above 32°F until the reservoir (depleted gas sandstone) is refilled. Stored gas is then re-produced into the Cook Inlet pipeline grid to meet spiking and high winter seasonal demand. SRU produced 122 barrels of oil per day from eight oil wells and 1 MMSCFD from four gas wells in February 2012. Oil production is on a steady flattened decline curve.

Hilcorp Alaska, the Alaska division of Houston-based Hilcorp Energy Company recently acquired the SRU. Because oil reservoirs are nearly depleted, Hilcorp is actively drilling and re-working existing gas wells to increase production within the unit. This will probably extend the production life of the unit for years to come.

Beaver Creek field is located south of the Shadura Unit. Facilities include 5 miles of roads, 7 well pads, 2 active oil wells, 9 active gas wells, a gas lift compressor, and 2 natural gas-fired electrical generators. In February 2012, Beaver Creek produced 123 barrels of oil a day from two wells and 8 million standard cubic feet per day (MMSCFD) from five wells on average for that month.

### 4.1.2.2 Hilcorp Seismic and Production from newly acquired Gas Fields

Hilcorp Alaska, the Alaska division of Houston-based Hilcorp Energy Co. purchased all of Chevron’s Cook Inlet oil and gas assets in 2011. Marathon Oil Corp. announced April 9, 2012 that it had agreed to sell of all of its Alaska assets to Hilcorp (Bailey 2012b). Marathon said in an April 9 press release the sale includes “…17 million barrels of oil equivalent of net proved reserves across 10 fields in the Cook Inlet, as well as natural gas storage, and interests in natural gas pipeline transmission systems,…” The Marathon pipeline assets include the Cook Inlet Gas Gathering System that crosses Cook Inlet and the
Kenai Nikiski pipeline. The acquisition adds gas fields in the Beaver Creek, Cannery Loop, Kasilof, Kenai, Ninilchik, and Sterling and Birch Hill units to Hilcorp’s Kenai Peninsula operations.

### 4.1.2.3 Sunrise Natural Gas Project

The Sunrise natural gas development is located 5 miles east of the SRU and is tied back into the SRU. CIRI, the resource owner, told Alaska state legislators in June 2009 that Marathon has been evaluating the prospect for several years and has shot 2-D seismic survey (Petroleum News 2009). In March 2010, Marathon drilled a gas exploration well in its Sunrise prospect, in Cook Inlet Region Inc. land inside the Kenai NWR. The company has not released the results of that drilling, other than saying that it “encountered a zone of interest.” Early completion data suggest the recent Cook Inlet exploration well is targeting a different prospect than the one encountered by a well drilled in the area 40 years ago. Marathon drilled the Sunrise LK2 well about one mile west of the Sunrise Lake Unit No. 1 well, which Forest Oil drilled in 1970 to a depth of 14,500 feet. Forest encountered gas shows in the Tyonek formation below 11,000 feet, but not in commercial quantities (Lidji 2010).

### 4.1.2.4 Birch Hill Natural Gas Project

This is an area where gas has been known since the 1960s, with a well drilled in 1965 at the north satellite, Birch Hill (Nelson 2009). Birch Hill has a shut-in Tyonek formation gas well. The final 2004 EIS selected an alternative that included a 3.83-mile gravel access road from Swanson River field to the existing Birch Hill unit 22–25 pad. The satellite is some three miles northeast of the northern Swanson River field boundary. Access will be via existing Swanson River field roads and the new road will originate from the ARCO Bufflehead ROW to the location of the former Bufflehead pad and then proceed north to the existing Birch Hill well. In addition to the natural gas flowline, other utilities might be buried in the pipeline trench. They include a 3- to 4-inch high-density polyethylene line for transport of produced water from the satellite to Swanson River facilities; a 4- to 6-inch steel secondary product line for possible use as a redundant gas or water line; and electrical, communication or other service lines.

Additional development drilling is not anticipated to occur until 2013 or later. Full-scale development of the north satellite, Birch Hill, would include some 3.4 miles of new gravel access roads, 5.3 miles of new buried pipelines and utilities, and two drill pads totaling 5.5 acres. Permitting efforts, including surveying the preferred ROW for the gravel road identified in the EIS, were initiated under the 43rd plan of development. The Birch Hill Unit is now owned by Hilcorp Alaska and the company is working on a plan of development for the unit, which may commence in 2013.

### 4.1.2.5 Apache Seismic and Exploratory Drilling for Oil

Apache, which is focused on the historic oil play in Cook Inlet, has acquired acreage it plans to drill. In 2011, it began a three-year 1,200-square mile 3-D seismic shoot in Cook Inlet employing 220 people on the west side of Cook Inlet deploying nodes and is imaging the deep subsurface with new 3-D seismic technology. Twelve small drill rigs will be used to drill the holes onshore; offshore air guns will be used (Nelson 2011a).

The onshore portions of the survey would occur during winter and the offshore would occur during spring, summer, and fall. The proposed activity includes use of helicopter-supported drill rigs for shot-hole method onshore and in tidal areas and use of air gun arrays and receiver nodes offshore. Shallow holes will be bored from track mounted or hand held drills. Explosive charges will be placed at the bottom of the holes and detonated one hole at a time. Geophones (nodes) will be placed on the surface to record data. Offshore, nodal receiver units will record data from air gun sources and retrieved using marine vessels, including modified landing craft, bowpickers, and small support vessels. The equipment will be retrieved and redeployed across the project area as seasons and other restrictions allow until...
completed. Both onshore and offshore operations will be conducted as weather and permit restrictions allow. Vegetative clearing on state lands will be minimized. The project will be supported from existing facilities located on the west side of Cook Inlet at West Forelands. The Division geophysical exploration permit only authorizes activity on state surface lands and waters. Depending on survey node and source positions, individual landowners that would be affected will be contacted and permission for access obtained (ADNR 2011). Apache has not yet announced plans to drill an exploratory well in the North Kenai area.

4.1.2.6 Buccaneer Gas Exploratory and Development Drilling and Production

Australian independent Buccaneer Energy is progressing with development of its 52-billion-cubic-foot Kenai Loop field just east of the Kenai airport on the Kenai Peninsula. Buccaneer drilled the Kenai Loop #1 and #3 on an Alaska Mental Health Trust lease in 2011. Buccaneer has some 66,000 acres onshore and at one prospect, Kenai Loop. On land, the company also plans to drill in its West Nicolai Creek gas prospect at Shirleyville and in its West Eagle gas prospect in the southern Kenai Peninsula. In August of this year, Apache announced that they had acquired CIRI subsurface leases within the Kenai NWR and are planning an extensive 3-D seismic survey project on Refuge managed surface lands starting in 2013. The field started production on January 13, 2012 from the Kenai Loop #1 well, which produced an average of 11 MMSCFD in March 2012.

The company is in the process of gathering 3-D seismic data over the field and hopes to drill three to four more wells, Watt said. “With the additional drilling…we’ll be able to ramp that production up to 15 million (cubic feet) a day by October this year,” he said. Buccaneer sees its onshore West Nicolai Creek prospect as a gas prospect close to the existing gas infrastructure, Watt said. Buccaneer plans to shoot seismic at this prospect next winter, with a view to drilling a well in 2013.

At West Eagle, on the Kenai Peninsula about six miles east of Armstrong’s North Fork unit, the company has reprocessed the existing seismic data for the area with the intention of drilling new wells. West Eagle has both oil and gas potential. “We could have over 100 billion cubic feet of gas and 30 million barrels of oil in this area,” Buccaneer said.

Onshore prospects could go on line in the second half of 2013, with the offshore prospects following about a year later, assuming presumably that the exploration drilling proves successful. Buccaneer thinks that increased drilling in the Cook Inlet basin can increase the gas reserves in the basin to a level capable of supporting gas supplies for Fairbanks, in Alaska’s interior, and the continued export of liquefied natural gas, as well as supporting local utility gas needs (Bailey 2012a).

Buccaneer is also looking at the potential of liquid natural gas (LNG) use in Alaska. Watt said “we feel we can move LNG from the Cook Inlet to Fairbanks and be very competitive” (Nelson 2011a). The company wants to drill as many as eight Cook Inlet wells in 2012 (Lidji 2011).

4.1.2.7 Nikiski LNG

Shadura gas will be sold directly into the pipeline that connects the Tyonek A platform from offshore to the LNG plant in Nikiski. The Kenai LNG Plant, which began operating in 1969, has exported approximately two-thirds of Cook Inlet gas production for decades to Tokyo electric utilities. The North Cook Inlet gas field (Tyonek A platform) was discovered in 1962 and primarily feeds the Kenai LNG Plant. Net production was 52 MMSCFD in 2009 (ConocoPhillips Alaska No date).

In February 2011, employees were notified that the plant would be shutting down later in the spring. The plant offered 30-plus jobs, with another 30-plus jobs on the Tyonek A platform (Dischner 2011).
If the plant does not liquefy gas, it could be used to handle imported LNG or refurbished as an export facility. Cook Inlet utilities have testified that a likely shortage of natural gas in Cook Inlet over the next several years will result in imports of LNG and regasification. Longer term, if North Slope natural gas becomes available in South-central Alaska or if there is a significant discovery of natural gas in Cook Inlet, “the plant could be refurbished and serve as an LNG export facility.” “Any expansion of the plant to handle more export capacity…would depend on the price and the commercial and fiscal terms” (Nelson 2011b).

In 2011, Buccaneer Energy and ConocoPhillips announced a new contract allowing the independent producer to deliver short-term supplies to the facility. The contract was to begin when Buccaneer’s Kenai Loop No. 1 well came online last year and run through April 30, 2012 or when Cook Inlet Natural Gas Storage Alaska LLC brings its Kenai Peninsula storage facility into production, whichever occurs sooner. The ConocoPhillips contract is for up to 2.5 billion cubic feet of gas, and Buccaneer described the pricing as being “consistent with recently executed gas contracts.” Co-owners ConocoPhillips and Marathon announced plans to shutter it, but preserve the plant for future use. With Asian demand on the rise, in particular as Japan replaces nuclear power with LNG, the companies kept the facility open to make four shipments over the summer and then delayed the closing again to accommodate an additional shipment in October. Around the time of that last delivery, ConocoPhillips bought out Marathon’s 30-percent interest in the facility, giving it sole ownership of the plant and export terminal (Lidji 2011).

4.1.2.8 CIRI Mineral Leasehold Exploration and Development

CIRI owns additional leasehold surrounding the Shadura Unit boundary. It is assumed CIRI will continue to offer for lease the acreage surrounding Shadura that may not currently be under lease, but still may be developed under the terms of ANILCA. It is assumed that one or more exploratory wells and additional seismic may be drilled in the future.

4.1.2.9 Shadura Natural Gas Development

Shadura full field development would include the full development of the Shadura field, including the addition of one or two satellite drill sites (one to north and one to south) with buried gathering lines back to the drilling or processing pads. In addition, NordAq would improve conditioning and transportation infrastructure as necessary.

4.1.2.10 Kenai Spur Highway Extension

The Kenai Spur Highway Extension Project, also referred to as the North Road Extension Project, has been in the planning stage for many years. Since December 2004, KPB has been seeking state and federal funding to proceed with extending Kenai Spur Highway to improve residential access. The project would include 26 miles of new road construction, widening and paving the existing corridor from the end of pavement at Milepost 39.5 to about Milepost 65.5. KPB platted a ROW for road construction for the entire length of this project. KPB has subdivisions along this stretch of ROW and has sold numerous parcels. Residents currently have only a heavily damaged dirt trail to access these lands. This project will address environmental damage, provide appropriate road access to residential and recreational parcels, and encourage economic development in the area. Following preparation of a preliminary assessment, it was determined that an EIS would be required, effectively taking the project off the Alaska Department of Transportation’s road construction list. A Supplement to the Memorandum of Agreement between KPB and Alaska Department of Transportation has been executed, which modifies the contract to allow KPB to proceed with the environmental work. KPB is still seeking funding for the road project.
4.1.3 Significance Criteria (elements leading to a significance threshold)

Each resource section in this chapter includes a discussion of factors used to determine the significance of direct, indirect, and cumulative impacts (40 CFR 1508.7 through 1508.8) and proposed mitigation, as appropriate for that resource. Impacts are defined as direct, indirect, and cumulative effects and are assigned a “significance rating”:

- Significant Effects
- Significant but Mitigable to less than Significant Effects
- Less than Significant Effects
- No Effects
- Beneficial Effects

4.1.4 Mitigation

Measures were identified where practicable to mitigate the adverse effects. Mitigation was not identified for every resource; however, SOPs, BMPs, or other standard practices would be implemented to ensure impacts are minimized. Beneficial impacts are also described when applicable.

Mitigation is divided into two categories:

- Regulatory and administrative mitigation which is required in compliance with federal environmental laws and regulations that are SOPs or BMPs, or that are part of an on-going program to minimize impacts through careful project design
- Additional mitigation, which is proposed by the Service, other agencies, or the public and which may be implemented, depending on funding availability.

The Service has listed these additional mitigations to provide the public and regulatory agencies with information on all possible mitigations. The final determination on mitigation commitments will be outlined in the Finding of No Significant Impact.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Meteorology and Air Quality

4.2.1.1 Resource-Specific Significance Criteria

Impacts to air quality would be considered significant if the proposed activity was to result in a violation of any NAAQS, contribute to an existing violation of any NAAQS, or impair visibility within any federally mandated PSD Class I area.

4.2.1.2 Alternative 1—No Action

4.2.1.2.1 Direct and Indirect Effects

With no implementation of the proposed project, neither direct nor indirect effects would occur to air quality. Thus, current resource conditions and trends would continue.

4.2.1.2.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.
4.2.1.2.3 Mitigation

No mitigation measures are proposed for the No Action Alternative.

4.2.1.3 Alternative 2—Proposed Action

4.2.1.3.1 Direct and Indirect Effects

Drilling operations would be strictly construction-phase emissions from mobile sources. Activity at individual locations would last no more than a few hours at each drill site. The only fixed locations for emission sources would be the helipad and associated access roads off the Kenai. The primary source of air pollutant emissions from these operations would be the helicopters used to move the generators and drill rigs from site to site. Operations would occur only during daylight hours during January through March/April. Days with high winds or limited visibility may restrict helicopter operations. Emission calculations are based on 100 days of drilling operations. Estimates for the resulting project emissions for criteria pollutants are summarized in Table 4–1. Estimates for emissions for greenhouse gas (GHG) pollutants are summarized in Table 4–2.

Table 4–1 Estimated Daily Emissions from 3D Seismic Drilling Operations

<table>
<thead>
<tr>
<th>Source</th>
<th>VOC</th>
<th>NO\textsubscript{x}</th>
<th>CO</th>
<th>PM\textsubscript{10}</th>
<th>PM\textsubscript{2.5}</th>
<th>SO\textsubscript{x}</th>
<th>CO\textsubscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopters\textsuperscript{2}</td>
<td>28.8</td>
<td>214.0</td>
<td>82.1</td>
<td>15.8</td>
<td>10.4</td>
<td>12.8</td>
<td>74,392.0</td>
</tr>
<tr>
<td>Diesel Generators\textsuperscript{3}</td>
<td>0.50</td>
<td>4.95</td>
<td>4.36</td>
<td>0.53</td>
<td>0.53</td>
<td>0.005</td>
<td>703.30</td>
</tr>
<tr>
<td>Crew Trucks (off-site)\textsuperscript{4}</td>
<td>0.49</td>
<td>4.64</td>
<td>3.18</td>
<td>0.084</td>
<td>0.084</td>
<td>0.0066</td>
<td>488.2</td>
</tr>
</tbody>
</table>

Notes:
1. Emissions were estimated using representative emission factors and emission rates.
2. One double-engine, two single-engine.
3. Six gen-sets, total 30 hours per day.
4. Four trucks, total 200 miles per day.
Sources: California Public Utilities Commission 2007, Rindlisbacher 2009

Table 4–2 Estimated Total Emissions from 3D Seismic Drilling Operations

<table>
<thead>
<tr>
<th>Source</th>
<th>VOC</th>
<th>NO\textsubscript{x}</th>
<th>CO</th>
<th>PM\textsubscript{10}</th>
<th>PM\textsubscript{2.5}</th>
<th>SO\textsubscript{x}</th>
<th>CO\textsubscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Sources</td>
<td>1.49</td>
<td>11.18</td>
<td>4.48</td>
<td>0.82</td>
<td>0.55</td>
<td>0.64</td>
<td>3,779.18</td>
</tr>
</tbody>
</table>

Notes:
1. Emissions were estimated using representative emission factors and emission rates.
Sources: California Public Utilities Commission 2007, Rindlisbacher 2009

All of the proposed emissions will result from construction-phase types of activities and no fixed sources are proposed. Consequently, this project would not trigger air permitting requirements. Direct impacts to air quality from the vehicles and equipment used to carry out the seismic survey would be temporary, localized, and short-term. The operations on any given day would be spread out over 20 or more drill sites, and much of the helicopter emissions would be released aloft, well above ground level. The total area covered over 3 to 4 months would be 48 square miles. These emission estimates (Table 4–1 and Table 4–2) demonstrate that the proposed activity would not pose any potential for exceeding ambient air quality standards. The estimated emissions would be widely distributed in time and space. The operations are also not expected to have significant impact on designated wilderness areas in the Kenai, or on the Tuxedni Wilderness, which is the nearest Class I area.
4.2.1.3.2 Cumulative Effects

All activities associated with the Proposed Action that have the potential to contribute air emissions would comply with local, state, and federal air quality regulations and standards, and vehicle and equipment operators would adhere to all applicable ambient air quality standards. Beyond temporary, short-term effects of fuel-generated combustible emissions, the cumulative effects for the Proposed Action are not expected to vary markedly from background levels.

4.2.1.3.3 Mitigation

In addition to any measures required by federal, state, or local regulatory agencies, the following measures are recommended to reduce air quality impacts associated with the proposed action:

- operate all fossil-fueled construction equipment in accordance with manufacturer’s recommendations to minimize construction-related emissions resulting from incomplete combustion;
- use modern, well-maintained machinery and vehicles meeting applicable emission performance standards to minimize combustion related emissions;
- shut down idling fossil-fueled equipment when not in use, if practicable, to minimize combustion related emissions;
- minimize tree and shrub removal necessary for helicopter and equipment access to offset the loss of carbon sequestration associated with tree removal.

4.2.2 Geology and Soils

4.2.2.1 Resource-Specific Significance Criteria

Factors considered in this analysis include the potential for soil compaction, displacement, erosion, or other effects that would impair vegetation growth or regeneration.

4.2.2.2 Alternative 1—No Action

4.2.2.2.1 Direct and Indirect Effects

With no implementation of the proposed project, there would be neither direct nor indirect effects to geologic or soil resources and current resource conditions and trends would continue.

4.2.2.2.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.2.2.2.3 Mitigation

No mitigation measures are proposed for the No Action alternative.

4.2.2.3 Alternative 2—Proposed Action

4.2.2.3.1 Direct and Indirect Effects

Drilling of shot holes would result in a temporary disturbance to approximately 0.01 acre of surface area and a volume of 10,800 cubic feet (400 cubic yards) of soil over the entire project area. A small portion of the charges that are detonated may result in a displacement of soil cuttings from the back-filled drill hole. These locations would be mapped and the holes refilled during post-survey inspection and cleanup.
Compaction of ground surface by survey crews or equipment would be negligible because of the timing of the survey—frozen ground and snow cover would be expected to prevail while the survey.

Drilling, setting a charge, and backfilling of a shot hole is expected to take approximately one hour. Direct effects would be limited to this temporary disruption of the soil surface and temporary displacement of soil within the 25-foot shot hole. Indirect effects are would be limited to the time necessary for vegetation regrowth within the four-inch diameter disruption of ground surface.

4.2.2.3.2 Cumulative Effects

No cumulative effects to geologic or soil resources are expected because of the limited amount and extent of soil disruption that would occur during the project.

4.2.2.3.3 Mitigation

The following measure is recommended to minimize or eliminate impacts to geologic and soil resources:

- Avoid uprooting of trees and shrubs by hand clearing vegetation to allow for helicopter deployment and retrieval of crews and equipment.

4.2.3 Hydrology

4.2.3.1 Surface Water

4.2.3.2 Resource-Specific Significance Criteria

Surface water within the project area includes Swanson River and its tributaries, Bishops Creek, and various named and unnamed lakes and ponds. Impacts to surface water resources would be considered significant if they resulted in a degradation of surface water quality such that existing or potential beneficial uses would be reduced, resulted in an alteration to surface water flow or drainage such that uses within or outside the project area would be adversely affected, resulted in an increase in the hazard of flooding, or resulted from actions that were out of compliance with existing water quality standards or other regulatory requirements related to protecting or managing water resources.

4.2.3.3 Alternative 1—No Action

4.2.3.3.1 Direct and Indirect Effects

With no implementation of the project, there would be neither direct nor indirect effects to water resources and current resource conditions and trends would continue.

4.2.3.3.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.2.3.3.3 Mitigation

No mitigation measures are proposed for the No Action Alternative.
4.2.3.4 Alternative 2—Proposed Action

4.2.3.4.1 Direct and Indirect Effects

No direct or indirect effects to surface water resources are expected because the activities associated with the proposed activities would take place outside the buffer zones of all waterbodies within the project area. All soil cuttings from drilling will be backfilled into the shot hole; this combined with working outside of the buffer zone is expected to eliminate the shot holes as a source of increased sedimentation to waterbodies during spring/summer snowmelt runoff.

4.2.3.4.2 Cumulative Effects

With neither direct nor indirect effects anticipated, no cumulative effects are expected.

4.2.3.4.3 Mitigation

The following measure is recommended to minimize or eliminate impacts to surface water resources:

- All activities associated with the Proposed Action shall adhere to the minimum setbacks from surface water sources.

4.2.3.5 Ground Water

4.2.3.6 Resource-Specific Significance Criteria

Impacts to ground water resources would be considered significant if they resulted in a degradation of ground water quality such that existing or potential beneficial uses would be reduced, resulted in an alteration to ground water flow such that uses within or outside the project area would be adversely affected, or resulted from actions that were out of compliance with existing water quality standards or other regulatory requirements related to protecting or managing water resources.

4.2.3.7 Alternative 1—No Action

4.2.3.7.1 Direct and Indirect Effects

With no implementation of the proposed project, there would be neither direct nor indirect effects to water resources and current resource conditions and trends would continue.

4.2.3.7.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.2.3.7.3 Mitigation

No mitigation measures are proposed for the No Action Alternative.

4.2.3.8 Alternative 2—Proposed Action

4.2.3.8.1 Direct and Indirect Effects

Aquifers within the project area may be confined (under pressure; artesian) or unconfined and are poorly defined due to the complexity of deposition and depth to the confining layer may be from 100 to 200 feet or greater in depth (Glass 1996). With depths of 100 to 200 feet to confining layers, drilling of source holes to depths of 25 feet is unlikely to penetrate any aquifers. If drilling of a shot hole were to penetrate a
confined aquifer and result in an artesian source, the hole would be confined and plugged. Considering the extremely low potential for this occurrence, no direct or indirect effects to ground water resources are anticipated.

4.2.3.8.2 Cumulative Effects

The potential for a temporary direct effect from tapping into and then confining and plugging sources of artesian water would not be expected to result in cumulative adverse effects to ground water resources.

4.2.3.8.3 Mitigation

The following measure is recommended to minimize or eliminate impacts to ground water resources:

- Any artesian water source uncovered through drilling of shot holes would be confined and plugged.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Vegetation and Wetlands

4.3.1.1 Resource-Specific Significance Criteria

The project area includes forested and shrub dominated upland communities and forested, scrub-shrub, and emergent wetland communities. In general, the vegetation communities in both uplands and wetlands within the project area receive minimal human disturbance outside of established trails and Service roads. Impacts to vegetation communities would be considered significant if they resulted in long-term loss, degradation, or reduction of diversity of high quality plant communities, uncontrolled transmission of invasive species to the project area, large scale fragmentation of habitat, or non-compliance with policies and regulations related to wetlands conservation and protection.

4.3.1.2 Alternative 1—No Action

4.3.1.2.1 Direct and Indirect Effects

With no implementation of the proposed project, neither direct nor indirect effects to vegetation and wetlands would occur and current resource conditions and trends would continue.

4.3.1.2.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.3.1.2.3 Mitigation

No mitigation measures are proposed for the No Action Alternative.

4.3.1.3 Alternative 2—Proposed Action

4.3.1.3.1 Direct and Indirect Effects

No permanent impacts to upland or wetland vegetation communities are anticipated. The proposed survey would occur during winter months when the ground is frozen and covered with snow. Low intensity direct impacts to vegetation are expected and may be short- and long-term in duration depending on the plant species. During the time of the proposed activities, herbaceous vegetation would have died back or
be reduced to dead aboveground stems. Impacts to trees and shrubs would include the hand clearing of sky holes in densely vegetated areas to facilitate the deployment, positioning, and retrieval of drilling units, as well as some trampling of shrubs above snow level immediately around the source holes. Clearing of shrubs or trees would involve hand trimming or cutting down to snow or ground surface level, but in all cases would be done to the minimum extent practicable. Source points (shot holes) would be repositioned wherever practicable to minimize tree felling. No clearing is anticipated in sparsely vegetated areas and no clearing is anticipated for the placement of the autonomous receivers.

Drill holes would be four inches in diameter, which would result in the temporary direct impacts to approximately 430 square feet (0.01 acre) of land, including impacts to sub-surface structures, such as roots, rhizomes, or seeds. The maximum area cleared for a skyhole would be 10 feet in diameter, which is equivalent to 78.5 square feet. It is anticipated that 10 to 20 percent of the 4,928 source holes (493 to 986 holes) within the project area would necessitate the clearing of vegetation to create sky holes for the helicopters to deploy and retrieve equipment. Therefore, the maximum area of impact to vegetation from would range from 0.89 acre to 1.79 acres distributed over a project area of 30,720 acres.

NordAq would operate under USACE’s Nationwide Permit 6, Survey Activities for proposed drilling activities that would occur in wetlands. Approximately 42 percent of the shot holes (2070 holes) are expected to be drilled within wetlands. Each 4-inch diameter hole drilled to a depth of 25 feet would disturb approximately 12.57 square inches of surface area, resulting in the temporary direct impact to approximately 181 square feet (.004 acre) surface area of wetland. The volume of soil temporarily displaced would be approximately 2.18 cubic feet per hole, for a total soil volume of 4,516 cubic feet (170 cubic yards). Side castings would be placed on tarps to ensure all soil is returned to the source hole.

Applying the same ratio of 10 to 20 percent of the shot holes necessitating clearing of skyholes (207 to 414 holes) and using 78.5 square feet of clearing per hole as the multiplier, the maximum area of impact to vegetation within wetlands would range from 16,250 square feet (0.37 acre) to 32,499 square feet (0.75 acre).

Combining the area of clearing expected from drilling 4,928 shot holes (0.01 acre) with the maximum clearing of vegetation expected for sky holes (1.78 acres) results in an expected impact of 1.79 acres, or less than 0.1 percent of the entire project area. The maximum combined area of impact to vegetation within wetlands (all shot holes plus sky holes) is 32,600 square feet, which is approximately 0.75 acre. This level of impact is not expected to result in degradation, or reduction of diversity of high quality plant communities within the project area. In addition, fragmentation of habitat would be negligible. Given the timing of the survey (winter) and that there would be no tracked vehicles used within the project area, the potential for uncontrolled transmission of invasive species to the project area also would be negligible.

Potential indirect impacts from clearing include a temporary reduction of nesting habitats for birds and of food stock. Because of the relatively small area for each individual clearing and overall clearing relative to available like habitats, indirect impacts would be negligible.

Cleared areas within uplands would be allowed to revegetate naturally or as directed by the Service. Natural regeneration eliminates the potential for invasive species to be introduced to the area through seed mixes, plant bundles, or tracked in by equipment or planting crews. The length of time necessary for regeneration of plant biomass may be one growing season for most herbaceous species and one or more growing seasons for woody plants, depending on the species, the extent of cutting back, and the maturity of the shrub or tree.
4.3.1.3.2 Cumulative Effects

The maximum area of vegetation clearing for the Proposed Action is approximately 1.79 acres over the proposed project area of 30,720 acres. This is expected to have a negligible cumulative effect when combined with vegetation clearing associated with other oil and gas operations within the Kenai NWR.

4.3.1.3.3 Mitigation

No mitigation measures are proposed for this alternative.

4.3.2 Wildlife

4.3.2.1 Mammals

4.3.2.1.1 Resource-Specific Significance Criteria

Impacts to mammals in the proposed project area would be considered significant if any of the following occurred:

- A substantial, long-term (> 2 years) reduction in the quantity or quality of habitat critical to the survival of local populations of common mammal species;
- Injury or mortality to common mammal species, such that species populations would not recover within 2 years; or
- Disturbance to bear denning locations.

4.3.2.1.2 Alternative 1—No Action

4.3.2.1.2.1 Direct and Indirect Effects

With no implementation of the project, neither direct nor indirect effects to mammals would occur and current conditions and trends related to mammals would continue.

4.3.2.1.2.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.3.2.1.2.3 Mitigation

No mitigation measures are proposed for the No Action Alternative.

4.3.2.1.3 Alternative 2—Proposed Action

4.3.2.1.3.1 Direct and Indirect Effects

Noise and the presence of survey crews may cause minor short-term direct impacts to mammals within the project area. Although wildlife use of the project area is expected to be lower during the wintertime than during summer, mammal species that could be expected to be active include wolves, lynx, and red fox, rabbits, and moose. Brown and black bears would be expected to be denning, but could leave their dens if disturbed.

Noise from drilling of shot holes, setting off charges, and helicopter activity may affect wildlife such that wildlife may avoid active work areas and move to adjacent undisturbed habitats. Approximately one hour is necessary to complete the preparation for, drilling, and backfilling of each shot hole before survey crews move to the next location. This impact would be short term in duration and localized. In addition, the effects would not to result in injury, mortality, or impacts at the population level.
Clearing of vegetation for skyholes is expected to be necessary for 10 to 20 percent of the drilling sites. Most herbaceous vegetation would not be present during the proposed survey period and clearing would be primarily to woody vegetation. Maximum combined area of vegetation cleared for skyholes is expected to range from 0.88 to 1.78 acres over the proposed project area. Direct impacts would include minor reductions in forage food stock and cover.

An indirect impact from clearing of woody species could have a positive, albeit minor effect on moose habitat. As described in chapter three, moose prefer early successional habitats to mature forested habitats. Although relatively small in areal extent, those areas cleared of vegetation would revert to an early successional stage that might attract moose in the area.

4.3.2.1.3.2 Cumulative Effects
As discussed above, implementation of this alternative would result in minor short-term impacts to mammals. Effects from other projects, especially RFFAs, would not overlap these minor short-term effects in time or space. Consequently, the minor short-term impacts would not result in any potentially significant cumulative impacts.

4.3.2.1.3.3 Mitigation
The following measure is recommended to minimize or eliminate impacts to ground water resources:

- Any bear dens identified within the project area before or during project implementation would be avoided by applying a setback of 660 feet.

4.3.2.2 Birds

4.3.2.2.1 Resource-Specific Significance Criteria
Impacts to birds in the proposed project area would be considered significant if any of the following occurred:

- A substantial, long-term (> 2 years) reduction in the quantity or quality of habitat critical to the survival of local populations of common bird species;
- Injury or mortality to common bird species, such that species populations would not recover within 2 years.

4.3.2.2.2 Alternative 1—No Action

4.3.2.2.2.1 Direct and Indirect Effects
With no implementation of the proposed project, there would be neither direct nor indirect effects to birds and current conditions and trends related to birds would continue.

4.3.2.2.2.2 Cumulative Effects
Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.3.2.2.2.3 Mitigation
No mitigation measures are proposed for the No Action Alternative.
Alternative 2—Proposed Action

Direct and Indirect Effects
Noise and the presence of survey crews are expected to cause minor short-term direct impacts to winter resident bird species within the project area. Fewer overall numbers of birds and bird species would be present within the project area during the winter months than the summer months because most species would have migrated south for the winter. Winter residents include owls, grouse, ptarmigan, juncos, chickadees, siskins, and woodpeckers. These species would avoid active work areas and use adjacent undisturbed areas for foraging or resting for the duration of local operations.

As described in Chapter 3, two Bald Eagle nests have been identified near the project area. In case April survey operations overlap with Bald Eagle nest selection in April, operations would observe a 660 foot source hole set back from all identified Bald Eagle nests within or adjacent to the proposed project area.

Clearing of skyholes would have minor short- and long-term direct impact through reduction of habitats for foraging and resting during winter months and minimal long-term impacts from reduction of foraging, resting, and nesting habitats until vegetation grows back within the cleared areas. This impact would be minor because of the abundance of similar habitat within the project area and the relatively small areas of clearing that would occur around the individual shot holes. Reduction of the quantity or quality of habitats critical to the survival of local populations of common bird species would be minimal and no injury or mortality of birds is expected.

Cumulative Effects
As discussed above, implementation of this alternative would result in minor short- and long-term impacts to birds. Effects from other projects, especially RFFAs, also would contribute to these effects. Their contribution, however, would be very limited because potential disturbances associated with these activities also would be very limited within the project area. Consequently, the minor direct and indirect short- and long-term impacts on birds would not result in any potentially significant cumulative impacts.

Mitigation
The following measure is recommended to minimize or eliminate impacts to ground water resources:

- All setbacks from identified Bald Eagle nests would be observed. Any eagle nests identified within the project area over the course of the proposed survey operations would be avoided by applying a setback of 660 feet.

Aquatic Life

Resource-Specific Significance Criteria
Impacts to aquatic life in the proposed project area would be considered significant if any of the following occurred:

- Long-term (> 2-year) impact on populations and/or habitat of federal or state species of concern that would result in a trend toward endangerment or the need for federal listing;
- Long-term loss of habitat for single or multiple common fish species;
- Creation of a fish barrier; or
- Contamination of water that violated regulatory compliance levels.
4.3.3.2 Alternative 1—No Action

4.3.3.2.1 Direct and Indirect Effects

With no implementation of the proposed project, neither direct nor indirect effects to aquatic species would occur and current conditions and trends related to such species would continue.

4.3.3.2.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.3.3.2.3 Mitigation

No mitigation measures are proposed for the No Action Alternative.

4.3.3.3 Alternative 2—Proposed Action

4.3.3.3.1 Direct and Indirect Effects

No direct or indirect impacts to aquatic life are anticipated with implementation of this alternative. Project activities would occur when all areas of surface water would be frozen. In addition, source holes would not be drilled nor charges detonated in water or within resource protection buffer zones. Therefore, no impacts to fish, other aquatic species, or essential fish habitat are anticipated.

4.3.3.3.2 Cumulative Effects

Because no impacts to aquatic life are anticipated from this alternative, no cumulative impacts to aquatic life are anticipated as well.

4.3.3.3.3 Mitigation

No mitigation measures are proposed for aquatic species or aquatic species habitat.

4.3.4 Special-Concern Species

4.3.4.1 Special-Concern Species

No federal listed threatened or endangered species are known to occur within the Refuge (Service 2009b). The focus of this section is on the two species of special concern specifically mentioned in Chapter 3—the wood frog and the Bald Eagle.

4.3.4.2 Resource-Specific Significance Criteria

Impacts to special-concern species would be considered significant if actions resulted in:

- A reduction in the population, habitats, or viability of a species of special concern that would result in a trend toward endangerment or the need for federal listing; or
- The introduction of chytrid fungus into the project area that could result in mortality of wood frogs.

4.3.4.3 Alternative 1—No Action

4.3.4.3.1 Direct and Indirect Effects

With no implementation of the proposed project, there would be neither direct nor indirect effects to listed species of concerns and current conditions and trends related to these species would continue.
4.3.4.3.2 Cumulative Effects
Without direct or indirect effects, there would be no cumulative effects under the No Action Alternative.

4.3.4.3.3 Mitigation
No mitigation measures are proposed for the No Action Alternative.

4.3.4.4 Alternative 2—Proposed Action

4.3.4.4.1 Direct and Indirect Effects
Bald Eagle nests would not be affected by the project. The seismic activities would occur during the winter when the birds are not nesting; and therefore, are not tied to their nests. In addition, amount of clearing of vegetation would be very limited and the duration of activities in any specific location would be short. Finally, seismic activities would observe a buffer of 660 feet from any known eagle nest within the proposed project area.

Wood frogs hibernate under the snow within forest litter in a physical state where their bodies are in effect frozen. The primary potential effect would be loss of habitat from the clearing of vegetation. As described in Section 4.3.2.2.3 for birds, this impact would be minimal because of the small amount of clearing that would occur around some of the individual source holes and the relative abundance of similar habitats within the project area. Reduction of the quantity or quality of habitats critical to the survival of local populations of wood frogs would be minimal and, barring an individual wood frog hibernating directly at the location of a drill hole, no injury or mortality to this species is expected.

The chytrid fungus has been identified as being lethal to wood frogs. This alternative is not expected to introduce or spread this fungus in the project area. All operations would occur during winter months, no drilling would occur in water, and no amphibians would be active during project implementation.

4.3.4.4.2 Cumulative Effects
Implementation of this alternative is not expected to result in adverse cumulative effects. No direct or indirect effects to bald eagles have been identified. In addition, potential effects of the seismic program on the wood frog would be very limited, localized, and unlikely to combine with the effects of other actions and result in cumulative impacts.

4.3.4.4.3 Mitigation
Measures identified to reduce and/or minimize the potential for adverse effects to species of concern include:

- Strict observation setbacks identified for eagle nests, bear dens, and all waterbodies;
- Minimize vegetation clearing for sky holes to the extent necessary for deployment, positioning, and retrieval of drill equipment; and
- Reposition source holes whenever possible to reduce the need for felling trees.

4.4 HUMAN ENVIRONMENT

4.4.1 Land Use
For this analysis, direct land use impacts are defined as displacement of existing land uses by project activities or conflicts with adopted laws and regulations, approved land use plans, or policies. Indirect
impacts are potential effects to neighboring land uses. Impacts to land uses were analyzed based on whether the proposed activities would be compatible with existing or planned land uses. The project is subject to the regulations and requirements of the Service 2009 CCP and State of Alaska.

4.4.1.1 Resource-Specific Significance Criteria

Implementation of an alternative would have a significant impact if it results in:

- Adverse effects to relatively large blocks of existing land uses; or
- Development that is inconsistent with adopted laws, regulations, or the long-term goals of approved land use plans or policies.

4.4.1.2 Alternative 1—No Action

4.4.1.2.1 Direct and Indirect Effects

Implementation of the No Action Alternative would result in no direct or indirect impacts to existing land uses or approved land use plans or policies because there would be no disturbances to existing conditions.

4.4.1.2.2 Cumulative Effects

Implementation of the No Action Alternative would cause no cumulative impacts to land use because it would result in no direct or indirect effects.

4.4.1.2.3 Mitigation

No mitigation would be necessary under the No Action Alternative.

4.4.1.3 Alternative 2—Proposed Action

4.4.1.3.1 Direct and Indirect Effects

Under this alternative, there would be no direct effects to land use, such as the displacement of land uses or changes in land access. However, indirect effects to nearby land uses may occur and may result in short-term, temporary inconveniences or disruption of existing land uses near the seismic activities. Land uses potentially affected would include winter recreation (Nordic skiing) or wilderness experience within the Kenai NWR and the CCSRA. The sights and sounds associated with seismic activities could adversely affect the sense of solitude or wilderness for recreational use in the Kenai NWR and the CCSRA.

Under the 2009 CCP, mechanized and motorized equipment may be allowed in areas in the Minimal management category lands when the overall impacts are temporary or where its use furthers management goals. Portable drills would be transported by helicopter to the operations area and put in place by survey crews on foot. All equipment necessary to drill a shot hole would be moved to the location by helicopter and, if necessary, left in the field overnight to reduce fuel consumption. The crews would mainly access the project area via existing roads, trails, and helicopter. However, if crews experience heavy or deep snow and if snowmachine use is authorized by the Service, the crews could access the project area via snowmachine to deploy receivers. Snowmachines may also be used to pack down the snow so foot crews would be able to access the project area.
4.4.1.3.2 Cumulative Effects

The Proposed Action would result in short-term temporary impacts to land use within the project area. Based on past, present and reasonably foreseeable oil and gas projects near the project, oil and gas exploration would continue to occur within the Kenai Peninsula. In combination with the impacts of activities underway or reasonably foreseeable in the surrounding areas, the Proposed Action would result in at most minor cumulative effects because few other projects would have activities occurring during the same period. Once the seismic project is completed, no additional cumulative effects would result.

4.4.1.3.3 Mitigation

Due to the short-term, temporary impacts to land use, no mitigation has been identified.

4.4.2 Recreation

In general, winter recreational activities that may occur within or near the project area include Nordic skiing, trapping, ice fishing, and snow machine travel. These activities could be directly impacted by the noise and activity associated with the seismic operations. Indirect impacts could be realized by changes in the biological or physical environment that results in fewer individuals of fish or wildlife species.

4.4.2.1 Resource-Specific Significance Criteria

Implementation of an alternative would have a significant impact if it:

- Substantially alters the area available for recreation;
- Substantially alters the quality of the recreational experience for users; or
- Substantially alters the physical or biological environment so that the continuation of current recreational activities is precluded.

4.4.2.2 Alternative 1—No Action

4.4.2.2.1 Direct and Indirect Effects

Implementation of the No Action Alternative would result in no direct or indirect impacts to winter recreationalists because there would be no disturbances beyond existing conditions.

4.4.2.2.2 Cumulative Effects

Implementation of the No Action Alternative would cause no cumulative impacts to recreation because it would result in no direct or indirect effects.

4.4.2.2.3 Mitigation

No mitigation would be necessary under the No Action Alternative.

4.4.2.3 Alternative 2—Proposed Action

4.4.2.3.1 Direct and Indirect Effects

The Proposed Action may temporarily affect Kenai NWR public recreational activities, like Nordic skiing, trapping, ice fishing, and snowmachine travel. Recreational activities would not be allowed in portions of the project area where active seismic activities are occurring. The effects of the activities and restrictions would be short-term in duration and limited to the January to April period. Because of the
relative remoteness of most of the project area and the limited recreational activity that occurs there, the Proposed Action is not expected to affect recreational activities substantially during project implementation. The potential effects of noise from the project on recreation are discussed in Section 4.4.5.

4.4.2.3.2 Cumulative Effects

General public access would be limited to portions of the project area during project activities. In addition, no activities from any other projects or RFFAs would be occurring simultaneously in the project area and only limited activities would be occurring near the boundaries of the project area. Therefore, the potential for the project’s direct and indirect effects on recreation to contribute to cumulative effects would be less than significant—especially considering the short-term duration of the project and overall sizes of the Kenai NWR and GMU 15A.

4.4.2.3.3 Mitigation

Signs could be posted around areas with ongoing seismic activities to warn recreational and other users of temporary closures within the area.

4.4.3 Transportation

The analysis of transportation impacts addresses the effects of the No Action and Proposed Action Alternatives on the public transportation system, local traffic circulation, and consistency with adopted laws and regulations, or approved transportation plans or policies. Project-related and equipment traveling on public roads could affect local traffic circulation or create safety problems.

4.4.3.1 Resource-Specific Significance Criteria

Factors considered when determining whether an alternative would have a significant impact to traffic and transportation facilities include the extent or degree to which its implementation would result in:

- Survey traffic effects, such as lane closures or impediments to traffic, that would result in long-term disruption of local traffic circulation.

4.4.3.2 Alternative 1— No Action

4.4.3.2.1 Direct and Indirect Effects

There would be no direct or indirect effects to transportation under the No Action Alternative.

4.4.3.2.2 Cumulative Effects

Under the No Action Alternative, cumulative effects to the public transportation system would not occur because there would be no direct or indirect effects to transportation under the No Action Alternative.

4.4.3.2.3 Mitigation

Because there are no direct or indirect impacts, no mitigation is necessary under the No Action Alternative.
4.4.3.3 Alternative 2—Proposed Action

4.4.3.3.1 Direct and Indirect Effects

Project related vehicles would travel on public roads and may have a negligible, short-term effect on local traffic conditions when workers make daily roundtrips from housing to the staging area. Impacts to transportation systems are expected to be negligible because of the limited number of personnel that would be working on the project. In addition, most of the equipment necessary to support the seismic operations would be transported by helicopters rather than ground transportation. All seismic acquisition efforts would take place on the Kenai NWR or lands adjacent to the Refuge and not on public highways or roads.

4.4.3.3.2 Cumulative Effects

The potential for the project’s direct and indirect effects to overlap with the effects of other projects or RFFAs to generate substantive cumulative effects is negligible. At most, only limited activity associated with these other projects and RFFAs is expected to occur during the January to April period. The only other project in the area that could be occurring is road construction associated with NordAq’s permitted appraisal well. Although no schedule has been set, the likelihood of NordAq initiating road construction for the appraisal well project during the winter is minimal because NordAq would not begin drilling of the well until the 3D seismic data have been acquired. Consequently, no significant cumulative effects are expected with implementation of the Proposed Action.

4.4.3.3.3 Mitigation

No substantial impacts would result from the Proposed Action; therefore, no mitigation measures would be necessary.

4.4.4 Visual Resources

This section describes the effects of the No Action and Proposed Action Alternatives on visual resources at key publicly accessible viewpoints from which project activities could be seen. When analyzing impacts to visual resources, factors considered include variations in vegetation, existing modifications to the landscape character, distance from which facilities would be viewed, and the length of time intrusions would be visible.

4.4.4.1 Resource-Specific Significance Criteria

Effects to visual resources would be considered adverse if implementation of an alternative noticeably increased visual contrast or substantially reduced scenic attractiveness as seen in the foreground view (within ½ mile) from key publically accessible viewing areas. An alternative would have significant effects to visual resources based on the extent or degree to which its implementation would result in:

- Project facilities would degrade the scenic attractiveness in the foreground view from publicly accessible key viewpoints.

4.4.4.2 Alternative 1—No Action

4.4.4.2.1 Direct and Indirect Effects

Implementation of the No Action Alternative would result in no direct or indirect impacts to visual resources because there would be no disturbances beyond existing conditions.
4.4.4.2.2 Cumulative Effects

With no direct or indirect effects to visual resources under the No Action Alternative, there would be no cumulative effects on these resources either.

4.4.4.2.3 Mitigation

No mitigation would be necessary under the No Action Alternative.

4.4.4.3 Alternative 2—Proposed Action

4.4.4.3.1 Direct and Indirect Effects

Implementation of this alternative would involve the use of heliportable drilling units and cable-free receivers, which would allow for minimal intrusion on the project area, especially compared to historic methods such as tracked vehicles, tethered receivers, and line clearing. Additionally, operations would occur during daylight hours only, so there is no need for overhead, night lighting equipment that may affect the visual sensitivity of the Refuge. Finally, most of the activities would occur away from key public viewpoints. As a result, visual impacts from key publicly accessible viewpoints would be minimal and short term in duration.

Tree clearing would be done to the minimum extent practicable to allow for safe helicopter operations in heavily treed areas. These skyholes are not anticipated to be visible from any publicly accessible key viewpoint. These areas, however, may be visible to recreational users within the Refuge, such as Nordic skiers. These skyholes would be very limited in occurrence and recolonized by vegetation over time. Therefore, the impacts are anticipated to minor and long-term.

4.4.4.3.2 Cumulative Effects

Project activities are anticipated to have a minor effect on visual aesthetics, and the cumulative effects are expected to be less than significant given that most activities would not be visible from key viewpoints.

4.4.4.3.3 Mitigation

No substantial impacts would result from the Proposed Action; therefore, no mitigation measures would be necessary.

4.4.5 Noise

4.4.5.1 Resource-Specific Significance Criteria

As discussed in Section 3.3.5, the mean ambient sound level within the Kenai NWR has been established as 45.1 dB, with a range of values from 32 to 95 dB. Significance of noise impacts can be evaluated in terms of increases in background noise resulting in noise levels above the EPA guideline for 55 DBA at sensitive receptor locations (EPA 1974). For this EA, sensitive receptors include residential areas, developed recreational areas, and wildlife.

4.4.5.2 Alternative 1—No Action

4.4.5.2.1 Direct and Indirect Effects

With no implementation of the project, there would be neither direct nor indirect effects from noise and current resource conditions and trends would continue.
4.4.5.2.2 Cumulative Effects

Without direct or indirect effects, there would be no cumulative effects under the No Action alternative.

4.4.5.2.3 Mitigation

No mitigation measures are proposed for the No Action alternative.

4.4.5.3 Alternative 2—Proposed Action

4.4.5.3.1 Direct and Indirect Effects

The greatest noise impacts would be from continual helicopter use throughout the daytime drilling operations. Noise within the project area would be from helicopters flying overhead and hovering as it deploys, positions, or retrieves drilling equipment and from occasional landings to deploy survey crewmembers. Noise levels for a Bell 206 helicopter range from 83.3 dBA for flyovers (at a height of 486 feet directly overhead) to 96.1 dBA during landings (California State Board of Forestry and Fire Protection 2005). Depending on the individual source hole locations within the project area, proposed project operations would range from 5 to 15.5 miles from the community of Nikiski, from approximately 0.75 to 8.9 miles from the Gray Cliff Subdivision northeast of Nikiski, and from directly adjacent to approximately 7 miles distant from the CCSRA.

In general, sound levels decrease at the rate of 6 dBA for every doubling of distance from the source (Fleming et al. 2000). Using this rate of decrease from the source, noise generated from a helicopter flyover would be reduced to below the EPA guideline of 55 dBA at sensitive receptors located less than 0.5 mile from the helicopter and to ambient levels (45.1 dBA) within 0.75 mile of the helicopter. For helicopter landings, noise would be reduced to below 55 dBA at a distance of approximately 0.75 mile and near ambient levels within 1.5 miles.

Direct impacts from noise to residential areas are expected to be low. Because of its distance from the project area, no impacts from noise are expected to the community of Nikiski, whereas impacts from noise to the Gray Cliff Subdivision would be temporary, intermittent, and low only at the closest shot hole locations. Recreationalists using CCSRA or Kenai NWR and within 0.5 mile of a drilling location would be exposed temporarily to sound levels at 55 dBA or higher. Given the short duration of noise levels exceeding 55 dBA at any drilling location, however, impacts to recreationalists would be minor.

Impacts from noise to wildlife are expected to be short term and minor. Moose, avian species, and animals hunting within the immediate area of drilling operations may be temporarily displaced to adjacent habitats by the helicopter traffic and overall noise of operations. These impacts are anticipated to be short-term, with wildlife use of habitats near a source hole resuming as drilling operations move farther away.

4.4.5.3.2 Cumulative Effects

The proposed project is expected to be completed within a three-month period. Noise generated from the project would be intermittent and of short duration in any specific location because source holes would be drilled and completed within an hour. As the survey operations move adjacent to oil and gas operations in the Swanson River Unit, there may be a temporary rise in ambient noise levels from the combined sounds from the two projects. This would be a short-term increase and would not be expected to result in a substantive cumulative effect.
4.4.5.3.3 Mitigation

To reduce the potential for noise impacts to recreationalists, signs warning of seismic survey operations could be posted at the entrance to CCSRA and at entrance locations for cross-country ski trails and snowmachine trails within the Kenai NWR allowing individuals to avoid the area. Beyond observing setback requirements from eagle nests and bear dens, no other resource-specific mitigation for noise is proposed.

4.4.6 Cultural Resources

Section 106 of the National Historic Preservation Act (16 USC 470–470t) requires that any Federal agency that is directly or indirectly providing funding for, permitting, licensing, or approving an activity or undertaking must take into account potential effects to historic properties. Cultural sites that have not been adequately documented or that have not been determined to be not eligible for the NRHP are considered potentially eligible and are considered historic properties.

Many cultural resources have been documented by archaeologists, but only limited areas of the Kenai NWR have been systematically inventoried for cultural resources. Undocumented sites may exist. Any newly discovered sites, whether discovered during operations, would be documented by archaeologists. These sites would be considered historic properties unless they are officially determined to be not eligible and appropriate steps would be taken to avoid impacts and to protect, preserve or mitigate the sites.

4.4.6.1 Resource-Specific Significance Criteria

The significance of impacts to historic properties is assessed by evaluating the degree to which the impacts would:

- Cause adverse effects to a historic property. Adverse effects could include: ground disturbance within a documented or undocumented cultural resource; damage to or alteration of any contributing or associated building, structure or cultural feature; displacement or removal of any contributing or associated object or cultural feature; altering aspects of the historic landscape or setting that make a site culturally significant; or restricting access to traditional cultural places or resources, including culturally important plant, animal or material resources. Any of these adverse effects to historic properties are considered significant impacts, but may be mitigable to less than significant through the implementation of an approved Historic Property Treatment Plan.

4.4.6.2 Alternative 1—No Action

4.4.6.2.1 Direct and Indirect Effects

Implementation of the No Action Alternative would result in no direct or indirect impacts to cultural resources because there would be no disturbances beyond existing conditions.

4.4.6.2.2 Cumulative Effects

With no direct or indirect effects to cultural resources under the No Action Alternative, there would be no cumulative effects on these resources either.

4.4.6.2.3 Mitigation

No mitigation would be necessary under the No Action Alternative.
4.4.6.3 Alternative 2—Proposed Action

4.4.6.3.1 Direct and Indirect Effects

No direct or indirect effects to historic properties are expected with implementation of this alternative. This conclusion is primarily based on the general lack of cultural resources present in the project area. The SHPO has concurred with this conclusion.

Although no direct or indirect effects to historic properties are expected, the possibility still exists that undocumented historic properties exist within or near the project area. If such undocumented cultural resources are discovered during seismic operations, they would be avoided. Finally, although very unlikely, indirect effects to documented or undocumented historic properties near the project could occur because of increased human presence during implementation of the project.

4.4.6.3.2 Cumulative Effects

There is fairly extensive past, present and reasonably foreseeable development in the oil and gas fields and related activities in the general area around the project. Closer past and present developments include the Swanson River Unit to the east and the Beaver Creek Unit to the south. Previous cultural resource surveys in and around the Swanson River Unit have identified few cultural resources. Except for historic resources related to oil and gas development, no reported cultural resources have been found near the Swanson River or Cook Inlet.

A low potential for historic properties exists in the project area, however, and a low potential for this project to contribute to cumulative effects to historic properties. Nevertheless, continued exploration and development in the region increases the potential for the discovery of undocumented sites and the possibility of damage to those sites.

4.4.6.3.3 Mitigation

If any historic properties are identified that may be affected by the Proposed Action, the sites would be avoided and protected from direct effects to the extent feasible.

4.4.7 Socioeconomics

The primary catalyst for changes to socioeconomic resources is a change in economic activity, such as industrial output (value of goods and services), employment, and income. Changes in employment have the potential to affect population, housing, and associated community services and infrastructure.

4.4.7.1 Resource-Specific Significance Criteria

Factors considered in determining whether an alternative would have a significant impact on the socioeconomic structure of the region of impact would include the extent or degree to which its implementation:

- Creates a number of employment positions in excess of what the regional labor market could provide; and
- Changes the local housing market or vacancy rates, particularly when compared to the availability of affordable housing.
4.4.7.2 Alternative 1—No Action

4.4.7.2.1 Direct and Indirect Effects

Under the No Action Alternative, the small positive economic benefits to the federal, state, and borough governments would not be realized, nor would the positive economic benefits of temporary seismic operation jobs in the KPB be realized.

4.4.7.2.2 Cumulative Effects

There would be no cumulative effects under the No Action Alternative.

4.4.7.2.3 Mitigation

No significant impacts would result from the No Action Alternative; therefore, no mitigation measures would be necessary.

4.4.7.3 Alternative 2—Proposed Action

4.4.7.3.1 Direct and Indirect Effects

Because the Proposed Action involves the exploration of natural gas, neither public nor private mineral owners would benefit economically from the discovery of gas deposits unless they are developed in the future. The mineral owner would realize an increase in revenue from royalty payments if natural gas is found and developed because of seismic efforts.

Short-term, direct effects would be realized by survey crews employed for the 60 to 90 days estimated duration of the project. The economic gains for those employed by the project would indirectly benefit the KPB and local businesses through spending in the community.

4.4.7.3.2 Cumulative Effects

Seismic operations would occur on a short-term basis and socioeconomic gains would be limited to the duration of project activities; therefore, cumulative effects are expected to be less than significant given the temporary nature of the project.

There are several operating oil and gas fields in the KPB near the project area, and there are numerous exploration projects currently underway or planned for the near future. These activities are also set against the backdrop of increasing employment in the North Slope oilfields and increased exploration activity on the North Slope.

The Proposed Action would not cumulatively result in the creation of a number of jobs that could not be filled by the local or regional labor pools, or a number such that an in-migration of workers would be triggered, which could change the local housing market or vacancy rates as the Proposed Action is of short temporal duration and scope.

4.4.7.3.3 Mitigation

No significant impacts would result from the Proposed Action; therefore, no mitigation measures would be necessary.
4.4.8 Subsistence

ANILCA Section 810 requires an evaluation of the effects on subsistence uses for any action to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands. This evaluation consists of:

- A finding of whether or not a proposed action would have a significant restriction on subsistence uses;
- A notice and hearing if an action is found to have a significant restriction on subsistence uses; and
- A three-part determination prior to authorization of any action if there is a significant restriction on subsistence uses.

The following serves as the basis for that evaluation.

The Proposed Action would not result in substantial direct impacts to subsistence resources or habitats. No activities would occur in the Swanson River or other fish-bearing waterbodies. The ADF&G guidelines for setbacks for blasting would be implemented. Therefore, because no components of the Proposed Action are anticipated to disturb fish-bearing streams, there would be no direct impacts to the habitats used by fish. Additionally, the development and implementation of an SPCC and adherence to BMPs related to the use, transfer, and storage of liquids would minimize the likelihood and magnitude of liquid spills.

Approximately 48 square miles of lands would be surveyed, which provide habitats for bear and moose. Direct impacts to habitats would be minor and would consist of vegetation removal for sky holes. The overall availability of bear or moose near the proposed project and in the Kenai NWR would not be impacted by the Proposed Action. Bears would be in their dens during project implementation. The noise and activities associated with the project would be similar to that associated with current and past seismic exploration and development conducted within the Refuge and on adjoining lands. Consequently, it is not anticipated that Proposed Action would result in more than short-term displacement of moose from the area. Project controls, including a prohibition of hunting by workers, would minimize the potential of direct mortality. Therefore, no change in the availability of moose or bear would result from the Project Action.

The Proposed Action would not increase competition for any subsistence resource. Subsistence hunting for moose and bear is limited to residents of select communities on the Kenai Peninsula. These communities are located a far distance from the project area and are unlikely to experience an increase in population because of the Proposed Action. Because there would be no project-related increase in the population of these communities, there would be no project-related increase in competition for moose and bear subsistence hunts. Consequently, there would be no project-related population increase and no increased competition for subsistence resources.

4.4.8.1 Resource-Specific Significance Criteria

The analysis of impacts to subsistence focuses on the non-commercial, customary, and traditional hunting, fishing and trapping activities of rural residents within the proposed project area. A significant impact to subsistence would occur if the Proposed Action results in a:

- Reduction in the abundance or availability of subsistence resources due to project impacts on population or habitats;
- Reduction in access to subsistence harvest areas (due to legal or physical barriers associated with the Proposed Action); or
• Increase in competition for subsistence resources.

4.4.8.2 Alternative 1—No Action

4.4.8.2.1 Direct and Indirect Effects

There would be no direct or indirect effects related to the reduction in the abundance or availability of subsistence resources, reduction in access to subsistence harvest areas, or an increase in competition for subsistence resources under the No Action Alternative.

4.4.8.2.2 Cumulative Effects

There would be no cumulative effects related to the reduction in the abundance or availability of subsistence resources, reduction in access to subsistence harvest areas, or an increase in competition for subsistence resources under the No Action Alternative.

4.4.8.2.3 Mitigation

Because there would be no effects to subsistence activities and resources under the No Action Alternative, no mitigation measures are necessary.

4.4.8.3 Alternative 2—Proposed Action

4.4.8.3.1 Direct and Indirect Effects

4.4.8.3.1.1 Effects on Subsistence Resources

Noise and an increase in human activity associated with seismic activities under the Proposed Action may result in minor, short-term disturbance to subsistence wildlife should they be in proximity to the project area and may temporarily displace these wildlife to adjacent undisturbed habitats. This impact would occur at the individual level and would not result in an impact at the population level. The Proposed Action activities would not occur within anadromous streams and are not anticipated to have any impact on fish populations or fish habitats.

4.4.8.3.1.2 Increased Competition for Subsistence Resources

The Proposed Action would require a small, temporary workforce that would be present from approximately January 2013 to April 2013. The workforce would not be allowed to engage in consumptive activities such as hunting, fishing, and gathering while on site for work. The Proposed Action would not result in a new, permanent workforce in the project region resulting in an increased competition for subsistence resources. Additionally, the Proposed Action would not include the construction of new roads or trails that could result in an increased accessibility to subsistence resources. Therefore, the Proposed Action is not anticipated to increase competition for subsistence resources in the project area.

4.4.8.3.2 Cumulative Effects

Impacts to subsistence sources are not expected to be substantial because subsistence hunting is limited to residents of select communities on the Kenai Peninsula. These communities are distant from the project area and are unlikely to experience an increase in population because of the proposed project.

Because of the timing of the seismic activities and level of subsistence uses occurring in the project area during the time frame, the Proposed Action is not likely to result in a significant reduction in subsistence use as a result of direct or indirect impacts on the resource or habitats, changes in availability of the
resource, or limitations on access to the resource. The Proposed Action is not likely to increase competition for any subsistence resource.

4.4.8.3.3 Mitigation

No specific mitigation measures are recommended for the Proposed Action.

4.4.9 Environmental Justice

Executive Order 12898 and its accompanying memorandum have the primary purpose of ensuring that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.”

As presented in Chapter 3, there are both minority and low-income populations present near the Proposed Action, including those identifying as American Indian or Alaska Native. There is no known concentration of either minority or low-income populations in the vicinity.

4.4.9.1 Resource-Specific Significance Criteria

An evaluation of environmental justice must examine whether disproportionate and adverse human health and environmental impacts fall upon minority or low-income populations. For this section, a significant impact would result from changes in any social, economic, physical, environmental, or health conditions that disproportionately and significantly affect low-income or minority populations.

4.4.9.2 Alternative 1—No Action

4.4.9.2.1 Direct and Indirect Effects

No impacts would occur from the No Action Alternative; therefore, no impacts could be disproportionately realized by low-income or minority populations.

4.4.9.2.2 Cumulative Effects

No cumulative effects would occur under the No Action Alternative; therefore, no impacts could be disproportionately realized by low-income or minority populations.

4.4.9.2.3 Mitigation

No mitigation is required because no effects would be disproportionately realized by low-income or minority populations.

4.4.9.3 Alternative 2—Proposed Action

4.4.9.3.1 Direct and Indirect Effects

The area around the Proposed Action is sparsely populated, and there are no known concentrations of either minority or low-income populations near the project area. There would be no disproportionate effects to low-income populations or minority populations based upon the geographic proximity of such populations to the project area.

Some minority populations (Alaska Natives from select communities as described in Chapter 3) have been afforded preferential rights to the subsistence hunting of moose and bear on the Kenai NWR,
including on and near the project area. As presented in subsistence section, the Proposed Action would not have substantial effects on subsistence resources or on the harvest of subsistence resources.

### 4.4.9.3.2 Cumulative Effects

No cumulative effects would be realized under the Proposed Action and therefore no cumulative impacts could be disproportionately realized by low-income or minority populations.

### 4.4.9.3.3 Mitigation

No mitigation is required because no effects would be disproportionately realized by low-income or minority populations.

### 4.4.10 Hazardous Substances and Waste

Numerous federal, state, and local laws regulate the storage, use, recycling, disposal, and transportation of hazardous materials, wastes, and fuels. NordAq would comply with all appropriate federal, state, and local regulatory requirements to minimize impacts to the environment or human health and safety. Although not defined as hazardous substances under RCRA, fuels are included in the analysis for potential spills or accidental releases. Spills or releases of reportable quantities that occur must be reported to EPA and local agencies as required by Section 101(14) of CERCLA. The reportable quantity for each listed hazardous substance is also provided in the regulations and is 10,000 pounds for most chemicals. Transportation of hazardous materials is also addressed in federal regulations (Title 49 CFR Parts 171–180).

The methods for assessing potential hazards associated with hazardous materials, fuels, and wastes generally include the following:

- Reviewing and evaluating the potential quantities of hazardous materials and fuels required and the quantities of wastes generated; and
- Assessing whether activities would comply with applicable regulations and site-specific management plans for hazardous materials, fuels, and wastes.

All of the action alternatives would result in an increase in the quantities of hazardous materials and fuels transported, stored, and used within the project area, along with subsequent generation, handing, storage, and disposal of larger quantities of wastes, including hazardous wastes. The regulatory requirements implemented to minimize impacts to the environment or human health and safety would be the same for each action alternative.

### 4.4.10.1 Resource-Specific Significance Criteria

Factors considered when determining whether hazardous materials and wastes associated would result in a significant impact include the extent or degree to which the alternative’s implementation would:

- Endanger the public or environment during the transport, storage, or use of hazardous materials, fuels, or generation, transport, and disposal of hazardous wastes through accidental release of hazardous materials, fuels or hazardous wastes.
### 4.4.10.2 Alternative 1—No Action

#### 4.4.10.2.1 Direct and Indirect Effects

There would be no direct or indirect effects associated with hazardous materials, wastes, or fuels under the No Action Alternative.

#### 4.4.10.2.2 Cumulative Effects

There would be no cumulative effects under the No Action Alternative.

#### 4.4.10.2.3 Mitigation

Because there would be no impacts under the No Action Alternative, no mitigation would be necessary.

### 4.4.10.3 Alternative 2—Proposed Action

#### 4.4.10.3.1 Direct and Indirect Effects

Under the Proposed Alternative, there would be no hazardous materials transported, stored, and or used in the project area. Any solid waste generated during activities would be hauled out of the project area daily. Under this alternative, the quantities of fuels transported, stored, and used on the Kenai NWR would increase temporarily for helicopters and drilling equipment required for seismic operations. Implementation of SOPs and compliance with regulatory requirements would reduce the likelihood of a spill or release and would facilitate quick response and remediation of inadvertent spills. Under this alternative, the volumes fuels used would be relatively small. In the event of a spill or release, impacts would be short term in duration, localized in extent, and unlikely to endanger the public or environment.

#### 4.4.10.3.2 Cumulative Effects

Implementation of the Proposed Alternative, in combination with anticipated, ongoing oil and gas development would continue to increase the quantities of hazardous materials and fuels used and the amounts of solid and hazardous materials and wastes generated. With continued compliance with regulatory requirements, cumulative impacts would be less than substantial under this alternative.

#### 4.4.10.3.3 Mitigation

Helicopter fueling operations and all transport and storage of fuel would comply with NFPA 407 Standards for aircraft fueling and refueling would not occur within 100 feet of any waterbody. Fuel would be stored on a parcel of private land located outside the Refuge, near the survey area.

### 4.4.11 Wildfire Management

Alternative was evaluated for its potential to affect the frequency and intensity of wildland fires and its consistency with adopted laws and regulations, or approved fire management plans or policies.

#### 4.4.11.1 Resource-Specific Significance Criteria

Implementation of the No Action or Proposed Action Alternatives would have significant impacts if the action results in:

- Increased frequency or intensity of wildland fires resulting in damage to private development; or
• Activities that are inconsistent with adopted laws, regulations, or the long-term goals of approved fire management plans or policies.

4.4.11.2 Alternative 1—No Action

4.4.11.2.1 Direct and Indirect Effects

Implementation of the No Action Alternative would result in no direct or indirect impacts to wildland fire occurrence or approved fire management plans or policies because there would be no disturbances beyond existing conditions.

4.4.11.2.2 Cumulative Effects

Implementation of the No Action Alternative would cause no cumulative impacts to wildland fire occurrence or fire management because it would result in no direct or indirect effects.

4.4.11.2.3 Mitigation

No mitigation would be necessary under the No Action Alternative.

4.4.11.3 Alternative 2—Proposed Action

4.4.11.3.1 Direct and Indirect Effects

Implementation of the Proposed Action would result in an increased human presence, equipment use, and activity in the survey area. A proportionate increase in the risk of accidental ignition of wildland fires is possible although the probability is low due to operations occurring from December to April when snow generally covers the area. In addition, no open burning would occur during seismic operations. The increased potential for accidental ignition is anticipated to represent a low to moderate short-term risk.

Source energy shot holes would be drilled to a depth of 25 feet and backfilled with cuttings generated during drilling to prevent energy escaping to the surface during detonation. A small percentage of source charges may not detonate. These source locations will be mapped, and a crew will plug the holes during the survey inspection and cleanup to prevent possible detonation and associate fire and hazard risks.

Emergency Plans would be developed to cover all potential emergencies. The plans would include telephone numbers for all medical and emergency services and the contacts in event of emergencies. With adherence to these procedures and development of emergency plans and low to moderate risk of an accidental ignition, impacts associated with wildland fires are anticipated to be minor.

4.4.11.3.2 Cumulative Effects

Due to the low probability of a firing occurring because of the Proposed Action, cumulative impacts to fire management are negligible to minor.

4.4.11.3.3 Mitigation

No mitigation is identified due to the low risk of a fire occurring.
CHAPTER 5—CONSULTATION AND COORDINATION

Agencies, companies, and organizations consulted by the Service during the analysis include the following:

U.S. Army Corps of Engineers
Alaska Department of Natural Resources, Division of Oil and Gas
Alaska Department of Natural Resources, Office of History and Archaeology
Kenai River Center
Kenai Peninsula Borough
Clean Harbors Exploration Services
Haythorne Consulting Services, LLC
International Association of Geophysical Contractors
Weems Geophysical, Inc.
CHAPTER 6—PREPARERS AND CONTRIBUTORS

This EA was prepared by ARCADIS US, a third-party contractor, under the direction of the Service. Technical input regarding the proposed project was provided by NordAq. Table 6–1 and Table 6–2 present the names of the individuals and their area or areas of responsibility from the Service and ARCADIS US who were involved in the preparation of this EA.

Table 6–1  U.S. Fish and Wildlife Service

<table>
<thead>
<tr>
<th>Name</th>
<th>Project Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Regional Office</td>
<td></td>
</tr>
<tr>
<td>Doug Campbell</td>
<td>NEPA Review, Document Review</td>
</tr>
<tr>
<td>Peter Wikoff</td>
<td>NEPA Review, Document Review</td>
</tr>
<tr>
<td>Kenai National Wildlife Refuge</td>
<td></td>
</tr>
<tr>
<td>Andy Loranger</td>
<td>Document Review</td>
</tr>
<tr>
<td>Claire Caldes</td>
<td>Document Review</td>
</tr>
<tr>
<td>Debbie Corbett</td>
<td>Cultural Resource coordination with SHPO</td>
</tr>
</tbody>
</table>

Table 6–2  ARCADIS US

<table>
<thead>
<tr>
<th>Name</th>
<th>Project Responsibility</th>
<th>Education</th>
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<tbody>
<tr>
<td>David Cameron</td>
<td>Project Manager, Document Review</td>
<td>B.A. Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.S. Terrestrial Ecology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34 years of experience</td>
</tr>
<tr>
<td>Rachel Cruz</td>
<td>Analysis Coordination, Document Review</td>
<td>B.S. Environmental Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 Years of experience</td>
</tr>
<tr>
<td>Bonnie Easley-Appleyard</td>
<td>Biological Resources</td>
<td>B.S. Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.A. Organizational Leadership</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.A. Public Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 years of experience</td>
</tr>
<tr>
<td>Cecily Foo</td>
<td>Biological Resources</td>
<td>B.A. Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 years of experience</td>
</tr>
<tr>
<td>Brian Havelock</td>
<td>Alternative Development</td>
<td>B.A. Cultural Geography</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17 years of experience</td>
</tr>
<tr>
<td>Kristi Hickel</td>
<td>Land Use, Recreation, Transportation, Visual Resources, Cultural Resources, Socioeconomics</td>
<td>B.A. Political Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MPA, Public Administration Policy Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 years of experience</td>
</tr>
<tr>
<td>Dick Londergan</td>
<td>Air Quality, Modeling</td>
<td>BS, MS, PHD physics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38 years of experience</td>
</tr>
<tr>
<td>Susan Riggs</td>
<td>Air Quality</td>
<td>B.S. Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.S. Environmental Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 years of experience</td>
</tr>
<tr>
<td>Meredith Savage</td>
<td>Geology, Soils, Hydrology, Noise</td>
<td>B.S. Wildlife Ecology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.S. Environmental Studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 years of experience</td>
</tr>
</tbody>
</table>
CHAPTER 7—REFERENCES CITED


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Appendix A
Species of Concern on the
Kenai National Wildlife Refuge
# APPENDIX A — SPECIES OF CONCERN ON THE KENAI NATIONAL WILDLIFE REFUGE

## Table A-1 Species of Concern on the Kenai National Wildlife Refuge

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Species Name</th>
<th>Jurisdiction</th>
<th>Status</th>
<th>Common Habitats</th>
<th>Observed by the Service near Project Vicinity</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenai brown bear</td>
<td><em>Ursus arctos kenai</em></td>
<td>ADF&amp;G, SOA</td>
<td>State Species of Concern</td>
<td>Coniferous Forests, Deciduous Forests, Shrub, Wetlands/Aquatic</td>
<td></td>
<td>See section X for further discussion</td>
</tr>
<tr>
<td>Little brown bat</td>
<td><em>Myotis lucifugus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon, long-term concern</td>
<td>Coniferous Forests, Wetlands/Aquatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ermine</td>
<td><em>Mustela erminea</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern</td>
<td>Forest edges, Wetlands/Aquatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenai marten</td>
<td><em>Martes americana keniensis</em></td>
<td>ADF&amp;G</td>
<td>Conservation status not yet assessed</td>
<td>Coniferous Forests, Deciduous Forests</td>
<td></td>
<td>In 2002, marten were found in the western Kenai Lowlands for the first time in 100 years</td>
</tr>
<tr>
<td>Kenai wolverine</td>
<td><em>Gulo gulo katschemakensis</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon</td>
<td>Coniferous Forests8</td>
<td></td>
<td>The population on Kenai NWR has declining harvest and population estimates9</td>
</tr>
<tr>
<td>Dusky shrew</td>
<td><em>Sorex monticolus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Conservation status not yet assessed</td>
<td>Shrub, Coniferous Forests, Herbaceous3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pygmy shrew</td>
<td><em>Sorex hoyi</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Conservation status not yet assessed</td>
<td>Coniferous Forests, Deciduous Forests, Herbaceous3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alaska marmot</td>
<td><em>Marmota broweri</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern</td>
<td>Not found within Project Area (cite range map)10</td>
<td></td>
<td>Marmot spp. den in rocky areas adjacent to tundra</td>
</tr>
<tr>
<td>Northern bog lemming</td>
<td><em>Synaptomys borealis</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern</td>
<td>Wetlands/Aquatic, open Forests3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern red-backed vole</td>
<td><em>Clethrionomys rutilus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Conservation status not yet assessed</td>
<td>Coniferous Forests3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenai red squirrel</td>
<td><em>Tamiasciurus hudsonicus keniensis</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Conservation status not yet assessed</td>
<td>Coniferous Forests11</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
## Table A-1  
Species of Concern on the Kenai National Wildlife Refuge

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Species Name</th>
<th>Jurisdiction</th>
<th>Status</th>
<th>Common Habitats</th>
<th>Observed by the Service near Project Vicinity²</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singing vole</td>
<td>Microtus miurus</td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern</td>
<td>Wetlands/Aquatic³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tundra vole</td>
<td>Microtus oeconomus</td>
<td>ADF&amp;G, NatureServe</td>
<td>Conservation status not yet assessed</td>
<td>Wetlands/Aquatic³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longnose sucker</td>
<td>Catostomus catostomus</td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure</td>
<td>Wetlands/Aquatic¹²</td>
<td>X</td>
<td>Occur in Crane Lake and Snipe Lake¹³</td>
</tr>
<tr>
<td>Threespine stickleback</td>
<td>Gasterosteus aculeatus</td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure</td>
<td>Wetlands/Aquatic¹⁴</td>
<td>X</td>
<td>Occur in Salmo Lake and Snipe Lake¹³</td>
</tr>
<tr>
<td>Wood frog</td>
<td>Rana sylvatica</td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon, long-term concern</td>
<td>Wetlands/Aquatic, Coniferous Forests, Deciduous Forests, Herbaceous¹⁵</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horned Grebe</td>
<td>Podiceps auritus</td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon</td>
<td>Wetlands/Aquatic¹⁶</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bald Eagle</td>
<td>Haliaetus leuccephalus</td>
<td>ADF&amp;G, USFS, NatureServe</td>
<td>USFS: sensitive; NatureServe: rare or uncommon breeding population</td>
<td>Wetlands/Aquatic, Coniferous Forests, Deciduous Forests¹⁶</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilson’s Snipe</td>
<td>Gallinago delicata</td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon breeding population</td>
<td>Wetlands/Aquatic¹⁷</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
### Table A-1  Species of Concern on the Kenai National Wildlife Refuge

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Species Name</th>
<th>Jurisdiction</th>
<th>Status</th>
<th>Common Habitats</th>
<th>Observed by the Service near Project Vicinity</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swainson’s Thrush</td>
<td><em>Catharus ustulatus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon breeding population</td>
<td>Coniferous Forests, Deciduous Forests16</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>American Robin</td>
<td><em>Turdus migratorius</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon breeding population</td>
<td>All habitat types16</td>
<td>X</td>
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</tr>
<tr>
<td>Fox Sparrow</td>
<td><em>Passerella iliaca</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon breeding population</td>
<td>Shrub16</td>
<td></td>
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<tr>
<td>Golden-crowned Sparrow</td>
<td><em>Zonotrichia atricapilla</em></td>
<td>ADF&amp;G, NatureServe, BPIF20</td>
<td>Rare or uncommon breeding population</td>
<td>Shrub, Herbaceous16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-crowned Sparrow</td>
<td><em>Zonotrichia leucophrys</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon breeding population</td>
<td>Shrub, Herbaceous16</td>
<td>X</td>
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<tr>
<td>Dark-eyed Junco</td>
<td><em>Junco hyemalis</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Rare or uncommon breeding population</td>
<td>Coniferous Forests, Deciduous Forests, Shrub16</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pine Siskin</td>
<td><em>Carduelis pinus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure</td>
<td>Coniferous Forests, Deciduous Forests, Shrub16</td>
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<td></td>
</tr>
<tr>
<td>Bank Swallow</td>
<td><em>Riparia riparia</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure breeding population</td>
<td>Wetland/Aquatic, Herbaceous16</td>
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<td></td>
</tr>
<tr>
<td>Boreal Chickadee</td>
<td><em>Poecile hudsonica</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure</td>
<td>Coniferous Forests16</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Common Loon</td>
<td><em>Gavia immer</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern</td>
<td>Wetlands/Aquatic16</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Great Horned Owl</td>
<td><em>Bubo virginianus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure</td>
<td>Coniferous Forests, Deciduous Forests, Herbaceous16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hairy Woodpecker</td>
<td><em>Picoides villosus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern</td>
<td>Coniferous Forests, Deciduous Forests, Herbaceous16</td>
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</tr>
</tbody>
</table>
### Table A-1  Species of Concern on the Kenai National Wildlife Refuge

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Species Name</th>
<th>Jurisdiction</th>
<th>Status1</th>
<th>Common Habitats</th>
<th>Observed by the Service near Project Vicinity2</th>
<th>Other Information</th>
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</thead>
<tbody>
<tr>
<td>Lesser Yellowlegs</td>
<td><em>Tringa flavipes</em></td>
<td>ADF&amp;G, Audubon Alaska19, NatureServe</td>
<td>Secure breeding population</td>
<td>Wetlands/Aquatic16</td>
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<tr>
<td>Northern Harrier</td>
<td><em>Circus cyaneus</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern breeding population</td>
<td>Wetlands/Aquatic, Herbaceous16</td>
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<tr>
<td>Red-necked Grebe</td>
<td><em>Podiceps grisegena</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Not rare, long-term concern breeding population</td>
<td>Wetlands/Aquatic16</td>
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<td></td>
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<tr>
<td>Short-billed Dowitcher</td>
<td><em>Limnodromus griseus</em></td>
<td>ADF&amp;G, Audubon Alaska19, NatureServe</td>
<td>Secure breeding population</td>
<td>Wetlands/Aquatic16</td>
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<tr>
<td>Violet-green Swallow</td>
<td><em>Tachycineta thalassina</em></td>
<td>ADF&amp;G, NatureServe</td>
<td>Secure breeding population</td>
<td>Wetlands/Aquatic16</td>
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<td></td>
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</tbody>
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Sources:
1. ADF&G 2006c
2. Service 2012b
3. Reid 2006
4. ADF&G 2005
5. ADF&G 2006b
6. Shepherd and Melchior 2008
7. Baltensperger 2008
8. Taylor 2008
9. Bailey 2010
10. ADF&G 2006a
11. Earnest 2008
12. Mansfield 2004
13. Palmer 2012
14. ADF&G 2006d
15. Broderson and Tessler 2008
16. Sibley 2003
17. USGS no date
18. Cornell 2011b
19. Audubon Alaska 2010